CITY OF HOUSTON
DEPARTMENT OF PUBLIC WORKS AND ENGINEERING
ENGINEERING AND CONSTRUCTION DIVISION

Northeast Water Purification Plant (NEWPP) Improvements Package No. 2 – High Service Pump Station and Miscellaneous Piping Improvements

WBS No. S-000066-012A-4

VOLUME 1 of 1

Divisions 00 through 16

July 2015

STATE OF TEXAS
YUE SUN
96723
LICENSED PROFESSIONAL ENGINEER
7-31-2015

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Document 00010

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NOTE: Bold capitalized Specification Sections are included in the City of Houston Department of Public Works and Engineering Standard Construction Specifications for Wastewater Collection Systems, Water Lines, Storm Drainage, Street Paving, and Traffic located here: **http://edocs.publicworks.houstontx.gov/engineering-and-construction/specifications/division-02-16-standard-specifications.html**; and are incorporated in Project Manuals by reference as if copied verbatim. Documents listed "for filing" are to be provided by Bidder and are not included in this Project Manual unless indicated for example only. The Document numbers and titles hold places for actual documents to be submitted by Contractor during Bid, post-bid, or construction phase of the Project. Specification Sections marked with an asterisk (*) are amended by a supplemental specification, printed on blue paper and placed in front of the Specification it amends. Documents in the 200, 300 and 400 series of Division 00, except for Document 00410B – Bid Form, Part B, are not part of the Contract.

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Document 00200

INSTRUCTIONS TO BIDDERS

1.0 *RELATED DOCUMENTS*

A. Document 00210 – Supplementary Instructions to Bidders.

B. Document 00320 – Geotechnical Information.

C. Document 00330 – Existing Conditions.

D. Document 00410 – Bid Form, Parts A & B.

E. Document 00495 – Post-Bid Procedures.

F. Document 00520 – Agreement.

G. Document 00700 – General Conditions.

H. Document 00800 – Supplementary Conditions.

2.0 *DEFINITIONS*

A. Definitions set forth in Document 00700 – General Conditions and in other documents of Project Manual, are applicable to Bid Documents.

B. *Addendum:* Written or graphic instrument issued prior to Bid opening, which clarifies, modifies, corrects, or changes Bid Documents.

C. *Alternate:* The total amount bid for additions to work, as described in Section 01110 – Summary of Work. Each Alternate includes cost of effects on adjacent or related components, and Bidder's overhead and profit.

D. *Bid:* A complete and properly signed offer to perform the Work in accordance with this Document and Document 00210 – Supplementary Instructions to Bidders.

E. *Bid Date:* Date and time set for receipt of Bids as stated in Document 00210 – Supplementary Instructions to Bidders, or as modified by Addenda.

F. *Bid Documents:* Project Manual, Drawings, and Addenda.

G. *Bid Supplement: A* Bid submittal that is required in Document 00410 – Bid Form.

H. *Bidder:* Person or firm, identified in Document 00410B – Bid Form – Part B, including its successors, and its authorized representative.

I. *Code:* Code of Ordinances, Houston, Texas.

J. *Low Bidder:* Apparent successful Bidder that qualifies as a responsible Bidder and that submits Bid with lowest Total Bid Price.

K. *Project Manager:* Person designated in Document 00100 – Advertisement for Bids and Document 00220 – Request for Bid Information to represent the City during bidding and post-bid periods.

L. *Project Manual:* Volume assembled for the Work that includes the bidding requirements, sample forms, Conditions of the Contract, and Specifications.

M. *Security Deposit:* A certified check, cashier's check, or bid bond in the amount of 10 percent of the Total Bid Price.

N. *Total Bid Price:* Total amount bid for performing the Work as identified by Bidder in Document 00410B – Bid Form – Part B, which amount includes:

1. Stipulated Price;

2. Total Base Unit Prices;

3. Total Extra Unit Prices;

4. Total Cash Allowances; and

5. Total Alternates.

3.0 *NOTICE TO BIDDERS*

A. The City of Houston Fair Campaign Ordinance makes it unlawful for a Contractor to offer any contribution to a candidate for City elective office (including elected officers and officers-elect) during a certain period of time prior to and following the award of the Contract by the City Council. The term "Contractor" includes proprietors of proprietorships, all partners of partnerships, and all officers, directors, and holders of 10 percent or more of the outstanding shares of corporations. A statement disclosing the names and business addresses of each of those persons will be required to be submitted with each bid or proposal; for a City Contract. Bidder shall complete and submit Document 00452 – Form A, Contractor Submission List, City of Houston Fair Campaign Ordinance, with its Bid to comply with this requirement. See Chapter 18 of the Code for further information.

B. Chapter 15, Article VIII, of the City's Code provides that no contract shall be let, nor any other business transaction entered into, by the City with any person indebted to the City or a qualifying entity, if the contractor or transaction comes within the provisions of Section 15-1 (c) of the Code. Exceptions are provided in Section 15-126 of the Code. Bidder shall complete and submit Document 00455 – Affidavit of Ownership or Control, with its Bid to comply with this requirement.

C. Neither bidder(s) nor any person acting on bidder(s)'s behalf shall attempt to influence the outcome of the award by the offer, presentation or promise of gratuities, favors, or anything of value to any appointed or elected official or employee of the City of Houston, their families or staff members. All inquiries regarding the solicitation are to be directed to the designated City Representative identified on the first page of the solicitation. Upon issuance of the solicitation through the pre-award phase and up to the date the City Secretary publicly posts notice of any City Council agenda containing the applicable award, aside from bidder's formal response to the solicitation, through the pre-award phase, written requests for clarification during the period officially designated for such purpose by the City Representative, neither bidder(s) nor persons acting on their behalf shall communicate with any appointed or elected official or employee of the City of Houston, their families or staff through written or oral means in an attempt to persuade or influence the outcome of the award or to obtain or deliver information intended to or which could reasonably result in an advantage to any bidder. However, nothing in this paragraph shall prevent a bidder from making public statements to the City Council convened for a regularly scheduled session after the official selection has been made and placed on the City Council agenda for action, or to a City Council committee convened to discuss a recommendation regarding the solicitation.

4.0 *BID DOCUMENTS*

A. The Bid Documents may be obtained at location specified in Document 00210 – Supplementary Instructions to Bidders.

B. The Bid Documents are made available only for the purpose of bidding on the Work. Receipt of Bid Documents does not grant a license for other purposes.

C. On receipt of Bid Documents, Bidder shall verify that documents are legible and complete, compare contents of Project Manual with Document 00010 – Table of Contents, and compare Index of Drawings with Document 00015 – List of Drawings. Bidder shall notify Project Manager if Bid Documents are incomplete.

D. If City of Houston Standard Specifications or Standard Details are required by the Project Manual, Bidder shall refer to Document 00210 – Supplementary Instructions to Bidders for purchase information.

5.0 *EXAMINATION OF DOCUMENTS, SITE, AND LOCAL CONDITIONS*

A. Bidder shall examine Project site, become familiar with local conditions under which the Work shall be performed, conduct appropriate investigations, and correlate personal observations with requirements of the Bid Documents before submitting a Bid.

B. Bidder shall make site investigations to the extent Bidder deems necessary to ascertain extent of subsurface conditions.

C. Failure of Bidder to perform the investigations prior to submitting a Bid does not relieve Bidder of responsibility for investigations, interpretations and proper use of available information in the preparation of its Bid.

D. Bidder shall observe limitations of access to occupied or restricted site as stated in Document 00210 – Supplementary Instructions to Bidders.

6.0 *INTERPRETATIONS DURING BIDDING*

A. Bidder shall immediately submit Document 00220 – Request for Bid Information to Project Manager upon finding errors, discrepancies, or omissions in Bid Documents. Confirmation of receipt of questions by the City is the responsibility of Bidder. Verbal discussions and answers are not binding.

B. Document 00220 – Request for Bid Information must be received at least 10 days before the Bid Date to allow issuance of Addenda in accordance with Paragraph 7.O.D. Replies, if issued, are by Addenda.

7.0 *ADDENDA*

A. Addenda that affect bidding requirements are applicable only during applicable only through issuance of the Notice to Proceed. Addenda that affect the Contract are a part of the Contract.

B. BIDDERS WHO SUBMIT A BID ON THIS PROJECT SHALL BE PRESUMED TO HAVE RECEIVED ALL ADDENDA AND TO HAVE INCLUDED ANY COST THEREOF IN THEIR BIDS, REGARDLESS OF WHETHER THEY ACKNOWLEDGE THE ADDENDA OR NOT.

C. The City will make Addenda available at same location where the Bid Documents may be obtained. The City will notify plan holders of record when Addenda are available. Bidders are responsible for obtaining Addenda after notification.

D. No Addendum will be issued later than noon on Monday before Bid Date, except Addenda with minor clarifications, withdrawing request for Bids, or postponing Bid Date.

8.0 *SUBSTITUTION OF PRODUCTS*

A. No substitutions of Products will be considered during the bidding period.

9.0 *PREPARATION OF BIDS*

A. Bidder shall fill in applicable blanks in Document 00410A&B – Bid Form – Parts A & B and Bid Supplements. In addition, Bidder shall bid all Alternates. Bidder shall properly sign Document 00410B -Bid Form.

B. Bidder shall initial all pages, except signature page, of Document 00410B – Bid Form – Part B.

C. Bidder is responsible for all costs incurred by the Bidder, associated with preparation of its Bid and compliance with Post-bid Procedures.

D. Bidder may not adjust preprinted price on line items stating "Fixed Unit Price" in the description on the Bid Form.

E. Bidder may increase, but not decrease, preprinted price on line items stating "Minimum Bid Price" in the description on the Bid Form by crossing out the minimum and inserting revised price on the line above. Bidder **may not** decrease the preprinted price on line items stating "Minimum Bid Price".

F. Bidder may decrease, but not increase, preprinted price on line items stating "Maximum Bid Price" in the description on the Bid Form by crossing out the maximum and inserting revised price on the line above. Bidder **may not** increase the preprinted price on line items stating "Maximum Bid Price".

G. Bidder shall insert a price no greater than the maximum preprinted range and no less than the preprinted range for line items stating "Fixed Range Unit Price" in the description on the Bid Form by crossing out prices noted and inserting revised price on the line above.

H. Bidder may not adjust Cash Allowance amounts.

10.0 *BID SUBMISSION*

A. City Secretary will receive Bids on Bid Date at location specified in Document 00210 – Supplementary Instructions to Bidders.

B. Bids submitted after Bid Date will be returned to Bidder unopened.

C. Verbal, facsimile, or electronic Bids are invalid and will not be considered.

D. Bidder shall submit in person or by mail one copy of the signed Document 00410 – Bid Form, Parts A and B, along with required Security Deposit, and required Bid Supplements, in a sealed, opaque envelope. In addition, Bidder shall clearly identify Project, Bid Date and Bidder's name on outside of envelope. If forwarded by mail, the sealed envelope containing the Bid must be enclosed in another envelope addressed for postal delivery.

11.0 *BID SECURITY*

A. Bidder shall submit a Security Deposit with its Bid.

B. Certified Check or Cashier's Check

1. Bidder shall make check payable to the City of Houston.

2. A check is submitted on the condition that if Bidder is named Low Bidder and fails either to timely and properly submit documents required in Document 00495 – Post-Bid Procedures, the City will cash the check in accordance with Paragraph 11.0.E.

C. Bid Bond

1. The bid bond must be a valid and enforceable bond, signed by a surety that complies with other requirements set out by law.

2. The bid bond must name the City of Houston as obligee, and be signed by the Bidder as principal and signed and sealed by the surety.

3. The bid bond must be conditioned such that if Bidder is named Low Bidder and then fails to timely and properly submit documents required in Document 00495 – Post-Bid Procedures, surety will be obligated to pay to the City an amount in accordance with Paragraph 11.0.E.

D. Security Deposits will be retained until after the Contract is awarded or all Bids are rejected.

E. Low Bidder forfeits Security Deposit if it fails to timely and properly submit documents required in Document 00495 – Post-Bid Procedures. The City may claim an amount equal to the difference between the Total Bid Price of the defaulting Bidder and the Total Bid Price of the Bidder awarded the Contract. If Security Deposit is a check, the City will reimburse any remaining balance to the defaulting Bidder.

12.0 *SUBCONTRACTORS AND SUPPLIERS*

A. The City may reject proposed Subcontractors or Suppliers.

B. Refer to Document 00800 – Supplementary Conditions, for MWBEPDBE, DBE and SBE goals.

13.0 *MODIFICATION OR WITHDRAWAL OF BID*

A. A Bidder may modify or withdraw a Bid submitted before the Bid Date by written notice to the City Secretary. The notice may not reveal the amount of the original Bid and must be signed by the Bidder.

B. Bidder may not modify or withdraw its Bid by verbal, facsimile, or electronic means.

C. A withdrawn Bid may be resubmitted up to the time designated for receipt of Bids.

14.0 *BID DISQUALIFICATION*

A. The City may disqualify a Bid if the Bidder:

1. fails to provide required Security Deposit in the proper amount;
2. improperly or illegibly completes information required by the Bid Documents;
3. fails to sign Bid or improperly signs Bid;
4. qualifies its Bid; or
5. improperly submits its Bid.

B. When requested, Low Bidder shall present satisfactory evidence that Bidder has regularly engaged in performing construction work as proposed, and has the capital, labor, equipment, and material to perform the Work.

15.0 *PREBID MEETING*

A. A prebid meeting is scheduled to be held at the place, time, and date listed in Document 00210 – Supplementary Instructions to Bidders.

B. All Bidders, subcontractors, and suppliers are invited to attend.

C. Representatives of City Engineer will attend.

16.0 *OPENING OF BIDS*

A. Bids are opened by the City Secretary and publicly read in City Council Chambers on the Public Level in City Hall Annex at 11:00 a.m. on Bid Date.

B. Place and date of Bid opening may be changed in accordance with Sections 15-3(b)(5) and 15-3(b)(6) of the City Code.

17.0 *EVALUATION AND CONSIDERATION OF BIDS*

A. Project Manager will tabulate, record and evaluate Bids.

B. The City may reject all Bids or may reject any defective Bid.

18.0 *ACCEPTANCE OF THE BID*

A. The City will send to Low Bidder Document 00498 – Notice of Intent to Award. Acceptance by the City is conditioned upon Bidder's timely and proper submittal of documents required in Document 00495 – Post-Bid Procedures.

B. The Bid remains open to acceptance and is irrevocable for the period of time stated in Document 00410A – Bid Form – Part A.

END OF DOCUMENT

Document 00210

SUPPLEMENTARY INSTRUCTIONS TO BIDDERS

The following Paragraphs modify Document 00200 - Instructions to Bidders. Where a portion of the Instructions to Bidders is modified or deleted by these Supplementary Instructions, the unaltered portions of the Instructions to Bidders remains in effect.

2.0 – DEFINITIONS: Add the following Paragraphs to this Section:

O. *Office of Business Opportunity (OBO):* All references to Affirmative Action Contract Compliance Division (AACC) set forth in Document 00700 – General Conditions and in other documents of the Project Manual, shall refer to, and include, the Office of Business Opportunity.

3.0 - NOTICE TO BIDDERS: Add the following Paragraph to this Section:

C. The City will award this contract to a "Local Business", as that term is defined in Section 15-176 of the City of Houston Code of Ordinances ("the Code"):

- If the bid of the Local Business is less than $100,000 and is the lowest responsible bid or is within 5% of the lowest bid received, or
- If the bid of the Local Business is more than $100,000 and is the lowest responsible bid or is within 3% of the lowest bid received, and
- Unless the Director determines that such an award would unduly interfere with contract needs, as provided in Section 15-181 of the Code.

If there is no bid of a Local Business that meets these criteria, the City will award the contract to the lowest responsible bidder.

4.0 – BID DOCUMENTS: Add the following Paragraphs to this Section:

A. Add the following Paragraph A.1:

1. Bid documents may only be obtained electronically at the City's website: http://bidsets.publicworks.houstontx.gov/.

D. Add the following Paragraph D.1:

1. Copies of the City Standard Specifications and Details may be acquired at no cost on the City's website **http://documents.publicworks.houstontx.gov/document-center/cat_view/88-engineering-and-construction/92-specifications/208-division-02-16-standard-specifications.html**

E. The following plan rooms, whose names, addresses, phone and fax numbers were last updated on April 9, 2007, have been authorized by the City to display Bid Documents for examination:
(Note: The Bid Documents furnished to the plan rooms for examination can be in electronic format, in hard copies, or in any other formats pertaining to each City Contracting Division's discretion.)

1. AMTEK Information Services, Inc., 4001 Sherwood Lane, Houston, TX 77092, 713-956-0100, Fax 713-956-5340, Email: planroom@amtekusa.com

2. Associated Builders & Contractors, Inc., (ABC), 3910 Kirby, Suite 131, Houston, TX 77098-4151, 713-523-6222, Fax 713-874-0747. Email: lori@abchouston.org

3. Associated General Contractors (AGC-BB) Building Branch, 3825 Dacoma, Houston, TX 77092-8717, 713-843-3700, Fax 713-843-3701. Email: karla.s@agchouston.org

4. Associated General Contractors, (AGC-HHUI), Highway, Heavy Utilities and Industrial Branch, 2400 Augusta St., Suite 180, Houston, TX 77057, 713-334-7100, Fax 713-334-7130. Email: houston@agctx.org (Attention: Mel Keyser)

5. Construction Information Network, 1225 North Loop West, Suite 550, Houston, TX 77008, 713-868-2233 ext. 329, Fax 866-852-2713. Email: paul.tilford@cnsx.com

6. F. W. Dodge Corporation, 4101 Greenbriar, Suite 320, Houston, TX 77098, 713-529-4895, Fax 713-524-7639. Email: terrie_harris@mcgraw-hill.com

7. Hispanic Contractors Association of Houston (HCA-GHA), 11 Parker Road, Suite 7, Houston, TX 77241, 713-699-2732 or 832-754-3705, Fax 713-695-1556, Email: hispanicontractorsassociation@yahoo.com; or Randymagdaleno@yahoo.com

8. Houston Minority Business Development Center, 2900 Woodridge, Suite 124, Houston, TX 77087, 713-644-0821, Fax 713-644-3523. Email: gtamez@gacompanies.com

9. Reed Construction Data, 30 Technology Parkway South, Suite 100, Norcross, GA – 30092-8629. Tel. 1-800-424-3996 or 1-800-699-8640; Fax 1-800-317-0870 or 1-800-508-5370.

10. The Builders' Exchange of Texas, Inc., 3910 Kirby, Suite 131, Houston, TX 77098, 210-564-6900, Fax: 210-564-6921, Email: houston@bxtx.com

F. Add the following Paragraph F.1:

1. Designation as a City Business or Local Business

To be designated as a City or Local Business for the purpose of the Hire Houston First Program, as set out in Article XI of Chapter 15 of the Houston City Code, a bidder or proposer must submit the Hire Houston First Application and Affidavit to the Director of the Mayor's Office of Business Opportunity (OBO) and receive notice that the designation has been approved prior to submission of a bid or proposal. Submit with your bid a valid official letter from OBO with your designation as a City or Local Business.

5.0 - EXAMINATION OF DOCUMENTS, SITE, AND LOCAL CONDITIONS: Insert the following paragraph:

A. Add the following Paragraph D.1:

1. The site, or part of it, is currently occupied and access is limited. Premises will be open to site inspection tour immediately after the pre-bid meeting if requested by bidders.

9.0 – PREPARATION OF BIDS: Add the following Paragraph I to this Paragraph:

I. For math errors the City encounters in analyzing Bids, the following guidance will be used:

In the event of a conflict between:	The Bid Price is:
1. Individual Unit Price and Extension of that Unit Price	Individual Unit Price times Estimated Quantity
2. A Unit Price extension and total of Unit Price Extensions	Sum of all Individual Unit Price Extensions
3. Individual Alternate and total of Alternates	Sum of all Individual Alternates
4. Individual subtotals for Stipulated Price, Base Unit Prices, Extra Unit Prices, Contractor Bonus, Cash Allowances, and Alternates; and the Total Bid Price	Sum of Individual subtotals for Stipulated Price, Base Unit Prices, Extra Unit Prices, Contractor Bonus, Cash Allowances and Alternates

10.0 – BID SUBMISSION: Add the following Paragraph A.1 to this Section:

A. Add the following Paragraph A.1:

1. City Secretary will receive Bids at 900 Bagby, Room P101, Houston, Texas until 10:30 a.m., local time on November 19, 2015.

15.0 – PREBID MEETING: Add the following Paragraph A.1 to this Section:

A. Add the following Paragraph A.1:

1. A Prebid Meeting will be held at 10:00 A.M. on Tuesday, October 27, 2015, at NEWPP Conference Room at 12121 North Sam Houston Parkway East, Humble, Texas 77396.

2. It is the contractors' responsibilities to contact during normal business hours (8:00 to 5:00 pm, M-F) one of the following PUD representatives identified below to coordinate completion of criminal background checks to be given access to COH/PUD facility.

   Shandra Jones – (832) 395-5179
   Tammy Spriggs – (832) 395-5175

END OF DOCUMENT

Document 00220

REQUEST FOR BID INFORMATION

PROJECT: Northeast Water Purification Plant Improvements Package No.2 – High Service Pump Station and Miscellaneous Piping Improvements

PROJECT No.: WBS No. S-000066-012A-4

TO: Tina Yao, P.E.
15th Floor
611 Walker, Houston, Texas 77002

Phone No. (832) 395-2324
Fax No. (832) 395-2344
Email Addr. tina.yao@houstontx.gov

(Type or Print question legibly; use back if more space is needed)

This request relates to _____ and/or _____
Drawing / Detail No. Specification Section No.

Attachments to this request: _____

_____
Signature

_____
Date

_____
(Type or Print Name)

_____
(Type or Print Company Name)

END OF DOCUMENT

Document 00320

GEOTECHNICAL INFORMATION

1. DOCUMENT INCLUDES

   A. Soils investigation reports.
   B. Bidder's responsibilities.

2. RELATED DOCUMENTS

   A. Document 00340 – Environmental Information
   B. Section 02260 - Trench Safety Systems

3. SITE INVESTIGATION REPORTS

   A. In the design and preparation of Contract documents for this Project, the City and Design Consultant have used information in geotechnical reports for the investigation and analysis of soils and subsurface conditions at the Project site.

   B. An electronic copy of the report for this project is included in a CD-Rom affixed to the inside front cover of the project manual.

   C. Neither the City nor Design Consultant is responsible for accuracy or completeness of any information or data.

4. GEOTECHNICAL REPORTS

   A. Report No.: 1140204601 Prepared by (Firm Name): Geotest Engineering, Inc.; Title: Geotechnical Investigation / High Service Pump Station (HSPS) Improvements at the Northeast Water Purification Plant (NEWPP) / WBS No. S-000066-012A-4.; Report Date: October 3, 2014 No. of Pages: 15 + Attachments + Contents.

5. BIDDER RESPONSIBILITIES

   A. Bidder shall take full responsibility for interpretation and use of information contained in above listed reports for its bidding and construction purposes.

   B. Bidder may perform additional soils investigations as Bidder deems appropriate.

END OF DOCUMENT

Document 00330

EXISTING CONDITIONS

1.0 DOCUMENT INCLUDES

A. Existing structures

2.0 SUBSURFACE INVESTIGATION REPORT

A. In the design and preparation of Contract documents for this Project, the City and Design Consultant have used information with respect to Underground Facilities and existing structures at or contiguous to the site, based on data furnished to the City or Design Consultant by owners of the Underground Facilities.

B. Neither the City nor Design Consultant is responsible for the accuracy or completeness of any such information or data.

3.0 EXISTING STRUCTURES

A. Contract documents indicate physical conditions in or relating to existing surface and subsurface structures which are at or contiguous to the site that were known to, and have been used by, the City and Design Consultant in preparation of Contract documents.

B. Refer to Table 00330-1 for a list of existing Record Drawings associated with the proposed project area.

C. Refer to CD-ROMs attached within these specifications for Northeast Water Purification Plant Improvements Transient Analysis Report prepared by Lockwood, Andrews, & Newnam, Inc., dated Feubruary 2014.

D. Refer to CD-ROMs attached within these specifications for Northeast Water Purification Plant Improvements High Service Pump Station and UV Buildings Piping Stress Analysis Report prepared by WorleyParsons, dated March 8, 2014.

E. Refer to CD-ROMs attached within these specifications for Northeast Water Purification Plant Improvements Electrical Power System Studies Report prepared by Kalluri Group, Inc., dated March 2014.

F. Refer to CD-ROMs attached within these specifications for Northeast Water Purification Plant Improvements Harmonic Analysis Report prepared by Kalluri Group, Inc., dated September 22, 2014.

G. Refer to CD-ROMs attached within these specifications for Northeast Water Purification Plant Improvements Temporary Liquid Ammonium Sulfate (LAS) System Drawings prepared by Kalluri Group, Inc., dated April 2012.

H. Bidder shall have full responsibility for reviewing and verifying information and data, for locating Underground Facilities and existing structures shown or indicated in the Contract documents, and for coordination of the Work with the owners of such Underground Facilities and existing structures during construction.

REST OF PAGE INTENTIONALLY LEFT BLANK

TABLE 00330-1
Record Drawings Associated with the Project Area

ID	Project Title	Date	COH Drawing No.
1	Houston Area Water Corporation Northeast Water Purification Plant – Proposed 36", 24" & 16" Water Main to MUD 342 and W. Lake Houston MUDS	Sept-05	
2	Houston Area Water Corporation Northeast Water Purification System Design-Build-Operate Project Plant Phase I and Phase I Modifications	Oct-05	
3	Houston Area Water Corporation Northeast Water Purification System Design-Build-Operate Project Plant Phase II and Phase II Modifications	Jan-06	
4	City of Houston Lime Feed System at the Norheast Water Purificaiton Plant; WBS No: S-000066-0007-4	March-11	47994
5	City of Houston Northeast Water Purification Plant (NEWPP) Improvements Sedimentation Basin Sludge Collector Replacement; WBS No. S-000066-0013-4	Jan-12	49128
6	City of Houston Northeast Water Purification Plant (NEWPP) Improvements Plant Security, Truck Scale and Miscellaneous Improvements; WBS No. S-000066-0008-4	Jun-13	51515

END OF DOCUMENT

Document 00410A

BID FORM – PART A

To: **The Honorable Mayor and City Council of the City of Houston**
City Hall Annex
900 Bagby Street
Houston, Texas 77002

Project: *Northeast Water Purification Plant (NEWPP) Improvements Package No. 2 – High Service Pump Station and Miscellaneous Piping Improvements*

Project No.: *WBS No. S-000066-012A-4*

Bidder: _____

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

1.0 OFFER

A. Total Bid Price: Having examined the Project location and all matters referred to in Bid Documents for the Project, we, the undersigned, offer to enter into a Contract to perform the Work for the Total Bid Price shown on the signature page of this Document

B. Security Deposit: Included with the Bid is a Security Deposit in the amount of 10 percent of the Total Bid Price subject to terms described in Document 00200 – Instructions to Bidders.

C. Period for Bid Acceptance: This offer is open to acceptance and is irrevocable for 90 days from Bid Date. That period may be extended by mutual written agreement of the City and Bidder.

D. Addenda: All Addenda have been received. Modifications to Bid Documents have been considered and all related costs are included in the Total Bid Price.

E. Bid Supplements: The following documents are attached:

[X] Security Deposit *(as defined in Document 00200 – Instructions to Bidders)*
[X] Document 00450 - Bidder's Statement of MWBE/PDBE/DBE/SBE Status
[X] Document 00452 - Contractor's Submission List - Fair Campaign Ordinance Form A
[X] Document 00453 – Bidder's Statement of Residency *(not required for AIP funded project)*
[X] Document 00454 - Affidavit of Non-interest
[X] Document 00455 - Affidavit of Ownership or Control
[ ] Document 00456 - Bidder's Certificate of Compliance with Buy American Program (*Required for AIP funded Project*)
[X] Document 00457 – Conflicts of Interest Questionnaire (CIQ)
[ ] Document 00458 - Bidder's Certificate Regarding Foreign Trade Restriction *(required for AIP funded project)*
[ ] Document 00459 - Contractor's Statement Regarding Previous Contracts Subject to EEO (*Required for AIP funded Project*)

[X] Page 00460 – (POP 1) Pay or Play Acknowledgement Form
[X] Page 00470 – Bidder's MWSBE Participation Plan
[ ] Document 00471 – Pre-bid Good Faith Efforts *(required if the goal in Bidder's Participation Plan–Document 00470 is lower than the Goal).*
[ ] Document 00472 – Bidder's Goal Deviation Request *(required if the goal in Bidder's Participation Plan–Document 00470 is lower than the Goal).*
[ ] Others as listed: _____

2.0 CONTRACT TIME

A. If offer is accepted, Contractor shall achieve Date of Substantial Completion within 720 days after Date of Commencement of the Work, subject to adjustments of Contract Time as provided in the Contract.

Document 00410B

BID FORM – PART B

1.0 TOTAL BID PRICE HAS BEEN CALCULATED BY BIDDER, USING THE FOLLOWING COMPONENT PRICES AND PROCESS (PRINT OR TYPE NUMERICAL AMOUNTS):

A. STIPULATED PRICE: N/A

(Total Bid Price; minus Base Unit Prices, Extra Unit Prices, Cash Allowances and All Alternates, if any)

B. BASE UNIT PRICE TABLE:

Item No.	Spec Ref.	Base Unit	Unit of Measure	Estimated Quantity	Unit Price (this Column controls)	Total in Figures
1.	01502	Mobilization	LS	1	$250,000(1)	$250,000(1)
2.	01570	Installation of stormwater pollution prevention control measures including filter fabric fencing, storm inlet sediment trap, and inlet protection barrier to comply with the requirement of the Storm Water Pollution Prevention Plan, including furnishing all materials and incidentals.	LS	1		
3.	01110	Coordination of new CenterPoint easement installation, including clearing, grubbing, new electrical service and temporary roadway provisions in the Construction Staging Area, to be utilized for this and subsequent projects.	LS	1		
4.	09910S, 09910, 15114, 15120, 15140, 15200, 15953, 15954, Division 13, Division 16	Replacement of existing globe style silent check valves (quantity 8) at the plant High Service Pump Station with new pump control valves and actuators to provide fail-close upon power failure. Provide complete package in place with associated process mechanical demolition, piping modifications, structural, electrical, instrumentation and control improvements	LS	1		

Bidder's Initials [ ]

B. BASE UNIT PRICE TABLE:

Item No.	Spec Ref.	Base Unit	Unit of Measure	Estimated Quantity	Unit Price (this Column controls)	Total in Figures
5.	02050	Demolition of two existing hydropneumatic surge tanks and associated piping, fittings, valves, all related electrical and structural foundation. Installation of flush-type hydrant.	LS	1		
6.	02050, 16060	Demolition and removal of the High Service Pump Station Powerhouse and two 10,000 kVA transformers. These items shall be the Contractors sole possession for Salvage	LS	1		
7.	Division 13, 16402	Installation of duct bank for 12.47kV Medium Voltage feeders and Communications from the 138kV Substation Electrical Building to the proposed Substation Transformers and High Service Electrical Building and new pad-mounted transformers	LS	1		
8.	Division 13, Division 16	Installation of four Medium Voltage 4.16 kV Adjustable Speed Drives (ASDs) and medium-voltage electrical switchgear with all required electrical and instrumentation and control improvements	LS	1		
9.	Divisions 2 through 10, 11501, 15500, 15855, 15860, and Division 13, Division 16	Construction of a new Electrical Building to house new electrical switchgear, ASDs and PLC control panel and ancillary equipment. Provide all associated building structural, architectural, HVAC and pluming, and civil and site improvements	LS	1		
10.	13900	Implementation of a new pump operation and optimization software to maximize pump station operation efficiency.	LS	1		

B. BASE UNIT PRICE TABLE:

Item No.	Spec Ref.	Base Unit	Unit of Measure	Estimated Quantity	Unit Price (this Column controls)	Total in Figures
11.	13340	Replacement of existing 42-inch distribution flow meter (quantity 2.), existing 8-inch plant potable water (utility water) flow meter, HSPS suction and discharge header pressure indicating transmitters, plant potable water loop pressure indicating transmitter, post-GST1 chlorine analyzer, and associated electrical and instrumentation and control improvements	LS	1		
12.	02050, 02518, 02768, 11500, 15120, 15140	Miscellaneous piping elements and structural support improvements at the plant High Service Pump Station, Treated Water Flow Meter Station, and UV1 and UV2 Buildings areas as shown on the Drawings and specified herein, including installation of temporary line stops and bypass piping to remove existing Victaulic Depend-O-Lok couplings and replace with new piping connections	LS	1		
13.	01110	Enter equipment data of new material provided on this project into the City's work Management System (WMS) database. Coordinate with Drinking Water Operations (DWO) staff for training and data input	LS	1		
14.	Division 2	All miscellaneous civil and site work including paving, grading, drainage, and utilities as shown on the Drawings and specified herein, including provisions for storm water Inlet and storm water line to connect the existing storm water line.	LS	1		

B. BASE UNIT PRICE TABLE:

Item No.	Spec Ref.	Base Unit	Unit of Measure	Estimated Quantity	Unit Price (this Column controls)	Total in Figures
15.	01576S, 01576, Division 2	Stormwater quality detention basin cleaning including handling, removing, laboratory testing, transporting, and disposal of vegetation and soil (total quantity 1,000 cu. Yds), and hydromulching the basin.	LS	1		
TOTAL BASE UNIT PRICES						$_____

C. EXTRA UNIT PRICE TABLE:

Item No.	Spec Ref.	Extra Unit	Unit of Measure	Estimated Quantity	Unit Price (this Column controls)	Total in figures
1.	01576S, 01576	Extra vegetation and soil handling, removing, laboratory testing, transporting, and disposal in excess of the quantity in base unit price item 15	CY	250	[$60.00][2]	[$15,000][2]
2.	02318	Hand Excavation and Backfill	CY	10	[$100.00][2]	[$1,000][2]
3.	02318	Machine Excavation and Backfill	CY	10	[$25.00][2]	[$250.00][2]
4.	02320	Bank Sand Backfill	CY	10	[$10.00][2]	[$100.00][2]
5.	02320	Select Backfill	CY	10	[$15.00][2]	[$150.00][2]
6.	02321	Cement Stabilized Sand Backfill	TON	10	[$40.00][2]	[$400.00][2]
7.	02465	30" Ø Drilled Pier with Reinforcement and Casing	LF	60	[$100.00][2]	[$6,000.00][2]
8.	02751	Concrete Pavement and Subgrade	SY	20	[$70.00][2]	[$1,400.00][2]
9.	02768	Extra Allowance on 42" Line Stop Installation on HSPS Suction Pipe including excavation, replacement of fill, and compaction etc. to complete the installation.	EA	4	[$65,500.00][2]	[$262,000.00][2]

C. EXTRA UNIT PRICE TABLE:

Item No.	Spec Ref.	Extra Unit	Unit of Measure	Estimated Quantity	Unit Price (this Column controls)	Total in figures
10.	02768	Extra Allowance on 30" Line Stop Installation on HSPS Discharge Pipe including excavation, replacement of fill, and compaction etc. to complete the installation.	EA	4	[$50,000.00][(2)]	[$200,000.00][(2)]
11.	03200	Reinforced Steel	LB	3,000	[$0.75][(2)]	[$2,250.00][(2)]
12.	03200	Grade 60 Reinforcement	Ton	5	[$1,200.00][(2)]	[$6,000.00][(2)]
13.	03300	Class A (4,000 psi) Concrete	CY	10	[$300.00][(2)]	[$3,000.00][(2)]
14.	03600	Non-shrink Epoxy Grout (14,000 psi)	CF	5	[$555][(2)]	[$2,775.00][(2)]
15.	03600	Concrete Grout (2,500 psi min)	CY	2	[$800][(2)]	[$1,600.00][(2)]
16.	05580	Fabricated Structural Steel	Ton	1	[$2,500][(2)]	[$2,500][(2)]
17.	02518, 15061	Steel Piping and Fittings	Ton	5	[$4,000.00][(2)]	[$20,000][(2)]
18.	15100	Extra Unit Cost for seat repairing/replacing existing 30" pump discharge butterfly valves with new as specified in Section 15100	EA	4	[$10,000.00][(2)]	[$40,000.00][(2)]
19.	15100	Extra Unit Cost for seat repairing or replacing existing 42" pump suction butterfly valves with new as specified in Section 15100	EA	4	[$25,000.00][(2)]	[$100,000.00][(2)]
20.	15120	Extra Allowance for Removing existing Depend-o-Lok couplings and replacement with welded butt strap connection complete with pipe interior coating repair and finish painting complete in place	EA	2	[$2,000.00][(2)]	[$4,000.00][(2)]

C. EXTRA UNIT PRICE TABLE:

Item No.	Spec Ref.	Extra Unit	Unit of Measure	Estimated Quantity	Unit Price (this Column controls)	Total in figures
21.	16111	1" Rigid Aluminum Conduit installed above ground	LF	200	[$15.50](2)	[$3,100.00](2)
22.	16111	2" Rigid Aluminum Conduit installed above ground	LF	100	[$29.50](2)	[$2,950.00](2)
23.	16111	3" Rigid Aluminum Conduit installed above ground	LF	100	[$55.50](2)	[$5,550.00](2)
24.	16120	Copper No. 12 AWG conductor with XHHW-2 insulation, installed	LF	2,000	[$0.72](2)	[$1,440.00](2)
25.	16120	Copper No. 10 AWG conductor with XHHW-2 insulation, installed	LF	1,000	[$0.94)(2)	[$940.00](2)
26.	16120	Copper No. 6 AWG conductor with XHHW-2 insulation, installed	LF	500	[$1.68](2)	[$840.00](2)
27.	16120	Copper No. 2 AWG conductor with XHHW-2 insulation, installed	LF	500	[$3.25](2)	[$1,625.00](2)
28.	16120	Copper No. 1/0 AWG conductor with XHHW-2 insulation, installed	LF	250	[$4.63](2)	[$1,157.50](2)
29.	16120	Copper No. 4/0 AWG conductor with XHHW-2 insulation, installed	LF	100	[$7.25](2)	[$725.00](2)
30.	16123	Copper No. 2/0 AWG conductor with (15Kv) EPR insulation, installed, and terminated	LF	400	[$21.40](2)	[$8,560.00](2)
31.	16123	Copper 250 KCMIL conductor with (15Kv) EPR insulation, installed, and terminated	LF	300	[$27.90](2)	[$8,370.00](2)
32.	16126	2/C or 3/C, #16 AWG twisted shielded instrument cable, installed	LF	1,000	[$2.10](2)	[$2,100.00](2)
33.	16402	1" PVC SCH 40 Conduit installed in Underground duct bank	LF	500	[$2.50](2)	[$1,250.00](2)

C. EXTRA UNIT PRICE TABLE:

Item No.	Spec Ref.	Extra Unit	Unit of Measure	Estimated Quantity	Unit Price (this Column controls)	Total in figures
34.	16402	2" PVC SCH 40 Conduit installed in Underground duct bank	LF	500	[$4.30][2]	[$2,150.00][2]
35.	16402	3" PVC SCH 40 Conduit installed in Underground duct bank	LF	400	[$5.50][2]	[$2,200.00][2]
36.	16402	4" PVC SCH 40 Conduit installed in Underground duct bank	LF	200	[$6.50][2]	[$1,300.00][2]
37.	16402	Duct bank trenching, rebar, concrete encasement and backfill for duct bank where the top of the duct bank is 48" below grade or less	LF	200	[$35.00][2]	[$7,000.00][2]
38.	16402	Duct bank trenching, rebar, concrete encasement and backfill for duct bank where the top of the duct bank is 48" below grade or more	LF	200	[$50.00][2]	[$10,000.00][2]
TOTAL EXTRA UNIT PRICES						[$729,682.50][2]

REST OF PAGE INTENTIONALLY LEFT BLANK

D. CASH ALLOWANCE TABLE:

Item No.	Spec Ref.	Cash Allowance Short Title	Cash Allowance in figures (1)
1	01110	Building Permit Fee	$28,000
2	01110	CenterPoint Energy Temporary Power	$50,000
TOTAL CASH ALLOWANCES			$78,000

REST OF PAGE INTENTIONALLY LEFT BLANK

E. ALTERNATES TABLE: N/A

REST OF PAGE INTENTIONALLY LEFT BLANK

F. TOTAL BID PRICE: _____
(Add Totals for Items A., B., C., D., and E. above)

2.0 SIGNATURES: By signing this Document, I agree that I have received and reviewed all Addenda and considered all costs associated with the Addenda in calculating the Total Bid Price.

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.

Footnotes for Tables B through E:

(1) Fixed Unit Price determined prior to Bid. Cannot be adjusted by the Bidder.
(2) Minimum Bid Price determined prior to Bid. Can be increased by the Bidder, but not decreased, by crossing out the Minimum and inserting revised price on the line above. **Cannot** be decreased by the Bidder.
(3) Maximum Bid Price determined prior to Bid. Can be decreased by the Bidder, but not increased, by crossing out the Maximum and inserting revised price on the line above. A Bid that increases the Maximum Bid Price may be found non-conforming and non-responsive. **Cannot** be increased by the Bidder.
(4) Fixed Range Bid Price determined prior to Bid. Unit Price can be adjusted by Bidder to any amount within the range defined by crossing out prices noted and noting revised price on the line above.

Document 00430

BIDDER'S BOND

THAT WE, _____, as Principal,
(Bidder)
("Bidder"), and the other subscriber hereto, _____, as Surety, do hereby acknowledge ourselves to be held and firmly bound to the City of Houston, a municipal corporation, in the sum of _____ Dollars ($_____) (an amount equal to 10 percent of the Total Bid Price, including Cash Allowances and Alternates, if any, for the payment of which sum, well and truly to be made to the City of Houston and its successors, the Bidder and Surety do bind themselves, their heirs, executors, administrators, successors, and assigns, jointly and severally.

THE CONDITIONS OF THIS OBLIGATION ARE SUCH THAT:

WHEREAS, the Bidder has submitted on or about this day a proposal offering to perform the following:

_____
(Project Name, Location and Number)
in accordance with the Drawings, Specifications, and terms and conditions related thereto to which reference is hereby made.

NOW, THEREFORE, if the Bidder's offer as stated in the Document 00410 – Bid Form is accepted by the City, and the Bidder executes and returns to the City Document 00520 – Agreement, required by the City, on the forms prepared by the City, for the Work and also executes and returns the same number of the Performance, Payment and Maintenance Bonds (such bonds to be executed by a Corporate Surety authorized by the State Board of Insurance to conduct insurance business in the State of Texas, and having an underwriting limitation in at least the amount of the bond) and other submittals as required by Document 00495 - Post-Bid Procedures, in connection with the Work, within the Contract Time, then this obligation shall become null and void; otherwise it is to remain in full force and effect.

If Bidder is unable to or fails to perform the obligations undertaken herein, the undersigned Bidder and Surety shall be liable to the City for the full amount of this obligation which is hereby acknowledged as the amount of damages which will be suffered by the City on account of the failure of such Bidder to perform such obligations, the actual amount of such damages being difficult to ascertain.

Notices required or permitted hereunder shall be in writing and shall be deemed delivered when actually received or, if earlier, on the third day following deposit in a United States Postal Service post office or receptacle, with proper postage affixed (certified mail, return receipt requested), addressed to the respective other Party at the address prescribed in the Contract documents, or at such other address as the receiving Party may hereafter prescribe by written notice to the sending Party.

IN WITNESS THEREOF, the Bidder and Surety have signed and sealed this instrument on the respective dates written below their signatures and have attached current Power of Attorney.

ATTEST, SEAL: (if a corporation)
WITNESS: (if not a corporation)

By: _____
Name:
Title:

ATTEST/SURETY WITNESS: (SEAL)

By: _____
Name:
Title:
Date:

_____
(Name of Bidder)

By: _____
Name:
Title:
Date:

_____
(Full Name of Surety)

_____
(Address of Surety for Notice)

_____
(Telephone Number of Surety)

By: _____
Name:
Title:
Date:

END OF DOCUMENT

Document 00450

BIDDER'S STATEMENT OF MWBE/PDBE/DBE/SBE STATUS

This certifies that the status of the Bidder, _____, in
(Bidder's Name)
regard to the City of Houston Code of Ordinances, Chapter 15, Article V, relating to City-wide percentage goals for contracting with Minority and Women-owned Business Enterprises (MWBE) and Disadvantaged Business Enterprises (DBE), Chapter 15, Article VI, relating to City-wide percentage goals for contracting with Persons with Disabilities Business Enterprises (PDBE) and Chapter 15, Article IX, relating to City-wide percentage goals for contracting with a Small Business Enterprise (SBE) is as follows:

1. Bidder (individual, partnership, corporation) is [__] is not [__] a Minority Business Enterprise as certified by the Office of Business Opportunity.

2. Bidder (individual, partnership, corporation) is [__] is not [__] a Women-owned Business Enterprise as certified by the Office of Business Opportunity

3. Bidder (individual, partnership, corporation) does [__] does not [__] declare itself to be a Persons with Disabilities Business Enterprise as defined above.

4. Bidder (individual, partnership, corporation) does [__] does not [__] declare itself to be a Disadvantaged Business Enterprise as defined above.

5. Bidder (individual, partnership, corporation) does [__] does not [__] declare itself to be a Small Business Enterprise as defined above.

Signature: _____

Title: _____

Date: _____

END OF DOCUMENT

Document 00452
Form A
CONTRACTOR SUBMISSION LIST
CITY OF HOUSTON FAIR CAMPAIGN ORDINANCE

The City of Houston Fair Campaign Ordinance makes it unlawful for a Contractor to offer any contribution to a candidate for City elective office (including elected officers-elect) during a certain period of time prior to and following the award of the Contract by the City Council. The term "Contractor" includes proprietors of proprietorships, partners or joint venturers having an equity interest of 10 percent or more for the partnership or joint venture, and officers, directors and holders of 10 percent or more of the outstanding shares of corporations. Submission of a statement disclosing the names and business addresses of each of those persons is required with each Bid/Proposal for a City Contract. See Chapter 18 of the City of Houston Code of Ordinances for further information.

This list is submitted under the provisions of Section 18-36(b) of the City of Houston Code of Ordinances in connection with the attached Bid/Proposal of:

Firm or Company Name: _____
Firm or Company Address: _____
_____

The firm/company is organized as indicated below. Check one as applicable and attach additional pages if needed to supply the required names and addresses.

[ ] SOLE PROPRIETOR

Name _____ (Proprietor) _____ (Address)

[ ] A PARTNERSHIP

LIST EACH PARTNER HAVING EQUITY INTEREST OF 10% OR MORE OF PARTNERSHIP (IF NONE STATE "NONE")

Name _____ (Partner) _____ (Address)

Name _____ (Partner) _____ (Address)

[ ] A CORPORATION

LIST ALL DIRECTORS OF THE CORPORATION (IF NONE STATE "NONE")

Name _____ (Director) _____ (Address)

Name _____ (Director) _____ (Address)

Name _____ (Director) _____ (Address)

LIST ALL OFFICERS OF THE CORPORATION (IF NONE STATE "NONE")

Name _____ (Officer) _____ (Address)

Name _____ (Officer) _____ (Address)

Name _____ (Officer) _____ (Address)

LIST ALL INDIVIDUALS OWNING 10% OR MORE OF OUTSTANDING SHARES OF STOCK OF THE CORPORATION (IF NONE STATE "NONE")

Name _____ (Owner) _____ (Address)

Name _____ (Owner) _____ (Address)

Name _____ (Owner) _____ (Address)

I certify that I am duly authorized to submit this list on behalf of the firm, that I am associated with the firm in the capacity noted below, and that I have knowledge of the accuracy of the information provided herein.

_____
Signature

_____
Printed Name

_____
Title

Note: This list constitutes a government record as defined by § 37.01 of the Texas Penal Code.

END OF DOCUMENT

Document 00453

BIDDER'S STATEMENT OF RESIDENCY

The City may not award a contract for general construction, services, or purchases to a Nonresident Bidder unless Nonresident's Bid is lower than the lowest Bid submitted by a responsible Texas Resident Bidder by the same amount that a Texas Resident bidder would be required to underbid the Nonresident Bidder to obtain a comparable contract in the state in which Nonresident's principle place of business is located.

1. This certifies that the Bidder, _____, is a State of Texas Resident Bidder as defined in TEX. GOVT. CODE ANN. § 2252.001(4) (Vernon 1994).

_____ _____
Signature Title

"Texas Resident Bidder" means a bidder whose principal place of business is in this State, and includes a Contractor whose ultimate parent company or majority owner has its principal place of business in this State. *When bidder cannot sign 1, above, proceed to 2.*

2. a. _____ is a resident of _____ and is a Nonresident Bidder as defined in TEX. GOVT. CODE ANN. § 2252.001(3) (Vernon 1994).

_____ _____
Signature Title

"Nonresident Bidder" means a bidder whose principal place of business is not in this State, but excludes a contractor whose ultimate parent company or majority owner has its principal place of business in this State.

b. The State of _____ _____ have a state statute giving
Bidder's resident state Does or Does Not
preference to resident bidders.

_____ _____
Signature Title

If the answer to 2.b is that your state does have a statute giving preference to resident bidders, then you must provide a copy and proceed to 3.

3. A copy of the State of _____ statute is attached.

_____ _____
Signature Title

_____
Date

END OF DOCUMENT

Document 00454

AFFIDAVIT OF NON-INTEREST

BEFORE ME, the undersigned authority, a Notary Public in and for the State of Texas, on this day personally appeared _____, who
Affiant
being by me duly sworn on his oath stated that he is _____, of
Title
_____,
Name of Firm
the firm named and referred to and in the foregoing; and that he knows of no officer, agent, or employee of the City of Houston being in any manner interested either directly or indirectly in such Contract.

_____
Affiant's Signature

SWORN AND SUBSCRIBED before me on _____.
Date

_____
Notary Public in and for the State of TEXAS

_____
Print or type name

My Commission Expires: _____
Expiration Date

END OF DOCUMENT

Document 00455

AFFIDAVIT OF OWNERSHIP OR CONTROL

ORIG. DEPT.: DEPARTMENT OF PUBLIC WORKS AND ENGINEERING **FILE/I.D. NO.:** S-000066-012A-4

INSTRUCTION: ENTITIES USING AN ASSUMED NAME SHOULD DISCLOSE SUCH FACT TO AVOID REJECTION OF THE AFFIDAVIT. THE FOLLOWING FORMAT IS RECOMMENDED: CORPORATE/LEGAL NAME DBA ASSUMED NAME.

STATE OF _____ §
§ **AFFIDAVIT OF OWNERSHIP OR CONTROL**
COUNTY OF _____ §

BEFORE ME, the undersigned authority, on this day personally appeared _____ [*FULL NAME*] (hereafter "Affiant"), _____ [*STATE TITLE/CAPACITY WITH CONTRACTING ENTITY*] of _____ [*CONTRACTING ENTITY'S CORPORATE/LEGAL NAME*] ("Contracting Entity"), who being by me duly sworn on oath stated as follows:

1. Affiant is authorized to give this affidavit and has personal knowledge of the facts and matters herein stated.

2. Contracting Entity seeks to do business with the City in connection with _____ [*DESCRIBE PROJECT OR MATTER*] which is expected to be in an amount that exceeds $50,000.

3. The following information is submitted in connection with the proposal, submission or bid of Contracting Entity in connection with the above described project or matter.

4. Contracting Entity is organized as a business entity as noted below (check box as applicable).

FOR PROFIT ENTITY:

[ ] SOLE PROPRIETORSHIP
[ ] CORPORATION
[ ] PARTNERSHIP
[ ] LIMITED PARTNERSHIP
[ ] JOINT VENTURE
[ ] LIMITED LIABILITY COMPANY
[ ] OTHER (Specify type in space below)

NON-PROFIT ENTITY:

[ ] NON-PROFIT CORPORATION
[ ] UNINCORPORATED ASSOCIATION

_____

_____

_____

5. The information shown below is true and correct for the Contracting Entity and all owners of 5% or more of the Contracting Entity and, where the Contracting Entity is a non-profit entity, the required information has been shown for each officer, *i.e.*, president, vice-president, secretary, treasurer, etc. ***[NOTE: IN ALL CASES, USE FULL NAMES, LOCAL BUSINESS AND RESIDENCE ADDRESSES AND TELEPHONE NUMBERS. DO NOT USE POST OFFICE BOXES FOR ANY ADDRESS. INCLUSION OF E-MAIL ADDRESSES IS OPTIONAL, BUT RECOMMENDED. ATTACH ADDITIONAL SHEETS AS NEEDED.]***

Contracting Entity

Name: _____

Business Address *[NO./STREET]* _____

[CITY/STATE/ZIP CODE] _____

Telephone Number (____)_____

Email Address *[OPTIONAL]* _____

Residence Address *[NO./STREET]* _____

[CITY/STATE/ZIP CODE] _____

Telephone Number (____)_____

Email Address *[OPTIONAL]* _____

5% Owner(s) or More (IF NONE, STATE "NONE.")

Name: _____

Business Address *[NO./STREET]* _____

[CITY/STATE/ZIP CODE] _____

Telephone Number (____)_____

Email Address *[OPTIONAL]* _____

Residence Address *[NO./STREET]* _____

[CITY/STATE/ZIP CODE] _____

Telephone Number (____)_____

Email Address *[OPTIONAL]* _____

6. ***Optional Information***

Contracting Entity and/or _____ [***NAME OF OWNER OR NON-PROFIT OFFICER***] is actively protesting, challenging or appealing the accuracy and/or amount of taxes levied against _____ [***CONTRACTING ENTITY, OWNER OR NON-PROFIT OFFICER***] as follows:

Name of Debtor: _____

Tax Account Nos. _____

Case or File Nos. _____

Attorney/Agent Name _____

Attorney/Agent Phone No. (_____)_____

Tax Years _____

Status of Appeal ***[DESCRIBE]*** _____

_____

_____

_____

Affiant certifies that he or she is duly authorized to submit the above information on behalf of the Contracting Entity, that Affiant is associated with the Contracting Entity in the capacity noted above and has personal knowledge of the accuracy of the information provided herein, and that the information provided herein is true and correct to the best of Affiant's knowledge and belief.

_____
Affiant

SWORN TO AND SUBSCRIBED before me this _____ day of _____, 20_____.

(Seal)

_____
Notary Public

NOTE:
This affidavit constitutes a **government record** as defined by Section 37.01 of the Texas Penal Code. Submission of a false government record is punishable as provided in Section 37.10 of the Texas Penal Code. Attach additional pages if needed to supply the required names and addresses.

END OF DOCUMENT

Document 00457

Conflict of Interest Questionnaire

****

Print out latest version of CIQ form from website listed below:

****

Local Government Code Chapter 176 requires Bidders with the City of Houston ("City") to file a Conflict of Interest Questionnaire with the City Secretary of the City of Houston.

The Conflict of Interest Questionnaire is available for downloading on the Texas Ethics Commission's website at: http://www.ethics.state.tx.us/forms/CIQ.pdf. The completed Conflict of Interest Questionnaire will be posted on the City Secretary's website. Also you will find a list of the City Local Government Officers on the City Secretary's website.

For your convenience the CIQ form is attached as part of this document. Although the City has provided this document for the Bidders convenience, it is the Bidders responsibility to submit the latest version of the CIQ form as promulgated by the Texas Ethics Commission.

The Failure of any Bidder to comply with this law is a Class C misdemeanor.

END OF DOCUMENT

Document 00460
(POP -1)
City of Houston
Pay or Play Program
Acknowledgement Form

It has been determined that the project currently open for bidding meets the criteria of the City of Houston Pay or Play program. This form acknowledges your awareness of the Pay or Play program which is authorized by Ordinance 2007-534. Your signature below affirms that you will comply with the requirements of the program if you are the successful bidder/proposer, and ensure the same on behalf of subcontracts subject to the Pay or Play Program.

I declare under penalty of perjury under the laws of the State of Texas that if awarded this contract which meets the criteria for the City of Houston's Pay or Play Program, I will comply with all requirements of the Pay or Play Program in accordance with Executive Order 1-7.

***Fill out all information below and submit this form with your bid/proposal packet.**

_____
Solicitation Number

_____ _____
Signature Date

_____ _____
Print Name City Vendor ID

_____ _____
Company Name Phone Number

_____
Email Address

Note: For more information contact your POP Liaison or the POP Contract Administrator. All contact information can be found on www.houstontx.gov →Departments→Office of Business Opportunity→Pay or Play.

Document 00470

BIDDER'S MWSBE PARTICIPATION PLAN

The Bidder or Proposer shall submit this completed form with the bid, to demonstrate the Bidder/Proposer's plan to meet the contract-specific MWSBE goal ("contract goal"). If the Bidder or Proposer cannot meet the contract goal, the Bidder/Proposer has the burden to demonstrate "Good Faith Efforts", which shall include correctly and accurately preparing and submitting this form, a Record of Good Faith Efforts (Document 00471), a Request for Deviation from the Goal (Document 00472), and providing supporting documentation evidencing their "Good Faith Efforts", as required by the City of Houston's Good Faith Efforts Policy (Document 00808). The City will review the Participation Plan and Good Faith Efforts at the time of bid opening. Visit http://www.houstontx.gov/obo for more information.

City Contract Goal	MBE 13%	WBE 7%	• MBE and WBE Goals are two separate Contract Goals. • Any excess of one Goal cannot be applied to meet another Goal. • An SBE can be applied to the MBE and/or WBE Goal, but not to exceed 4%.

NAICS Code (6 digit)	Description of Work (Plan Sheet #, Unit Price #, Scope of Work #, as applicable)	% of Total Bid Price (2 decimal places; for example, 5.00%)	Cert. Type for Goal: MBE, WBE, or SBE	Certified Firm Name Firm Address Contact Name Phone No. and E-Mail
			MBE ☐ WBE ☐ SBE ☐	
			MBE ☐ WBE ☐ SBE ☐	
			MBE ☐ WBE ☐ SBE ☐	
			MBE ☐ WBE ☐ SBE ☐	
			MBE ☐ WBE ☐ SBE ☐	
			MBE ☐ WBE ☐ SBE ☐	
			MBE ☐ WBE ☐ SBE ☐	

Bidder's Participation Plan Total	MBE	WBE	SBE

Signature for Company: _____ *

Printed Name: _____

Company Name: _____

Phone #: _____

Date: _____

*I understand that supplying inaccurate information may violate Texas Penal Code Section 37.10 and lead to City sanctions.

Document 00470

CONTINUATION PAGE

NAICS Code (6 digit)	Description of Work (Plan Sheet #, Unit Price #, Scope of Work #, as applicable)	% of Total Bid Price (2 decimal places; for example, 5.00%)	Cert. Type for Goal MBE, WBE, or SBE	Certified Firm Name Firm Address Contact Name Phone No. and E-Mail
			MBE ☐ WBE ☐ SBE ☐	
			MBE ☐ WBE ☐ SBE ☐	
			MBE ☐ WBE ☐ SBE ☐	
			MBE ☐ WBE ☐ SBE ☐	
			MBE ☐ WBE ☐ SBE ☐	
			MBE ☐ WBE ☐ SBE ☐	
			MBE ☐ WBE ☐ SBE ☐	
			MBE ☐ WBE ☐ SBE ☐	
			MBE ☐ WBE ☐ SBE ☐	
			MBE ☐ WBE ☐ SBE ☐	
			MBE ☐ WBE ☐ SBE ☐	
			MBE ☐ WBE ☐ SBE ☐	

Signature for Company: _____* Date: _____

Print Name/Company Name:_____ Phone: _____

*I understand that supplying inaccurate information may violate Texas Penal Code Section 37.10 and lead to City sanctions.

Document 00471

PRE-BID GOOD FAITH EFFORTS

Bidder Name: _____ **Project Name**_____

A Bidder or Proposer that may be unable to complete or follow a Participation Plan (Document 00470) to meet the Contract Goal in the Supplemental Conditions (Document 00800), must submit this completed form, Goal Deviation Request Form (Document 00472), providing supporting documentation evidencing their "Good Faith Efforts", as required by the City of Houston's Good Faith Efforts Policy (see Document 00808).

The Bidder or Prime Contractor has the burden to demonstrate "Good Faith Efforts" to meet the MWSBE goal, which includes correctly and accurately preparing and submitting this form and other efforts described in the City's Good Faith Efforts Policy (Document 00808). The Office of Business Opportunity will review Good Faith Efforts and Participation Plan after selection of an apparent low bidder.

UNLESS THE BIDDER'S/PROPOSER'S PARTICIPATION PLAN MEETS THE CONTRACT GOAL, FAILURE TO SUBMIT THIS FORM MAY RESULT IN THE BID BEING FOUND NON-RESPONSIVE.

NAICS Code	Plan Item No.	MWSBE Type for Goal	Certified Firm Name Address, Phone No., and E-Mail	Certified Firm Contact Person	Methods of Contact	Prime Contact Dates	Certified Firm Response	Results of Contact (why suitable or not suitable for work)
		MBE ☐ WBE ☐ SBE ☐			Phone ☐ E-mail ☐ Fax ☐			
		MBE ☐ WBE ☐ SBE ☐			Phone ☐ E-mail ☐ Fax ☐			
		MBE ☐ WBE ☐ SBE ☐			Phone ☐ E-mail ☐ Fax ☐			
		MBE ☐ WBE ☐ SBE ☐			Phone ☐ E-mail ☐ Fax ☐			

Authorized Signature: _____ Date: _____ Phone: _____

Print Name: _____ Email Address: _____

Company Name: _____

CONTINUATION PAGE

NAICS Code	Plan Item No.	MWSBE Type for Goal	Certified Firm Name Address, Phone No., and E-Mail	Certified Firm Contact Person	Method of Contact	Prime Contact Dates	Certified Firm Respons e	Results of Contact (why suitable or not suitable for work)
		MBE ☐ WBE ☐ SBE ☐			Phone ☐ E-mail ☐ Fax ☐			
		MBE ☐ WBE ☐ SBE ☐			Phone ☐ E-mail ☐ Fax ☐			
		MBE ☐ WBE ☐ SBE ☐			Phone ☐ E-mail ☐ Fax ☐			
		MBE ☐ WBE ☐ SBE ☐			Phone ☐ E-mail ☐ Fax ☐			
		MBE ☐ WBE ☐ SBE ☐			Phone ☐ E-mail ☐ Fax ☐			
		MBE ☐ WBE ☐ SBE ☐			Phone ☐ E-mail ☐ Fax ☐			
		MBE ☐ WBE ☐ SBE ☐			Phone ☐ E-mail ☐ Fax ☐			

Authorized Signature: _____ Date: _____ Phone: _____

Print Name: _____ Email Address: _____

Company Name: _____

Document 00472
BIDDER'S MWSBE GOAL DEVIATION REQUEST

Company Name: _____

Project Name: _____

	MBE %	WBE %	Total %
Department Approved Contract Goals			

	MBE %	WBE %	SBE (Max 4% for Credit) %	Total %
Bidder's Proposed Participation Plan				

Justification: Please provide the reason the Bidder is unable to meet the Contract Goal in Document 00800.

_____

_____

_____

Good Faith Efforts: Please list any efforts not listed in the Bidder's Pre-Bid Good Faith Effort (Document 00471) and provide supporting documentation evidencing "Good Faith Efforts", as required by the City of Houston's Good Faith Efforts Policy (Document 808).

_____

_____

_____

_____

Date: _____ Company Name: _____
Email: _____ Company Representative: _____
Phone Number: _____ Title: _____

FOR OFFICIAL USE ONLY: Approved [ ] Not Approved [ ]

OBO Representative _____ Date: _____

_____ Title: _____

Document 00495

POST-BID PROCEDURES

3.0 DOCUMENT ADDRESSES

A. Notice of Intent to Award

B. Monitoring Authority/Contracting Department

C. Requirements of Bidder

D. Failure of Bidder to comply with requirements

E. Notice to Proceed

4.0 NOTICE OF INTENT TO AWARD

A. The City will provide written Notice of Intent to Award to Low Bidder.

5.0 DEFINITIONS

A. The "Monitoring Authority" or "OBO" for this Project is:

Director, Office of Business Opportunity Division
City of Houston
611 Walker Street, 7th Floor
Houston, Texas 77002

B. The "Contracting Department" for this Project is:
Director, Department of DEPARTMENT OF PUBLIC WORKS AND ENGINEERING
City of Houston
611 Walker Street
Houston, Texas 77002
ATTN: **Tina Yao, P.E.,**

6.0 REQUIREMENTS OF BIDDER

A. Within10 days of receipt of Notice of Intent to Award, Low Bidder shall execute and deliver to Tina Yao, P.E., Project Manager and Monitoring Authority, for the City's approval, documents indicated by an "X" below:
[ ] Document 00570 – Revised MWSBE Participation Plan *(Do not submit if OBO Director approved Bidder's Plan – Document 00470)*

[X] Executed Subcontract(s), Letter(s) of Intent, or documentation of good faith efforts to meet the MWSBE goals

B. Within 10 days of receipt of Notice of Intent to Award, Low Bidder shall execute and deliver to Tina Yao, P.E., Project Manager for the City's approval, documents indicated by an "X" below:

[ ] Document 00500 - Form of Business
[X] Document 00501 - Resolution of Contractor
[X] Document 00520 - Agreement
[X] Document 00600 - List of Proposed Subcontractors and Suppliers
[X] Document 00601 - Drug Policy Compliance Agreement
[X] Document 00602 - Contractor's Drug-free Workplace Policy *(Contractor creates this document.)*
[X] Document 00604 - History of OSHA Actions and List of On-the-job Injuries
[X] Document 00605 - List of Safety Impact Positions *(Contractor completes this list. Do not submit if submitting Document 00606.)*
[ ] Document 00606 - Contractor's Certification of No Safety Impact Positions *(Do not submit if submitting Document 00605.)*
[ ] Document 00607 - Certification Regarding Debarment, Suspension, and Other Responsibility Matters
[ ] Document 00608 - Contractor's Certification Regarding Non-segregated Facilities for Project Funded by AIP Grant
[X] Document 00610 - Performance Bond
[X] Document 00611 - Statutory Payment Bond
[X] Document 00612 - One-year Maintenance Bond
[ ] Document 00613 - One-year Surface Correction Bond
[X] Document 00620 - Affidavit of Insurance *(with Certificate of Insurance attached)*
[X] Document 00622 - Name and Qualifications of Proposed Superintendent *(Contractor creates this document.)*
[ ] Document 00623 - Contractor's Act of Assurance (SRF Form ED-103)
[X] Document 00624 - Affidavit of Compliance with S/WMBE Program
[ ] Document 00625 - SRF Participation Summary
[ ] Document 00626 - SRF Affirmative Steps Solicitation Report
[ ] Document 00627 - SRF Prime Contractor Affirmative Steps Certification and Goals
[ ] Document 00629 - Affidavit for FAA Form 7460-1
[X] Document 00630 - Certification of Compliance with Pay or Play Program
[X] Document 00631 - City of Houston Pay or Play Program – List of Subcontractors
[ ] Document 00809 – CDBG Requirements for Federally Funded Projects

C. Within 10 days of receipt of Notice of Intent to Award, Low Bidder shall execute the following forms and deliver them directly to the Monitoring Authority.

1. Original forms contained in Document 00805 – Equal Employment Opportunity Program Requirements:
   [X] Pages 00805-3 to 00805-5, Certification by Bidder Regarding Equal

Employment Opportunity

[X] *Page 00805-6, Total Work Force Composition of the Company, or copy of latest EEO-1 form (required only if Contractor has a work force of 50 or more people and the Original Contract Price is $50,000 or more)*

[X] *Page 00805-7, Equal Employment Opportunity Compliance Program*

[X] *Page 00805-26, Certification by Proposed Subcontractor Regarding Equal Employment Opportunity*

[X] *Page 00805-29, Certification by Proposed Material Supplier, Lessor, and Professional Service Providers Regarding Equal Employment Opportunity*

2. Original completed form Document 00633 - Certification by Proposed Material Suppliers, Lessors, and Professional Service Providers Regarding Equal Employment Opportunity, for each proposed material supplier and equipment supplier.

3. Original forms contained in Document 00820 – Wage Scale for Engineering Construction.

[X] *Certificate from Contractor Appointing Officer or Employee to Supervise Payment of Employees*

[ ] *Certificate from SubContractor Appointing Officer or Employee to Supervise Payment of Employees*

[ ] Document 00812, Exhibit "A" – Certificate from Contractor Appointing Officer or Employee to Supervise Payment of Employees

D. Designations of Subcontractors and Suppliers, who have been selected by Bidder in Document 00600 - List of Proposed Subcontractors and Suppliers, and accepted by the City, may be changed only with prior notice and acceptance by Project Manager as provided in Conditions of the Contract. For each Product Supplier subsequently added or substituted, provide an original completed form, Document 00633 - Certification by Proposed Material Suppliers, Lessors, and Professional Service Providers Regarding Equal Employment Opportunity, directly to the Monitoring Authority.

E. On Bidder's written request, Tina Yao, P.E., Project Manager may grant an extension of time, not to exceed 5 days, to furnish documents specified in Paragraphs 4.0.A and 4.0.B. If Bidder is required to resubmit documents specified in Paragraph 4.0.A or 4.0.B, Bidder shall do so within time limits provided in the request for resubmission.

F. Designations of Subcontractors and Suppliers, who have been selected by Bidder in its Participation Plan, and accepted by the City, may be changed only with prior notice and acceptance by the Monitoring Authority as provided in Document 00808 – Bidder/Contractor Requirements for the City of Houston Minority, Women, and Small Business Enterprise (MWSBE), and Persons with Disabilities Business Enterprise (PDBE).

5.0 FAILURE OF BIDDER TO COMPLY WITH REQUIREMENTS

A. Should Bidder, on receipt of Notice of Intent to Award, fail to comply with requirements of this Document 00495 within stated time, the City may declare award in default and require forfeiture of the Security Deposit.

B. After the City's written notice of default to Low Bidder, the City may award the Contract to Bidder whose offer is the next lowest bid, and Security Deposit of Bidder in default shall be forfeited to the City in accordance with provisions of Document 00200 - Instructions to Bidders.

6.0 NOTICE TO PROCEED

A. Upon the City's execution of the Agreement and delivery to Contractor, City Engineer will give Document 00551 - Notice to Proceed to Contractor, which establishes Date of Commencement of the Work.

END OF DOCUMENT

Document 00501

RESOLUTION OF CONTRACTOR

_____ ("Contractor"),
(Name of Contractor, e.g., "Biz. Inc.", "Biz LLP")

is a _____,
(Type of Organization, e.g.: Corporation, Limited Partnership, Limited Liability Partnership, Limited Liability Company, etc.)

which is bound by acts of _____,
(Name and Form of Governing Entity, e.g., "Biz Inc. Board of Directors", "Bill Smith, GP", etc.)

("Governing Entity").

On the _____ day of _____, 20___, the Governing Entity resolved, in accordance with all documents, rules, and laws applicable to the Contractor, that

_____, is authorized to act as the
(Contractor's Representative)

Contractor's Representative in all business transactions (initial one) ____ conducted in the State of Texas OR ____ related to this Contract; and

The Governing Entity warrants that the above resolution (a) was entered into without dissent or reservation by the Governing Entity, (b) has not been rescinded or amended, and (c) is now in full force and effect; and

In authentication of the adoption of this resolution, I subscribe my name on this day of _____, 20___.

_____ _____
(Authorized Signature for Governing Entity) (Print or Type Name and Title of Authorized Signatory)

SWORN AND SUBSCRIBED before me on _____
Date

_____
Notary Public in and for the State of Texas

My Commission Expires: _____ _____
Expiration Date Print or Type Name of Notary Public

Document 00520

AGREEMENT

Project: Northeast Water Purification Plant Improvements Package No.2 – High Service Pump Station and Miscellaneous Piping Improvements

Project Location: This project is located on 12121 North Sam Houston Parkway East, Humble, Texas 77396(Key Map No. 376Z, 377W)

Project No: WBS No. S-000066-012A-4

The City: THE CITY OF HOUSTON, 900 Bagby Street, Houston, Texas 77002 (the "City")

and

Contractor: _____

(Address for Written Notice) _____

_____

Fax Number: _____ **Phone Number:** _____

City Engineer, with respect to Sections 4.3 thru 4.5 of the General Conditions, is:

J. Timothy Lincoln, P.E. (or his successor)

P. O. Box 1562, Houston, Texas 77251-1562 (Address for Written Notice)

City Engineer, with respect to all other terms of the General Conditions, is:

Joseph T. Myers, P.E. (or his successor)

Fax Number: (832) 395-2410

THE CITY AND CONTRACTOR AGREE AS FOLLOWS:

ARTICLE 1
THE WORK OF THE CONTRACT

1.1 Contractor shall perform the Work in accordance with the Contract.

ARTICLE 2
CONTRACT TIME

2.1 Contractor shall achieve Date of Substantial Completion within **720** days after Date of Commencement of the Work, subject to adjustments of Contract Time as provided in the Contract.

2.2 The Parties recognize that time is of the essence for this Agreement and that the City will suffer financial loss if the Work is not completed within the Contract Time. Parties also recognize delays, expense, and difficulties involved in proving in a legal or arbitration proceeding actual loss suffered by the City if the Work is not completed on time. Accordingly, instead of requiring any such proof, the Parties agree that as

liquidated damages for delay (but not as a penalty), Contractor shall pay the City the amount stipulated in Document 00800 – Supplementary Conditions, for each day beyond Contract Time.

ARTICLE 3
CONTRACT PRICE

3.1 Subject to terms of the Contract, the City will pay Contractor in current funds for Contractor's performance of the Contract, Contract Price of $__ which includes Alternates, if any, accepted below.

3.2 The City accepts Alternates as follows:

****

Delete or add lines below to indicate all Alternates that were included in Request for competative sealed proposals. Remove brackets and instructions when done. Change color of remaining text to black.

****

Alternate No. 1 [*Accepted or Not Accepted*]
Alternate No. 2 [*Accepted or Not Accepted*]
Alternate No. 3 [*Accepted or Not Accepted*]
Alternate No. 4 [*Accepted or Not Accepted*]

ARTICLE 4
PAYMENTS

4.1 The City will make progress payments to Contractor as provided below and in Conditions of the Contract.

4.2 The Period covered by each progress payment is one calendar month ending on the [___] 15th or [___] last day of the month.

4.3 The City will issue Certificates for Payment and will make progress payments on the basis of such Certificates as provided in Conditions of the Contract.

4.4 Final payment, constituting entire unpaid balance of Contract Price, will be made by the City to Contractor as provided in Conditions of the Contract.

ARTICLE 5
CONTRACTOR REPRESENTATIONS

5.1 Contractor represents:

5.1.1 Contractor has examined and carefully studied Contract documents and other related data identified in Request For or Competitive Sealed Proposals or Competitive Sealed Bids.

5.1.2 Contractor has visited the site and become familiar with and is satisfied as to general, local, and site conditions that may affect cost, progress, and performance of the Work.

5.1.3 Contractor is familiar with and is satisfied as to all federal, state, and local laws and regulations that may affect cost, progress, and performance of the Work.

5.1.4 Contractor has carefully studied all: (1) reports of explorations and tests of subsurface conditions at or contiguous to the site and all drawings of physical conditions in or relating to existing surface or subsurface structures at or contiguous to the site (except Underground Facilities) which have been identified in Contract documents and (2) reports and drawings of a hazardous environmental condition, if any, at the site which has been identified in Contract documents.

5.1.5 Contractor has obtained and carefully studied (or assumes responsibility for having done so) all additional or supplementary examinations, investigations, explorations, tests, studies, and data concerning conditions (surface, subsurface, and Underground Facilities) at or contiguous to the site which may affect cost, progress, or performance of the Work or which relate to any aspect of the means, methods, techniques, sequences, and procedures of construction to be employed by Contractor, including applying specific means, methods, techniques, sequences, and procedures of construction, if any, expressly required by the Contract to be employed by Contractor, and safety precautions and programs incident thereto

5.1.6 Contractor does not consider that any further examinations, investigations, explorations, tests, studies, or data are necessary for performance of the Work at Contract Price, within Contract Time, and in accordance with the Contract.

5.1.7 Contractor is aware of general nature of work to be performed by the City and others at the site that relates to the Work as indicated in Contract documents.

5.1.8 Contractor has correlated information known to Contractor, information and observations obtained from visits to the site, reports and drawings identified in the Contract, and all additional examinations, investigations, explorations, tests, studies, and data with the Contract.

5.1.9 Contractor has given City Engineer written notice of all conflicts, errors, ambiguities, or discrepancies that Contractor has discovered in the Contract, and written resolution thereof by City Engineer is acceptable to Contractor.

5.1.10 Contract documents are generally sufficient to indicate and convey understanding of all terms and conditions for performance and furnishing of the Work.

ARTICLE 6
MISCELLANEOUS PROVISIONS

6.1 The Contract may be terminated by either Party as provided in Conditions of the Contract.

6.2 The Work may be suspended by the City as provided in Conditions of the Contract.

ARTICLE 7
ENUMERATION OF CONTRACT DOCUMENTS

7.1 The following documents are incorporated into this Agreement:

7.1.1 Document 00700 - General Conditions.

7.1.2 Document 00800 - Supplementary Conditions.

7.1.3 Division 01 - General Requirements.

7.1.4 Divisions 02 through 16 of Specifications.

7.1.5 Drawings listed in Document 00015 - List of Drawings. Drawing No. _____and bound separately.

7.1.6 Addenda [and Riders] which apply to the Contract, are as follows:

Addendum No. 1, dated None

Addendum No. 2, dated None

Addendum No. 3, dated None

Rider No. [__], dated None

7.1.7 Other documents:

	Document No.	Title
[X]	00410B	Bid Form – Part B
[X]	00470	Standard Pre-Bid Participation Plan Document
[ ]	00471	Pre-Bid Good Faith Efforts Report
[ ]	00472	Goal Deviation Request
[ ]	00500	Form of Business
[X]	00501	Resolution of Contractor (if a corporation)
[ ]	00570	Amended S/MWBE Participation Plan
[ ]	00571	Contractor's Good Faith Efforts Report
[ ]	00572	Plan Deviation Request
[ ]	00608	Contractor's Certification Regarding Non-Segregated Facilities for Project Funded by AIP Grant
[X]	00610	Performance Bond
[X]	00611	Statutory Payment Bond
[X]	00612	One-year Maintenance Bond
[ ]	00613	One-year Surface Correction Bond
[X]	00620	Affidavit of Insurance (with the Certificate of Insurance attached)
[ ]	00623	Contractor's Act of Assurance (SRF Form ED-103)
[X]	00624	Affidavit of Compliance with Affirmative Action Program
[ ]	00628	Affidavit of Compliance with Disadvantaged Business Enterprise (DBE) Program for Project Funded By AIP Grant
[X]	00630	(POP-2) Certification of Compliance with Pay or Play Program
[X]	00631	(POP-3) City of Houston Pay or Play Program – List of Subcontractors
[X]	00800	Supplementary Conditions for Project CIP or AIP Funded
[ ]	00801	Supplementary Conditions for Project AIP Funded
[ ]	00802	SRF Supplementary Conditions
[X]	00805	Equal Employment Opportunity Program Requirements
[ ]	00806	EPA DBE and Wage Rate Requirements (SRF only)
[ ]	00807	Bidder/Contractor Requirements for DBE Program
[X]	00808	Minority and Women-owned Business Enterprise (MWBE) & Persons with Disabilities Business Enterprise (PDBE) Program
[ ]	00810	Federal Wage Rate - Highway
[ ]	00811	Federal Wage Rate - Building
[ ]	00812	Federal Wage Rate - Heavy
[X]	00820	Wage Rate for Engineering Construction
[X]	00821	Wage Rate for Building Construction
[ ]	00830	Trench Safety Geotechnical Information
[X]	00840	Pay or Play Program
[ ]	00912	Rider

ARTICLE 8
SIGNATURES

8.1 This Agreement is executed in two original copies and is effective as of the date of countersignature by City Controller.

CONTRACTOR:

By: _____
Name: _____
Title: _____
Date: _____
Tax Identification Number: _____

(If Joint Venture)

By: _____
Name: _____
Title: _____
Date: _____
Tax Identification Number: _____

CITY OF HOUSTON, TEXAS

APPROVED:

By: _____
Director,
Department of Public Works and Engineering

SIGNED:

By: _____
Mayor

COUNTERSIGNED:

By: _____
City Controller

Date Countersigned:

_____

ATTEST/SEAL:

By: _____
City Secretary

8.2 This Contract and Ordinance have been reviewed as to form by the undersigned legal assistant and have been found to meet established Legal Department criteria. Legal Department has not reviewed the content of these documents.

_____ _____
Legal Assistant Date

END OF DOCUMENT

Document 00570

CONTRACTOR'S REVISED MWSBE PARTICIPATION PLAN

As soon as the Contractor becomes aware that the Contractor may not abide by the most current approved Plan, the Contractor shall submit this completed form with a Record of Post-Bid Good Faith Efforts (Document 00571), a Request for Plan Deviation (Document 00572), and any other document evidencing "Good Faith Efforts", as required by the Good Faith Efforts Policy (Document 00808). The City will review this Revised Participation Plan and may approve this Revised Plan if the Contractor has made Good Faith Efforts. For more information, visit http://www.houstontx.gov/obo.

Original Participation Plan Percentage	MBE	WBE	SBE	Revised Participation Plan Percentage	MBE	WBE	SBE

NAICS Code (6 digit)	Description of Work (Plan Sheet #, Unit Price #, Scope of Work #, as applicable)	% of Total Bid Price (2 decimal places)	Cert. Type for Goal (MBE, WBE, SBE)	Certified Firm Name Firm Address Contact Name Phone No. and E-Mail (if available)

Signature for Company: _____* Date: _____
Print Name: _____ Phone: _____

*I understand that supplying inaccurate information may violate Texas Penal Code Section 37.10 and lead to City sanctions.

Document 00570

CONTINUATION PAGE

NAICS Code (6 digit)	Plan Item Number (if applicable)/ Description of Work	% of Total Bid Price (2 decimal places)	Cert. Type for Goal (MBE, WBE, SBE)	Certified Firm Name Firm Address Contact Name Phone No. and E-Mail (if available)

Signature for Company: _____* Date: _____
Print Name: _____ Phone: _____

*I understand that supplying inaccurate information may violate Texas Penal Code Section 37.10 and lead to City sanctions.

Document 00571

RECORD OF POST-AWARD GOOD FAITH EFFORTS

Contractor Name: _____ **Project Name:** _____

A Contractor that may be unable to follow an agreed Participation Plan (Document 00470 or 00570) must submit this completed form, a Plan Deviation Request Form (Document 00572), and any other documentation of "Good Faith Efforts" (see Document 00808) that the OBO Representative may require. The Contractor shall submit one completed Document 00571 (Part A) for each Certified Firm that is no longer performing part or all of its work duties under the Approved Plan. The Contractor has the burden to demonstrate "Good Faith Efforts" to meet the MWSBE goal, which includes correctly and accurately preparing and submitting this form and other efforts described in the Good Faith Efforts Policy (Document 00808). The Office of Business Opportunity may review Participation Plan and Good Faith Efforts from time to time and may request that the Contractor submit this form and other information.

UNLESS THE CONTRACTOR MEETS THE GOALS IN THE AGREED PARTICIPATION PLAN, FAILURE TO SUBMIT THIS FORM MAY RESULT IN A DEFAULT OF THE CONTRACT.

PART A (REASON FOR NON-USE OF CERTIFIED FIRM IN AGREED PLAN)

NAICS Code	Plan Item No.	MWSBE Type for Goal	Certified Firm Name, Address, Phone No. and E-mail	Plan Goal & Actual Use (in % of total)	Method of Contact	Reason for Non-Use (why the Contractor was not able to use the Certified Firm in accordance with the Agreed Plan)
				Plan %: ____ Actual %: ____	Phone ☐ E-mail ☐ Fax ☐	

PART B (REASON FOR NONUSE OF REPLACEMENT CERTIFIED FIRMS—IF APPLICABLE)

NAICS Code	Plan Item No.	MWSBE Type for Goal	Certified Firm Name Address, Phone No. and E-Mail	Certified Firm Contact Person	Method of Contact	Prime Contact Date	Certified Firm Response	Results of Contact (why Certified Firm was unsuitable or unusable)
					Phone ☐ E-mail ☐ Fax ☐			
					Phone ☐ E-mail ☐ Fax ☐			

Authorized Signature: _____ Date: _____ Phone: _____

Print Name: _____ Email Address: _____

Document 00571

PART B CONTINUATION (REASON FOR NONUSE OF REPLACEMENT CERTIFIED FIRMS)

NAICS Code	Plan Item No.	MWSBE Type for Goal	Certified Firm Name Address, Phone No. and E-Mail	Certified Firm Contact Person	Method of Contact	Prime Contact Date	Certified Firm Response	Results of Contact (why Certified Firm was unsuitable or unusable)
					Phone ☐ E-mail ☐ Fax ☐			
					Phone ☐ E-mail ☐ Fax ☐			
					Phone ☐ E-mail ☐ Fax ☐			
					Phone ☐ E-mail ☐ Fax ☐			
					Phone ☐ E-mail ☐ Fax ☐			
					Phone ☐ E-mail ☐ Fax ☐			
					Phone ☐ E-mail ☐ Fax ☐			
					Phone ☐ E-mail ☐ Fax ☐			

Authorized Signature: _____ Date: _____ Phone: _____

Print Name: _____ Email Address: _____

Document 00572

CONTRACTOR'S REQUEST FOR PLAN DEVIATION

Contractor Name:_____

Project Name:_____

	MBE	WBE	SBE	Total
Approved Participation Plan Percentages	%	%	%	%

	MBE	WBE	SBE	Total
Contractor's Requested Participation Plan	%	%	%	%

Justification: Please provide the reason the Contractor is unable to meet the MWSBE goal in the Approved Plan.

_____

_____

_____

Good Faith Efforts: Please list any efforts not listed in Contractor's Record of Good Faith Effort (Document 00571).

_____

_____

_____

_____

Please attach additional pages if the space for Justification or Good Faith Efforts is insufficient.

Date:_____ *Contractor:_____

E-mail: _____ *By:_____

Phone Number: _____ Title:_____

*I understand that the approval of this deviation request does not constitute a final decision by OBO that Contractor has used Good Faith Efforts in meeting the Contracting Goal.

FOR OFFICIAL USE ONLY: Approved ☐ Not Approved ☐

OBO Representative Date:_____

_____ Title: _____

Document 00600

LIST OF PROPOSED SUBCONTRACTORS AND SUPPLIERS

PROJECT NAME: Northeast Water Purification Plant Improvements Package No.2 – High Service Pump Station and Miscellaneous Piping Improvements
TOTAL DBE AWARD: $ _____
ORIG. CONTRACT PRICE: $_____ TOTAL MWSBE AWARD: $ _____
PROJECT NO.: WBS No. S-000066-012A-4 TOTAL HUB AWARD: $ _____
DATE OF REPORT: _____ TOTAL PDBE AWARD: $ _____

NAICS (6 digits)	**SUBCONTRACTOR OR SUPPLIER (INCLUDE "MWSBE", "PDBE", "DBE", OR "HUB" DESIGNATION)[2]**	**ADDRESS**	**SCOPE OF WORK[3]**

NOTES:
1. RETURN FOR ALL PROJECTS AS REQUIRED IN DOCUMENT 00800 – SUPPLEMENTARY CONDITIONS. RETURN WITHIN THE SPECIFIED NUMBER OF DAYS AFTER RECEIPT OF NOTICE OF INTENT TO AWARD
2. DESIGNATE FIRMS CERTIFIED BY THE CITY OFFICE OF BUSINESS OPPORTUNITY ON THIS FORM.
3. DESCRIBE THE WORK TO BE PERFORMED, FOR WHICH THE FIRM IS CERTIFIED, SUCH AS "PAVING", "ELECTRICAL", ETC.
4. **CONTRACTOR SHALL EXECUTE CONTRACTS WITH APPROVED SUBCONTRACTORS AND SUPPLIERS WITHIN 30 DAYS AFTER THE DATE OF THE NOTICE TO PROCEED. COPIES OF CONTRACTS WITH DESIGNNATED FIRMS MUST BE SENT TO THE OFFICE OF BUSINESS OPPORTUNITY.**

SIGNATURE: _____ COMPANY NAME: _____

NAME: _____ TITLE: _____
(Type or Print)

Document 00600

Continuation Page

PROJECT NAME: Northeast Water Purification Plant Improvements Package No.2 – High Service Pump Station and Miscellaneous Piping Improvements

DATE OF REPORT: _____

PROJECT NO.: WBS No. S-000066-012A-4

NAICS (6 digits)	SUBCONTRACTOR OR SUPPLIER (INCLUDE "MWSBE", "PDBE", "DBE", OR "HUB" DESIGNATION)[2]	ADDRESS	SCOPE OF WORK[3]

SIGNATURE: _____ COMPANY NAME: _____

NAME: _____ TITLE: _____
(Type or Print)

END OF DOCUMENT

Document 00601

DRUG POLICY COMPLIANCE AGREEMENT

I, _____ _____
Name Title

of _____
Contractor

have authority to bind Contractor with respect to its Bid, Proposal, or performance of any and all contracts it may enter into with the City of Houston; and that by making this Agreement, I affirm that Contractor is aware of and by the time the Contract is awarded will be bound by and agree to designate appropriate safety impact positions for company employee positions, and to comply with the following requirements before the City issues a Notice to Proceed:

1. Develop and implement a written Drug Free Workplace Policy and related drug testing procedures for Contractor that meet the criteria and requirements established by the Mayor's Amended Policy on Drug Detection and Deterrence (Mayor's Drug Policy) and the Mayor's Drug Detection and Deterrence Procedures for Contractors (Executive Order No. 1-31).

2. Obtain a facility to collect urine samples consistent with Health and Human Services (HHS) guidelines and an HHS-certified drug-testing laboratory to perform drug tests.

3. Monitor and keep records of drug tests given and results; and upon request from the City of Houston, provide confirmation of such testing and results.

4. Submit semi-annual Drug Policy Compliance Declarations.

I affirm on behalf of Contractor that full compliance with the Mayor's Drug Policy and Executive Order No. 1-31 is a material condition of the Contract with the City of Houston,

I further acknowledge that falsification, failure to comply with or failure to timely submit declarations or documentation in compliance with the Mayor's Drug Policy or Executive Order No. 1-31 will be considered a breach of the Contract with the City and may result in non-award or termination of the Contract by the City.

_____ _____
Contractor Title

_____ _____
Signature Date

END OF DOCUMENT

Document 00604

HISTORY OF OSHA ACTIONS AND LIST OF ON-THE-JOB INJURIES

Prior to award of the Contract, Low Bidder will be required to file the following with the City:

1. A history of all OSHA actions, advisories, etc., Contractor has received on all jobs worked in any capacity, prime or subcontractor. The history shall be for the two-year period preceding the Bid Date of the Project.

2. A list of all on-the-job injuries, accidents, and fatalities suffered by any present or former employees of Contractor during the same two-year period.

3. If less than the two-year period, give the date Contractor started doing business.

This information must be submitted to the City within the time period stated in Document 00498 - Notice of Intent to Award. An officer of the company must certify in a notarized statement that the information submitted is true and correct.

END OF DOCUMENT

Document 00605

LIST OF SAFETY IMPACT POSITIONS

****

Contractor is to provide a complete List of Employee Classifications that are considered in a "Safety Impact Position" and the number of employees in each of those classifications.

****

Employee Classification	**Number of Employees**

END OF DOCUMENT

Document 00606

CONTRACTOR'S CERTIFICATION OF NO SAFETY IMPACT POSITIONS IN PERFORMANCE OF A CITY CONTRACT

BEFORE ME, the undersigned authority, on this day personally appeared

_____,
Affiant

who being by me duly sworn on his oath stated that he is _____
Title

of _____
Contractor

and that no employee safety impact positions, as defined in §5.17 of Executive Order No. 1-31, will be involved in performing _____.
Project

Contractor agrees and covenants that it shall immediately notify the City of Houston Director of Personnel if any safety impact positions are established to provide services in performing this City Contract.

_____
Affiant's Signature

SWORN AND SUBSCRIBED before me on this day of _____, 20___.

_____
Notary Public in and for the State of TEXAS

_____
Print or Type Notary Public Name

My Commission Expires: _____
Expiration Date

END OF DOCUMENT

Document 00610

PERFORMANCE BOND

THAT WE, _____, as Principal, (the "Contractor"), and the other subscriber hereto, _____, as Surety, do hereby acknowledge ourselves to be held and firmly bound to the City of Houston (the "City"), a municipal corporation, in the penal sum of $_____ for the payment of which sum, well and truly to be made to the City, its successors and assigns, Contractor and Surety do bind themselves, their heirs, executors, administrators, successors and assigns, jointly and severally.

THE CONDITIONS OF THIS OBLIGATION ARE SUCH THAT:

WHEREAS, the Contractor has on or about this day executed a Contract in writing with the City for _____

_____,

all of such work to be done as set out in full in said Contract documents therein referred to and adopted by the City Council, all of which are made a part of this instrument as fully and completely as if set out in full herein.

NOW THEREFORE, if the said Contractor shall faithfully and strictly perform the Contract in all its terms, provisions, and stipulations in accordance with its true meaning and effect, and in accordance with the Contract documents referred to therein and shall comply strictly with each and every provision of the Contract and with this Bond, then this obligation shall become null and void and shall have no further force and effect; otherwise the same is to remain in full force and effect. Should the Contractor fail to faithfully and strictly perform the Contract in all its terms, including but not limited to the indemnifications thereunder, the Surety shall be liable for all damages, losses, expenses and liabilities that the City may suffer in consequence thereof, as more fully set forth herein.

It is further understood and agreed that the Surety does hereby relieve the City or its representatives from the exercise of any diligence whatever in securing compliance on the part of the Contractor with the terms of the Contract, and the Surety agrees that it shall be bound to take notice of and shall be held to have knowledge of all acts or omissions of the Contractor in all matters pertaining to the Contract. The Surety understands and agrees that the provision in the Contract that the City will retain certain amounts due the Contractor until the expiration of 30 days from the acceptance of the Work is intended for the City's benefit, and the City will have the right to pay or withhold such retained amounts or any other amount owing under the Contract without changing or affecting the liability of the Surety hereon in any degree.

It is further expressly agreed by Surety that the City or its representatives are at liberty at any time, without notice to the Surety, to make any change in the Contract documents and in the Work to be done thereunder, as provided in the Contract, and in the terms and conditions thereof, or to make any change in, addition to, or deduction from the Work to be done thereunder; and that such changes, if made, shall not in any way vitiate the obligation in this Bond and undertaking or release the Surety therefrom.

It is further expressly agreed and understood that the Contractor and Surety will fully indemnify and save harmless the City from any liability, loss, cost, expense, or damage arising out of Contractor's performance of the Contract.

If the City gives Surety notice of Contractor's default, Surety shall, within 45 days, take one of the following actions:

1. Arrange for Contractor, with consent of the City, to perform and complete the Contract; or

2. Take over and assume completion of the Contract itself, through its agents or through independent contractors, and become entitled to the payment of the balance of the Contract Price.

If the Surety fails to take either of the actions set out above, it shall be deemed to have waived its right to perform and complete the Contract and receive payment of the balance of the Contract Price and the City shall be entitled to enforce any remedies available at law, including but not limited to completing the Contract itself and recovering any cost in excess of the Original Contract Price from the Surety.

This Bond and all obligations created hereunder shall be performable in Harris County, Texas. This Bond is given in compliance with the provisions of Chapter 2253, Texas Government Code, as amended, which is incorporated herein by this reference.

Notices required or permitted hereunder shall be in writing and shall be deemed delivered when actually received or, if earlier, on the third day following deposit in a United States Postal Service post office or receptacle, with proper postage affixed (certified mail, return receipt requested), addressed to the respective other Party at the address prescribed in the Contract documents, or at such other address as the receiving party may hereafter prescribe by written notice to the sending party.

IN WITNESS THEREOF, the said Contractor and Surety have signed and sealed this instrument on the respective dates written below their signatures and have attached current Power of Attorney.

ATTEST, SEAL: (if a corporation)
WITNESS: (if not a corporation)

_____
Name of Contractor

By: _____
Name:
Title:

By: _____
Name:
Title:
Date:

ATTEST/SURETY WITNESS:

(SEAL)

_____
Full Name of Surety

_____
Address of Surety for Notice

_____

_____
Telephone Number of Surety

By: _____
Name:
Title:
Date:

By: _____
Name:
Title: Attorney-in-Fact
Date:

This Ordinance or Contract has been reviewed as to form by the undersigned legal assistant and have been found to meet established Legal Department criteria. The Legal Department has not reviewed the content of these documents.

_____ _____
Legal Assistant Date

END OF DOCUMENT

Document 00611

STATUTORY PAYMENT BOND

THAT WE, _____, as Principal, hereinafter called Contractor and the other subscriber hereto, _____, as Surety, do hereby acknowledge ourselves to be held and firmly bound unto the City of Houston, a municipal corporation, in the sum of $_____ for the payment of which sum, well and truly to be made to the City of Houston, and its successors, the said Contractor and Surety do bind themselves, their heirs, executors, administrators, successors, jointly and severally.

THE CONDITIONS OF THIS OBLIGATION ARE SUCH THAT:

WHEREAS, the Contractor has on or about this day executed a contract in writing with the City of Houston for _____

_____,

all of such work to be done as set out in full in said Contract documents therein referred to and adopted by the City Council, all of which are made a part of this instrument as fully and completely as if set out in full herein;

NOW, THEREFORE, if the said Contractor shall pay all claimants supplying labor and materials to him or a Subcontractor in the prosecution of the Work provided for in the Contract, then, this obligation shall be void; otherwise the same is to remain in full force and effect;

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

IN WITNESS THEREOF, the said Contractor and Surety have signed and sealed this instrument on the respective dates written below their signatures and have attached current Power of Attorney.

ATTEST, SEAL: (if a corporation)
WITNESS: (if not a corporation)

_____
Name of Contractor

By: _____
Name:
Title:

By: _____
Name:
Title:
Date:

ATTEST/SURETY WITNESS:

(SEAL)

_____
Full Name of Surety

_____
Address of Surety for Notice

_____

_____
Telephone Number of Surety

By: _____
Name:
Title:
Date:

By: _____
Name:
Title: Attorney-in-Fact
Date:

This Ordinance or Contract has been reviewed as to form by the undersigned legal assistant and have been found to meet established Legal Department criteria. The Legal Department has not reviewed the content of these documents.

_____ _____
Legal Assistant Date

END OF DOCUMENT

Document 00612

ONE-YEAR MAINTENANCE BOND

THAT WE, _____, as Principal, hereinafter called Contractor, and the other subscriber hereto, _____, as Surety, do hereby acknowledge ourselves to be held and firmly bound to the City of Houston, a municipal corporation, in the sum of $_____, for the payment of which sum well and truly to be made to the City of Houston and its successors, the said Contractor and Surety do bind themselves, their heirs, executors, administrators, successors, jointly and severally.

THE CONDITIONS OF THIS OBLIGATION ARE SUCH THAT:

WHEREAS, the Contractor has on or about this day executed a Contract in writing with the City of Houston for _____

_____,

all of such work to be done as set out in full in said Contract documents therein referred to and adopted by the City Council, all of which are made a part of this instrument as fully and completely as if set out in full herein.

NOW THEREFORE, if the said Contractor shall comply with the provisions of Paragraph 11.5.1 of the General Conditions, and correct work not in accordance with the Contract documents discovered within the established one-year period, then this obligation shall become null and void, and shall be of no further force and effect; otherwise, the same is to remain in full force and effect.

Notices required or permitted hereunder shall be in writing and shall be deemed delivered when actually received or, if earlier, on the third day following deposit in a United States Postal Service post office or receptacle, with proper postage affixed (certified mail, return receipt requested), addressed to the respective other party at the address prescribed in the Contract documents, or at such other address as the receiving party may hereafter prescribe by written notice to the sending party.

IN WITNESS THEREOF, the said Contractor and Surety have signed and sealed this instrument on the respective dates written below their signatures and have attached current Power of Attorney.

ATTEST, SEAL: (if a corporation)
WITNESS: (if not a corporation)

_____
Name of Contractor

By: _____
Name:
Title:

By: _____
Name:
Title:
Date:

ATTEST/SURETY WITNESS:

(SEAL)

_____
Full Name of Surety

_____
Address of Surety for Notice

_____

_____
Telephone Number of Surety

By: _____
Name:
Title:
Date:

By: _____
Name:
Title: Attorney-in-Fact
Date:

This Ordinance or Contract has been reviewed as to form by the undersigned legal assistant and have been found to meet established Legal Department criteria. The Legal Department has not reviewed the content of these documents.

_____
Legal Assistant

_____
Date

END OF DOCUMENT

Document 00620

AFFIDAVIT OF INSURANCE

BEFORE ME, the undersigned authority, on this day personally appeared

_____, who
Affiant

being by me duly sworn on his oath stated that he is _____, of
Title

_____,
Contractor's Company Name

the Contractor named and referred to within the Contract documents; that he is fully competent and authorized to give this affidavit and that the attached original insurance certificate truly and accurately reflects the insurance coverage that is now available and will be available during the term of the Contract.

_____
Affiant's Signature

SWORN AND SUBSCRIBED before me on _____.
Date

_____
Notary Public in and for the State of TEXAS

_____
Print or type Notary Public name

My Commission Expires: _____
Expiration Date

END OF DOCUMENT

Document 00624

AFFIDAVIT OF COMPLIANCE WITH AFFIRMATIVE ACTION PROGRAM

BEFORE ME, the undersigned authority, on this day personally appeared _____, who
Affiant

being by me duly sworn on his oath stated that he is _____,
Title

of _____,
Contractor

the Contractor named and referred to within the Contract documents; that he is fully competent and authorized to give this affidavit and that the Contract is in compliance with the Affirmative Action Program of the City and has done all that is required by the Contract documents, the Affirmative Action Program, and pursuant to Chapter 15, Code of Ordinances, City of Houston, §15.16 et seq.

_____
Affiant's Signature

SWORN AND SUBSCRIBED before me on this day of _____, 20__.

_____
Notary Public in and for the State of TEXAS

_____
Print or Type Notary Public Name

My Commission Expires: _____
Expiration

END OF DOCUMENT

Document 00630
(POP-2)
City of Houston
Certification of Compliance with
Pay or Play Program

Contractor Name: _____ $ _____
(Contractor/Subcontractor) *(Amount of Contract)*

Contractor Address: _____

Project No.: «WBSNo» _____

Project Name: «LegalPrjName» _____

POP Liaison Name: _____

In accordance with the City of Houston Pay or Play Program authorized by Ordinance 2007-534 and Executive Order 1-7, Contractor/Subcontractor agrees to abide by the terms of this Program. This certification is required of all contractors for contracts subject to the program. You must agree EITHER to PAY or to PLAY for all covered employees. The Contractor/Subcontractor may also Pay on behalf of some covered employees and Play on behalf of other covered employees.

The Contractor/Subcontractor will comply with all provisions of the Pay or Play Program and will furnish all information and reports requested to determine compliance with program requirements of the Pay or Play Program (See Executive Order 1-7 for the terms of the Pay or Play program) The criteria of the program is as follows:

The Contractor/Subcontractor agrees to **"Pay"** $1.00 per hour for work performed by covered employees under the contract with the City. If independent contract labor is utilized the Contractor/Subcontractor agrees to report hours worked by the independent contract laborer and pay $1.00 per hour for work performed.

Otherwise the Contractor/Subcontractor agrees to **"Play"** by providing health benefits to each covered employee. The health benefits must meet the following criteria:

1. The employer will contribute no less than $150 per employee per month toward the total premium cost for single coverage only; and
2. The employee contribution, if any amount, will be no greater than 50% of the total premium cost and no more than $150 per month.
3. Pursuant to E.O. 1-7 section 4.04 a contractor is deemed to have complied with respect to a covered employee who is not provided health benefits if the employee refuses the benefits and the employee's contribution to the premium is no more than $40 per month.

Please select whether you choose to:	Pay	Play	Both

The Contractor/Subcontractor will file compliance reports with the City, which will include activity for covered employees subject to the program, in the form and to the extent requested by the administering department. Compliance reports shall contain information including, but not limited to, documentation showing employee health coverage and employee work records.
Note: The Contractor is responsible to the City for the compliance of covered employees of covered subcontractors and only forms that are accurate and complete will be accepted.

*Estimated Number of:	Prime Contractor	Sub-Contractor
Total Employees on City Job		
Covered Employees		
Non-Covered Employees		
Exempt Employees		

***Required**

I hereby certify that the above information is true and correct.

_____ _____
Contractor ***(Signature)*** Date

_____
Name and Title ***(Print or type)***

Document 00631
(POP-3)
City of Houston
Pay or Play Program
List of Subcontractors

Prime Contractor: _____ POP Contact Person: _____
Project Number/Description: _____ Address: _____
_____ Email: _____
Phone: _____

Note: Include ALL subcontractors (use additional form if necessary)

			Check One							
Subcontractor Name	**Supplier Y/N?**	**Amount of Subcontract**	**Pay**	**Play**	**Both (Pay and Play)**	**N/A**	**Contact Person**	**Phone**	**Email Address**	**Mailing Address**

*If the above information is found to be submitted fraudulently with the intent to bypass or deceive the purpose of the Pay or Play Program the contractor will be held liable for all compliance requirements from the inception of the contract. All subcontracts that surpass the $200,000.00 threshold will be responsible for Pay or Play compliance from the inception of the contract.

Affidavit

I hereby solemnly affirm, certify and confirm that the total sub-contract value stated above is the final value of the contract (*) including all material costs, fuel, payroll, taxes, fees, profit sharing, labor or any payments in relation to the contracted work and no separate payment or contract has been made for the sub-contract under contract no._____ . The above sub-contract value includes all the costs related to work under the contract. The contractor and sub-contractor(s) agree to inform The Mayor's Office of Business Opportunity of any related cost(s) added to the contracted work and re-submit POP-3 with the current value of the sub-contract. I understand that compliance with "Pay or Play" program is mandatory and nothing has been hidden to circumvent the program requirements.

_____
Contractor Authorized Representative & Title Date
Name & Signature

Document 00642

MONTHLY SUBCONTRACTOR PAYMENT REPORTING FORM

Legal Project Name:_____

Outline Agreement No.:_____ WBS No.:_____

Contractor's Company Name: _____

Address: _____

CERTIFICATION

_____, Contractor's Representative for the above referenced Contract, hereby certifies that (1) Contractor has paid all subcontractors, except those noted below, (2) Contractor made such payments (a) in proportion to the amount City paid Contractor and (b) in accordance and compliance with all applicable Contract Documents and laws; and (3) Contractor withheld no sums from any subcontractor for allegations of deficiency in Work. The term "subcontractor", as used herein, includes all persons or firms furnishing work, materials, services or equipment Contractor ordered incorporated into Work or placed near the Project for which the City made partial payment.

EXCEPTION: Contractor sent Payment Notifications to the following subcontractors explaining why Contractor withheld payment. Copies are attached.

Subcontractor Name:_____	Subcontractor Name: _____
Street Address: _____	Street Address: _____
City, State, and Zip Code: _____	City, State, and Zip Code: _____
Amount of Payment Withheld:_____	Amount of Payment Withheld: _____
Date Payment First Withheld: _____	Date Payment First Withheld: _____
Description of Good Faith Reason:_____	Description of Good Faith Reason:_____
_____	_____

_____ _____
(Signature of Contractor's Representative) (Print or Type Name of Contractor's Representative)

SWORN TO AND SUBSCRIBED before me on: _____
Date

_____
Notary Public in and for the State of Texas

My Commission Expires: _____ _____
Expiration Date Print or Type Name of Notary Public

Document 00646

PAYMENT NOTIFICATION – EXPLANATION OF WITHHOLDING

Legal Project Name:_____

Outline Agreement No.:_____ WBS No.:_____

Contractor's Company Name: _____

Address: _____

Date: _____

SUBCONTRACTOR PAYMENT INFORMATION:

Subcontractor Name:_____

Street Address: _____

City, State, and Zip Code: _____

Business Phone Number: _____

Amount of Subcontractor Invoice: _____

Amount of Payment Made: _____

Amount of Payment Withheld:_____

Date Payment First Withheld: _____

DETAILED EXPLANATION OF WITHHOLDING: _____

_____

_____

_____

_____

_____ _____

(Signature of Contractor's Representative) (Print or Type Name of Contractor's Representative)

Document 00700

GENERAL CONDITIONS

August 15, 2015 EDITION

TABLE OF ARTICLES

ARTICLE 1 - GENERAL PROVISIONS

1.1 DEFINITIONS

1.1.1 Agreement: Document signed by the Parties and binding the Parties, containing the name of Contractor, title and location of the Project, Original Contract Time, Original Contract Price, enumeration of documents included in the Contract, and other provisions.

1.1.2 Bonds: Performance Bond, Payment Bond, Maintenance Bond, and other Surety instruments executed by Surety. When in singular form, refers to individual instrument.

1.1.3 Business Enterprise: Any business entity registered in a program authorized by 49 C.F.R. § 26 (where applicable) or City Code of Ordinances, Chapter 15, Article II, relating to Equal Opportunity Employment and taking affirmative action to ensure that applicants are employed and employees are treated without regard to race, religion, color, sex, national origin, or age. The term "Business Enterprise" may include any Disadvantaged Business Enterprise ("DBE"), Minority Business Enterprise ("MBE"), Woman Business Enterprise ("WBE"), Small Business Enterprise ("SBE"), Person with Disability Enterprise ("PDBE"), and any Historically Underutilized Business ("HUB").

1.1.4 Business Enterprise Policy: Contract documents and applicable policies relating to Business Enterprises and authorized under 49 C.F.R. § 26 or City Code of Ordinances, Chapter 15, Article II.

1.1.5 Cash Allowance: An estimated sum of money to be used only for a limited class of expenditures such as utility relocation costs, fees for special licenses or permits, or other "pass-through" costs that would be the same for any contractor. Cash Allowances may not be used to purchase goods or services that are not specified in the Contract. The unspecified items must be purchased according to the terms of Article 7.

1.1.6 Change Order: Written instrument prepared by the City and signed by City Engineer and Contractor, specifying the following:

1.1.6.1 a change in the Work;
1.1.6.2 a change in Contract Price, if any; and
1.1.6.3 a change in Contract Time, if any.

The value of a Change Order is the net amount after offsetting all deductions against all additions effected by the Change Order.

1.1.7 City: The City of Houston, a home rule municipality located principally within Harris County, Texas, including its successors and its authorized representatives.

1.1.8 City Engineer: The City Engineer, or the City employee representing the City Engineer, designated in the Agreement and authorized to represent the City, or successors.

1.1.9 Claim: Written demand or written assertion by one Party seeking adjustment of the Contract, payment of money, extension of time, or other relief under the Contract and includes, but is not limited to, claims for materials, labor, equipment, delay, changes, adjustments, substitutions, fees and third party claims. The Party making the Claim has the responsibility to substantiate the Claim.

1.1.10 Conditions of the Contract: General Conditions and Supplementary Conditions.

1.1.11 Construction Manager: Person or firm under contract with the City as its authorized representative to oversee and administer construction of the Work, and who may perform the role of Project Manager and Inspector, as designated by City Engineer in writing.

1.1.12 Contract: The Agreement; documents enumerated in and incorporated into the Agreement, Modifications, and amendments.

1.1.13 Contract Price: The monetary amount stated in the Agreement adjusted by Change Order, and increases or decreases in Unit Price Quantities, if any.

1.1.14 Contract Time: The number of days stated in the Agreement to substantially complete the Work, plus days authorized by Change Order.

1.1.15 Contractor: Person or firm identified as such in the Agreement including its successors and its authorized representatives.

1.1.16 Date of Commencement of the Work: Date established in Notice to Proceed on which Contract Time will commence. This date will not be changed by failure of Contractor, or persons or entities for whom Contractor is responsible, to act.

1.1.17 Date of Substantial Completion: Date that construction, or portion thereof designated by City Engineer, is certified by City Engineer to be substantially complete.

1.1.18 Design Consultant: Person or firm, under contract with the City, to provide professional services during construction and its authorized representatives. If a Design Consultant is not employed for services during construction, Project Manager will perform duties of Design Consultant designated in the Contract in addition to usual duties of Project Manager.

1.1.19 Drawings: Graphic and pictorial portions of the Contract that define the character and scope of the Work.

1.1.20 Extra Unit Price: Unit Prices, which may be required for completion of the Work. These Unit Prices and Unit Price Quantities are in the Contract and are included in Original Contract Price.

1.1.21 Furnish: To supply, pay for, deliver to the site, and unload.

1.1.22 General Requirements: The sections of Division 01 Specifications that specify administrative and procedural requirements and temporary facilities required for the Work.

1.1.23 Inspector: City's employee or agent authorized to assist with inspection of the Work.

1.1.24 Install: Unpack, assemble, erect, place, anchor, apply, work to dimension, finish, cure, clean, protect, and similar operations.

1.1.25 Legal Holiday: Day established by the City Council as a holiday.

1.1.26 Major Unit Price Work: An individual Unit Price item,

1.1.26.1 whose value is greater than five percent of Original Contract Price,

1.1.26.2 whose value becomes greater than five percent of Original Contract Price as the result of an increase in quantity, or

1.1.26.3 whose value is $100,000, whichever is least.

1.1.27 Minor Change in the Work: A written change in the Work, ordered by City Engineer, that does not change Contract Price or Contract Time, and that is consistent with the general scope of the Contract.

1.1.28 Modification: Change Order, Work Change Directive, or Minor Change in the Work.

1.1.29 Notice of Noncompliance: A written notice by City Engineer to Contractor regarding defective or nonconforming work that does not meet the Contract requirements, and that establishes a time by which Contractor shall correct the defective or nonconforming work.

1.1.30 Notice to Proceed: A written notice by City Engineer to Contractor establishing Date of Commencement of the Work.

1.1.31 Office of Business Opportunity: any reference to, or use of, the "Office of Affirmative Action" shall mean the Office of Business Opportunity, or any such future name to which it is changed.

1.1.32 Original Contract Price: The monetary amount originally stated in the Agreement.

1.1.33 Parties: Contractor and the City. When in singular form, refers to Contractor or the City.

1.1.34 Pollutant: Any materials subject to the Texas Solid Waste Disposal Act.

1.1.35 Pollutant Facility: Any facility regulated by the State of Texas to protect the health and environment from contamination by Pollutants, including without limitation, landfills, oil and gas production and storage facilities, wastewater facilities, waste injection wells, and storage tanks (including drums).

1.1.36 Product: Materials, equipment, or systems incorporated into the Work or to be incorporated into the Work.

1.1.37 Product Data: Illustrations, standard schedules, performance charts, instructions, brochures, diagrams, and other information furnished by Contractor to illustrate a Product.

1.1.38 Project: Total construction, of which the Work performed under the Contract may be the whole or a part, and which may include construction by the City or by separate contractors.

1.1.39 Project Manager: City Engineer's authorized representative for administration of the Work. Titles used within the City's departments may be different than those used in this definition.

1.1.40 Provide: Furnish and Install, complete, ready for intended use.

1.1.41 Samples: Physical examples that illustrate Products, or workmanship, and establish standards by which the Work is judged.

1.1.42 Shop Drawings: Drawings, diagrams, schedules, and other data specially prepared for the Work by Contractor, Subcontractor or Supplier, to illustrate a portion of the Work.

1.1.43 Specifications: Divisions 01 through 16 of the documents that are incorporated into the Agreement, consisting of written General Requirements and requirements for Products, standards, and workmanship for the Work, and performance of related services.

1.1.44 Stipulated Price: Single lump sum amount stated in the Contract for completion of the Work, or for designated portion of the Work.

1.1.45 Subcontractor: Person or firm that has direct or indirect contract with Contractor or with another Subcontractor to perform a portion of the Work and its authorized representatives.

1.1.46 Superintendent: Employee of Contractor having authority and responsibility to act for and represent Contractor.

1.1.47 Supplementary Conditions: Part of Conditions of the Contract that amends or supplements General Conditions.

1.1.48 Supplier: Manufacturer, distributor, materialman, or vendor having a direct agreement with Contractor or Subcontractor for Products, or services and its authorized representatives.

1.1.49 Surety: Corporate entity that is bound by one or more Bonds, and is responsible for completion of the Work, including the correction period, and for payment of debts incurred in fulfilling the Contract. Surety shall include co-surety or reinsurer, as applicable.

1.1.50 Underground Facilities: Pipes, conduits, ducts, cables, wires, manholes, vaults, tanks, tunnels, or other such facilities or attachments and encasements containing such facilities that exist below ground level.

1.1.51 Unit Price: An amount stated in the Contract for an individual, measurable item of work, which, when multiplied by actual quantity incorporated into the Work, amounts to full compensation for completion of the item, including work incidental to it.

1.1.52 Unit Price Quantities: Quantities indicated in the Contract that are approximations made by the City for contracting purposes.

1.1.53 Work: Entire construction required by the Contract, including all labor, Products, and services provided by Contractor to fulfill Contractor's obligations. The Work may constitute the whole or a portion of the Project.

1.1.54 Work Change Directive: A written change in the Work, ordered by City Engineer, that is within the general scope of the Contract and consisting of additions, deletions, or other revisions. A Work Change Directive will state proposed basis for adjustment, if any, in Contract Price or Contract Time, or both.

1.2 EXECUTION, CORRELATION, AND INTENT

1.2.1 Execution of the Contract by Contractor is conclusive that Contractor has visited the Work site, become familiar with local conditions under which the Work will be performed, and fully informed itself as to conditions and matters which can affect the Work or costs. Contractor further agrees that it has carefully correlated personal observations with requirements of the Contract.

1.2.2 The Contract and Modifications have been read and carefully considered by Contractor, who understands and agrees to their sufficiency for the Work. The Contract may not be more strongly construed against the City than against Contractor and Surety.

1.2.3 Contractor shall include all items necessary for proper execution and completion of the Work.

1.2.4 Reference to standard specifications, manuals, or codes of a technical society, organization, or association, or to laws or regulations of a governmental authority, whether specific or implied, mean the latest edition in effect as of date of receipt of bids, except as may be otherwise specifically stated in the Contract.

1.2.5 No provision of any referenced standard, specification, or manual changes the duties and responsibilities of the City, City Engineer, Contractor, or Design Consultant from those set forth in the Contract. Nor do these provisions assign to Design Consultant any duty or authority to supervise or direct performance of the Work or any duty or

authority to undertake any actions contrary to provisions of the Contract.

1.2.6 Organization of Specifications into divisions, sections, and articles and arrangement of Drawings does not control Contractor in dividing the Work among Subcontractors or in establishing the extent of work to be performed by any trade.

1.2.7 Unless otherwise defined in the Contract, words which have well-known construction industry technical meanings are used in the Contract in accordance with these recognized meanings.

1.3 OWNERSHIP AND USE OF DOCUMENTS

1.3.1 Drawings, Specifications, and other documents prepared by the City or by Design Consultant are instruments of service through which the Work to be executed by Contractor is described. Contractor may retain one Contract record set.

1.3.2 Neither Contractor, Subcontractor, nor Supplier will own or claim a copyright to documents contained in the Contract or any part of the Contract.

1.3.3 Documents contained in the Contract, prepared by the City or by Design Consultant, and copies furnished to Contractor, are for use solely with respect to the Work. They may not be used by Contractor, Subcontractor or Supplier on other projects or for additions to the Work, outside the scope of the Work, without the specific written consent of City Engineer, and Design Consultant, when applicable.

1.3.4 Contractor, Subcontractors, and Suppliers are granted a limited license to use and reproduce applicable portions of the Contract appropriate to and for use in execution of their work under the Contract.

1.4 *INTERPRETATION*

1.4.1 Specifications are written in an imperative streamlined form and are directed to Contractor, unless noted otherwise. When written in this form, words "shall be" are included by inference where a colon (:) is used within sentences or phrases.

1.4.2 In the interest of brevity, the Contract frequently omits modifying words such as "all" and "any" and articles such as "the" and "an", but an absent modifier or article is not intended to affect interpretation of a statement.

ARTICLE 2 - THE CITY

2.1 *LIMITATIONS OF THE CITY'S OFFICERS AND EMPLOYEES*

2.1.1 No officer or employee of the City may authorize Contractor to perform an act or work contrary to the Contract, except as otherwise provided in the Contract.

2.2 *DUTIES OF THE CITY*

2.2.1 If a building permit is required, the City will process an application for, and Contractor shall purchase the building permit before Date of Commencement of the Work.

2.2.2 The City will make available to Contractor a reproducible set of Drawings. Additional copies will be furnished, on Contractor's request, at the cost of reproduction.

2.2.3 When necessary for performance of the Work, the City will provide surveys describing physical characteristics, legal limitations, legal description of site, and horizontal and vertical control adequate to lay out the Work.

2.2.4 Information or services that the City is required to provide under the Contract will be provided by the City with reasonable promptness to avoid delay in orderly progress of the Work.

2.2.5 The Contract imposes no implied duty on the City. The City does not warrant any plans or specifications associated with the Contract.

2.2.6 Except as expressly stated in this Article, the City owes no duty to the Contractor or any subcontractor.

2.3 *AVAILABILITY OF LAND AND USE OF SITE*

2.3.1 The City will furnish, as indicated in the Contract, rights-of-way, land on which the Work is to be performed, and other land designated in the Contract for use by Contractor unless otherwise provided in the Contract.

2.3.2 Contractor shall confine operations at site to those areas permitted by law, ordinances, permits, and the Contract, and may not unreasonably encumber site with materials or equipment.

2.3.3 In addition to land provided by the City under Section 2.3, Contractor shall provide all land and access to land that may be required for use by Contractor for temporary construction facilities or for storage of materials and equipment, and shall indemnify the City during its use of the land as stated in Section 3.25.

2.4 *THE CITY'S RIGHT TO STOP THE WORK*

2.4.1 If Contractor fails to carry out the Work in accordance with the Contract, or fails to correct work which is not in accordance with requirements of the Contract as required in Sections 12.1 and 12.2, the City may, by Notice of Noncompliance, order Contractor to stop the Work or any portion of the Work until the cause for the order has been eliminated. However, the right of the City to stop the Work will not give rise to a Claim for delay or to a duty on the part of the City to exercise this right for the benefit of Contractor or any other person or entity, except to the extent required by Section 6.2. If Contractor corrects the defective or nonconforming work within the time established in Notice of Noncompliance, City Engineer will give written notice to Contractor to resume performance of the Work.

2.5 *THE CITY'S RIGHT TO CARRY OUT WORK*

2.5.1 If Contractor fails to carry out work in accordance with the Contract, and fails within the period established in a Notice of Noncompliance to correct the nonconforming work, the City may, after expiration of the required period, correct the deficiencies without prejudice to other remedies the City may have, including rights of the City under Section 14.1.

2.5.1.1 When the City corrects deficiencies, City Engineer will issue an appropriate Change Order and deduct from payments then or thereafter due Contractor the cost of correcting the deficiencies, including compensation for Design Consultant's and Construction Manager's additional services and expenses made necessary by such default, neglect, or failure. This action by the City and amounts charged to Contractor are both subject to prior approval of City Engineer. If payments, then or thereafter due Contractor, are not sufficient to cover these amounts, Contractor shall pay the difference to the City.

2.5.2 Notwithstanding the City's right to carry out work, maintenance and protection of the Work remains Contractor's responsibility, as provided in the Contract.

ARTICLE 3 - CONTRACTOR

3.1 *RESPONSIBILITIES*

3.1.1 Contractor shall maintain office with agent in the greater City of Houston area during the Contractor's performance under the Contract. Contractor shall file its street address with City Engineer.

3.1.2 Contractor and Contractor's employees shall not give or lend money or anything of value to an officer or employee of the City. Should this Paragraph 3.1.2 be violated, City Engineer may terminate the Contract under Section 14.1.

3.2 *REVIEW OF CONTRACT AND FIELD CONDITIONS BY CONTRACTOR*

3.2.1 Contractor shall carefully study and compare documents contained in the Contract with each other and with information furnished by the City pursuant to Section 2.2 and shall immediately report, in writing, any errors, inconsistencies, or omissions to City Engineer. If work is affected, Contractor shall obtain a written interpretation or clarification from City Engineer before proceeding with the affected work. However, Contractor will not be liable to the City for failure to report an error, inconsistency, or omission in the Contract unless Contractor had actual knowledge or should have had knowledge of the error, inconsistency, or omission.

3.2.2 Contractor shall take field measurements and verify field conditions, and shall carefully compare the conditions and other information known to Contractor with the Contract, before commencing activities. Contractor shall immediately report, in writing, to City Engineer for interpretation or clarification of discrepancies, inconsistencies, or omissions discovered during this process.

3.2.3 Contractor shall make a reasonable attempt to understand the Contract before requesting interpretation from City Engineer.

3.3 *SUPERVISION AND CONSTRUCTION PROCEDURES*

3.3.1 Contractor shall supervise, direct, and inspect the Work competently and efficiently, devoting the attention and applying the skills and

expertise as necessary to perform the Work in accordance with the Contract. Contractor is solely responsible and has control over construction means, methods, techniques, sequences, and procedures of construction; for safety precautions and programs in connection with the Work; and for coordinating all work under the Contract.

3.3.2 Regardless of observations or inspections by the City or City's consultants, Contractor shall perform and complete the Work in accordance with the Contract and submittals approved pursuant to Section 3.18. The City is not liable or responsible to Contractor or Surety for work performed by Contractor that is not in accordance with the Contract regardless of whether discovered during construction or after acceptance of the Work.

3.4 *SUPERINTENDENT*

3.4.1 Contractor shall employ a competent Superintendent and necessary assistants who shall be present at the site during performance of the Work. Communications given to Superintendent are binding on the Contractor.

3.4.2 Contractor shall notify City Engineer in writing of its intent to replace the Superintendent. Contractor may not replace the Superintendent if City Engineer makes a reasonable objection in writing.

3.5 *LABOR*

3.5.1 Contractor shall provide competent, qualified personnel to survey and lay out the Work and perform construction as required by the Contract. The City may, by written notice, require Contractor to remove from the Work any employee of Contractor or Subcontractors to whom City Engineer makes reasonable objection.

3.5.2 Contractor shall comply with the applicable Business Enterprise Policy set out in this Agreement and in the Supplementary Conditions, as set out in Chapter 15, Article V of the City of Houston Code of Ordinances.

3.5.3 When Original Contract Price is greater than $1,000,000, Contractor shall make Good Faith Efforts to award subcontracts or supply agreements in at least the percentages set out in the Supplementary Conditions for Business Enterprise Policy. Contractor acknowledges that it has reviewed the requirements for Good Faith Efforts on file with the City's Office of Business Opportunity and shall comply with them.

3.5.3.1 Contractor shall require written subcontracts with Business Enterprises and shall submit all disputes with Business Enterprises to voluntary mediation. Business Enterprise subcontracts complying with City Code of Ordinances Chapter 15, Article II must contain the terms set out in Subparagraph 3.5.3.2. If Contractor is an individual person, as distinguished from a corporation, partnership, or other legal entity, and the amount of the subcontract is $50,000 or less, the subcontract must also be signed by the attorneys of the respective parties.

3.5.3.2 Contractor shall ensure that subcontracts with Business Enterprise firms are clearly labeled **"THIS CONTRACT MAY BE SUBJECT TO MEDIATION ACCORDING TO THE TEXAS ALTERNATIVE DISPUTE RESOLUTION ACT"** and contain the following terms:

3.5.3.2.1 (Business Enterprise) may not delegate or subcontract more than 50 percent of work under this subcontract to any other subcontractor without the express written consent of the City's OBO Director (the "Director").

3.5.3.2.2 (Business Enterprise) shall permit representatives of the City of Houston, at all reasonable times, to perform (1) audits of the books and records of the Subcontractors and Suppliers, and (2) inspections of all places where work is to be undertaken in connection with this subcontract. (Business Enterprise) shall keep the books and records available for this purpose for at least four years after the end of its performance under this subcontract. Nothing in this provision shall affect the time for bringing a cause of action nor the applicable statute of limitations.

3.5.3.2.3 Within five business days of execution of this subcontract, Contractor and (Business Enterprise) shall designate in writing to the Director an agent for receiving any notice required or permitted to be given pursuant to Chapter 15 of the Houston City Code of Ordinances, along with the street and mailing address and phone number of the agent.

3.5.4 The requirements and terms of the City of Houston Pay or Play Program, as set out in Executive Order 1-7 and Ordinance 2007-0534, are incorporated into the Contract for all purposes. Contractor shall comply with the terms and conditions of the Pay or Play Program as they are set out at the time of City Council approval of this

agreement. IF CONTRACTOR DOES NOT PAY IN ACCORDANCE WITH THE PAY OR PLAY PROGRAM WITHIN 30 DAYS OF THE DATE CITY ENGINEEER SENDS CONTRACTOR WRITTEN NOTIFICATION, CITY CONTROLLER MAY DEDUCT FUNDS UP TO THE AMOUNT OWED FROM ANY PAYMENTS OWED TO CONTRACTOR UNDER THIS AGREEMENT, AND CONTRACTOR WAIVES ANY RECOURSE.

3.6 *PREVAILING WAGE RATES*

3.6.1 Contractor shall comply with governing statutes providing for labor classification of wage scales for each craft or type of laborer, worker, or mechanic.

3.6.2 Prevailing wage rates applicable to the Work may be one or a combination of the following wage rates identified in Division 00:

- 3.6.2.1 Federal Wage Rate General Decisions
  - 3.6.2.1.1 Highway Rates
  - 3.6.2.1.2 Building Rates
  - 3.6.2.1.3 Heavy Construction Rates
  - 3.6.2.1.4 Residential Rates
- 3.6.2.2 City Prevailing Wage Rates
  - 3.6.2.2.1 Building Construction Rates
  - 3.6.2.2.2 Engineering Construction Rates
  - 3.6.2.2.3 Asbestos Worker Rates

3.6.3 Each week Contractor shall submit to the City's Mayor's Office of Business Opportunity certified copies of payrolls showing classifications and wages paid by Contractor, Subcontractors, and Suppliers for each employee under the Contract, for any day included in the Contract.

3.7 *LABOR CONDITIONS*

3.7.1 In the event of labor disputes affecting Contractor or Contractor's employees, Contractor shall utilize all possible means to resolve disputes in order that the Work not be delayed to any extent. These means will include seeking injunctive relief and filing unfair labor practice charges, and any other action available to Contractor.

3.7.2 When Contractor has knowledge that any actual or potential labor dispute is delaying or is threatening to delay timely performance of the Work, Contractor shall immediately notify City Engineer in writing. No Claims will be accepted by City Engineer for costs incurred as a result of jurisdictional or labor disputes.

3.8 *DRUG DETECTION AND DETERRENCE*

3.8.1 It is the policy of the City to achieve a drug-free work force and to provide a workplace that is free from the use of illegal drugs and alcohol. It is also the policy of the City that manufacture, distribution, dispensation, possession, sale, or use of illegal drugs or alcohol by contractors while on the City's premises is prohibited. By executing the Contract, Contractor represents and certifies that it meets and will comply with all requirements and procedures set forth in the Mayor's Policy on Drug Detection and Deterrence, City Council Motion No. 92-1971 ("Mayor's Policy") and the Mayor's Drug Detection and Deterrence Procedures for Contractors, Executive Order No. 1-31, (Revised) ("Executive Order"). Mayor's Policy is on file in the office of the City Secretary. Copies of Executive Order may be obtained at the location specified in the Advertisement for Bids.

3.8.1.1 The Executive Order applies to the City's contracts for labor or services except the following:

- 3.8.1.1.1 contracts authorized by Emergency Purchase Orders,
- 3.8.1.1.2 contracts in which imposition of requirements of the Executive Order would exclude all potential bidders or proposers, or would eliminate meaningful competition for the Contract,
- 3.8.1.1.3 contracts with companies that have fewer than 15 employees during any 20-week period during a calendar year and no safety impact positions,
- 3.8.1.1.4 contracts with non-profit organizations providing services at no cost or reduced cost to the public, and
- 3.8.1.1.5 contracts with federal, state, or local governmental entities.

3.8.1.2 Prior to execution of the Contract, Contractor shall have filed with the City:

- 3.8.1.2.1 a Drug Policy Compliance Agreement form (Attachment "A" to the Executive Order), and
- 3.8.1.2.2 a copy of Contractor's drug free workplace policy, and
- 3.8.1.2.3 a written designation of all safety impact positions, if applicable, or a Contractor's Certification of a No Safety Impact Positions form (Attachment "C" to the Executive Order).

3.8.1.3 Every six months during performance of the Contract and upon completion of the Contract, Contractor shall file a Drug Policy Compliance Declaration form (Attachment "B" to the Executive Order). The Contractor shall submit the Drug Policy Compliance Declaration within 30 days of expiration of each six-month period of performance and within 30 days of completion of the Contract. The first six-month period shall begin on Date of Commencement of the Work.

3.8.1.4 Contractor shall have a continuing obligation to file updated designation of safety impact positions when additional safety impact positions are added to Contractor's employee workforce during performance of the Work.

3.8.1.5 Contractor shall require its Subcontractors and Suppliers to comply with the Mayor's Policy and Executive Order. Contractor is responsible for securing and maintaining required documents from Subcontractors and Suppliers for the City inspection throughout the term of the Contract.

3.8.1.6 Failure of Contractor to comply with requirements will be a material breach of the Contract entitling the City to terminate in accordance with Section 14.1.

3.9 *MATERIALS & EQUIPMENT*

3.9.1 Unless otherwise provided in the Contract, Contractor shall provide and assume full responsibility for Products, labor, transportation, construction equipment and machinery, tools, appliances, fuel, power, light, heat, telephone, water, sanitary facilities, transportation, temporary facilities, supplies, and other facilities and incidentals necessary for Furnishing, performing, testing, starting-up, and completing the Work.

3.9.1.1 Contractor, Subcontractors, and Suppliers shall use Ultra Low Sulfur Diesel Fuel in all diesel operating vehicles and motorized equipment utilized in performing the Work. Ultra Low Sulfur Diesel Fuel is defined as diesel fuel having 15 ppm or the applicable standard set by state or federal law or rules and regulations of the Texas Commission on Environmental Quality, or the Environmental Protection Agency, whichever is less in sulfur content. Off-road Ultra Low Sulfur Diesel Fuel may be used in lieu of on-road Ultra Low Sulfur Diesel Fuel. Contractor shall provide, upon request by City Engineer, proof that Contractor, Subcontractors, and Suppliers are using Ultra Low Sulfur Diesel Fuel.

3.9.2 Contractor shall provide Products that are:

3.9.2.1 new, unless otherwise required or permitted by the Contract, and

3.9.2.2 of specified quality.

If required by City Engineer, Contractor shall furnish satisfactory evidence, including reports of required tests, as to kind and quality of Products.

3.9.3 Contractor shall store Products in a safe, neat, compact, and protected manner. Contractor shall also store Products delivered during the work, along the right-of-way:

3.9.3.1 so as to cause the least inconvenience to property owners, tenants, and general public; and

3.9.3.2 so as not to block access to, or be closer than, three feet to any fire hydrant.

Contractor shall protect trees, lawns, walks, drives, streets, and other improvements that are to remain, from damage. If private or public property is damaged by Contractor, Contractor shall, at its sole expense, restore the damaged property to at least its original condition.

3.9.3.1 Contractor shall obtain City Engineer's approval for storage areas used for Products for which payment has been requested under Paragraph 9.6.1. Contractor shall provide the City access to the storage areas for inspection purposes. Products, once paid for by the City, become the property of the City and may not be removed from place of storage, without City Engineer's written permission except for a movement to the site. Contractor's Installation Floater, required under Section 11.2, shall cover all perils, including loss or damage to Products during storage, loading, unloading, and transit to the site.

3.10 *PRODUCT OPTIONS AND SUBSTITUTIONS*

3.10.1 For Products specified by reference standards or by description only, Contractor may provide any Product meeting those standards or description.

3.10.2 For Products specified by naming one or more manufacturers with provision for substitutions or equal, Contractor may submit a request for substitution for any manufacturer not named.

3.10.3 City Engineer will consider requests for substitutions only within the first 15 percent of Contract Time, or first 90 days after date of Notice to Proceed, whichever is less.

3.10.4 Contractor shall document each request for substitution with complete data

substantiating compliance of proposed substitution with the Contract.

3.10.5 A request for substitution constitutes a representation that Contractor:

3.10.5.1 has investigated the proposed Product and determined that it meets or exceeds the quality level of the specified Product;

3.10.5.2 shall provide the same warranty for the substitution as for the specified Product;

3.10.5.3 shall coordinate installation of the proposed substitution and make changes to other work which may be required for the Work to be completed, with no additional cost or increase in time to the City;

3.10.5.4 confirms that cost data is complete and includes all related costs under the Contract;

3.10.5.5 waives Claim for additional costs or time extensions that may subsequently become apparent; and

3.10.5.6 shall provide review or redesign services by a design consultant with appropriate professional license and shall obtain re-approval and permits from authorities.

3.10.6 City Engineer will not consider and will not approve substitutions when:

3.10.6.1 they are indicated or implied on Shop Drawing or Product Data submittals without separate written request; or

3.10.6.2 acceptance will require revision to the Contract.

3.10.7 City Engineer may reject requests for substitution, and his decision will be final and binding on the Parties.

3.11 *CASH ALLOWANCES*

3.11.1 Contract Price includes Cash Allowances as identified in the Contract.

3.11.2 The City will pay the actual costs of Cash Allowance item exclusive of profit, overhead or administrative costs. If actual costs exceed the Cash Allowance, City Engineer must approve a Change Order for the additional costs.

3.12 *WARRANTY*

3.12.1 Contractor warrants to the City that Products furnished under the Contract are:

3.12.1.1 free of defects in title;

3.12.1.2 of good quality; and

3.12.1.3 new, unless otherwise required or permitted by the Contract.

If required by the City Engineer, Contractor shall furnish satisfactory evidence as to kind, quality and title of Products, and that Products conform to requirements of the Contract.

3.12.2 In the event of a defect in a Product, either during construction or warranty period, Contractor shall take appropriate action with manufacturer of Product to assure correction or replacement of defective Product with minimum delay.

3.12.3 Contractor warrants that the Work is free of defects not inherent in the quality required or permitted, and that the Work does conform with the requirements of the Contract. Contractor further warrants that the Work has been performed in a thorough and workmanlike manner.

3.12.4 Contractor warrants that the Work is free of concentrations on polychlorinated biphenyl (PCB) and other substances defined as hazardous by the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) or any other applicable law or regulation.

3.12.5 Work not conforming to requirements of Section 3.12, including substitutions not properly approved and authorized, may be considered nonconforming work.

3.12.6 Contractor's warranty excludes remedy for damage or defect caused by:

3.12.6.1 improper or insufficient maintenance by the City;

3.12.6.2 normal wear and tear under normal usage; or

3.12.6.3 claim that hazardous material was incorporated into the Work, if that material was specified in the Contract.

3.12.7 Contractor warrants that title to all work covered by Contractor's request for payment passes to the City upon incorporation into the Work or upon Contractor's receipt of payment, whichever occurs first. The Contractor further warrants that the title is free of all liens, claims, security interests or other interests ("Encumbrances"). If not, upon written demand from City Engineer, Contractor shall immediately take legal action necessary to remove Encumbrances.

3.13 *TAXES*

3.13.1 Contractor shall pay all sales, consumer, use, and similar taxes, which are in effect or scheduled to go into effect on or before bids are received, related to work provided by Contractor.

3.13.2 Contractor shall obtain, and require Subcontractors and Suppliers to obtain, necessary permits from the state and local taxing authorities to perform contractual obligations under the Contract, including sales tax permits.

3.13.3 The City is exempt from the Federal Transportation and Excise Tax. Contractor shall comply with federal regulations governing the exemptions.

3.13.4 Products incorporated into the Work are exempt from state sales tax according to provisions of the TEX. TAX CODE ANN. CH. 151, Subsection H.

3.14 *PERMITS, FEES, AND NOTICES*

3.14.1 Unless otherwise provided in the Contract, Contractor shall secure and pay for all construction permits, licenses, and inspections:

3.14.1.1 necessary for proper execution and completion of the Work; and

3.14.1.2 legally required at time bids are received.

3.15 *CONSTRUCTION SCHEDULES*

3.15.1 On receipt of Notice to Proceed, Contractor shall promptly prepare and submit construction schedule for the Work for City Engineer's review. The schedule must reflect the minimum time required to complete the Work not to exceed Contract Time.

3.15.2 Contractor shall give 24-hour written notice to City Engineer before commencing work or resuming work where work has been stopped. Contractor shall also give the same notice to inspectors.

3.15.3 Contractor shall incorporate milestones specified in Summary of Work Specification into the construction schedule. Contractor's failure to meet a milestone, as determined by City Engineer, may be considered a material breach of the Contract.

3.15.4 Each month, Contractor shall submit to City Engineer a copy of an updated construction schedule indicating actual progress, incorporating applicable changes, and indicating courses of action required to assure completion of the Work within Contract Time.

3.15.5 Contractor shall keep a current schedule of submittals that coordinates with the construction schedule, and shall submit the initial schedule of submittals to City Engineer for approval.

3.16 *DOCUMENTS AND SAMPLES AT THE SITE*

3.16.1 Contractor shall maintain at the site, and make available to City Engineer, one record copy of Drawings, Specifications, and Modifications. Contractor shall maintain the documents in good order and marked currently to record changes and selections made during construction. In addition, Contractor shall maintain at the site, approved Shop Drawings, Product Data, Samples, and similar submittals, which will be delivered to City Engineer prior to final inspection as required in Paragraph 9.11.4.

3.16.2 Contractor shall maintain all books, documents, papers, accounting records, and other relevant documentation pursuant to the Work and shall make the books, documents, papers, and accounting records available to representatives of the City for review and audits during the Contract term and for the greater of three years following Date of Substantial Completion or until all litigation or audits are fully resolved.

3.16.3 Contractor shall provide to City Attorney all documents and records that City Attorney deems necessary to assist in determining Contractor's compliance with the Contract, with the exception of those documents made confidential by federal or state law or regulation.

3.17 *MANUFACTURER'S SPECIFICATIONS*

3.17.1 Contractor shall handle, store, and Install Products and perform all work in the manner required by Product manufacturer. Should the Contract and manufacturer's instructions conflict, Contractor shall report conflict to City Engineer for resolution prior to proceeding with the affected work.

3.17.2 References in the Contract to the manufacturer's specifications, directions, or recommendations, mean manufacturer's current published documents in effect as of date of receipt of bids, or in the case of a Modification, as of date of Modification.

3.18 SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES

3.18.1 Shop Drawings, Product Data, and Samples are not part of the Contract. The purpose of Contractor submittals is to demonstrate, for those portions of the Work for which submittals are required, the way Contractor proposes to conform to information given and design concept expressed in the Contract.

3.18.2 Contractor shall submit to Project Manager for review the Shop Drawings, Product Data, and Samples, which are required by the Contract. Review by Project Manager is subject to limitations of Paragraph 4.1.4. Contractor shall transmit the submittals to the Project Manager with reasonable promptness and in a sequence, so as to cause no delay in the Work or in activities of the City or of separate contractors. Contractor shall transmit submittals in time to allow a minimum of 30 days for Project Manager's review prior to date Contractor needs reviewed submittals returned. This time may be shortened for a particular job requirement if approved by Project Manager in advance of submittal.

3.18.3 Contractor shall certify that the content of submittals conforms to the Contract without exception by affixing Contractor's approval stamp and signature. By certifying and submitting Shop Drawings, Product Data, and Samples, Contractor represents, and Contractor's stamp of approval shall state, that Contractor has determined and verified materials, quantities, field measurements, and field construction criteria related to the submittal, and has checked and coordinated information contained within the submittals with requirements of the Contract.

3.18.4 Contractor may not perform any work requiring submittal and review of Shop Drawings, Product Data, or Samples until the submittal has been returned with appropriate review decision by the Project Manager. Contractor shall perform work in accordance with the review.

3.18.5 If Contractor performs any work requiring submittals prior to review and acceptance of the submittals by Project Manager, such work is at Contractor's risk and the City is not obligated to accept work if the submittals are later found to be unacceptable.

3.18.6 If, in the opinion of Project Manager, the submittals are incomplete, or demonstrate an inadequate understanding of the Work or lack of review by the Contractor, then submittals may be returned to the Contractor for correction and resubmittal.

3.18.7 Contractor shall direct specific attention in writing and on the resubmitted Shop Drawings, Product Data, or Samples to any additional proposed revisions, other than those revisions requested by Project Manager on previous submittals.

3.18.8 Contractor is not relieved of responsibility for deviations from requirements of the Contract by Project Manager's review of Shop Drawings, Product Data, or Samples unless Contractor has specifically informed Project Manager in writing of the deviation at the time of the submittal, and Project Manager has given written approval of the deviation.

3.18.9 When professional certification of performance criteria of Products is required by the Contract, the City may rely upon accuracy and completeness of the calculations and certifications.

3.18.10 For Product colors or textures to be selected by the City, Contractor shall submit all samples together to allow preparation of a complete selection schedule.

3.18.11 Contractor shall submit informational submittals, on which Project Manager is not expected to take responsive action, as required by the Contract.

3.18.12 Submittals made by Contractor which are not required by the Contract may be returned to Contractor without action.

3.19 CULTURAL RESOURCES AND ENDANGERED SPECIES

3.19.1 Contractor may not remove or disturb, or cause to be removed or disturbed, any historical, archaeological, architectural, or other cultural artifacts, relics, vestiges, remains, or objects of antiquity. If Contractor discovers one of these items, Contractor shall immediately notify City Engineer and further comply with the requirements of 13 Tex. Admin. Code Chs. 25 and 26 (2002), or successor regulation. Contractor shall protect site and cultural resources from further disturbance until professional examination can be made or until clearance to proceed is authorized in writing by City Engineer.

3.19.2 Should either threatened or endangered plant or animal species be encountered,

Contractor shall cease work immediately in the area of encounter and notify City Engineer.

3.20 *CUTTING AND PATCHING*

3.20.1 Contractor is responsible for necessary cutting, fitting, and patching to accomplish the Work and shall suitably support, anchor, attach, match, and trim or seal materials to work of other contractors. Contractor shall coordinate the Work with work of other contractors to minimize conflicts, as provided in Article 6.

3.20.2 Contractor may not endanger work by cutting, digging, or other action, and may not cut or alter work of other contractors except by written consent of City Engineer and affected contractor.

3.21 *CLEANING*

3.21.1 Contractor shall perform daily cleanup of all dirt, debris, scrap materials and other disposable items resulting from Contractor's operations, whether on-site or off-site. Unless otherwise authorized in writing by City Engineer, Contractor shall keep all streets, access streets, driveways, areas of public access, walkways, and other designated areas clean and open at all times.

3.21.2 Failure of Contractor to maintain a clean site, including access streets, is the basis for City Engineer to issue a Notice of Noncompliance. Should compliance not be attained within the time period in the Notice of Noncompliance, City Engineer may authorize necessary cleanup to be performed by others and the cost of the cleanup will be deducted from monies due Contractor.

Contractor shall legally dispose off-site, all waste materials and other excess materials resulting from Contractor's operations.

3.22 *SANITATION*

3.22.1 Contractor shall provide and maintain sanitary facilities at site for use of all construction forces under the Contract. Newly-constructed or existing sanitary facilities may not be used by Contractor.

3.23 *ACCESS TO WORK AND TO INFORMATION*

3.23.1 Contractor shall provide the City, Design Consultant, testing laboratories, and governmental agencies which have jurisdictional interests, access to the Work in preparation and in progress wherever located. Contractor shall provide proper and safe conditions for the access.

3.23.2 If required by City Engineer, Contractor shall furnish information concerning character of Products and progress and manner of the Work, including information necessary to determine cost of the Work, such as number of employees, pay of employees, and time employees worked on various classes of the Work.

3.24 *TRADE SECRETS*

3.24.1 Contractor will not make any claim of ownership of trade secrets as to products used in the Work, or preparation of any mixture for the Work. City Engineer will at all times have the right to demand and Contractor shall furnish information concerning materials or samples of ingredients of any materials used, or proposed to be used, in preparation of concrete placed or other work to be done. Mixtures, once agreed on, shall not be changed in any manner without knowledge and consent of City Engineer. The City will make its best efforts to protect confidentiality of proprietary information.

3.25 *INDEMNIFICATION*

3.25.1 CONTRACTOR AGREES TO AND SHALL DEFEND, INDEMNIFY, AND HOLD THE CITY, ITS AGENTS, EMPLOYEES, OFFICERS, AND LEGAL REPRESENTATIVES (COLLECTIVELY THE "CITY") HARMLESS FOR ALL CLAIMS, CAUSES OF ACTION, LIABILITIES, FINES, AND EXPENSES (INCLUDING, WITHOUT LIMITATION, ATTORNEYS' FEES, COURT COSTS, AND ALL OTHER DEFENSE COSTS AND INTEREST) FOR INJURY, DEATH, DAMAGE, OR LOSS TO PERSONS OR PROPERTY SUSTAINED IN CONNECTION WITH OR INCIDENTAL TO PERFORMANCE UNDER THE CONTRACT INCLUDING, WITHOUT LIMITATION, THOSE CAUSED BY:

3.25.1.1 CONTRACTOR'S AND/OR ITS AGENTS', EMPLOYEES', OFFICERS', DIRECTORS', CONTRACTORS', OR SUBCONTRACTORS' (COLLECTIVELY IN NUMBERED SUBPARAGRAPHS .1 through .3, "CONTRACTOR") ACTUAL OR ALLEGED NEGLIGENCE OR INTENTIONAL ACTS OR OMISSIONS;

3.25.1.2 THE CITY'S AND CONTRACTOR'S ACTUAL OR ALLEGED CONCURRENT NEGLIGENCE, WHETHER CONTRACTOR IS IMMUNE FROM LIABILITY OR NOT;

3.25.1.3 THE CITY'S AND CONTRACTOR'S ACTUAL OR ALLEGED STRICT PRODUCTS LIABILITY OR STRICT STATUTORY LIABILITY, WHETHER CONTRACTOR IS IMMUNE FROM LIABILITY OR NOT.

CONTRACTOR SHALL DEFEND, INDEMNIFY, AND HOLD THE CITY HARMLESS DURING THE TERM OF THE CONTRACT AND FOR FOUR YEARS AFTER THE CONTRACT TERMINATES. CONTRACTOR SHALL NOT INDEMNIFY THE CITY FOR THE CITY'S SOLE NEGLIGENCE.

3.25.2 NOTWITHSTANDING ANYTHING TO THE CONTRARY, THE LIABILITY OF CONTRACTOR FOR THE CITY'S CONCURRENT NEGLIGENCE SHALL NOT EXCEED $1,000,000.

3.26 *RELEASE AND INDEMNIFICATION – PATENT, COPYRIGHT, TRADEMARK, AND TRADE SECRET INFRINGEMENT*

3.26.1 UNLESS OTHERWISE SPECIFICALLY REQUIRED BY THE CONTRACT, CONTRACTOR AGREES TO AND SHALL RELEASE AND DEFEND, INDEMNIFY, AND HOLD HARMLESS THE CITY, ITS AGENTS, EMPLOYEES, OFFICERS, AND LEGAL REPRESENTATIVES (COLLECTIVELY THE "CITY") FROM ALL CLAIMS OR CAUSES OF ACTION BROUGHT AGAINST THE CITY BY ANY PARTY, INCLUDING CONTRACTOR, ALLEGING THAT THE CITY'S USE OF ANY EQUIPMENT, SOFTWARE, PROCESS, OR DOCUMENTS CONTRACTOR FURNISHES DURING THE TERM OF THE CONTRACT INFRINGES ON A PATENT, COPYRIGHT, OR TRADEMARK, OR MISAPPROPRIATES A TRADE SECRET. CONTRACTOR SHALL PAY ALL COSTS (INCLUDING, WITHOUT LIMITATION, ATTORNEYS' FEES, COURT COSTS, AND ALL OTHER DEFENSE COSTS, AND INTEREST) AND DAMAGES AWARDED.

3.26.2 CONTRACTOR SHALL NOT SETTLE ANY CLAIM ON TERMS WHICH PREVENT THE CITY FROM USING THE EQUIPMENT, SOFTWARE, PROCESS, OR PRODUCT WITHOUT THE CITY ENGINEER'S PRIOR WRITTEN CONSENT.

3.26.3 UNLESS OTHERWISE SPECIFICALLY REQUIRED BY THE CONTRACT, WITHIN 60 DAYS AFTER BEING NOTIFIED OF THE CLAIM, CONTRACTOR SHALL, AT ITS OWN EXPENSE, EITHER:

3.26.3.1 OBTAIN FOR THE CITY THE RIGHT TO CONTINUE USING THE EQUIPMENT, SOFTWARE, PROCESS, OR PRODUCT, OR

3.26.3.2 IF BOTH PARTIES AGREE, REPLACE OR MODIFY THEM WITH COMPATIBLE AND FUNCTIONALLY EQUIVALENT PRODUCTS.

IF NONE OF THESE ALTERNATIVES IS REASONABLY AVAILABLE, THE CITY MAY RETURN THE EQUIPMENT, SOFTWARE, OR PRODUCT, OR DISCONTINUE THE PROCESS, AND CONTRACTOR SHALL REFUND THE PURCHASE PRICE.

3.27 *INDEMNIFICATION PROCEDURES*

3.27.1 *Notice of Indemnification Claims:* If the City or Contractor receives notice of any claim or circumstances which could give rise to an indemnified loss, the receiving party shall give written notice to the other Party within 10 days. The notice must include the following:

3.27.1.1 a description of the indemnification event in reasonable detail,

3.27.1.2 the basis on which indemnification may be due, and

3.27.1.3 the anticipated amount of the indemnified loss.

This notice does not estop or prevent the City from later asserting a different basis for indemnification or a different amount of indemnified loss than that indicated in the initial notice. If the City does not provide this notice within the 10-day period, it does not waive any right to indemnification except to the extent that Contractor is prejudiced, suffers loss, or incurs expense because of the delay.

3.27.2 *Defense of Indemnification Claims:*

3.27.2.1 *Assumption of Defense:* Contractor may assume the defense of the claim at its own expense with counsel chosen by it that is reasonably satisfactory to the City. Contractor shall then control the defense and any negotiations to settle the claim. Within 10 days after receiving written notice of the indemnification request, Contractor must advise the City as to whether or not it will defend the claim. If Contractor does not assume the defense, the City shall assume and control the defense, and all defense expenses constitute an indemnified loss.

3.27.2.2 *Continued Participation:* If Contractor elects to defend the claim, the City may

retain separate counsel to participate in, but not control, the defense and to participate in, but not control, any settlement negotiations. Contractor may settle the claim without the consent or agreement of the City, unless it:

3.27.2.2.1 would result in injunctive relief or other equitable remedies or otherwise require the City to comply with restrictions or limitations that adversely affect the City;

3.27.2.2.2 would require the City to pay amounts that Contractor does not fund in full; or

3.27.2.2.3 would not result in the City's full and complete release from all liability to the plaintiffs or claimants who are parties to or otherwise bound by the settlement.

3.28 *CONTRACTOR DEBT*

IF CONTRACTOR, AT ANY TIME DURING THE TERM OF THIS AGREEMENT, INCURS A DEBT, AS THE WORD IS DEFINED IN SECTION 15-122 OF THE HOUSTON CITY CODE OF ORDINANCES, IT SHALL IMMEDIATELY NOTIFY CITY CONTROLLER IN WRITING. IF CITY CONTROLLER BECOMES AWARE THAT CONTRACTOR HAS INCURRED A DEBT, IT SHALL IMMEDIATELY NOTIFY CONTRACTOR IN WRITING. IF CONTRACTOR DOES NOT PAY THE DEBT WITHIN 30 DAYS OF EITHER SUCH NOTIFICATION, CITY CONTROLLER MAY DEDUCT FUNDS IN AN AMOUNT EQUAL TO THE DEBT FROM ANY PAYMENTS OWED TO CONTRACTOR UNDER THIS AGREEMENT, AND CONTRACTOR WAIVES ANY RECOURSE THEREFOR. CONTRACTOR SHALL FILE A NEW AFFIDAVIT OF OWNERSHIP, USING THE FORM DESIGNATED BY CITY, BETWEEN FEBRUARY 1 AND MARCH 1 OF EVERY YEAR DURING THE TERM OF THE CONTRACT.

ARTICLE 4 - ADMINISTRATION OF THE CONTRACT

4.1 *CONTRACT ADMINISTRATION*

4.1.1 City Engineer will provide administration of the Contract and City Engineer is authorized to issue Change Orders, Work Change Directives, and Minor Changes in the Work.

4.1.2 City Engineer may act through Project Manager, Design Consultant, or Inspector. When the term "City Engineer" is used in the Contract, action by City Engineer is required unless City Engineer delegates his authority in writing. The City Engineer may not delegate authority to render decisions under Section 4.4.

The City does not have control over or charge of, and is not responsible for, supervision, construction, and safety procedures enumerated in Section 3.3. The City does not have control over or charge of and is not responsible for acts or omissions of Contractor, Subcontractors, or Suppliers.

4.1.3 The City and Design Consultant may attend project meetings and visit the site to observe progress and quality of the Work. The City and Design Consultant are not required to make exhaustive or continuous on-site inspections to check quality or quantity of the Work.

4.1.4 Project Manager will review and approve or take other appropriate action on Contractor's submittals, but only for limited purpose of checking for conformance with information given and design concept expressed in the Contract.

4.1.5 Project Manager's review of the submittals is not conducted for purpose of determining accuracy and completeness of other details, such as dimensions and quantities, or for substantiating instructions for installation or performance of Products, all of which remain the responsibility of Contractor.

4.1.6 Project Manager's review of submittals does not relieve Contractor of its obligations under Sections 3.3, 3.12, and 3.18. Review does not constitute approval of safety precautions or, unless otherwise specifically stated by Project Manager in writing, of construction means, methods, techniques, sequences, or procedures. Project Manager's review of a specific item does not indicate approval of an assembly of which the item is a component.

4.1.7 Based on field observations and evaluations, Project Manager will process Contractor's progress payments, certify amounts due Contractor, and issue Certificates for Payment in the amount certified.

4.1.8 Project Manager will receive and forward to City Engineer for his review and records, written warranties and related documents required by the Contract and assembled by Contractor.

4.1.9 Upon written request by Contractor or Project Manager, City Engineer will resolve matters of interpretation of or performance of the Contract, which are not Claims. City Engineer's decisions are final and binding on the Parties.

4.1.10 City Engineer may reject work which does not conform to the Contract.

4.1.11 When City Engineer considers it necessary to implement the intent of the Contract, City Engineer may require additional inspection or testing of work in accordance with Paragraphs 13.6.3 and 13.6.4, whether such work is fabricated, Installed, or completed.

4.2 *COMMUNICATIONS IN ADMINISTRATION OF THE CONTRACT*

4.2.1 Except as otherwise provided in the Contract or when authorized by City Engineer in writing, Contractor shall communicate with Project Manager. Contractor shall communicate with Design Consultant, Design Consultant's subconsultants, and separate contractors through Project Manager. The City will communicate with Subcontractors and Suppliers through Contractor.

4.3 *CLAIMS AND DISPUTES*

4.3.1 *Documentation by Project Manager:* Contractor shall submit Claims, including those alleging an error or omission by Project Manager or Design Consultant; to Project Manager for documentation and recommendation to City Engineer.

4.3.2 *Decision of City Engineer:* Upon submission of Claim by Project Manager or Contractor, City Engineer will resolve Claims in accordance with Section 4.4.

4.3.3 *Time Limits on Claims:* Claims by Contractor must be made within 90 days after occurrence of event giving rise to the Claim.

4.3.4 *Continuing the Contract Performance:* Pending final resolution of a Claim including referral to non-binding mediation, unless otherwise agreed in writing, Contractor shall proceed diligently with the performance of the Contract and the City will continue to make payments in accordance with the Contract.

4.3.4.1 Pending final resolution of a Claim including referral to non-binding mediation, Contractor is responsible for safety and protection of physical properties and conditions at site.

4.3.5 *Claims for Concealed or Unknown Conditions:* Concealed or unknown physical conditions include utility lines, other man-made structures, storage facilities, Pollutants and Pollutant Facilities, and the like, but do not include conditions arising from Contractor operations, or failure of Contractor to properly protect and safeguard subsurface facilities. Concealed conditions also include naturally-occurring soil conditions outside the range of soil conditions identified through geotechnical investigations, but do not include conditions arising from groundwater, rain, or flood.

4.3.5.1 If conditions are encountered at the site which are Underground Facilities or otherwise concealed or unknown conditions which differ materially from:

4.3.5.1.1 those indicated by the Contract; or

4.3.5.1.2 conditions which Contractor could have discovered through site inspection, geotechnical testing, or otherwise;

then Contractor will give written notice to City Engineer no later than five days after Contractor's first observation of the condition and before condition is disturbed. Contractor's failure to provide notice constitutes a waiver of a Claim.

4.3.5.2 City Engineer will promptly investigate concealed or unknown conditions. If City Engineer determines that conditions at the site are not materially different and that no change in Contract Price or Contract Time is justified, City Engineer will notify Contractor in writing, stating reasons. If City Engineer determines the conditions differ materially and cause increase or decrease in Contractor's cost or time required for performance of part of the Work, City Engineer will recommend an adjustment in Contract Price or Contract Time, or both, as provided in Article 7. Opposition by a Party to the City Engineer's determination must be made within 21 days after City Engineer has given notice of the decision. If the Parties cannot agree on adjustment to Contract Price or Contract Time, adjustment is subject to further proceedings pursuant to Section 4.4.

4.3.6 *Claims for Additional Cost:* If Contractor wishes to make a Claim for increase in Contract Price, Contractor shall give written notice before proceeding with work for which Contractor intends to submit a Claim. Prior notice is not required for Claims relating to an emergency

endangering life or property arising under Section 10.4.

4.3.6.1 Contractor may file a Claim in accordance with Section 4.4 if Contractor believes it has incurred additional costs, for the following reasons:

- 4.3.6.1.1 written interpretation of City Engineer;
- 4.3.6.1.2 order by City Engineer to stop the Work when Contractor is not at fault;
- 4.3.6.1.3 suspension of the Work by City Engineer;
- 4.3.6.1.4 termination of the Contract by City Engineer; or
- 4.3.6.1.5 The City's non-compliance with another provision of the Contract.

4.3.6.2 No increase in Contract Price is allowed for delays or hindrances to the Work, except for direct and unavoidable extra costs to Contractor caused by failure of the City to provide information and services, or to make land and materials available, when required of the City under the Contract. Any increase claimed is subject to the provisions of Section 4.4 and Article 7.

4.3.6.3 The City is not liable for Claims for delay when Date of Substantial Completion occurs prior to expiration of Contract Time.

4.3.7 *Claims for Additional Time:* If Contractor wishes to make a Claim for an increase in Contract Time, Contractor shall give written notice as provided in Section 8.2. In case of continuing delay, only one Claim is necessary.

4.4 *RESOLUTION OF CLAIMS AND DISPUTES*

4.4.1 City Engineer will review Claims and take one or more of the following preliminary actions within 30 days of receipt of Claim:

- 4.4.1.1 submit a suggested time to meet and discuss the Claim with City Engineer;
- 4.4.1.2 reject Claim, in whole or in part, stating reasons for rejection;
- 4.4.1.3 recommend approval of the Claim by the other Party;
- 4.4.1.4 suggest a compromise; or
- 4.4.1.5 take other actions as City Engineer deems appropriate to resolve the Claim.

4.4.2 City Engineer may request additional supporting data from claimant. Party making Claim shall, within 10 days after receipt of City Engineer's request, submit additional supporting data requested by City Engineer.

4.4.3 At any time prior to rendering a written decision regarding a Claim, City Engineer may refer Claim to non-binding mediation. If Claim is resolved, City Engineer will prepare and obtain all appropriate documentation. If Claim is not resolved, City Engineer will take receipt of Claim and begin a new review under Section 4.4.

4.4.4 If Claim is not referred to or settled in non-binding mediation, City Engineer may conduct a hearing and will render a written decision, including findings of fact, within 75 days of receipt of Claim, or a time mutually agreed upon by the Parties in writing. City Engineer may notify Surety and request Surety's assistance in resolving Claim. City Engineer's decision is final and binding on the Parties.

4.5 *CONDITION PRECEDENT TO SUIT; WAIVER OF ATTORNEY FEES AND INTEREST*

4.5.1 Neither the City nor Contractor may recover attorney fees for any claim brought in connection with this Contract.

4.5.2 Neither the City nor the Contractor may recover interest for any damages claim brought in connection with this Contract except as allowed by TEXAS LOCAL GOVERNMENT CODE Chapter 2251.

4.6 *INTERIM PAYMENT WAIVER & RELEASE*

4.6.1 In accordance with section 4.3, the Contractor shall use due diligence in the discovery and submission of any Claim against the City related to the Contractor's work.

4.6.2 The Contractor shall submit any Claim to the City not later than the 90th day after the occurrence of the event giving rise to the Claim.

4.6.3 Any failure to timely comply with the requirements of section 4.6.2 waives and releases any Claim when the Contractor submits an application for payment after the 90th day.

4.6.4 This waiver does not cover any retainage. In case of any conflict of law, this language shall be revised to the minimum extent necessary to avoid legal conflict. This waiver is made specifically for the benefit of the City.

ARTICLE 5 - SUBCONTRACTORS AND SUPPLIERS

5.1 *AWARD OF SUBCONTRACTS OTHER CONTRACTS FOR PORTIONS OF THE WORK*

5.1.1 Contractor may not contract with a Subcontractor, Supplier, person, or entity that City Engineer has made a reasonable and timely objection to.

5.1.2 If City Engineer has a reasonable objection to person or entity proposed by Contractor, Contractor shall propose another with whom City Engineer has no reasonable objection.

5.1.3 Contractor shall execute contracts with approved Subcontractors, Suppliers, persons, or entities before the Subcontractors or Suppliers begin work under the Contract. All such contracts must be executed and sent to the OBO Director and Contracting Department within 30 days after the date of the Notice to Proceed and must include provisions set forth in Articles 3 and 5 of this Document.

5.1.4 Contractor shall notify City Engineer in writing of any proposed change of Subcontractor, Supplier, person, or entity previously accepted by the City.

5.1.5 Contractor shall make timely payments to Subcontractors and Suppliers for performance of the Contract. Contractor shall protect, defend, and indemnify the City from any claim or liability arising out of Contractor's failure to make the payments. Disputes relating to payment of Business Enterprise Subcontractors or Suppliers will be submitted to arbitration in same manner as other disputes under Business Enterprise subcontracts. Failure of Contractor to comply with decisions of arbitrator may be determined by City Engineer a material breach leading to termination of the Contract.

5.2 *CONTRACTOR RESPONSIBILITY FOR SUBCONTRACTORS*

5.2.1 Contractor is responsible to the City, as may be required by laws and regulations, for all acts and omissions of Subcontractors, Suppliers, and other persons and organizations performing or furnishing any of the Work under direct or indirect contract with Contractor.

5.2.2 Contractor shall make available to each proposed Subcontractor, prior to execution of subcontract, copies of the Contract to which Subcontractor is bound by this Section 5.2. Contractor shall notify Subcontractor of any terms of proposed subcontract which may be at variance with the Contract.

5.2.3 The City's approval of Subcontractor or Suppliers does not relieve Contractor of its obligation to perform, or to have performed to the full satisfaction of the City, the Work required by the Contract.

5.2.4 Unless there is a contractual relationship between Contractor and a Subcontractor or Supplier to the contrary, Contractor shall withhold no more retainage from Subcontractors or Suppliers than City withholds from Contractor under this Agreement. However, once a Subcontractor or Supplier completes performance, Contractor shall release all retainage to that Subcontractor or Supplier regardless if City continues to retain under this Agreement.

5.2.5 Prior to a Subcontractor or Supplier commencing performance for Contractor, Contractor shall meet with that Subcontractor or Supplier to provide instructions on invoicing procedures, dispute resolution procedures, and statutory rights, such as claim filing procedures under the McGregor Act. Subcontractors and Suppliers must certify to the City Engineer that Contractor has fulfilled the requirements of this Section.

ARTICLE 6 - CONSTRUCTION BY THE CITY OR BY SEPARATE CONTRACTORS

6.1 *THE CITY'S RIGHT TO PERFORM CONSTRUCTION AND TO AWARD SEPARATE CONTRACTS*

6.1.1 The City may perform on-site construction operations related to the Work and as part of the Project with the City's workforce or with separate contractors.

6.2 *COORDINATION*

6.2.1 The City will coordinate activities of the City's workforce and of each separate contractor with work of Contractor, and Contractor shall cooperate with the City and separate contractors.

6.2.1.1 Contractor shall participate with other separate contractors and the City in reviewing their construction schedules when directed to do so by the Project Manager. Contractor shall make revisions to construction schedule and Contract Price deemed

necessary after joint review and mutual agreement. Construction schedules shall then constitute schedules to be used by Contractor, separate contractors, and the City, until subsequently revised.

6.2.2 Contractor shall afford to the City and to separate contractors reasonable opportunity for introduction and storage of their materials and equipment, and for performance of their activities.

6.2.3 If part of Contractor's work depends on proper execution of construction or operations by the City or a separate contractor, Contractor shall, prior to proceeding with that portion of the Work, inspect the other work and promptly report to City Engineer apparent discrepancies or defects in the other construction that would render it unsuitable for the proper execution of the Work. Failure of Contractor to report apparent discrepancies or defects in the other construction shall constitute acknowledgment that the City's or separate contractor's completed or partially completed construction is fit and proper to receive Contractor's work, except as to discrepancies or defects not then reasonably discoverable.

6.3 *MUTUAL RESPONSIBILITY*

6.3.1 The responsible party bears the costs caused by delays, by improperly timed activities, or by nonconforming construction.

6.3.2 Contractor shall promptly remedy damage caused by Contractor to completed or partially completed construction or to property of the City or separate contractor.

6.3.3 Claims or disputes between Contractor and other City contractors, or subcontractors of other City contractors, working on the Project must be submitted to binding arbitration in accordance with Construction Industry Arbitration Rules of the American Arbitration Association upon demand by any party to the dispute or by the City.

6.4 *THE CITY'S RIGHT TO CLEAN UP*

6.4.1 If dispute arises among Contractor, separate contractors, and the City as to responsibility under their respective contracts for maintaining premises and surrounding area free from waste materials and rubbish as described in Section 3.21, the City may clean up and allocate cost among those responsible, as determined by City Engineer.

ARTICLE 7 - CHANGES IN THE WORK

7.1 *CHANGES*

7.1.1 Changes in scope of the Work, subject to limitations in Article 7 and elsewhere in the Contract, may be accomplished without invalidating the Contract, or without notifying Surety by:

- 7.1.1.1 Change Order;
- 7.1.1.2 Work Change Directive; or
- 7.1.1.3 Minor Change in the Work.

7.1.2 The following types of Change Orders require City Council approval:

- 7.1.2.1 a single Change Order that exceeds five percent of Original Contract Price,
- 7.1.2.2 a Change Order which, when added to previous Change Orders, exceeds five percent of Original Contract Price,
- 7.1.2.3 a Change Order, in which the total value of increases outside of the general scope of work approved by City Council, when added to increases outside the general scope of work approved by City Council in previous Change Orders, exceeds 40 percent of the Original Contract Price, even if the net increase to the Original Contract Price is five percent or less.

  In this context, "increase" means an increase in quantity resulting from the addition of locations not within the scope of work approved by City Council, or the addition of types of goods or services not bid as unit price items.

Nothing in this Section is intended to permit an increase of the Contract Price in excess of the limit set out in TEX. LOC. GOV'T CODE ANN. §252.048 or its successor statute.

7.1.3 Contractor shall proceed promptly to execute changes in the Work provided in Modifications, unless otherwise stated in the Modification.

7.2 *WORK CHANGE DIRECTIVES*

7.2.1 A Work Change Directive cannot change Contract Price or Contract Time, but is evidence that the Parties agree that a change, ordered by directive, will be incorporated in a subsequently issued Change Order as to its effect, if any, on Contract Price or Contract Time.

7.2.2 Failure by Contractor to commence work identified in a Work Change Directive within the time specified by City Engineer, or to complete the

work in a reasonable period of time, may be determined by City Engineer to be a material breach of Contract.

7.2.3 A Work Change Directive is used in the absence of total agreement of the terms of a Change Order. Interim payments are made in accordance with Paragraph 9.6.1.

7.2.4 If Contractor signs a Work Change Directive, then Contractor agrees to its terms including adjustment in Contract Price and Contract Time or method for determining them. Agreement by the Parties to adjustments in Contract Price and Contract Time are immediately recorded as a Change Order.

7.2.5 City Engineer, by Work Change Directive, may direct Contractor to take measures as necessary to expedite construction to achieve Date of Substantial Completion on or before expiration of Contract Time. When the Work is expedited solely for convenience of the City and not due to Contractor's failure to prosecute timely completion of the Work, then Contractor is entitled to an adjustment in Contract Price equal to actual costs determined in accordance with Article 7.

7.3 *ADJUSTMENTS IN CONTRACT PRICE*

7.3.1 Adjustments in Contract Price are accomplished by Change Order and are based on one of the following methods:

- 7.3.1.1 mutual acceptance of fixed price, properly itemized and supported by sufficient data to permit evaluation;
- 7.3.1.2 unit prices stated in the Contract or subsequently agreed upon;
- 7.3.1.3 cost to be determined in a manner agreed upon by the Parties and mutually acceptable fixed or percentage fee; or
- 7.3.1.4 as provided in Paragraph 7.3.2.

7.3.2 If Contractor does not agree with a change in Contract Price or Contract Time or the method for adjusting them specified in the Work Change Directive within 21 days from date of the Work Change Directive's issuance, method and adjustment are determined by City Engineer. If Project Manager or Contractor disagree with City Engineer's determination they then may file a Claim in accordance with Section 4.4.

7.3.2.1 If City Engineer determines a method and adjustment in Contract Price under Paragraph 7.3.2, Contractor shall provide, in a form as City Engineer may prescribe, appropriate supporting data for items submitted under Paragraph 7.3.2. Failure to submit the data within 21 days of request for the data by City Engineer shall constitute waiver of a Claim.

7.3.2.2 Unless otherwise provided in the Contract, costs for the purposes of this Paragraph 7.3.2 are limited to the following:

- 7.3.2.2.1 costs of labor, including labor burden as stated below for social security, unemployment insurance, customary and usual fringe benefits required by agreement or custom, and Workers' Compensation insurance;
  - 7.3.2.2..1.1 the maximum labor burden applied to costs of labor for changes in the Work is 55 percent;
- 7.3.2.2.2 costs of materials, supplies, and equipment, including cost of transportation, whether incorporated or consumed;
- 7.3.2.2.3 rental costs of machinery and equipment, exclusive of hand tools, whether rented from Contractor or others, with prior approval of City Engineer;
- 7.3.2.2.4 costs of premiums for Bonds and insurance and permit fees related to the change in the Work;
- 7.3.2.2.5 additional costs of direct supervision of work and field office personnel directly attributable to the change; and
- 7.3.2.2.6 allowances for overhead and profit as stated below.
  - 7.3.2.2.6.1 the maximum allowances for overhead and profit on increases due to Change Orders:
  - 7.3.2.2.6.2 for changes in the Work performed by Contractor and Subcontractors, allowance for overhead and profit are applied to an amount equal to cost of all additions less cost of all deletions to the Work. Allowance for overhead to Contractor and first tier Subcontractors on changes performed by Subcontractors are applied to an amount equal to the sum of all increases to the Work by applicable Subcontractors.

	Overhead	Profit
to Contractor for change in the Work performed by Subcontractors:	10 percent	0 percent
to first tier Subcontractors for change in the Work performed by its Subcontractors:	10 percent	0 percent
to Contractor and Subcontractor for change in the Work performed by their respective firms:	10 percent	5 percent

7.3.3 If the City deletes or makes a change, which results in a net decrease in Contract Price, the City is entitled to a credit calculated in accordance with Paragraphs 7.3.1 and 7.3.2 and Subparagraphs 7.3.2.1, and 7.3.2.2.1 through 7.3.2.2.5. When both additions and credits covering related work or substitutions are involved in a change, allowance for overhead and profit is figured on the basis of a net increase, if any, with respect to that change in accordance with Subparagraph 7.3.2.2.6.

7.3.4 When Contractor agrees with the determination made by City Engineer concerning adjustments in Contract Price and Contract Time, or the Parties otherwise reach agreement upon the adjustments, the agreement will be immediately recorded by Change Order.

7.4 *MINOR CHANGES IN THE WORK*

7.4.1 A Minor Change in Work is binding on the Parties. Contractor shall acknowledge, in a written form acceptable to City Engineer, that there is no change in Contract Time or Contract Price and shall carry out the written orders promptly.

ARTICLE 8 - TIME

8.1 *PROGRESS AND COMPLETION*

8.1.1 Time is of the essence in the Contract. By executing the Contract, Contractor agrees that Contract Time is a reasonable period for performing the Work.

8.1.2 *Computation of Time:* In computing any period of time prescribed or allowed by the General Conditions, the day of the act, event, or default after which designated period of time begins to run is not to be included. Last day of the period so computed is to be included, unless it is a Sunday or Legal Holiday, in which event the period runs until end of next day which is not a Sunday or Legal Holiday. Sundays and Legal Holidays are considered to be days and are to be included in all other time computations relative to Contract Time.

8.1.3 Contractor may not commence the Work prior to the effective date of insurance and Bonds required by Article 11.

8.1.4 Contractor shall proceed expeditiously and without interruption, with adequate forces, and shall achieve Date of Substantial Completion within Contract Time.

8.1.5 Should progress of the Work fall behind construction schedule, except for reasons stated in Paragraph 8.2.1, Contractor shall promptly submit at the request of Project Manager, updated construction schedule to City Engineer for approval. Contractor's failure to submit updated schedule may, at City Engineer's discretion, constitute a material breach of the Contract. Contractor shall take action necessary to restore progress by working the hours, including night shifts and lawful overtime operations as necessary, to achieve Date of Substantial Completion within Contract Time.

8.1.6 Except in connection with safety or protection of persons or the Work or property at the site or adjacent to the site, and except as otherwise indicated in the Contract, all the Work at the site will be performed Monday through Saturday between the hours of 7:00 a.m. and 7:00 p.m. Contractor may not perform work between 7:00 p.m. and 7:00 a.m., on a Sunday, or on a Legal Holiday, without giving City Engineer 24-hour prior written notice and receiving written consent of City Engineer.

8.2 *DELAYS AND EXTENSIONS OF TIME*

8.2.1 Contractor may request extension of Contract Time for a delay in performance of work that arises from causes beyond control and without fault or negligence of Contractor. Examples of these causes are:

- 8.2.1.1 acts of God or of the public enemy;
- 8.2.1.2 acts of government in its sovereign capacity;
- 8.2.1.3 fires;
- 8.2.1.4 floods;
- 8.2.1.5 epidemics;
- 8.2.1.6 quarantine restrictions;
- 8.2.1.7 strikes;
- 8.2.1.8 freight embargoes;
- 8.2.1.9 unusually severe weather; and
- 8.2.1.10 discovery of Pollutants or Pollutant Facilities at the site.

8.2.2 For any reason other than those listed in Section 4.3.6.2, if the Contractor's work is delayed in any manner or respect, the Contractor shall have no claim for damages and shall have no right of additional compensation from the City by reason of any delay or increased expense to the Contractor's work, except for an extension of time as provided in this provision.

8.2.3 Contractor may request an extension of Contract Time for delay only if:

8.2.3.1 delay is caused by failure of Subcontractor or Supplier to perform or make progress; and

8.2.3.2 cause of failure is beyond control of both Contractor and Subcontractor or Supplier.

8.2.4 Claims relating to Contract Time must be made in accordance with Paragraph 4.3.7.

8.2.5 Claims for extending or shortening Contract Time are based on written notice promptly delivered by the Party making Claim to other Party. Claim must accurately describe occurrence generating Claim, and a statement of probable effect on progress of the Work.

8.2.6 Claims for extension of Contract Time are considered only when a Claim is filed within the time limits stated in Paragraph 4.3.3.

8.2.6.1 Notwithstanding paragraph 4.3.3, an extension of time for delays under this paragraph may be granted only upon written application by the Contractor within 48 hours from the claimed delay.

8.2.7 Written notice of Claim must be accompanied by claimant's written statement that adjustment claimed is entire adjustment to which claimant is entitled as a result of the occurrence of the event. When the Parties cannot agree, Claims for adjustment in Contract Time are determined by City Engineer in accordance with Section 4.4.

8.2.8 Adjustments to Contract Time are accomplished by Change Order.

ARTICLE 9 - PAYMENTS AND COMPLETION

9.1 *UNIT PRICE WORK*

9.1.1 Where the Contract provides that all or part of the Work is based on Unit Prices, the Original Contract Price includes, for all Unit Price work, an amount equal to the sum of Unit Prices times Unit Price Quantities for each separately identified item of Unit Price work.

9.1.2 Each Unit Price includes an amount to cover Contractor's overhead and profit for each separately identified item.

9.1.3 The Contractor may not make a Claim against the City for excess or deficiency in Unit Price Quantities provided in the Contract, except as provided in Subparagraph 9.1.4. Payment at the prices stated in the Contract is in full for the completed work. Contractor is not entitled to additional payment for materials, supplies, labor, tools, machinery and all other expenditures incidental to satisfactory completion of the Work.

9.1.4 City Engineer may increase or decrease quantities of the Work within limitations stated in Paragraph 7.1.2. Contractor is entitled to payment for actual quantities of items provided at Unit Prices set forth in the Contract.

9.1.5 Where the final quantity of work performed by Contractor on Major Unit Price Work item differs by more than 25 percent from quantity of the item stated in the Contract, a Party may request an adjustment in Unit Price, for the portion that differs by more than 25 percent, by a Change Order under Section 7.3.

9.2 *ESTIMATES FOR PAYMENT, UNIT PRICE WORK*

9.2.1 Following the day of each month indicated in the Contract, Project Manager will prepare a Certificate for Payment for the preceding monthly period based on estimated units of work completed. Prior to preparing Certificate of Payment, Contractor shall have submitted to City Engineer, on a form approved by the Director of the Office of Business Opportunity, evidence satisfactory to the City Engineer of payments made to Subcontractors and Suppliers for the month preceding the month for which the Certificate for Payment is prepared, including evidence of electronic submission of certified payrolls.

9.2.2 Before final completion, City Engineer will review and confirm with Contractor the actual final installed Unit Price quantities. City Engineer's determination of actual final installed Unit Price quantities will be included in the final Certificate for Payment and any previous underpayments and overpayments will be reconciled with the actual final Unit Price quantities. Contractor shall file written notice of intent to appeal, if any, City Engineer's

determination within 10 days of receipt of final Certificate for Payment. Upon expiration of the 10-day period, City Engineer's decision is final and binding on the Parties. If Contractor submits notice within the 10-day period, Contractor shall submit a Claim in accordance with Section 4.4.

9.3 *STIPULATED PRICE WORK*

9.3.1 For work contracted on a Stipulated Price basis, 10 days before submittal of first Application for Payment, Contractor shall submit to City Engineer a Schedule of Values allocated to various portions of the Work, prepared in the form and supported by the data as City Engineer may require to substantiate its accuracy. This schedule, as approved by City Engineer, is used as a basis for approval of Contractor's Applications for Payment.

9.4 *APPLICATIONS FOR PAYMENT, STIPULATED PRICE WORK*

9.4.1 For work contracted on a Stipulated Price basis, Contractor shall submit Applications for Payment to City Engineer each month on a form acceptable to City Engineer in accordance with Schedule of Values. Application must indicate percentages of completion of each portion of the Work listed in Schedule of Values as of the end of the period covered by the Application for Payment.

9.4.2 Applications for Payment must be supported by substantiating data as City Engineer may require and must reflect retainages as provided below. Evidence satisfactory to the City Engineer of payments made to Subcontractors and Suppliers for the month preceding the month for which the Application for Payment is submitted must accompany each Application for Payment on a form approved by the Director of the Office of Business Opportunity. Evidence of electronic submission of certified payrolls must be included. Application must be sworn and notarized.

9.5 *CERTIFICATES FOR PAYMENT*

9.5.1 City Engineer will, within 10 days after the date specified in the Contract for Unit Price work, or upon receipt of Contractor's Application for Payment for Stipulated Price work, issue a Certificate for Payment for work based on amount which City Engineer determines is properly due, with copy to Contractor.

9.5.2 Unless otherwise provided in the Contract, payment for completed work and for properly stored Products is conditioned upon compliance with procedures satisfactory to City Engineer to protect the City's interests. Procedures will include applicable insurance, storage, and transportation to site for materials and equipment stored off-site. Contractor is responsible for maintaining materials and equipment until Date of Substantial Completion.

9.5.3 Contractor shall document its use of Ultra Low Sulfur Diesel Fuel by providing invoices and receipts evidencing Contractor's use.

9.6 *COMPUTATIONS OF CERTIFICATES FOR PAYMENT*

9.6.1 Subject to the provisions of the Contract, the amount of each Certificate for Payment is calculated as follows:

- 9.6.1.1 that portion of Contract Price allocated to completed work as determined by:
  - 9.6.1.1.1 multiplying the percentage of completion of each portion of the Work listed in the Schedule of Values by the value of that portion of the Work, or
  - 9.6.1.1.2 multiplying Unit Price quantities Installed times the Unit Prices listed in the Contract;
- 9.6.1.2 plus progress payments for completed work that has been properly authorized by Modifications;
- 9.6.1.3 less retainage of five percent;
- 9.6.1.4 plus actual costs, properly substantiated by certified copies of invoices and freight bills, of non-perishable materials and equipment delivered and properly stored, if approved in advance by Project Manager, less 15 percent;
- 9.6.1.5 less any previous payments by the City.

9.7 *DECISIONS TO WITHHOLD CERTIFICATION*

9.7.1 City Engineer may decline to certify payment and may withhold payment in whole or in part to the extent reasonably necessary to protect the City if, in City Engineer's opinion, there is reason to believe that:

- 9.7.1.1 nonconforming work has not been remedied;
- 9.7.1.2 the Work cannot be completed for unpaid balance of Contract Price;
- 9.7.1.3 there is damage to the City or another contractor;
- 9.7.1.4 the Work will not be completed within Contract Time and that unpaid balance

will not be adequate to cover actual and liquidated damages;

9.7.1.5 probable evidence that third party claims will be filed in court, in arbitration, or otherwise;

9.7.1.6 Contractor has failed to make payments to Subcontractors or Suppliers for labor, material, or equipment; or

9.7.1.7 Contractor has persistently failed to carry out work in accordance with the Contract.

9.7.1.8 Contractor has not paid Subcontractors or Suppliers because of a payment dispute; or

9.7.1.9 Contractor has failed to provide satisfactory evidence described in Paragraphs 9.2.1, 9.4.2, and 9.8.2.

9.7.2 When the above reasons for withholding certification are removed, certification will be made for amounts previously withheld.

9.7.3 City Engineer may decline to certify payment and may withhold request for payment in whole or in part upon failure of Contractor to submit initial construction schedule or monthly schedule updates, as required in Paragraphs 3.15.1 and 3.15.3.

9.8 *PROGRESS PAYMENTS*

9.8.1 The City will make payment, in an amount certified by City Engineer, within 20 days after City Engineer has issued a Certificate for Payment.

9.8.2 The City has no obligation to pay or to facilitate the payment to a Subcontractor or Supplier, except as may otherwise be required by law. Contractor shall comply with the prompt payment requirements of Chapter 2251 of the Government Code. State law requires payment of Subcontractors and Suppliers by Contractor within 7 calendar days of Contractor's receipt of payment from the City, unless there is a payment dispute between Contractor and a Subcontractor or Supplier evidenced on a form approved by the Director of Mayor's Office of Business Opportunity and submitted to the City Engineer each month with Application for Payment or Estimate for Payment. **CONTRACTOR SHALL DEFEND AND INDEMNIFY THE CITY FROM ANY CLAIMS OR LIABILITY ARISING OUT OF CONTRACTOR'S FAILURE TO MAKE THESE PAYMENTS.**

9.8.2.1 The City may, upon request and at the discretion of City Engineer, furnish to Subcontractor information regarding percentages of completion or the amounts applied for by Contractor, and action taken thereon by the City because of work done by the Subcontractor.

9.8.2.2 Contractor shall prepare and submit to City Engineer a Certification of Payment to Subcontractors and Suppliers form to be attached to each monthly Estimate for Payment or Application for Payment.

9.8.3 A Certificate for Payment, a progress payment, or partial or entire use or occupancy of the Work by the City, does not constitute acceptance of work which is not in accordance with the Contract.

9.9 *DATE OF SUBSTANTIAL COMPLETION*

9.9.1 When Contractor considers the Work, or a portion thereof designated by City Engineer, to be substantially complete, Contractor shall prepare and submit to Project Manager a comprehensive punch list of items to be completed or corrected. Failure to include an item on the punch list does not alter the responsibility of Contractor to comply with the Contract.

9.9.1.1 By submitting the punch list to Project Manager, Contractor represents that work on the punch list will be completed within the time provided for in Subparagraph 9.9.4.3.

9.9.2 Upon receipt of Contractor's punch list, Project Manager will inspect the Work, or designated portion thereof, to verify that the punch list contains all items needing completion or correction. If Project Manager's inspection discloses items not on Contractor's punch list, the items must be added to the punch list of items to be completed or corrected. If Project Manager's inspection reveals that Contractor is not yet substantially complete, Contractor shall complete or correct the deficiencies and request another inspection by Project Manager. The City may recover the costs of re-inspection from Contractor.

9.9.3 Prior to City Engineer's issuing a Certificate of Substantial Completion, Contractor shall also provide:

9.9.3.1 Certificate of Occupancy for new construction, or Certificate of Compliance for remodeled work, as applicable, and

9.9.3.2 compliance with Texas Accessibility Standards through state inspection of the Work, if required. If Contractor calls for inspection in a timely manner and the inspection is delayed through no fault of Contractor, and City Engineer so confirms, City Engineer may, upon request by Contractor, add the inspection to the punch list in Paragraph 9.9.2 and issue a Certificate of Substantial Completion.

9.9.4 When the Work, or designated portion thereof, is determined by City Engineer to be sufficiently complete in accordance with the Contract so the City can occupy or utilize the Work, or designated portion thereof, for the purpose for which it is intended, City Engineer will prepare a Certificate of Substantial Completion that incorporates the punch list in Paragraph 9.9.2 and establishes:

9.9.4.1 Date of Substantial Completion;

9.9.4.2 responsibilities of the Parties for security, maintenance, heating, ventilating and air conditioning, utilities, damage to the Work, and insurance; and

9.9.4.3 fixed time within which Contractor shall complete all items on punch list of items to be corrected accompanying the certificate.

9.9.5 Warranties required by the Contract shall commence on the Date of Substantial Completion unless otherwise provided by City Engineer in Certificate of Substantial Completion. Warranties may not commence on items not substantially completed.

9.9.6 After Date of Substantial Completion and upon application by Contractor and approval by City Engineer, the City may make payment, reflecting adjustment in retainage, if any, as follows:

9.9.6.1 with the consent of Surety, the City may increase payment to Contractor to 96 percent of Contract Price, less value of items to be completed and accrued liquidated damages.

9.9.7 Contractor shall complete or correct the items in Paragraph 9.9.2 within the time period set out in the Certificate of Substantial Completion. If Contractor fails to do so, the City may issue a Notice of Noncompliance and proceed according to Section 2.5.

9.10 *PARTIAL OCCUPANCY OR USE*

9.10.1 The City may occupy or use any completed or partially completed portion of the Work at any stage, provided the occupancy or use is consented to by Contractor and Contractor's insurer and authorized by public authorities having jurisdiction over the Work. Consent of Contractor to partial occupancy or use may not be unreasonably withheld.

9.10.2 Immediately prior to the partial occupancy or use, Project Manager and Contractor shall jointly inspect the area to be occupied or portion of the Work to be used to determine and record condition of the Work.

9.10.3 Partial occupancy or use of a portion of the Work does not constitute acceptance of work not in compliance with requirements of the Contract.

9.11 *FINAL COMPLETION AND FINAL PAYMENT*

9.11.1 Contractor shall review the Contract and inspect the Work prior to Contractor notification to City Engineer that the Work is complete and ready for final inspection. Contractor shall submit affidavit that the Work has been inspected and that the Work is complete in accordance with requirements of the Contract.

9.11.2 Project Manager will make final inspection within 15 days after receipt of Contractor's written notice that the Work is ready for final inspection and acceptance. If Project Manager finds the Work has been completed in accordance with the Contract, Contractor shall submit items set out in Paragraph 9.11.4 and, for stipulated price contracts, a final Application for Payment. City Engineer will, within 10 days, issue Certificate of Final Completion stating that to the best of City Engineer's knowledge, information, and belief, the Work has been completed in accordance with the Contract, and will recommend acceptance of the Work by City Council.

9.11.3 Should work be found not in compliance with requirements of the Contract, City Engineer will notify Contractor in writing of items of noncompliance. Upon inspection and acceptance of the corrections by Project Manager, compliance with all procedures of Paragraph 9.11.2, and Contractor's submission of the items set out in Paragraph 9.11.4, the City Engineer will issue Certificate of Final Completion to Contractor as provided in Paragraph 9.11.2.

9.11.4 Contractor shall submit the following items to City Engineer before City Engineer will issue a Certificate of Final Completion:

9.11.4.1 affidavit that payrolls, invoices for materials and equipment, and other indebtedness of Contractor connected

with the Work, less amounts withheld by the City, have been paid or otherwise satisfied. If required by City Engineer, Contractor shall submit further proof including waiver or release of lien or claims from laborers or Suppliers of Products;

9.11.4.2 certificate evidencing that insurance required by the Contract to remain in force after final payment is currently in effect, will not be canceled or materially changed until at least 30 days written notice has been given to the City;

9.11.4.3 written statement that Contractor knows of no substantial reason that insurance will not be renewable to cover correction and warranty period required by the Contract;

9.11.4.4 consent of Surety to final payment; and

9.11.4.5 copies of record documents, maintenance manuals, tests, inspections, and approvals.

Upon City Engineer's issuance of a Certificate of Final Completion, Contractor may request increase in payment to 99 percent of Contract Price, less accrued liquidated damages.

9.11.5 If Contractor fails to submit required items in Paragraph 9.11.4 within 10 days of Project Manager's inspection of the Work under Paragraph 9.11.2 or Paragraph 9.11.3, City Engineer may, but is not obligated to:

9.11.5.1 deduct liquidated damages accrued from monies held;

9.11.5.2 proceed to City Council for acceptance of the Work, minus some or all of the items Contractor fails to submit under Paragraph 9.11.4; and,

9.11.5.3 upon acceptance by City Council of the portion of the Work completed, make final payment as set out in Paragraph 9.11.8.

9.11.6 If final completion is materially delayed through no fault of Contractor, or by issuance of Change Orders affecting date of final completion, and City Engineer so confirms, the City may, upon application by Contractor and certification by City Engineer, and without terminating the Contract, make payment of balance due for that portion of the Work fully completed and accepted.

9.11.7 If remaining balance due for work not corrected is less than retainage stipulated in the Contract, Contractor shall submit to City Engineer written consent of Surety to payment of balance due for that portion of the Work fully completed and accepted, prior to certification of the payment. The payment is made under terms governing final payment, except that it does not constitute waiver of Claims.

9.11.8 The City will make final payment to Contractor within 30 days after acceptance of the Work by City Council, subject to limitations, if any, as stated in the Contract.

9.11.9 Acceptance of final payment by Contractor shall constitute a waiver of all Claims, whether known or unknown, by Contractor, except those previously made in writing and identified by Contractor as unsettled at time of final Application for Payment.

9.12 *LIQUIDATED DAMAGES*

9.12.1 Contractor, Surety, and the City agree that failure to complete the Work within Contract Time will cause damages to the City and that actual damages from harm are difficult to estimate accurately. Therefore, Contractor, Surety, and the City agree that Contractor and Surety are liable for and shall pay to the City the amount stipulated in Supplementary Conditions as liquidated damages, and that the amount of damages fixed therein is a reasonable forecast of just compensation for harm to the City resulting from Contractor's failure to complete the Work within Contract Time. The amount stipulated will be paid for each day of delay beyond Contract Time until Date of Substantial Completion.

9.12.2 Contractor shall pay the City an amount equal to $1,200.00 per diesel operating vehicle or piece of motorized equipment per incident of high sulfur diesel fuel usage.

ARTICLE 10 - SAFETY PRECAUTIONS

10.1 *SAFETY PROGRAMS*

10.1.1 Contractor is responsible for initiating, maintaining, and supervising all safety precautions and programs in connection with performance of the Contract. Contractor shall submit a safety program to City Engineer prior to mobilizing for the Work, and is solely responsible for safety, efficiency, and adequacy of ways, means, and methods, and for damage which might result from failure or improper construction, maintenance, or operation performed by Contractor.

10.2 *POLLUTANTS AND POLLUTANT FACILITIES*

10.2.1 If Contractor encounters material on-site which it reasonably believes to be a Pollutant or facilities which it reasonably believes to be a Pollutant Facility, Contractor shall immediately stop work in affected area and immediately notify City Engineer, confirming the notice thereafter in writing.

10.2.2 If City Engineer determines that the material is a Pollutant or facility is a Pollutant Facility, work in affected area may not be resumed except by Modification, and only if the work would not violate applicable laws or regulations.

10.2.3 If City Engineer determines that the material is not a Pollutant or a facility is not a Pollutant Facility, work in affected area will be resumed upon issuance of a Modification.

10.2.4 Contractor is not required to perform, unless authorized by Change Order, work relating to Pollutants or Pollutant Facilities except for that work relating to Pollutants or Pollutant Facilities specified in the Contract.

10.3 *SAFETY OF THE ENVIRONMENT, PERSONS, AND PROPERTY*

10.3.1 Contractor shall take reasonable precautions for safety and shall provide reasonable protection to prevent damage, injury, or loss from all causes, to:

10.3.1.1 employees performing work on-site, and other persons who may be affected thereby;

10.3.1.2 work, including Products to be incorporated into the Work, whether in proper storage, under control of Contractor or Subcontractor; and

10.3.1.3 other property at or adjacent to the site, such as trees, shrubs, lawns, walks, pavements, roadways, structures, utilities, and Underground Facilities not designated for removal or replacement in course of construction.

10.3.2 Contractor shall give notices and comply with applicable laws, ordinances, rules, regulations, and lawful orders of public authorities bearing on safety of persons, property, or environment.

10.3.2.1 Contractor shall comply with requirements of Underground Facility Damage Prevention and Safety Act TEX. UTIL. CODE ANN. Ch. 251 (Vernon Supp. 2002).

10.3.2.2 Contractor shall comply with all safety rules and regulations of the Federal Occupational Health and Safety Act of 1970 and subsequent amendments (OSHA).

10.3.3 Contractor shall erect and maintain, as required by existing conditions and performance of the Contract, reasonable safeguards for safety and protection of persons and property, including posting danger signs and other warnings against hazards, promulgating safety regulations, and notifying owners and users of adjacent sites and utilities.

10.3.4 Contractor shall designate responsible member of Contractor's organization at site whose duty is prevention of accidents. This person will be Contractor's Superintendent unless otherwise designated by Contractor in writing to City Engineer.

10.3.5 Contractor shall prevent windblown dust and may not burn or bury trash debris or waste products on-site. Contractor shall prevent environmental pollution, including but not limited to particulates, gases and noise, as a result of the Work.

10.3.6 When use or storage of hazardous materials or equipment, or unusual methods are necessary for execution of the Work, Contractor shall exercise utmost care and carry on the activities under supervision of properly qualified personnel.

10.3.7 Contractor shall promptly remedy damage and loss to property referred to in Subparagraphs 10.3.1.2 and 10.3.1.3, caused in whole or in part by Contractor, or Subcontractors, which is not covered by insurance required by the Contract. Contractor is not required to remedy damage or loss attributable to the City, Design Consultant, or other contractors.

10.4 *EMERGENCIES*

10.4.1 In emergencies affecting safety of persons or property, Contractor shall act at Contractor's discretion to prevent imminent damage, injury, or loss. Additional compensation or extension of time claimed by Contractor because of emergencies are determined as provided in Article 7.

ARTICLE 11 - INSURANCE AND BONDS

11.1 *GENERAL INSURANCE REQUIREMENTS*

11.1.1 With no intent to limit Contractor's liability under indemnification provisions set forth in Paragraphs 3.25 and 3.26, Contractor shall provide and maintain in full force and effect during term of the Contract and all extensions and amendments thereto, at least the following insurance and available limits of liability.

11.1.2 If any of the following insurance is written as "claims made" coverage and the City is required to be carried as additional insured, then Contractor's insurance shall include a two-year extended discovery period after last date that Contractor provides any work under the Contract.

11.1.3 Aggregate amounts of coverage, for purposes of the Contract, are agreed to be amounts of coverage available during fixed 12-month policy period.

11.2 *INSURANCE TO BE PROVIDED BY CONTRACTOR*

11.2.1 *Risks and Limits of Liability:* Contractor shall maintain the insurance coverages in the listed amounts, as set out in Table 1.

11.2.2 If Limit of Liability for Excess Coverage is $2,000,000 or more, Limit of Liability for Employer's Liability may be reduced to $500,000.

11.2.3 *Insurance Coverage*: At all times during the term of this Contract and any extensions or renewals, Contractor shall provide and maintain insurance coverage that meets the Contract requirements. Prior to beginning performance under the Contract, at any time upon the Director's request, or each time coverage is renewed or updated, Contractor shall furnish to the Director current certificates of insurance, endorsements, all policies, or other policy documents evidencing adequate coverage, as necessary. Contractor shall be responsible for and pay (a) all premiums and (b) any claims or losses to the extent of any deductible amounts. Contractor waives any claim it may have for premiums or deductibles against the City, its officers, agents, or employees. Contractor shall also require all subcontractors or consultants whose subcontracts exceed $100,000 to provide proof of insurance coverage meeting all requirements stated above except amount. The amount must be commensurate with the amount of the subcontract, but no less than $500,000 per claim.

11.2.4 *Form of insurance*: The form of the insurance shall be approved by the Director and the City Attorney; such approval (or lack thereof) shall never (a) excuse non-compliance with the terms of this Section, or (b) waive or estop the City from asserting its rights to terminate this Contract. The policy issuer shall (1) have a Certificate of Authority to transact insurance business in Texas, or (2) be an eligible non-admitted insurer in the State of Texas and have a Best's rating of at least B+, and a Best's Financial Size Category of Class VI or better, according to the most current Best's Key Rating Guide. Each insurer is subject to approval by City Engineer in City Engineer's sole discretion as to conformance with these requirements.

11.2.5 *Required Coverage*: The City shall be an Additional Insured under this Contract, and all policies except Professional Liability and Worker's Compensation must name the City as an Additional Insured. Contactor waives any claim or right of subrogation to recover against the City, its officers, agents, or employees, and each of Contractor's insurance policies except professional liability must contain coverage waiving such claim. Each policy, except Workers' Compensation and Professional Liability, must also contain an endorsement that the policy is primary to any other insurance available to the Additional Insured with respect to claims arising under this Contract. If professional liability coverage is written on a "claims made" basis, Contractor shall also provide proof of renewal each year for two years after substantial completion of the Project, or in the alternative: evidence of extended reporting period coverage for a period of two years after substantial completion, or a project liability policy for the Project covered by this Contract with a duration of two years after substantial completion.

11.2.6 *Deductibles:* Contractor assumes and bears any claims or losses to extent of deductible amounts and waives any claim it may ever have for same against the City, its officers, agents, or employees.

11.2.7 *Notice*: **CONTRACTOR SHALL GIVE 30 DAYS' ADVANCE WRITTEN NOTICE TO THE DIRECTOR IF ANY OF ITS INSURANCE POLICIES ARE CANCELED OR NON-RENEWED**. Within the 30-day period, Contractor shall provide other suitable policies in order to maintain the required coverage. If Contractor does not comply with this requirement, the Director, at his or her sole discretion, may immediately suspend Contractor from any further performance under this Agreement and begin procedures to terminate for default.

11.2.8 *Subrogation:* Contractor waives any claim or right of subrogation to recover against the City, its officers, agents, or employees. Each policy,

except professional liability, must contain an endorsement waiving such claim.

11.2.9 *Endorsement of Primary Insurance:* Each policy, except Workers' Compensation policies, must contain an endorsement that the policy is primary insurance to any other insurance available to additional insured with respect to claims arising hereunder.

11.2.10 *Liability for Premium:* Contractor is solely responsible for payment of all insurance premium requirements hereunder and the City is not obligated to pay any premiums.

11.2.11 *Additional Requirements for Workers' Compensation Insurance Coverage:* Contractor shall, in addition to meeting the obligations set forth in Table 1, maintain throughout the term of the Contract Workers' Compensation coverage as required by statute, and Contractor shall specifically comply with requirements set forth in Paragraph 11.2.10. The definitions set out below shall apply only for purposes of this Paragraph 11.2.10.

11.2.12 Definitions:

11.2.12.1 *Certificate of Coverage:* A copy of certificate of insurance, or coverage agreement (TWCC-81, TWCC-82, TWCC-83, or TWCC-84), showing statutory Workers' Compensation insurance coverage for Contractor's, Subcontractor's, or Supplier's employees providing services for the duration of the Contract.

11.2.12.2 *Duration of the Work:* Includes the time from Date of Commencement of the Work until Contractor's work under the Contract has been completed and accepted by City Council.

11.2.12.3 *Persons providing services for the Work (Subcontractor in Texas Labor Code § 406.096):* includes all persons or entities performing all or part of services Contractor has undertaken to perform on the Work, regardless of whether that person contracted directly with Contractor and regardless of whether that person has employees. This includes, without limitation, independent contractors, subcontractors, leasing companies, motor carriers, owner-operators, employees of the entity, or employees of entity which furnishes persons to provide services on the Work. Services include, without limitation, providing, hauling, or delivering equipment or materials, or providing labor, transportation, or other service related to the Work. Services do not include activities unrelated to the Work, such as food/beverage vendors, office supply deliveries, and delivery of portable toilets.

11.2.13 Contractor shall provide coverage, based on proper reporting of classification codes and payroll amounts and filing of coverage agreements, which meets the statutory requirements of TEX. LAB. CODE ANN., Section 401.011(44) for employees of Contractor providing services on the Work, for duration of the Work.

11.2.14 Contractor shall provide a Certificate of Coverage to the City prior to being awarded the Contract.

11.2.15 If coverage period shown on Contractor's original Certificate of Coverage ends during duration of the Work, Contractor shall file new Certificate of Coverage with the City showing that coverage has been extended.

11.2.16 Contractor shall obtain from each person providing services on the Work, and provide to City Engineer:

11.2.16.1 Certificate of Coverage, prior to that person beginning work on the Work, so the City will have on file Certificates of Coverage showing coverage for all persons providing services on the Work; and

11.2.16.2 no later than seven days after receipt by Contractor, new Certificate of Coverage showing extension of coverage, if coverage period shown on current Certificate of Coverage ends during the duration of the Work.

11.2.17 Contractor shall retain all required Certificates of Coverage for the duration of the Work and for one year thereafter.

11.2.18 Contractor shall notify City Engineer in writing by certified mail or personal delivery, within 10 days after Contractor knew or should have known, of any change that materially affects provision of coverage of any person providing services on the Work.

11.2.19 Contractor shall post on-site a notice, in text, form and manner prescribed by Texas Workers'

Compensation Commission, informing all persons providing services on the Work that they are required to be covered, and stating how person may verify coverage and report lack of coverage.

11.2.20 Contractor shall contractually require each person with whom it contracts to provide services on the Work to:

11.2.20.1 provide coverage, based on proper reporting of classification codes, payroll amounts and filing of any coverage agreements, which meets statutory requirements of TEX. LAB. CODE ANN., Section 401.011(44) for all its employees providing services on the Work, for the duration of the Work;

11.2.20.2 provide to Contractor, prior to that person's beginning work on the Work, a Certificate of Coverage showing that coverage is being provided for all employees of the person providing services on the Work, for the duration of the Work;

11.2.20.3 provide Contractor, prior to the end of the coverage period, a new Certificate of Coverage showing extension of coverage, if the coverage period shown on the current Certificate of Coverage ends during the duration of the Work;

11.2.20.4 obtain from each other person with whom it contracts, and provide to Contractor: (1) Certificate of Coverage, prior to other person's beginning work on the Work; and (2) new Certificate of Coverage showing extension of coverage, prior to end of coverage period, if coverage period shown on the current Certificate of Coverage ends during duration of the Work.

11.2.20.5 retain all required Certificates of Coverage on file for the duration of the Work and for one year thereafter;

11.2.20.6 notify City Engineer in writing by certified mail or personal delivery within 10 days after person knew, or should have known, of change that materially affects provision of coverage of any person providing services on the Work; and

11.2.20.7 contractually require each person with whom it contracts to perform as required by Paragraphs 11.2.10.1 through 11.2.10.7, with Certificates of Coverage to be provided to person for whom they are providing services.

11.2.21 By signing the Contract or providing or causing to be provided a Certificate of Coverage, Contractor is representing to the City that all employees of Contractor who will provide services on the Work will be covered by Workers' Compensation coverage for the duration of the Work, that coverage will be based on proper reporting of classification codes and payroll amounts, and that all coverage agreements will be filed with appropriate insurance carrier. Contractor is not allowed to self-insure Workers' Compensation. Contractor may be subject to administrative penalties, criminal penalties, civil penalties, or other civil actions for providing false or misleading information.

11.2.22 Contractor's failure to comply with Paragraph 11.2.10 is a breach of the Contract by Contractor, which entitles the City to declare the Contract void if Contractor does not remedy breach within 10 days after receipt of notice of breach from City Engineer.

11.2.23 *Subcontractor Insurance Requirements:* Contractor shall require Subcontractors and Suppliers to obtain Commercial General Liability, Workers' Compensation, Employer's Liability and Automobile Liability coverage that meets all the requirements of Paragraph 11.2. The amount must be commensurate with the amount of the subcontract, but not less than $500,000 per occurrence. Contractor shall require all Subcontractors with whom it contracts directly, whose subcontracts exceed $100,000, to provide proof of Commercial General Liability and Automobile Liability insurance coverage meeting the above requirements. Contractor shall comply with all requirements set out under Paragraph 11.2.10 as to Workers' Compensation Insurance for all Subcontractors and Suppliers.

TABLE 1

REQUIRED COVERAGE

(Coverage)	(Limit of Liability)
.1 Workers' Compensation	• Statutory Limits for Workers' Compensation
.2 Employer's Liability	• Bodily Injury by Accident $1,000,000 (each accident) • Bodily Injury by Disease $1,000,000 (policy limit) • Bodily Injury by Disease $1,000,000 (each employee)
.3 Commercial General Liability: Including Contractor's Protective, Broad Form Property Damage, Contractual Liability, Explosion, Underground and Collapse, Bodily Injury, Personal Injury, Products, and Completed Operations (for a period of one year following completion of the Work).	• Combined single limit of $1,000,000 (each occurrence), subject to general aggregate of $1,000,000; • Products and Completed Operations $1,000,000 aggregate.
.4 Owner's and Contractor's Protective Liability	• $1,000,000 combined single limit each Occurrence/ aggregate
.5 Installation Floater (Unless alternative coverage approved by City Attorney)	• Value of stored material or equipment, listed on Certificates of Payments, but not yet incorporated into the Work
.6 Automobile Liability Insurance: (For automobiles furnished by Contractor in course of his performance under the Contract, including Owned, Non-owned, and Hired Auto coverage)	• $1,000,000 combined single limit each occurrence for (1) Any Auto or (2) All Owned, Hired, and Non-Owned Autos
.7 Excess Coverage	• $1,000,000 each occurrence/combined aggregate in excess of limits specified for Employer's Liability, Commercial General Liability, and Automobile Liability
Aggregate Limits are per 12-month policy period unless otherwise indicated.	

11.3 *PROOF OF INSURANCE*

11.3.1 Prior to commencing services and at time during the term of the Contract, Contractor shall furnish City Engineer with Certificates of Insurance, along with Affidavit from Contractor confirming that Certificate accurately reflects insurance coverage that is available during term of the Contract. If requested in writing by City Engineer, Contractor shall furnish City Engineer with certified copies of Contractor's actual insurance policies. Failure of Contractor to provide certified copies, as requested, may be deemed, at City Engineer's or City Attorney's discretion, a material breach of the Contract.

11.3.2 Notwithstanding the proof of insurance requirements, Contractor shall continuously maintain in effect required insurance coverage set forth in Paragraph 11.2. Failure of Contractor to comply with this requirement does constitute a material breach by Contractor allowing the City, at its option, to immediately suspend or terminate work, or exercise any other remedy allowed under the Contract. Contractor agrees that the City has not waived or is not estopped to assert a material breach of the Contract because of any acts or omissions by the City regarding its review or non-review of insurance documents provided by Contractor, its agents, employees, or assigns.

11.3.3 Contractor shall provide updated certificates of insurance to the Director upon request. The Contractor shall be responsible for delivering a current certificate of insurance in the proper form to the Director as long as Contractor is required to furnish insurance coverage under Paragraph 11.2.

11.3.4 Every certificate of insurance Contractor delivers in connection with this Contract shall

11.3.4.1 be less than 12 months old;

11.3.4.2 include all pertinent identification information for the Insurer, including the company name and address, policy

number, NAIC number or AMB number, and authorized signature;

11.3.4.3 include in the Certificate Holder Box the Project name and reference numbers, contractor's email address, and indicates the name and address of the Project Manager;

11.3.4.4 include the Contractor's email address in the Certificate Holder Box;

11.3.4.5 include the Project reference numbers on the City address so the Project reference number is visible in the envelope window; and

11.3.4.6 be appropriately marked to accurately identify all coverages and limits of the policy, effective and expiration dates, and waivers of subrogation in favor of the City for Commercial General Liability, Automobile Liability, and Worker's Compensation/Employers' Liability.

11.4 *PERFORMANCE AND PAYMENT BONDS*

11.4.1 For Contracts over the value of $25,000, Contractor shall provide Bonds on the City's standard forms covering faithful performance of the Contract and payment of obligations arising thereunder as required in the Contract pursuant to Chapter 2253 of the Government Code. The Bonds must be for 100 percent of Original Contract Price and in accordance with conditions stated on standard City Performance and Payment Bond and Statutory Payment Bond forms. Bonds may be obtained from Contractor's usual source and cost for the Bonds are included in Contract Price.

11.5 *MAINTENANCE BONDS*

11.5.1 *One-year Maintenance Bond:* Contractor shall provide Bond on standard City One-year Maintenance Bond form, providing for Contractor's correction, replacement, or restoration of any portion of the Work which is found to be not in compliance with requirements of the Contract during one-year correction period required in Paragraph 12.2. The Maintenance Bond must be for 100 percent of the Original Contract Price.

11.6 *SURETY*

11.6.1 A Bond that is given or tendered to the City pursuant to the Contract must be executed by a surety company that is authorized and admitted to write surety Bonds in the State of Texas.

11.6.2 If a Bond is given or tendered to the City pursuant to the Contract in an amount greater than 10 percent of Surety's capital and surplus, Surety shall provide certification that Surety has reinsured that portion of the risk that exceeds 10 percent of Surety's capital and surplus. The reinsurance must be with one or more reinsurers who are duly authorized, accredited, or trusted to do business in the State of Texas. The amount reinsured by reinsurer may not exceed 10 percent of reinsurer's capital and surplus. The amount of allowed capital and surplus must be based on information received from State Board of Insurance.

11.6.3 If the amount of a Bond is greater than $100,000, Surety shall:

11.6.3.1 also hold certificate of authority from the United States Secretary of Treasury to qualify as surety on obligations permitted or required under federal law; or,

11.6.3.2 Surety may obtain reinsurance for any liability in excess of $100,000 from reinsurer that is authorized and admitted as a reinsurer in the State of Texas and is the holder of a certificate of authority from the United States Secretary of the Treasury to qualify as surety or reinsurer on obligations permitted or required under federal law.

11.6.4 Determination of whether Surety on the Bond or the reinsurer holds a certificate of authority from the United States Secretary of the Treasury is based on information published in Federal Register covering the date on which Bond was executed.

11.6.5 Each Bond given or tendered to the City pursuant to the Contract must be on City forms with no changes made by Contractor or Surety, and must be dated, executed, and accompanied by power of attorney stating that the attorney in fact executing such the bond has requisite authority to execute such Bond. The Bonds must be dated and must be no more than 30 days old.

11.6.6 Surety shall designate in its Bond, power of attorney, or written notice to the City, an agent resident in Harris County to whom any requisite notices may be delivered and on whom service of process may be had in matters arising out of the suretyship.

11.6.7 Contractor shall furnish information to a payment bond beneficiary as required by TEX. GOV'T CODE ANN. CH. 2253.

11.7 *DELIVERY OF BONDS*

11.7.1 Contractor shall deliver required Bonds to the City within time limits stated in Notice of Intent to Award and prior to Date of Commencement of the Work.

ARTICLE 12 - UNCOVERING AND CORRECTION OF THE WORK

12.1 *UNCOVERING OF THE WORK*

12.1.1 If a portion of the Work has been covered which City Engineer has not specifically requested to observe prior to its being covered, City Engineer may request to see such work and it must be uncovered by Contractor. If such work is in accordance with the Contract, the costs of uncovering and covering such work are charged to the City by Change Order. If such work is not in accordance with the Contract, Contractor shall pay for uncovering and shall correct the nonconforming Work promptly after receipt of Notice of Noncompliance to do so.

12.2 *CORRECTION OF THE WORK*

12.2.1 Contractor shall promptly correct or remove work rejected by City Engineer or work failing to conform to requirements of the Contract, whether observed before or after Date of Substantial Completion and whether fabricated, Installed, or completed.

12.2.2 Contractor bears costs of correcting the rejected or nonconforming work including additional testing and inspections, and compensation for Design Consultant's services and expenses made necessary thereby.

12.2.3 If within one year after Date of Substantial Completion, or after date for commencement of warranties established under Paragraph 9.9.5 or by other applicable special warranty required by the Contract, whichever is later in time, any of the Work is found not to be in accordance with the requirements of the Contract, Contractor shall correct such work promptly after receipt of Notice of Noncompliance to do so.

12.2.4 One-year correction period for portions of the Work completed after Date of Substantial Completion will begin on the date of acceptance of that portion of the Work. This obligation under this Paragraph survives acceptance of the Work under the Contract and termination of the Contract.

12.2.5 The one-year correction period does not establish a duration for the Contractor's general warranty under Paragraph 3.12. The City retains the right to recover damages from the Contractor as long as may be permitted by the applicable statute of limitations.

12.2.6 If Contractor does not proceed with correction of the nonconforming work within time fixed by Notice of Noncompliance, the City may correct nonconforming work or remove nonconforming work and store salvageable Products at Contractor's expense. Contractor shall pay the costs of correction of nonconforming work and removal and storage of salvageable Products to the City. If Contractor does not pay costs of the correction or removal and storage within 10 days after written notice, the City may sell the Products at auction or at private sale. The City will account for proceeds thereof after deducting costs and damages that would have been borne by Contractor, including compensation for services of Design Consultant and necessary expenses. If the proceeds of sale do not cover costs which Contractor should have borne, Contractor shall pay the value of the deficiency to the City.

12.2.7 Contractor bears cost of correcting work originally installed by Contractor, the City, or by separate contractors and damaged by Contractor's correction or removal of Contractor's work.

12.3 *ACCEPTANCE OF NONCONFORMING WORK*

12.3.1 If City Engineer prefers to accept work which is not in accordance with requirements of the Contract, City Engineer may do so only by issuance of Change Order, instead of requiring its removal and correction. City Engineer will determine Contract Price reduction. The reduction will become effective even if final payment has been made.

ARTICLE 13 - MISCELLANEOUS PROVISIONS

13.1 *GOVERNING LAWS*

13.1.1 The Contract is subject to the laws of the State of Texas, the City Charter and Ordinances, the laws of the federal government of the United States, and all rules and regulations of any regulatory body or officer having jurisdiction.

13.1.2 Venue for any litigation relating to the Contract is Harris County, Texas.

13.2 *SUCCESSORS*

13.2.1 The Contract binds and benefits the Parties and their legal successors and permitted assigns; however, this Paragraph 13.2.1 does not alter the restrictions on assignment and disposal of assets set out in Paragraph 13.3.1. The Contract does not create any personal liability on the part of any officer or agent of the City.

13.3 *BUSINESS STRUCTURE AND ASSIGNMENTS*

13.3.1 Contractor may not assign the Contract at law or otherwise, or dispose of all or substantially all of its assets without City Engineer's prior written consent. Nothing in this Section, however, prevents the assignment of accounts receivable or the creation of a security interest as described in §9.406 of the Texas Business & Commerce Code. In the case of such an assignment, Contractor shall immediately furnish the City with proof of the assignment and the name, telephone number, and address of the assignee and a clear identification of the fees to be paid to the assignee.

13.3.2 Any series, as defined by the TEX. BUS. ORG. CODE ANN., affiliate, subsidiary, or successor to which Contractor assigns or transfers assets shall join in privity and be jointly and severally liable under this Contract.

13.4 *WRITTEN NOTICE*

13.4.1 All notices required or permitted by the Contract must be in writing and must be effected by hand delivery; registered or certified mail, return receipt requested; or facsimile with confirmation copy mailed to receiving Party. Notice is sufficient if made or addressed with proper postage to the address stated in the Agreement for each Party ("Notice Address") or faxed to the facsimile number stated in the Agreement for each Party. The notice is deemed delivered on the earlier of:

13.4.1.1 the date the Notice is actually received;

13.4.1.2 the third day following deposit in a United States Postal Service post office or receptacle; or

13.4.1.3 the date the facsimile is sent unless the facsimile is sent after 5:00 p.m. local time of the recipient and then it is deemed received on the following day.

Any Party may change its Notice Address or facsimile number at any time by giving written notice of the change to the other Party in the manner provided for in this Paragraph at least 15 days prior to the date the change is affected.

13.5 *RIGHTS AND REMEDIES*

13.5.1 Duties and obligations imposed by the Contract and rights and remedies available thereunder are in addition to and not a limitation of duties, obligations, rights, and remedies otherwise imposed or available by law.

13.5.2 No act or failure to act by the City or Contractor is a waiver of rights or duties afforded them under the Contract, nor is the act or failure to act constitute approval of or acquiescence in a breach of the Contract. No waiver, approval or acquiescence is binding unless in writing and, in the case of the City, signed by City Engineer.

13.6 *TESTS AND INSPECTIONS*

13.6.1 Contractor shall give City Engineer, Construction Manager, and Design Consultant timely notice of the time and place where tests and inspections are to be made. Contractor shall cooperate with inspection and testing personnel to facilitate required inspections or tests.

13.6.2 The City will employ and pay for services of an independent testing laboratory to perform inspections or acceptance tests required by the Contract except:

13.6.2.1 inspections or tests covered by Paragraph 13.6.3;

13.6.2.2 those otherwise specifically provided in the Contract; or

13.6.2.3 costs incurred in connection with tests or inspections conducted pursuant to Paragraph 12.2.2.

13.6.3 Contractor is responsible for and shall pay all costs in connection with inspection or testing required in connection with City Engineer's acceptance of a Product to be incorporated into the Work, or of materials, mix designs, or equipment submitted for approval prior to Contractor's purchase thereof for incorporation into the Work.

13.6.4 Neither observations by the City, Construction Manager, or Design Consultant, nor inspections, tests, or approvals by others, relieves Contractor from Contractor's obligations to perform the Work in accordance with the Contract.

13.7 *INTEREST*

13.7.1 No interest will accrue on late payments by the City except as provided under Chapter 2251 of the Government Code.

13.8 *PARTIES IN INTEREST*

13.8.1 The Contract does not bestow any rights upon any third party, but binds and benefits the Parties only.

13.9 *ENTIRE CONTRACT*

13.9.1 The Contract merges the prior negotiations and understandings of the Parties and embodies the entire agreement of the Parties. No other agreements, assurances, conditions, covenants, express or implied, or other terms of any kind, exist between the Parties regarding the Contract.

13.10 *WRITTEN AMENDMENT*

13.10.1 Changes to the Contract that cannot be effected by Modifications, must be made by written amendment, which will not be effective until approved by City Council.

13.11 *COMPLIANCE WITH LAWS*

13.11.1 Contractor shall comply with the Americans with Disabilities Act of 1990 as amended (ADA) and Texas Architectural Barriers Act and all regulations relating to either statute.

13.11.2 Contractor shall comply with all applicable federal, state, and city laws, rules and regulations.

13.12 *SEVERABILITY*

13.12.1 If any part of the Contract is for any reason found to be unenforceable, all other parts remain enforceable to the extent permitted by law.

ARTICLE 14 - TERMINATION OR SUSPENSION OF THE CONTRACT

14.1 *TERMINATION BY THE CITY FOR CAUSE*

14.1.1 Each of the following acts or omissions of Contractor or occurrences shall constitute an "Event of Default" under the Contract:

14.1.1.1 Contractor refuses or fails to supply enough properly skilled workers or proper Products;

14.1.1.2 Contractor disregards laws, ordinances, rules, regulations, or orders of a public authority having jurisdiction;

14.1.1.3 Contractor is guilty of material breach of any duty or obligation of Contractor under the Contract, including, but not limited to, failure to submit certified payrolls electronically;

14.1.1.4 Contractor has had any other contract with the City terminated for cause at any time subsequent to the effective date of the Contract as set out in the Agreement; or

14.1.1.5 Contractor fails to utilize Ultra Low Sulfur Diesel Fuel, as required in Paragraph 3.9.1.1.

14.1.2 If an Event of Default occurs, City Engineer may, at his option and without prejudice to any other rights or remedies which the City may have, deliver a written notice to Contractor and Surety describing the Event of Default and giving the Contractor 10 days to cure the Event of Default. If after the cure period, Contractor has failed or refused to cure the Event of Default, then City Engineer may deliver a second written notice to Contractor giving notice of the termination of the Contract or of the termination of Contractor's performance under the Contract ("Notice of Termination"). If City Engineer issues a Notice of Termination, then City Engineer may, subject to any prior rights of Surety and any other rights of the City under the Contract or at law:

14.1.2.1 request that Surety complete the Work; or

14.1.2.2 take possession of the site and all materials, equipment, tools, and construction equipment and machinery on the site owned by Contractor; and

14.1.2.3 finish the Work by whatever reasonable method City Engineer may deem expedient.

14.1.3 After Contractor's receipt of a Notice of Termination, and except as otherwise directed in writing by City Engineer, Contractor shall:

14.1.3.1 stop the Work on the date and to the extent specified in the Notice of Termination;

14.1.3.2 place no further orders or subcontracts for Products or services;

14.1.3.3 terminate all orders and subcontracts to the extent that they relate to performance of work terminated;

14.1.3.4 assign to the City, in the manner, at the times, and to the extent directed by City Engineer, all rights, title, and interest of Contractor, under the terminated supply orders and subcontracts. The City may settle or pay claims arising out of termination of the orders and subcontracts;

14.1.3.5 settle all outstanding liabilities and all claims arising out of the termination of

supply orders and subcontracts with approval of City Engineer;

14.1.3.6 take action as may be necessary, or as City Engineer may direct, for protection and preservation of property related to the Work that is in possession of Contractor, and in which the City has or may acquire an interest; and

14.1.3.7 secure the Work in a safe state before leaving the site, providing any necessary safety measures, shoring, or other devices.

14.1.4 If the City terminates the Contract or terminates Contractor's performance under the Contract for any one or more of the reasons stated in Paragraph 14.1.1, Contractor may not receive any further payment until the Work is complete, subject to Paragraph 14.1.5.

14.1.5 If the unpaid balance of Contract Price exceeds the costs of finishing the Work, including liquidated damages and other amounts due under the Contract, the balance will be paid to Contractor. If the costs of finishing the Work exceed the unpaid balance, Contractor shall, within 10 days of receipt of written notice setting out the amount of the excess costs, pay the difference to the City. The amount to be paid to Contractor or the City will be certified by City Engineer in writing, and this obligation for payment shall survive termination of the Contract or termination of Contractor's performance under the Contract. Termination of the Contractor for cause shall not relieve the Surety from its obligation to complete the project.

14.2 *TERMINATION BY THE CITY FOR CONVENIENCE*

14.2.1 City Engineer may, without cause and without prejudice to other rights or remedies of the City, give Contractor and Surety a Notice of Termination with a seven days written notice.

14.2.2 After receipt of the Notice of Termination, and except as otherwise approved by City Engineer, Contractor shall conform to requirements of Paragraph 14.1.3.

14.2.3 After receipt of the Notice of Termination, Contractor shall submit to the City its termination Claim, in forms required by City Engineer. The Claim will be submitted to the City promptly, but no later than six months from the effective date of termination, unless one or more extensions are granted by City Engineer in writing. If Contractor fails to submit its termination Claim within the time allowed, in accordance with Paragraph 14.2.4, City Engineer will determine, on the basis of available information, the amount, if any, due to Contractor because of termination, and City Engineer's determination is final and binding on the Parties. The City will then pay to Contractor the amount so determined.

14.2.4 City Engineer will determine, on the basis of information available to City Engineer, the amount due, if any, to Contractor for the termination as follows:

14.2.4.1 Contract Price for all work performed in accordance with the Contract up to the date of termination determined in the manner prescribed for monthly payments in Article 9, except no retainage is withheld by the City either for payment determined by percentage of completion or for materials and equipment delivered to the site, in storage or in transit.

14.2.4.2 Reasonable termination expenses, including costs for settling and paying Subcontractor and Supplier claims arising out of termination of the Work, reasonable cost of preservation and protection of the City's property after termination, if required, and the cost of Claim preparation. Termination expenses do not include field or central office overhead, salaries of employees of Contractor, or litigation costs, including attorneys' fees.

No amount is allowed for anticipated profit or central office overhead on uncompleted work, or any cost or lost profit for other business of Contractor alleged to be damaged by the termination.

14.2.5 Contractor shall promptly remove from the site any construction equipment, tools, and temporary facilities, except the temporary facilities which City Engineer may wish to purchase and retain.

14.2.6 Contractor shall cooperate with City Engineer during the transition period.

14.2.7 The City will take possession of the Work and materials delivered to the site, in storage, or in transit, as of date or dates specified in the Notice of Termination, and is responsible for maintenance, utilities, security, and insurance, as stated in Notice of Termination.

14.3 *SUSPENSION BY THE CITY FOR CONVENIENCE*

14.3.1 City Engineer may, without cause, after giving Contractor and Surety 24-hour prior written notice, order Contractor to suspend, delay, or interrupt the Work in whole or in part for a period of time as City Engineer may determine.

14.3.2 An adjustment will be made in Contract Time equivalent to the time of suspension.

14.3.3 Adjustment will be made to Contract Price for increases in the cost of performance of the Work, including profit on increased cost of performance caused by suspension, delay, or interruption of the Work in accordance with Paragraph 7.3. No adjustment will be made to the extent that:

14.3.3.1 performance was, or would have been, suspended, delayed, or interrupted by another cause for which Contractor is responsible; or

14.3.3.2 adjustment is made or denied under another provision of the Contract.

14.4 *TERMINATION BY CONTRACTOR*

14.4.1 Contractor may terminate the Contract if the Work is stopped for a period of 30 days through no act or fault of Contractor, directly related to one of these events:

14.4.1.1 issuance of an order of a court or other public authority having jurisdiction;

14.4.1.2 act of government, such as a declaration of national emergency which makes material unavailable; or

14.4.1.3 if repeated suspensions, delays, or interruptions by the City as described in Paragraph 14.3 constitute, in the aggregate, more than 100 percent of the total number of days scheduled for completion, or 120 days in any 365-day period, whichever is less;

No termination will be effective for the above reasons if Contractor delivers written notice to City Engineer describing the reason for termination, giving the proposed termination date, and granting the City a reasonable opportunity to respond and cure any City default before termination is effective.

14.4.2 If the Contract is terminated pursuant to this Paragraph 14.4, Contractor shall comply with the requirements of Paragraphs 14.2.2 through 14.2.7.

END OF DOCUMENT

Document 00800

SUPPLEMENTARY CONDITIONS

The following Paragraphs amend and supplement the August 15, 2015 edition of General Conditions. Unaltered portions of General Conditions remain in effect.

ARTICLE 1 - GENERAL PROVISIONS:

1.1 *DEFINITIONS*: *Insert the following Paragraph 1.1.22.1, and reorder the remaining definitions accordingly.*

1.1.22.1 *Good Faith Efforts.* Steps taken to achieve an MBE, WBE, SBE, or PDBE goal or other requirements which, by their scope, intensity, and usefulness, demonstrate the bidder's responsiveness to fulfill the business opportunity objective, as well as the Contractor's responsibility to put forth measures to meet or exceed the MBE, WBE, SBE, or PDBE goal (Contract Goal). These steps apply from before a contract's award, through its duration, and after its conclusion, in the event the Contractor has been unsuccessful in meeting the Contract Goal. These efforts are required whether a Goal Oriented Contract or a Regulated Contract, as defined in the Office of Business Opportunity's Policy & Procedures Manual, available at http://www.houstontx.gov/obo.

ARTICLE 3 - THE CONTRACTOR

3.5 *LABOR*: *Insert the following Paragraphs, 3.5.3.1.1, 3.5.3.1.2 and3.5.3.1.3.*

3.5.3.1.1 If the Original Contract Price is greater than One Million Dollars, Contractor shall make Good Faith Efforts to comply with the City ordinances regarding Minority Business Enterprises (MBE), Women Business Enterprises (WBE), Persons with Disabilities Business Enterprises (PDBE) and Small Business Enterprise (SBE) participation goals which are as follows:

.1 the MBE goal is 13% percent,

.2 the WBE goal is 7% percent, and

.3 the PDBE goal is 0% percent.

.4 The bidder may substitute SBE participation of no more than four percent of the MBE goal, the WBE goal, or portions of the MBE Goal and WBE Goal.

3.5.3.1.2 The MBE, WBE, PDBE, and SBE goals are specific to this Agreement. The Contractor shall make reasonable efforts to achieve these goals.

3.5.3.1.3 Failure by Contractor to comply with the goals for MBE, WBE, SBE, or PDBE is a material breach of the Agreement, which may result in termination of the Agreement, or such other remedy permitted as the City deems appropriate.

ARTICLE 8 - TIME

8.1 *PROGRESS AND COMPLETION: Add the following Paragraph 8.1.6.1.*

8.1.6.1 Contractor shall credit the City by Change Order for inspection services for overtime work or work performed on Sundays or Legal Holidays. The amount Contractor credits the City will be [$50.00 per hour] per inspector for inspection services.

ARTICLE 9 - PAYMENTS AND COMPLETION

9.12 *LIQUIDATED DAMAGES: Insert the following Paragraph 9.12.1.1.*

9.12.1.1 The amount of liquidated damages payable by Contractor or Surety for each and every day of delay beyond Contract Time, are $2,000.00 per day.

ARTICLE 11 - INSURANCE AND BONDS

11.2 INSURANCE TO BE PROVIDED BY CONTRACTOR: Insert the following Paragraph 11.2.1.2.

11.2.1.2 Contractor shall purchase for the duration of the Contract the insurance set out in Table 2 in addition to the minimum insurance coverage set out in section 11.2.1.

TABLE 2
ADDITIONAL REQUIRED COVERAGE
DEFENSE COSTS EXCLUDED FROM FACE AMOUNT OF POLICY.

(Coverage)	(Limit of Liability)
Property and Casualty Coverage: "All Causes of Loss" Builder's Risk Form for directing physical change to building or plant construction on the Work site and/or all land improvements including all work. (Including but not limited to earthquake, flood, boiler, and machinery including testing, damage to existing or adjoining property, time element coverage, collapse, soft costs	100% of Contract Price, including change orders

(management, architecture, financial costs, pre-opening costs, etc.), transit coverage, off-site storage).

END OF DOCUMENT

Document 00805

EQUAL EMPLOYMENT OPPORTUNITY PROGRAM REQUIREMENTS
(City of Houston Information Requirements
for the Successful Bidder on All Construction Contracts)

DOCUMENTS THAT MUST BE SIGNED AND RETURNED TO THE CITY OF HOUSTON PRIOR TO FINAL EXECUTION OF CONTRACT

Certification by Bidder Regarding Equal Employment Opportunity EEO-3

Total Work Force Composition of the Company,..... EEO-6
or in lieu thereof, a copy of the latest Equal Employment Opportunity Commission's EEO-1 form (This information is required only if the Contractor has a work force of 50 or more people and the Contract is $50,000 or more.)

Company's Equal Employment Opportunity Compliance Program EEO-7

INFORMATION THAT MUST BE SUPPLIED DURING THE COURSE OF THE WORK

Certification By Proposed Subcontractor Regarding
Equal Employment Opportunity EEO-26

Certification by Proposed Material Suppliers, Lessors,and
Professional Service Providers Regarding Equal Employment Opportunity..... EEO-29

PLEASE COMPLETE PAGES EEO-3 THROUGH EEO-7 AND MAIL TO:

City of Houston
Mayor's Office of Business Opportunity
Contract Compliance Section
611 Walker, 7th Floor
Houston, Texas 77002
Attention: Director

The remainder of the reports can be mailed at the appropriate time.

EQUAL EMPLOYMENT OPPORTUNITY PROGRAM REQUIREMENTS

The following are Equal Employment Opportunity requirements to be met and documents to be submitted to:

Mayor's Office of Business Opportunity
Contract Compliance Section
611 Walker, 7th Floor
Houston, Texas 77002

Under the conditions and terms of all City construction contracts, the prime contractor is responsible for all Equal Employment Opportunity compliance, including subcontractor compliance.

EQUAL EMPLOYMENT OPPORTUNITY FORMS (EEO Forms)

These forms are submitted by the prime contractors at the beginning of the Project and as requested:

- EEO Forms 3, 6, and 7, by prime contractors

This form is submitted by all subcontractors before they begin work on the project:

- EEO Form 26 by subcontractors

This form is submitted by all suppliers, lessors, or professional services providers before they begin work on the project:

- EEO Form 29

POSTING

The following poster should be clearly displayed on each job site, or in case of annual service agreements, in the Contractor's office:

Equal Employment Opportunity is the Law Poster

JOB SITE VISITS

Site visits will be made by a Contract Compliance Officer, who will make their presence known to the Project Manager, Supervisor, or Foreman, and will conduct interviews with employees on site.

PAYMENT AND EVALUATION

Upon completion of the Project, as part of the contract-awarding department's total clearance process, the Office of Business Opportunity's Contract Compliance Section must certify to the department that all EEO compliance requirements have been met.

CERTIFICATION BY BIDDER REGARDING
EQUAL EMPLOYMENT OPPORTUNITY

GENERAL

In accordance with Executive Order 11246 (30 F.R. 12319-25), the implementing rules and regulations thereof, and orders of the Secretary of Labor, a certification regarding Equal Opportunity is required of bidders or prospective contractors and their proposed subcontractors prior to the award of contracts or subcontracts.

CERTIFICATION OF BIDDER

Bidder's Name:_____

Address:_____

Telephone Number:_____ Fax :_____

Name of the Company's EEO Officer: _____

E-mail Address:_____

Web Page/URL Address:_____

IRS Employer Identification Number:_____

Work to be performed:_____

Project No: _____

1. Participation in a previous contract or subcontract.

   a. Bidder has participated in a previous contract or subcontract subject to the Equal Opportunity Clause. ☐ YES ☐NO

   b. Compliance reports were required to be filed in connection with such contract or subcontract. ☐YES ☐NO

   c. Bidder has filed all compliance reports required by Executive Orders 10925, 11114, 11246, or by regulations of the Equal Employment Opportunity Commission issued pursuant to Title VII of the Civil Rights Act of 1964. ☐ YES ☐NO

   d. If answer of Item c. is "No", please explain in detail on reverse side of this certification.

2. Dollar amount of bid:$ _____

3. Anticipated performance period in days: _____

4. Expected total number of employees to perform the proposed construction: _____

5. Nonsegregated facilities.

   a. Notice to prospective federally-assisted construction contractors

      (1) A Certification of Nonsegregated Facilities, as required by the May 9, 1967, Order (32 F.R. 7439, May 19, 1967) on Elimination of Segregated Facilities, by the Secretary of Labor, must be submitted to the recipient prior to the award of a federally-assisted construction contract exceeding $10,000 which is not exempt from the provisions of the Equal Opportunity Clause.

      (2) Contractors receiving federally-assisted construction contract awards exceeding $10,000 which are not exempt from the provisions of the Equal Opportunity Clause will be required to provide the forwarding of the following notice to prospective subcontractors for supplies and construction contracts where the subcontracts exceed $10,000 and are not exempt from the provisions of the Equal Opportunity Clause.

      The federally-assisted construction Contractor certifies that he/she does not maintain or provide any segregated facilities at any of his/her establishments, and does not permit employees to perform their services at any location, under his/her control, where segregated facilities are maintained. The federally-assisted construction Contractor certifies further that he/she will not maintain or provide segregated facilities at any of his/her establishments, and will not permit employees to perform their services at any location, under his/her control, where segregated facilities are maintained. The federally-assisted construction Contractor agrees that a breach of this certification is a violation of the Equal Opportunity Clause in this Contract. As used in this certification, the term "segregated facilities" means any waiting rooms, work areas, restrooms and washrooms, restaurants and other eating areas, time clocks, locker rooms and other storage or dressing areas, parking lots, drinking fountains, recreation or entertainment areas, transportation, and housing facilities provided for employees which are segregated by explicit directive or are in fact segregated on the basis of race, creed, color, or national origin because of habit, local custom, or otherwise. The federally-assisted construction Contractor agrees that (except where he/she has obtained identical certifications from proposed Subcontractors for specific time periods) he/she will obtain identical certifications in duplicate from proposed Subcontractors prior to the award of subcontracts exceeding $10,000 which are not exempt from the provisions of the Equal Opportunity Clause, and that he/she will retain the duplicate of such certifications in his/her files. The Subcontractor will include the original in his/her bid package.

6. Race or ethnic group designation of bidder. Enter race or ethnic group in appropriate box:

☐ White ☐ Black ☐ Hispanic

☐ Pacific Islander, Asian ☐ American Indian, Aleut.

7. Gender of Owner ☐ Male ☐ Female

REMARKS: _____

Certification - The information above is true and complete to the best of my knowledge and belief.

_____
Company Officer (Please Type)

_____ _____
Signature Date

NOTE: The penalty for making false statements in offers is prescribed in 18 U.S.C. 1001.

Total Work Force Composition of the Company

City of Houston, Affirmative Action Requirements for All Construction Contracts

	White		Black		Hispanic		Pacific Islander/ Asian		Alaska Native/ Amer Ind.		Total Persons		Total Minority		Total Female	
	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F
Officials and Administrators																
Professionals																
Paraprofessionals																
Technicians																
Protective Service Workers																
Sales Workers																
Office and Clerical																
Skilled Craft Workers																
Operatives (Semi-skilled)																
Laborers (Unskilled)																
Service / Maintenance Workers																
Others																
Total																

This report includes all of the company's permanent work force. For description of job categories, see Pages CC-27 through CC-29.

Check One: [ ] **Contractor** [ ] **Subcontractor**

COMPANY: _____ **DATE:** _____

EQUAL EMPLOYMENT OPPORTUNITY COMPLIANCE PROGRAM FOR

_____

Name of Company

The Company's Office of Business Opportunity Program shall consist of documented good faith efforts to comply with the goals, timetables, and objectives set forth in the following Affirmative Action steps:

A. City of Houston's Specific Equal Employment Opportunity Policy and Clause as contained in City Council Ordinance No. 78-1538, passed August 9, 1978.

B. Notice of Requirement for Office of Business Opportunity to ensure Equal Employment Opportunity (Executive Order 11246).

C. Standard Federal Equal Employment Opportunity Construction Contract Specifications (Executive Order 11246).

Project: _____

_____
Company Officer (Please Type)

_____ _____
Signature Date

NOTE: The penalty for making false statements in offers is prescribed in 18 U.S.C. 1001.

SPECIAL PROVISIONS
SPECIFIC EQUAL EMPLOYMENT OPPORTUNITY POLICY

1. GENERAL

   a. Equal employment opportunity requirements not to discriminate and to take affirmative action to assure equal employment opportunity are required by Executive Order 11246, as amended. The requirements set forth in these Special Provisions shall constitute the specific affirmative action requirements for Project activities under this Contract and shall supplement the notice of requirement for affirmative action to ensure equal employment opportunity and standard federal equal employment opportunity construction contract specifications.

   b. The Contractor shall work with the City and the Federal Government in carrying out equal employment opportunity obligations and in their review of his/her activities under the Contract.

   c. The prime Contractor and all Subcontractors holding subcontracts of $10,000 or more shall comply with the following minimum specific requirement activities of equal employment opportunity. The Contractor shall include these requirements in every subcontract of $10,000 or more with such modification of language as is necessary to make them binding on the Subcontractor.

2. EQUAL EMPLOYMENT OPPORTUNITY POLICY

   The Contractor shall accept as his/her operating policy the following statement which is designed to further the provision of equal employment opportunity to all persons without regard to their race, age, color, religion, sex, or national origin, and to promote the full realization of equal employment opportunity through a positive continuing program:

   It is the policy of this Company to assure that applicants are employed, and that employees are treated during employment, without regard to their race, religion, color, sex, or national origin. Such action shall include: employment, upgrading, demotion, or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship.

3. EQUAL EMPLOYMENT OPPORTUNITY OFFICER

   The Contractor shall designate and make known to the City contracting officers an equal employment opportunity officer (hereinafter referred to as the EEO Officer) who must be capable of effectively administering and promoting an active Contractor program of equal employment opportunity and who must be assigned adequate authority and responsibilities to do so.

4. DISSEMINATION OF POLICY

a. All members of the Contractor's staff who are authorized to hire, supervise, promote, and discharge employees, or who recommend such action, or who are substantially involved in such action, will be made fully cognizant of, and will implement the Contractor's equal employment opportunity policy and contractual responsibilities to provide equal employment opportunity in each grade and classification of employment. To ensure that the above agreement will be met, the following actions shall be taken as a minimum:

(1) Periodic meetings of supervisory and personnel office employees shall be conducted before the start of work and then not less often than once every six months, at which time the Contractor's equal employment opportunity policy and its implementation will be reviewed and explained. The meetings shall be conducted by the EEO Officer or other knowledgeable company official.

(2) All new supervisory or personnel office employees will be given a thorough indoctrination by the EEO Officer, or other knowledgeable company official, covering all major aspects of the Contractor's equal employment opportunity obligations, within 30 days following their reporting for duty with the Contractor.

(3) The EEO Officer or appropriate company official shall instruct all employees engaged in the direct recruitment of employees for the Project relative to the methods followed by the Contractor in locating and hiring minorities and females.

b. In order to make the Contractor's equal employment opportunity policy known to all employees, prospective employees, and potential sources of employees, i.e., schools, employment agencies, labor unions (where appropriate), college placement officers, etc., the Contractor shall take the following actions:

(1) Notices and posters setting forth the Contractor's equal employment opportunity policy shall be placed in areas readily accessible to employees, applicants for employment, and potential employees.

(2) The Contractor's equal employment opportunity policy and the procedures to implement such policy shall be brought to the attention of employees by means of meetings, employee handbooks, or other appropriate means.

5. RECRUITMENT

a. When advertising for employees, the Contractor shall include in all advertisements for employees the notation "An Equal Opportunity Employer". All such advertisements will be published in newspapers, or

other publications, having a large circulation among minority groups in the area from which the Project work force would normally be derived.

b. The Contractor shall, unless precluded by a valid bargaining agreement, conduct systematic and direct recruitment through public and private employee-referral sources likely to yield qualified minority-group applicants, including, but not limited to, State employment agencies, schools, colleges, minority-group organizations, and female recruitment agencies. To meet this requirement, the Contractor shall, through his/her EEO Officer, identify sources of potential minority and female employees, and establish with such identified sources procedures whereby such group applicants may be referred to the Contractor for employment consideration.

In the event the Contractor has a valid bargaining agreement providing for exclusive hiring hall referrals, he/she is expected to observe the provisions of that agreement to the extent that the system permits the Contractor's compliance with equal employment opportunity Contract provisions. (The U. S. Department of Labor has held that where implementation of such agreements has the effect of discriminating against minorities or women, or obligates the Contractor to do the same, such implementation violates Executive Order 11246 as amended).

c. The Contractor shall encourage his/her present employees to refer female or minority-group applicants for employment by posting appropriate notices or bulletins in areas accessible to all such employees. In addition, information and procedures with regard to referring such applicants will be discussed with employees.

6. PERSONNEL ACTIONS

a. Wage, working conditions, and employee benefits shall be established and administered, and personnel actions of every type, including hiring, upgrading, promotion, transfer, demotion, layoff and termination, shall be taken without regard to race, color, religion, sex, national origin, or age. The following procedures shall be followed:

(1) The Contractor shall conduct periodic inspections of Project sites to ensure that working conditions and employee facilities do not indicate discriminatory treatment of Project-site personnel.

(2) The Contractor shall periodically evaluate the spread of wages paid within each classification to determine any evidence of discriminatory wage practices.

(3) The Contractor shall periodically review selected personnel actions in depth to determine whether there is evidence of discrimination. Where evidence is found, the Contractor shall promptly take corrective action. If the review indicates that the discrimination may extend beyond the actions reviewed, such corrective action shall include all affected persons.

(4) The Contractor shall promptly investigate all complaints of alleged discrimination made in connection with his/her obligations under this Contract, shall attempt to resolve such complaints, and shall take appropriate corrective action. If the investigation indicates that the discrimination may affect persons other than the complainant, such corrective action shall include such other persons. Upon completion of each investigation, the Contractor shall inform every complainant of all avenues of appeal.

7. TRAINING AND PROMOTION

a. The Contractor shall assist in locating, qualifying, and increasing the skills of minority-group and women employees and applicants for employment.

b. Consistent with the Contractor's work force requirements and as permissible under Federal and State regulations, the Contractor shall make full use of training programs, i.e., apprenticeship and on-the-job training programs, for the geographical area of Contract performance.

c. The Contractor shall advise employees and applicants for employment of available training programs and entrance requirements for each.

d. The Contractor shall periodically review the training and promotion potential of minority-group and women employees and shall encourage eligible employees to apply for such training and promotion.

8. UNIONS

If the Contractor relies in whole or in part upon unions as a source of employees, he/she shall use his/her best efforts to obtain the cooperation of such unions to increase minority groups and women within the unions, and to effect referrals by such unions of minority and female employees. Actions by the Contractor, either directly or through a contractor's association acting as his/her agent, will include the procedures set forth below:

a. The Contractor shall use best efforts to develop, in cooperation with the unions, joint training programs aimed toward qualifying more minority-group members and women for membership in the unions and increasing the skills of minority-group employees and women so that they may qualify for higher-paying employment.

b. The Contractor shall use best efforts to incorporate an equal employment opportunity clause into all union agreements to the end that such unions will be contractually bound to refer applicants without regard to their race, color, religion, sex, national origin, or age.

c. The Contractor is to obtain information as to the referral practices and policies of the labor union, except that to the extent such information is within the exclusive possession of the labor union, and such labor union refuses to furnish such information to the Contractor, the Contractor shall so certify to the City and shall set forth what efforts have been made to obtain such information.

d. In the event the union is unable to provide the Contractor with a reasonable flow of minority and women referrals within the time limit set forth in the collective bargaining agreement, the Contractor shall, through independent recruitment efforts, fill the employment vacancies without regard to race, color, religion, age, sex, or national origin, making full efforts to obtain qualified and/or qualifiable minority group persons and women. (The U. S. Department of Labor has held that it shall be no excuse that the union with which the Contractor has a collective bargaining agreement providing for exclusive referral failed to refer minority employees.) In the event the union referral practice prevents the Contractor from meeting the obligations pursuant to Executive Order 11246, as amended, and these special provisions, such Contractor shall immediately notify the City.

9. SUBCONTRACTING

a. The Contractor shall use his/her best efforts to solicit bids from and to utilize minority-group and female subcontractors or subcontractors with meaningful minority-group and/or female representation among their employees.

b. The Contractor shall use his/her best efforts to assure Subcontractors' compliance with their equal employment opportunity obligations.

10. RECORDS AND REPORTS

a. The Contractor shall keep such records as are necessary to determine compliance with the Contractor's equal employment opportunity obligations. The records kept by the Contractor will be designed to indicate:

(1) The number of minority and non-minority group members and women employed in each work classification on the Project.

(2) The progress and efforts being made in cooperation with unions to increase employment opportunities for minorities and women (applicable only to contractors who rely in whole or in part on unions as a source of their work force).

(3) The progress and efforts being made in locating, hiring, training, qualifying, and upgrading minority and female employees.

(4) The progress and efforts being made in securing the services of female and minority subcontractors.

b. All records, including payrolls, must be retained for a period of three years following completion of the Contract work and shall be available at reasonable times and places for inspection by authorized representatives of the City and/or the appropriate federal agency.

CITY OF HOUSTON, TEXAS

EQUAL EMPLOYMENT OPPORTUNITY CLAUSE

Pursuant to City Council Ordinance No. 78-1538, passed August 9, 1978, all contracts entered into by the City of Houston involving the expenditure of $10,000 or more, shall incorporate the following Equal Employment Opportunity Clause:

1. The Contractor, Subcontractor, vendor, Supplier, or lessee shall not discriminate against any employee or applicant for employment because of race, religion, color, sex, national origin, or age. The Contractor, Subcontractor, vendor, Supplier, or lessee shall take affirmative action to ensure that applicants are employed and that employees are treated during employment without regard to their race, religion, color, sex, national origin, or age. Such action will include, but not be limited to, the following: employment; upgrading; demotion or transfer; recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The Contractor, Subcontractor, vendor, Supplier, or lessee agrees to post in conspicuous places available to employees, and applicants for employment, notices to be provided by the City setting forth the provisions of this Equal Employment Opportunity Clause.

2. The Contractor, Subcontractor, vendor, Supplier, or lessee states that all qualified applicants will receive consideration for employment without regard to race, religion, color, sex, national origin, or age.

3. The Contractor, Subcontractor, vendor, Supplier, or lessee shall send to each labor union or representatives of workers with which it has a collective bargaining agreement or other contract or understanding, a notice to be provided by the agency contracting officer advising the said labor union or workers' representative of the Contractor's and Subcontractor's commitments under Section 202 of Executive Order No. 11246, and shall post copies of the notice in conspicuous places available to employees and applicants for employment.

4. The Contractor, Subcontractor, vendor, Supplier, or lessee will comply with all provisions of Executive Order No. 11246 and the rules, regulations, and relevant orders of the Secretary of Labor or other Federal Agency responsible for enforcement of the equal opportunity and affirmative action provisions applicable, and shall likewise furnish all information and reports required by the Mayor and/or Contractor Compliance Officers for purposes of investigation to ascertain and effect compliance with this program.

5. The Contractor, Subcontractor, vendor, Supplier, or lessee shall furnish all information and reports required by Executive Order No. 11246, and by the rules, regulations, and orders of the Secretary of Labor, or pursuant thereto, and shall permit access to all books, records, and accounts by the appropriate City and Federal officials for purposes of investigation to ascertain compliance with such rules, regulations, and orders. Compliance reports filed at such times as directed shall contain information as to the employment practice policies, program, and work force statistics of the Contractor, Subcontractor, vendor, Supplier, or lessee.

6. In the event of a Contractor's, Subcontractor's, vendor's, Supplier's, or lessee's non-compliance with the non-discrimination clause of this Contract or with any of such rules, regulations, or orders, this Contract may be canceled, terminated, or suspended in whole or in part, and the Contractor, Subcontractor, vendor, Supplier, or lessee may be declared ineligible for further City contracts in accordance with procedures provided in Executive Order No. 11246, and such other sanctions may be imposed and remedies invoked as provided in said Executive Order, or by rule, regulation, or order of the Secretary of Labor, or as may otherwise be provided by law.

7. The Contractor shall include the provisions of paragraphs 1 through 8 of this Equal Employment Opportunity Clause in every subcontract or purchase order unless exempted by rules, regulations, or orders of the Secretary of Labor issued pursuant to Section 204 of Executive Order No. 11246 of September 24, 1965 so that such provisions will be binding upon each Subcontractor or vendor. The Contractor shall take such action with respect to any subcontractor or purchase order as the contracting agency may direct as a means of enforcing such provisions, including sanctions for noncompliance; provided, however, that in the event the Contractor becomes involved in, or is threatened with litigation with a Subcontractor or vendor as a result of such direction by the contracting agency, the Contractor may request the United States to enter into such litigation to protect the interests of the United States.

8. The Contractor shall file and shall cause each of his Subcontractors, if any, to file compliance reports with the City in the form and to the extent as may be prescribed by the Mayor's Office of Business Opportunity. Compliance reports filed at such times as directed shall contain information as to the practices, policies, programs, employment policies, and employment statistics of the Contractor and each Subcontractor.

NOTICE OF REQUIREMENT FOR AFFIRMATIVE ACTION
TO ENSURE EQUAL EMPLOYMENT OPPORTUNITY
(EXECUTIVE ORDER 11246)

1. The Offeror's or Bidder's attention is called to the "Equal Opportunity Clause" and the "Standard Federal Equal Employment Opportunity Construction Contract Specifications" set forth herein.

2. The goals and timetables for minority and female participation, expressed in percentage terms for the Contractor's aggregate work force in each trade on all construction work in the covered area, are as follows:

Timetable	Goals for Minority Participation for Each Trade	Goals for Female Participation for Each Trade
	26.2% - 27.3%	6.9%

These goals are applicable to all the Contractor's construction work (whether or not it is Federal or Federally-assisted) performed in the covered area.

The Contractor's compliance with the Executive Order and the regulations in 41 CFR Part 60-4 shall be based on its implementation of the Equal Opportunity Clause, specific affirmative action obligations required by the specifications set forth in 41 CFR 60-4.3(a), and its efforts to meet the goals established for the geographical area where the Contract resulting from this solicitation is to be performed. The hours of minority and female employment and training must be substantially uniform throughout the length of the Contract, and in each trade, and the Contractor shall make a good faith effort to employ minorities and women evenly on each of its projects. The transfer of minority or female employees or trainees from Contractor to Contractor or from project to project for the sole purpose of meeting the Contractor's goals shall be a violation of the Contract, the Executive Order, and regulations in 41 CFR part 60-4. Compliance with the goals will be measured against the total work hours performed.

3. The Contractor shall provide written notification to the Director of the Office of Federal Contract Compliance Programs within 10 working days of award of any construction subcontract in excess of $10,000 at any tier for construction work under the Contract resulting from this solicitation. The notification shall list the name, address, and telephone number of the Subcontractor; employer identification number; estimated dollar amount of the subcontract; estimated starting and completion dates of the subcontract; and the geographical area in which the Contract is to be performed.

4. As used in this Notice, and in the Contract resulting from this solicitation, the "covered area" is The Houston, Texas Standard Metropolitan Statistical Area.

STANDARD FEDERAL EQUAL EMPLOYMENT OPPORTUNITY
CONSTRUCTION CONTRACT SPECIFICATIONS
(EXECUTIVE ORDER 11246)

1. As used in these specifications:

   a. "Covered area" means the geographical area described in the solicitation from which this Contract resulted;

   b. "Director" means Director, Office of Federal Contract Compliance Programs, United States Department of Labor, or any person to whom the Director delegates authority;

   c. "Employer identification number" means the Federal Social Security number used on the Employer's Quarterly Federal Tax Return, U. S. Treasury Department Form 941.

   d. "Minority" includes:

      (i) Black (all persons having origins in any of the Black African racial groups not of Hispanic origin);

      (ii) Hispanic (all persons of Mexican, Puerto Rican, Cuban, Central or South American, or other Spanish culture or origin regardless of race);

      (iii) Asian and Pacific Islander (all persons having origins in any of the original peoples of the Far East, Southeast Asia, the Indian Subcontinent, or the Pacific Islands); and

      (iv) American Indian or Alaskan Native (all persons having origins in any of the original peoples of North America and maintaining identifiable tribal affiliations through membership and participation or community identification).

2. Whenever the Contractor, or any Subcontractor at any tier, subcontracts a portion of the work involving any construction trade, it shall physically include in each subcontract in excess of $10,000 the provisions of these specifications and the Notice which contains the applicable goals for minority and female participation and which is set forth in the solicitations from which this Contract resulted.

3. If the Contractor is participating (pursuant to 41 CFR 60-4.5) in a Hometown Plan approved by the U. S. Department of Labor in the covered area either individually or through an association, its affirmative action obligations on all work in the Plan area (including goals and timetables) shall be in accordance with that Plan for

those trades which have unions participating in the Plan. Contractors must be able to demonstrate their participation in and compliance with the provisions of any such Hometown Plan. Each Contractor or Subcontractor participating in an approved Plan is individually required to comply with its obligations under the EEO clause, and to make a good faith effort to achieve each goal under the Plan in each trade in which it has employees. The overall good faith performance by other Contractors or Subcontractors toward a goal in an approved Plan does not excuse any covered Contractor's or Subcontractor's failure to take good efforts to achieve the Plan goals and timetables.

4. The Contractor shall implement the specific affirmative action standards provided in Paragraphs 7a through p of these specifications. The goals set forth in the solicitation from which this Contract resulted are expressed as percentages of the total hours of employment and training of minority and female utilization the Contractor should reasonably be able to achieve in each construction trade in which it has employees in the covered area. The Contractor is expected to make substantially uniform progress toward its goals in each craft during the period specified.

5. Neither the provisions of any collective bargaining agreement, nor the failure by a union with whom the Contractor has a collective bargaining agreement to refer either minorities or women, shall excuse the Contractor's obligations under these specifications, Executive Order 11246, or the regulations promulgated pursuant thereto.

6. In order for the non-working training hours of apprentices and trainees to be counted in meeting the goals, such apprentices and trainees must be employed by the Contractor during the training period, and the Contractor must have made a commitment to employ the apprentices and trainees at the completion of their training, subject to the availability of employment opportunities. Trainees must be trained pursuant to training programs approved by the U. S. Department of Labor.

7. The Contractor shall take specific affirmative actions to ensure equal employment opportunity. The evaluation of the Contractor's compliance with these specifications shall be based upon its effort to achieve maximum results from its actions. The Contractor shall document these efforts fully, and shall implement affirmative action steps at least as extensive as the following:

   a. Ensure and maintain a working environment free of harassment, intimidation, and coercion at all sites, and in all facilities at which Contractor's employees are assigned to work. The Contractor, where possible, shall assign two or more women to each construction project. The Contractor shall specifically ensure that all foremen, superintendents, and other on-site supervisory personnel are aware of and carry out the Contractor's obligation to maintain such a working environment, with specific attention to minority or female individuals working at such sites or in such facilities.

b. Establish and maintain a current list of minority and female recruitment sources; provide written notification to minority and female recruitment sources and to community organizations when the Contractor or its unions have employment opportunities available, and maintain a record of the organizations' responses.

c. Maintain a current file of the names, addresses, and telephone numbers of each minority and female off-the-street applicant and minority or female referral from a union, a recruitment source, or community organization and of what action was taken with respect to each such individual. If such individual was sent to the union hiring hall for referral and was not referred back to the Contractor by the union or, if referred, not employed by the Contractor, this shall be documented in the file with the reason therefor, along with whatever additional actions the Contractor may have taken.

d. Provide immediate written notification to the Director when the union or unions with which the Contractor has a collective bargaining agreement has not referred to the Contractor a minority person or woman sent by the Contractor, or when the Contractor has other information that the union referral process has impeded the Contractor's efforts to meet its obligations.

e. Develop on-the-job training opportunities and/or participate in training programs for the area which expressly include minorities and women, including upgrading programs and apprenticeship and trainee programs relevant to the Contractor's employment needs, especially those programs funded or approved by the Department of Labor. The Contractor shall provide notice of these programs to the sources compiled under 7b above.

f. Disseminate the Contractor's EEO policy by providing notice of the policy to unions and training programs and requesting their cooperation in assisting the Contractor in meeting its EEO obligations by including it in any policy manual and collective bargaining agreement; by publicizing it in the company newspaper, annual report, etc.; by specific review of the policy with all management personnel and with all minority and female employees at least once a year; and by posting the company EEO policy on bulletin boards accessible to all employees at each location where construction work is performed.

g. Review, at least annually, the company's EEO policy and affirmative action obligations under these specifications with all employees having any responsibility for hiring, assignment, layoff, termination, or other employment decisions, including specific review of these items with on-site supervisory personnel such as superintendents, general foremen, etc., prior to the initiation of construction work at any job site. A written record shall be made and maintained identifying the time and place of

these meetings, persons attending, subject matter discussed, and disposition of the subject matter.

h. Disseminate the Contractor's EEO policy externally by including it in any advertising in the news media, specifically including minority and female news media, and providing written notification to and discussing the Contractor's EEO policy with other contractors and subcontractors with whom the Contractor does or anticipates doing business.

i. Direct its recruitment efforts, both oral and written, to minority, female and community organizations, to schools with minority and female students, and to minority and female recruitment and training organizations serving the Contractor's recruitment area and employment needs. Not later than one month prior to the date for the acceptance of applications for apprenticeship or other training by any recruitment source, the Contractor shall send written notification to organizations such as the above, describing the openings, screening procedures, and tests to be used in the selection process.

j. Encourage present minority and female employees to recruit other minority persons and women and, where reasonable, provide after school, summer, and vacation employment to minority and female youth both on the site and in other areas of a Contractor's work force.

k. Validate all tests and other selection requirements where there is an obligation to do so under 41 CFR Part 60-3.

l. Conduct, at least annually, an inventory and evaluation at least of all minority and female personnel for promotional opportunities and encourage these employees to seek or to prepare, through appropriate training, etc., for such opportunities.

m. Ensure that seniority practices, job classifications, work assignments, and other personnel practices do not have a discriminatory effect by continually monitoring all personnel and employment-related activities to ensure that the EEO policy and the Contractor's obligations under these specifications are being carried out.

n. Ensure that all facilities and company activities are nonsegregated except that separate or single-user toilet and necessary changing facilities shall be provided to assure privacy between the sexes.

o. Document and maintain a record of all solicitations of offers for subcontracts from minority and female construction contractors and suppliers, including circulation of solicitations to minority and female contractor associations and other business associations.

p. Conduct a review, at least annually, of all supervisors' adherence to and performance under the Contractor's EEO policies and affirmative action obligations.

8. Contractors are encouraged to participate in voluntary associations which assist in fulfilling one or more of their affirmative action obligations (7a through p). The efforts of a contractor association, joint contractor union, contractor-community, or other similar group of which the Contractor is a member and participant, may be asserted as fulfilling any one or more of its obligations under 7a through p of these Specifications provided that the Contractor actively participates in the group, makes every effort to assure that the group has a positive impact on the employment of minorities and women in the industry, ensures that the concrete benefits of the program are reflected in the Contractor's minority and female work force participation, makes a good faith effort to meet its individual goals and timetables, and can provide access to documentation which demonstrates the effectiveness of actions taken on behalf of the Contractor. The obligation to comply, however, is the Contractor's and failure of such a group to fulfill an obligation shall not be a defense for the Contractor's noncompliance.

9. A single goal for minorities and a separate single goal for women have been established. The Contractor, however, is required to provide equal employment opportunity and to take affirmative action for all minority groups, both male and female, and all women, both minority and non-minority. Consequently, the Contractor may be in violation of the Executive Order if a particular group is employed in a substantially disparate manner (for example, even though the Contractor has achieved its goals for women generally, the Contractor may be in violation of the Executive Order if a specific minority group of women is under utilized).

10. The Contractor shall not use the goals and timetables or affirmative action standards to discriminate against any person because of race, color, religion, sex, or national origin.

11. The Contractor shall not enter into any subcontract with any person or firm debarred from Government contracts pursuant to Executive Order 11246.

12. The Contractor shall carry out such sanctions and penalties for violation of these specifications and of the Equal Opportunity Clause, including suspension, termination, and cancellation of existing subcontracts as may be imposed or ordered pursuant to Executive Order 11246, as amended, and its implementing regulations, by the Office of Federal Contract Compliance Programs. Any Contractor who fails to carry out such sanctions and penalties shall be in violation of these specifications and Executive Order 11246, as amended.

13. The Contractor, in fulfilling its obligations under these specifications, shall implement specific affirmative action steps, at least as extensive as those standards prescribed in Paragraph 7 of these specifications, so as to achieve maximum results from its efforts to ensure equal employment opportunity. If the

Contractor fails to comply with the requirements of the Executive Order, the implementing regulations, or these specifications, the Director shall proceed in accordance with 41 CFR 60-4.B.

14. The Contractor shall designate a responsible official to monitor all employment-related activity to ensure that the company EEO policy is being carried out, to submit reports relating to the provisions hereof as may be required by the Government, and to keep records. Records shall at least include for each employee the name, address, telephone number, construction trade, union affiliation, if any, employee identification number when assigned, social security number, race, sex, status (e.g., mechanic, apprentice, trainee, helper, or laborer), dates of changes in status, hours worked per week in the indicated trade, rate of pay, and locations at which the work was performed. Records shall be maintained in an easily-understandable and retrievable form; however to the degree that existing records satisfy this requirement, contractors shall not be required to maintain separate records.

15. Nothing herein provided shall be construed as a limitation upon the application of other laws which establish different standards of compliance or upon the application of requirements for the hiring of local or other area residents (e.g., those under the Public Works Employment Act of 1977 and the Community Development Block Grant Program).

DESCRIPTION OF JOB CATEGORIES

Officials, Managers, and Administrators

Occupations requiring administrative personnel who set board policies, exercise overall responsibility for the execution of these policies, or provide specialized consultation on a regional, district, area basis, or direct individual departments or special phases of a firm's operations.

Includes: Officials, executives, middle management, plant managers, department managers, superintendents, salaried foremen who are members of management, purchasing agents, buyers, bureau chiefs, directors, deputy directors, wardens, examiners, sheriffs, police and fire chiefs, and kindred workers.

Professionals

Occupations which require specialized and theoretical knowledge which is usually acquired through college or experience of such kind and amount as to provide a comparable background.

Includes: Accountants, auditors, airplane pilots and navigators, architects, artists, chemists, designers, dieticians, editors, engineers, lawyers, librarians, mathematicians, natural scientists, registered professional nurses, personnel and labor relations workers, physical scientists, teachers, social workers, doctors, psychologists, economists, systems analysts, employment and vocational rehabilitation counselors, instructors, police and fire captains and lieutenants, and kindred workers.

Paraprofessionals

Occupations in which workers perform some of the duties of a professional or technician in a supportive role, which usually requires less formal training and/or experience normally required for professional or technical status. Such positions may fall within an identified pattern of a "New Careers" concept.

Includes: Library assistants, medical aides, child support workers, police auxiliary, welfare service aides, recreation assistants, homemakers aides, home health aides, and kindred workers.

Technicians

Occupations requiring a combination of basic scientific knowledge and manual skill which can be obtained through about two (2) years of post high school education, such as is offered in many technical institutes and junior colleges, or through equivalent on-the-job training.

Includes: Computer programmers and operators, draftsmen, engineering aides, junior engineers, mathematical aides, licensed practical or vocational nurses, photographers, radio operators, scientific assistants, surveyors, technical illustrators, technicians (medical, dental, electronics, physical sciences), police and fire sergeants, and kindred workers.

Protective Service Workers

Occupations in which workers are entrusted with public safety, security, and protection from destructive forces.

Includes: Police patrol officers, fire fighters, guards, deputy sheriffs, bailiffs, correctional officers, detectives, marshals, harbor patrol officers, and kindred workers.

Sales Workers

Occupations engaging wholly or primarily in direct selling.

Includes: Advertising agents and salespersons, insurance agents and brokers, real estate agents and brokers, stock and bond salespersons, demonstrators, salespersons and sales clerks, grocery clerks, cashiers, and kindred workers.

Office and Clerical

Occupations in which workers are responsible for internal and external communications, recording and retrieval of data and/or information and other paper work required in an office predominantly non-manual, though some manual work not directly involved with altering or transporting the products is included.

Includes: Bookkeepers, cashiers, collectors (bills and accounts), messengers and office helpers, office machine operators, shipping and receiving clerks, stenographers, typists and secretaries, telegraph and telephone operators, court transcribers, hearing reporters, statistical clerks, dispatchers, license distributors, payroll clerks, and kindred workers.

Skilled Craft Workers

Occupations in which workers perform jobs which require special manual skill through on-the-job training and experience, or through apprenticeship or other formal training programs. These workers exercise considerable independent judgment and usually receive an extensive period of training.

Includes: The building trades, hourly paid foremen and leadmen who are not members of management, mechanics and repairmen, skilled machining occupations, compositors and typesetters, electricians, engravers, job setters

(metal), motion picture projectionists, pattern and model makers, stationary engineers, tailors, heavy equipment operators, carpenters, and kindred workers.

Operatives (semi-skilled)

Workers who operate machine or processing equipment or perform other factory-type duties of intermediate skill level which can be mastered in a few weeks and require only limited training.

Includes: Apprentices (auto mechanics), plumbers, bricklayers, carpenters, electricians, mechanics, building trades, metal workers, machinists, printing trades, operatives, attendants (auto service and parking), blasters, chauffeurs, deliverymen, dressmakers and seamstresses (except factory), dryers, furnacemen, heaters (metal), laundry and dry cleaning operatives, milliners, miners, motormen, oilers, greasers, etc. (except auto), painters (except construction and maintenance), photographic process workers, stationary firemen, truck and tractor drivers, weavers (textile), welders and flame cutters, and kindred workers.

Laborers (unskilled)

Workers in manual occupations which generally require no special training. These workers perform elementary duties that may be learned in a few days and require the application of little or no independent judgment.

Includes: Garage workers, car washers and greasers, gardeners (except farm) and groundskeepers, longshoremen and stevedores, lumbermen, craftsmen, and wood choppers, laborers performing lifting, digging, mixing, loading, and pulling operations, and kindred workers.

Service/Maintenance Workers

Occupations in which workers perform duties which result in or contribute to the comfort, convenience, hygiene or safety for the general public or which contribute to the upkeep and care of buildings, facilities or grounds, or public property. Workers in this group may operate machinery.

Includes: Chauffeurs, laundry and dry cleaning operatives, truck drivers, trash collectors, custodial personnel, gardeners and groundskeepers, construction laborers, attendants (hospital and other institutions), professional and personal service, counter and fountain workers, elevator operators, firemen and fire protection, guards, watchmen and doorkeepers, stewards, porters, waiters, and kindred workers.

CERTIFICATION BY PROPOSED SUBCONTRACTOR REGARDING EQUAL EMPLOYMENT OPPORTUNITY

_____
Name of Prime Contractor

_____
Address

GENERAL

In accordance with Executive Order 11246 (30 F.R. 12319-25), the implementing rules and regulations thereof, and orders of the Secretary of Labor, a certification regarding Equal Opportunity is required of bidders or prospective contractors and their proposed subcontractors prior to the award of contracts or subcontracts.

SUBCONTRACTOR'S CERTIFICATION

Subcontractor's Name: _____

Address: _____

IRS Employer Identification Number: _____

Job Description : _____

1. Participation in a previous contract or subcontract.

   a. Subcontractor has participated in a previous contract or subcontract subject to the Equal Opportunity Clause. ____YES ____NO

   b. Compliance reports were required to be filed in connection with such contract or subcontract. ____YES ____NO

   c. Subcontractor has filed all compliance reports required by Executive Orders 10925, 11114, 11246, or by regulations of the Equal Employment Opportunity Commission issued pursuant to Title VII of the Civil Rights Act of 1964. ____YES ____NO

   d. If answer of Item c. is "No", please explain in detail on reverse side of this certification.

2. Dollar amount of proposed subcontract: $ _____

3. Anticipated performance period in days: _____

4. Expected total number of employees to perform the proposed subcontract: _____

5. Nonsegregated facilities.

   a. Notice to prospective federally-assisted construction contractors
      (1) A Certification of Nonsegregated Facilities, as required by the May 9, 1967, order (32 F.R. 7439, May 19, 1967) on Elimination of Segregated Facilities, by the Secretary of Labor, must be submitted to the Contractor prior to the award of a subcontract exceeding $10,000 which is not exempt from the provisions of the Equal Opportunity Clause.
      (2) Contractors receiving subcontract awards exceeding $10,000 which are not exempt from the provisions of the Equal Opportunity Clause will be required to provide for the forwarding of this notice to prospective subcontractors for supplies and construction contracts where the subcontracts exceed $10,000 and are not exempt from the provisions of the Equal Opportunity clause.

   b. Certification of non-segregated facilities

      The federally-assisted construction contractor certified that he/she does not maintain or provide any segregated facilities at any of his/her establishments, and does not permit employees to perform their services at any location, under his/her control, where segregated facilities are maintained. The federally-assisted construction Contractor certifies further that he/she will not maintain or provide any segregated facilities at any of his/her establishments, and will not permit employees to perform their services at any location, under his/her control, where segregated facilities are maintained. The federally-assisted construction Contractor agrees that a breach of this certification is a violation of the Equal Opportunity Clause in this Contract. As used in this certification, the term "segregated facilities" means any waiting rooms, work areas, restrooms and washrooms, restaurants, and other eating areas, time clocks, locker rooms and other storage or dressing areas, parking lots, drinking fountains, recreation or entertainment areas, transportation, and housing facilities provided for employees which are segregated by explicit directive or are in fact segregated on the basis of race, creed, color, or national origin because of habit, local custom, or otherwise. The federally-assisted construction Contractor agrees that (except where he/she has obtained identical certifications from proposed Subcontractors for specific time periods) he/she will obtain identical certifications in duplicate from proposed Subcontractors prior to the award of subcontracts exceeding $10,000 which are not exempt from the provisions of the Equal Opportunity Clause, and that he/she will retain the duplicate of such certifications in his/her files. The Contractor will include the original in his/her Bid Package.

6. Race or ethnic group designation of bidder. Enter race or ethnic group in appropriate box:

☐ White ☐ Black ☐ Hispanic

☐ Pacific Islander, Asian ☐ American Indian, Aleut.

7. Gender

☐ Male ☐ Female

REMARKS: _

Certification - The information above is true and complete to the best of my knowledge and belief.

_____

Company Officer (Please Type)

_____ _____

Signature Date

NOTE: The penalty for making false statements in offers is prescribed in 18 U.S.C. 1001.

Certification by Proposed Material Suppliers, Lessors, and Professional Service Providers Regarding Equal Employment Opportunity

Company Name: _____ $_____
(Supplier, Lessor, Professional Service Provider) (Amount of Contract)

Company Address: _____

Company Telephone Number: _____ Fax: _____

E-mail Address: _____

Web Page/URL Address: _____

Company Tax Identification Number: _____

Project No.: [*WBS/CIP/AIP/File No.*] _____

Project Name: [*Legal Project Name*] _____

In accordance with the City of Houston Ordinance 78-1538, Supplier/Lessor/Professional Service Provider represents to be an equal opportunity employer and agrees to abide by the terms of the Ordinance. This certification is required of all Suppliers/Lessors/Professional Service Providers (herein Supplier) with contracts in the amount of $10,000.00 or more.

[ ] Yes [ ] No Supplier agrees not to discriminate against any employee or applicant for employment because of race, religion, color, sex, national origin, or age.

[ ] Yes [ ] No Supplier agrees that all qualified applicants will receive consideration for employment without regard to race, religion, color, sex, national origin, or age.

[ ] Yes [ ] No Supplier will comply with all provisions of Executive Order No. 11246 and rules, regulations and applicable orders of the Department of Labor or other Federal Agency responsible for enforcement of applicable equal opportunity and affirmative action provisions and will likewise furnish all information and reports required by the Mayor or Contract Compliance Officers for the purpose of investigation to ascertain and effect compliance with the City of Houston's Office of Affirmative Action and Contract Compliance.

[ ] Yes [ ] No The Supplier shall file and cause their sub-tier contractors to file compliance reports with the City in the form and to the extent as may be prescribed by the Mayor or Contract Compliance Officers. Compliance reports filed at such times as directed shall contain information including, but not limited to, the practices, policies, programs, and employment policies.

I hereby certify that the above information is true and correct.

_____ _____
COMPANY OFFICER (Signature) DATE

_____
NAME AND TITLE (Print or type)

END OF DOCUMENT

Document 00808

REQUIREMENTS FOR THE CITY OF HOUSTON PROGRAM FOR MINORITY, WOMEN, AND SMALL BUSINESS ENTERPRISES AND PERSONS WITH DISABILITIES ENTERPRISES (PDBE)

CONSTRUCTION CONTRACTS

I. GENERAL

A. CITY AUTHORITIES

1. The "OBO Director" is the City of Houston's Office of Business Opportunity Director, or his or her designee.
   City of Houston
   611 Walker Street, 7th Floor
   Houston, Texas 77002

2. The "Contracting Department" for this Project is the City of Houston Department specified in Document 00520 – Agreement.

3. The "Project Manager" is for this Project specified in Document 00550 – Contract Approval Notification.

II. REOCCURRING REPORTS THAT MUST BE SUBMITTED DURING THE COURSE OF THE CONTRACT:

A. MWSBE MONTHLY REPORT PROCESS

The Contractor shall complete the MWSBE Monthly Utilization Report in the Contract Compliance and Monitoring System (available at https://houston.mwdbe.com/).

B. The Contractor shall comply with further, applicable instructions regarding reporting and compliance as provided in Sections III.E and III.I below.

III. BUSINESS ENTERPRISE PROGRAM REQUIREMENTS:

A. PURPOSE

This Document facilitates implementation of City of Houston, Tex. Code of Ordinances Chapter 15, Article V, § 15-81 et seq., relating to MWSBE contract participation, and Code of Ordinances Chapter 15, Article VI, § 15-90 et seq., relating to PDBE contract participation (collectively, the "Business Enterprise Program or "MWSBE"). City of Houston, Tex. Ordinance 2013-0428, May 8, 2013.

B. POLICY

It is the policy of the City to encourage the full participation of Minority and Women-owned Business Enterprises, Small Business Enterprises, and Persons with Disabilities Business Enterprises in all phases of its procurement activities and to afford them a full and fair opportunity to compete for City contracts at all levels.

C. POLICY ELEMENTS

1. The Contractor agrees to ensure that MWSBE firms have a full and fair opportunity to participate in the performance of City contracts. In this regard the Contractor shall make all reasonable Good Faith Efforts to meet the Contract Goals for this Contract.

2. The Contractor and any Subcontractor shall not discriminate on the basis of race, color, religion, national origin, or sex in the performance of City contracts.

3. Contractor's performance in meeting the Participation Plan Percentage will be monitored during the construction phase of the Contract by the OBO Director and Contracting Department.

D. PERCENTAGE GOALS

The MWSBE goals and PDBE goals, if any, for the Work are specified in Document 00800 – Supplementary Conditions Goals.

E. CONTRACTOR RESPONSIBILITIES

1. Prior to Award:

The Bidder shall submit MWSBE documents in accordance with the requirements of Document 00410 – Bid Form Part A.

a. In accordance with the Code of Ordinances and the OBO Good Faith Efforts Policy (Attachment A), the Department shall approve an Apparent Low Bidder's MWSBE Participation Plan–Document 00470 (the "Bidder's Plan" or "Plan") within 3 business days of the Bid Opening only if the Department representative determines that Bidder's Plan meets the advertised Contract Goal and is administratively complete.

b. If the Department cannot approve the Bidder's Plan, it shall forward the Plan to the OBO Director, who shall review the Bidder's Plan, and if applicable, the Bidder's Document 00471 (Record of Good Faith Efforts) and Document 00472 (Pre-Award Deviation Request) and determine whether the Bidder has made Good Faith Efforts to meet the Contract Goals within 10 business days of the Bid Opening.

c. If the OBO Director determines that the Bidder has failed to provide a valid participation plan or make Good Faith Efforts or if the Bidder fails to provide documents and associated information required by this Document 00808 or reasonably requested in writing by the OBO Director, the OBO Director may declare the Bidder to be non-responsible.

d. If the OBO Director determines that the Bidder has made Good Faith Efforts, the Director may approve the Bidder's Contract Goal Deviation request. Thereafter, the Bidder/Contractor shall be bound by the Plan, as approved by the OBO Director.

e. The Contractor shall:

(1) ensure that all MWSBE firms listed in the Plan are certified by the Office of Business Opportunity prior to bid date. Qualified, non-certified firms may obtain priority consideration for certification if no more than two firms are certified with the same capability as the non-certified firm.

(2) execute written contracts with all certified Subcontractors and Suppliers. All such contracts must be executed and sent to the OBO Director and Contracting Department within 30 days after the date of the Notice to Proceed and must include provisions set forth in Articles 3 and 5 of Document 00700 - General Conditions.

(3) designate an MWSBE liaison officer who will administer the Contractor's MWSBE program and who shall document and maintain records of Good Faith Efforts to subcontract with MWSBE Subcontractors and Suppliers.

2. After Award:

a. The Contractor shall submit MWSBE Monthly Utilization Reports, requested in Article II above.

b. The Contractor shall complete and submit to the OBO Director a Post-Award Deviation Request–Document 00572 ("Post-Award Deviation Request") if the Contractor reasonably believes that it will not achieve the Business Enterprise Program Participation Plan Percentage documented in the Plan. The Contractors shall also submit to the OBO Director, with a Copy to the Contracting Department, a Record of Post-Award Good Faith Efforts (Document 00571) for each Certified Firm that the Contractor does not use in accordance with the Approved Plan before the Contractor uses another firm to perform the work.

c. The Contractor shall conform to the Plan unless the OBO Director grants a Post-Award Deviation Request. The OBO Director shall approve or reject a Deviation Request within 5 business days of receipt of the Deviation Request.

d. The OBO Director shall grant a Post-Award Deviation Request if

(1) for a reason beyond the Contractor's control, the Contractor is unable to use the certified MWSBE firm in the Plan to perform the specified work. In such cases, the Contractor shall use and document Good Faith Efforts to find a similarly qualified, certified MWSBE firm to perform such specified work; or

(2) the Contractor reasonably believes that, due to a change of scope, execution of the work in accordance with the directions from the Contracting Department is unlikely to meet the terms of the Plan. In such cases, the Contractor shall use and document Good Faith efforts to achieve a reasonable amount of MWSBE participation on the remaining work on the Contract.

(3) The OBO Director shall not unreasonably withhold approval of a Post-Award Deviation Request.

e. After the Date of Substantial Completion, the OBO Director shall evaluate the Contractor's Good Faith Efforts towards meeting the Plan, as it may amended.

f. If the Contractor fails to conform to the Plan and fails to submit a Post-Award Deviation Request or provide documents and associated information required by the Good Faith Efforts Policy or reasonably requested in writing by the OBO Director, the OBO Director may impose sanctions in accordance with Article VI of this Document 00808.

F. ELIGIBILITY OF MWSBE FIRMS FOR SUBCONTRACTING

1. To ensure that the City's Business Enterprise Program benefits only those firms that are owned and controlled by a minority person(s), a woman (women),a person(s) with a disability, or a small business enterprise, the Office of Business Opportunity will certify the eligibility of MWSBE and PDBE Contractors, Subcontractors, and Suppliers. Contact the Office of Business Opportunity Certification Section at 832-393-0600 for information regarding certification.

2. The Office of Business Opportunity maintains a Certified Minority, Women and Small Business Enterprises and Disabilities Business Enterprises Directory on the City's website. This Directory also lists federally-designated Disadvantaged Business Enterprises (DBEs).

NOTE: MWSBE firms, even if certified by another agency, may not qualify for Contract Goals unless certified by the Office of Business Opportunity prior to acceptance of the Participation Plan.

G. DETERMINATION OF MWSBE PARTICIPATION

MWSBE participation shall be counted toward meeting the Contract Goals in response to the following:

1. Once a firm is certified as a MWSBE firm, the total dollar value of the subcontract awarded to the MWSBE firm is counted toward the Contract Goals (See Sections III.G.4 and III.G.5 below). Safety and Participation goals do not count as a single goal concerning MWSBE/DBE requirements.

2. When the Contractor or Subcontractor is in a joint venture with one or more MWSBE firms, the OBO Director shall determine the percent of participation resulting from such joint venture to be counted toward the Contract Goals.

3. Contractor may count toward its Contract Goals only those MWSBE Subcontractors/ Suppliers performing a Commercially Usefully Function.

a. **COMMERCIALLY USEFUL FUNCTION** means a discrete task or group of tasks, the responsibility for performance of which shall be discharged by the MWSBE firm by using its own forces or by actively supervising on-site the execution of the tasks by another entity for whose work the MWSBE firm is responsible. In determining whether a certified firm is performing a commercially useful function, factors including but not limited to the following shall be considered: (1) whether the firm has the skill and expertise to perform the work for which it is being utilized and possesses all necessary licenses; (2) whether the firm is in the business of performing, managing, or supervising the work for which it has been certified and is being utilized; and

(3) whether it is performing a real and actual service that is a distinct and verifiable element of the work called for in a contract. Without limiting the generality of the foregoing, a MWSBE will not be considered to be performing a commercially useful function, if it subcontracts to non-MWSBE firms or to other MWSBE firms, more than 50 percent of a contract being counted toward the applicable Contract Goals, unless such subcontracting in excess of 50 percent has been expressly approved by the OBO Director in a Goal or Plan Deviation Request (Document 00472 or Document 00572) (either pre-bid or post award).

b. The OBO Director shall approve a Plan Deviation Request if the Contractor demonstrates that the industry standard for the type of work involved is to subcontract over 50 percent of the work.

4. A MWSBE firm cannot subcontract more than 50 percent of the work for which it is responsible to perform unless the OBO Director grants a Deviation Approval.

5. The Contractor may count 100 percent of MWSBE Manufacturer Supplier's participation and 60 percent of MWSBE Non-Manufacturer Supplier's participation toward its Contract Goals. Such MWSBE Supplier contracts shall not exceed 50 percent of contract's goals.

6. The OBO Policy and Procedures Manual, as amended, shall apply to the Contract for other determinations regarding counting MWSBE participation not explicitly provided for in the Contract.

H. CONTRACTOR COMPLIANCE

To ensure compliance with MWSBE requirements, the OBO Director and Contracting Department will monitor Contractor's efforts regarding MWSBE Subcontractors/Suppliers during the performance of this Contract. This may be accomplished through the following: job site visits, reviewing of records and reports, and interviews of randomly selected personnel.

I. RECORDS AND REPORTS

1. In accordance with II.A of this Document, the Contractor shall submit an initial report outlining MWSBE participation, 40 days after the Notice to Proceed date, and on or before the 15th day of each month thereafter until all MWSBE subcontracting or material supply activity is completed. Each report shall cover the preceding month's activity. The Contractor shall use the MWSBE Contract Compliance and Monitoring System (B2G Now) to meet this requirement.

2. Contractor shall maintain the following records for review upon request by the OBO Director or Contracting Department:

   a. Copies of executed Subcontractor agreements and purchase orders;
   b. Documentation of payments and other transactions with MWSBE Subcontractors/ Suppliers;
   c. Appropriate explanations of any changes or replacements of MWSBE Subcontractors/Suppliers;

NOTE: All replacement MWSBE Subcontractors/Suppliers must be certified by the Office of Business Opportunity.

   d. Any other records required by the OBO Director or Contracting Department.

3. If a Participation Plan Percentage is not being met, the monthly report shall include a narrative description of the progress being made in MWSBE participation. If sufficient MWSBE Subcontractors or Suppliers to meet the Participation Plan Percentage are being utilized, they should be identified by name and the dollar amount paid to date for work performed or materials furnished by each MWSBE during the monthly period. Reports are required when no activity has occurred in a monthly period.

4. Contractor shall retain all such records for a period of four years following completion of the Work and shall be available at reasonable times and places for inspection by authorized representatives of the City including the City Controller.

IV. SANCTIONS:

A. SUSPENSION PERIOD AND WAIVER

Pursuant to Section 15-86 of the Code of Ordinances, the OBO Director is authorized to suspend for a period of up to, but not to exceed, five years, any Contractor who has failed to make Good Faith Efforts.

B. GUIDELINES FOR IMPOSITION OF SANCTIONS

1. General:

a. The OBO Director shall not impose any sanction except upon evidence of specific conduct on the part of a MWSBE or Contractor that is inconsistent with or in direct contravention of specific applicable requirements for Good Faith Efforts.

b. Imposition and enforcement of suspensions shall be consistent with applicable state law.

2. Severity of Sanctions:

a. In determining the length of any suspension, the OBO Director shall consider the following factors:

(1) Whether the failure to comply with applicable requirements involved intentional conduct or, alternatively, may be reasonably concluded to have resulted from a misunderstanding on the part of the Contractor or MWSBE of the duties imposed on them by Article V of Chapter 15 of the Code of Ordinances and these procedures;

(2) The number of specific incidences of failure by Contractor or MWSBE to comply;

(3) Whether the Contractor or MWSBE has been previously suspended;

(4) Whether the Contractor or MWSBE has failed or refused to provide the OBO Director with any information requested by the Director or required to be submitted to the Director pursuant to law or these procedures;

(5) Whether the Contractor or MWSBE has materially misrepresented any applicable facts in any filing or communication to the OBO Director; and

(6) Whether any subsequent restructuring of the subject business or other action has been undertaken to cure the deficiencies in meeting applicable requirements.

b. Suspensions may be for any length of time not to exceed five years. Suspensions in excess of one year shall be reserved for cases involving intentional or fraudulent misrepresentation or concealment of material facts, multiple acts in contravention of applicable requirements, cases where the Contractor or MWSBE has been previously suspended, or other similarly egregious conduct.

C. DELEGATION

A decision to implement a suspension may be taken after notice and an opportunity for a hearing by an impartial person(s) designated by the OBO Director as the hearing officer.

The hearing officer(s) shall not have participated in the actions or investigations giving rise to the suspension hearing.

D. NOTICE

1. Prior to imposing any suspension, the OBO Director shall deliver written notice to the Contractor or MWSBE setting forth the grounds for the proposed suspension and setting a date, time, and place to appear before the hearing officer(s) for a hearing on the matter.

2. Any notice required or permitted to be given hereunder to any Contractor or MWSBE may be given either by personal delivery or by certified United States mail, postage prepaid, return receipt requested, addressed to their most recent address as specified in the records of the Office of Business Opportunity or in the Contract if no address is on file with the Office of Business Opportunity.

E. HEARING PROCEDURES

Proceedings before a hearing officer shall be conducted informally and in accordance with the OBO Policy and Procedures Manual, as amended, provided that each party may be represented by counsel and may present evidence and cross-examine witnesses. The City shall have the burden to prove by a preponderance of evidence that the Contractor's or MWSBE firm's actions constitute misconduct or failure to make Good Faith Efforts. The decision shall be reduced to writing and notice provided to the Contractor or MWSBE.

F. APPEALS

Appeals authorized pursuant to Section 15-86(b) of the Code of Ordinances shall be conducted by the OBO Director. Pursuant to Section 15-86(b), The contractor may appeal the OBO Director's decision in accordance with Section 15-23 of the Code of Ordinances and OBO Policy and Procedures.

ATTACHMENT A

City of Houston
Office of Business Opportunity
Good Faith Efforts Policy

General Policy.

Good Faith Efforts are steps taken to achieve an Contract Goal or other requirements which, by their scope, intensity and usefulness demonstrates the bidder's responsiveness to fulfill the business opportunity objective prior to the award of a contract, as well as the contractor's responsibility to put forth measures to meet or exceed the Contract Goal throughout the duration of the contract.

Good Faith Efforts are required to be made and demonstrated by an apparent successful bidder on goal oriented contracts or proposer on a regulated contract prior to award of a contract. Good Faith Efforts are required on professional services and construction contracts and on procurement of goods and non-professional service contracts with goals. If a bidder, when submitting a participation plan at the time of bid or proposal submission, anticipates it cannot or will not meet the Contract Goal prior to the award, the bidder must demonstrate to Office of Business Opportunity ("OBO") it has made Good Faith Efforts to meet the Contract Goal, to be eligible for the contract award.

Good Faith Efforts shall be evaluated on a case-by-case basis in making a determination whether a bidder or contractor is in compliance with this policy. The efforts employed by a bidder or contractor should be those that one could reasonably expect a bidder or contractor to take if the bidder were actively and aggressively attempting to obtain MWSBE participation sufficient to meet the Contract Goal. Efforts taken that are mere formalities or other perfunctory acts shall not be considered Good Faith Efforts to meet Contract Goals.

The factors provided herein are representative of the types of actions OBO will consider in determining whether the bidder or contractor made Good Faith Efforts to obtain MWSBE participation to meet the Contract Goal. The factors prescribed below are not intended to be a mandatory checklist, nor is it intended to be exhaustive or exclusive. OBO may consider other factors or types of efforts that may be relevant in appropriate cases.

If a contractor fails to submit Good Faith Efforts documentation as provided in this Policy, it waives the right to appeal OBO decisions related to this Policy. OBO will review all the efforts made by the contractor, including the quality and quantity of those efforts.

Pre–Award.

A bidder must submit a participation plan (Document 00470) to OBO at the time the bidder submits the bid. If the participation by certified MWSBE subcontractors documented on the participation plan ("participation") is less than the Contract Goal, a bidder should submit a Record of Good Faith Efforts (Document 00471) with the bid. A bidder should also submit a request for a deviation (Document 00472) if the bidder, having used Good Faith Efforts, reasonably believes that it cannot meet the Contract Goal or a commercially useful deviation.

In making a determination that the bidder has made a good faith effort to meet the Contract Goals, OBO shall consider specific documentation concerning the steps taken to obtain MWSBE participation, with a consideration of, by way of illustration and not limitation, whether the bidder demonstrated a genuine effort to comply with the following factors:

1. Attended any pre-bid or pre-proposal meetings scheduled by the City Department;

2. Followed up with MWSBEs that attended the pre-bid or pre-proposal meetings to discuss subcontracting and supplier opportunities and contacted MWSBEs listed in the City's online directory;

3. Conducted outreach with minority and women focused organizations and associations far in advance of solicitation due date (no less than 10 business days);

4. Identified and designated portions of the work to be performed by MWSBEs to increase the likelihood of meeting the Contract Goals (including where appropriate breaking down the contract into reasonably sized subcontracts to ensure participation);

5. Advertised subcontracting opportunities in news media focused towards minority and women persons far in advance of solicitation due date;

6. Provided MWSBEs with a point of contact that was knowledgeable about the project and possessed decision-making authority to answer questions from interested MWSBEs;

7. Provided a reasonable number of MWSBEs certified with timely written notices via email, mail, and/or fax and/or with documented contact regarding the subcontracting/supplier opportunities. A "reasonable number of MWSBEs" shall be based on the number of MWSBEs available in the directory;

8. Solicited the MWSBEs within a reasonable amount of time (no less than seven business days) before bid submission, as well as followed up with the MWSBEs solicited to determine if they were interested in submitting a bid or proposal or participating on a team.

9. Provided interested MWSBEs certified to perform the solicited work with prompt access to the plans, specifications, scope of work and requirements of the contract;

10. Negotiated in good faith with interested MWSBEs, and not rejecting MWSBEs as unqualified without sound reasons based on a thorough investigation of their capabilities;

11. Entered into a formal contract, or signing enforceable letters of intent with MWSBEs;

12. Provided an explanation to any MWSBE whose bid or price quotation is rejected, unless another MWSBE is accepted for the same work, as follows:
    a. Where price competitiveness is not the reason for rejection, a written rejection notice including the reason for rejection will be sent to the rejected MWSBE firm;
    b. Where price competitiveness is the reason for rejection, a meeting must be held with the price-rejected MWSBE, if requested, to discuss the rejection;

13. Made efforts to assist interested MWSBEs in obtaining bonding, lines of credit, insurance required for the contract, and documenting MWSBE denied by bona fide surety agents;

14. Ensured that the conditions and requirements for subcontracts are commensurate with industry standards and would not cause an economic hardship on MWSBEs, such as unnecessary insurance or coupling bid bonds with retainage;

15. Incorporated efforts not attempted earlier or on previous bids that appear more likely to lead to attaining the Contract Goal. Past performance on similar contracts with similar scopes will also be taken in consideration when determining Good Faith Efforts. A bidder that continues to make same efforts without any significant change in the level of participation may not be making Good Faith Efforts.

Post–Award.

The contractor must sign the approved participation plan (Document 00470 or Document 00570) prior to starting work on the Project. A contractor should submit a request for deviation (Document 00572) from OBO if the contractor, having made Good Faith Efforts, reasonably believes that it will not achieve the Participation Plan Percentage documented in the approved participation plan. Unless OBO approves a deviation, a contractor must submit to OBO a Participation Summary (Document 00660) prior to City Council's consideration of any close-out, term extension, or change order. If participation is less than anticipated in the approved participation plan, the contractor must submit a Record of Good Faith Efforts (Document 00571) along with the Participation Summary. A contractor that fails to submit a deviation request and Good Faith Efforts documentation waives the right to appeal OBO decisions related to this Policy.

If the contractor is awarded the contract and fails to achieve the established Participation Plan Percentage, the contractor must demonstrate to OBO its efforts to meet the Participation Plan Percentage and failure to do so based on circumstances that the contractor could not reasonably control. In determining whether the contractor made Good Faith Efforts to ensure full participation and achievement of the Participation Plan Percentage, OBO shall consider the following factors:

1. Whether the contractor designated an MWSBE liaison officer to administer the Contractor's MWSBE programs and to be responsible for maintenance of records of Good Faith Efforts.

2. Whether the contractor furnished prompt MWSBE Utilization Reports in a timely and accurate manner through the online Contract Monitoring System or via hard copy.

3. Whether the contractor responded to efforts to resolve disputes with MWSBEs, and genuinely attempted to resolve these issues.

4. Whether the contractor disclosed payment discrepancies timely and within the monthly reporting period;

5. Whether the contractor complied with the participation plan, unless the contractor received a deviation from the OBO Director and whether upon approval, the contractor made Good Faith Efforts to replace a removed MWSBE with another certified firm;

6. Whether the contractor furnished prompt written responses to written inquiries from the Director or any employee of OBO regarding the MWSBE's performance or information germane to the MWSBE's certification;

7. Whether the contractor ensured that at all times during the performance of any contract or subcontract the MWSBE firm is engaging in a commercially useful function as that term is defined in Chapter 15 of the City of Houston Code of Ordinances;

8. Whether the contractor provided the OBO information, or other material, that was factually accurate and free of material misrepresentation; and

9. Whether the contractor furnished prompt responses to requests for information, books and records needed to verify compliance from the department administering the Contract, the City Attorney and the City Controller;

10. Whether the contractor attended all meetings and mediation hearings as requested by the Director or his/her designee; and

11. How the contractor may be affected by change orders, with consideration given to the size of the change orders.

Change Orders.

The requirement to make Good Faith Efforts to achieve the approved Participation Plan Percentage is applicable to change orders. Contractors should make Good Faith Efforts to ensure that the Participation Plan Percentage remains substantially the same after the issuance of change orders. If a contractor cannot maintain substantially the same level of participation provided in the latest approved Participation Plan (Document 00470 or Document 00570) due to a change order, the contractor shall submit to the OBO Director and Contracting Department a Document 00571 (Post-Award Record of Good Faith Efforts) and Document 00572 (Post-Award Plan Deviation Request) in a timely manner that does not cause disruption to the project. In addition to other relevant factors, in evaluating whether Good Faith Efforts were made by the contractor to meet the Participation Plan Percentage despite change orders, the OBO Director shall consider the contractor's efforts to timely and efficiently deliver the project.

END OF DOCUMENT

Document 00820

WAGE SCALE AND PAYROLL REQUIREMENTS FOR ENGINEERING CONSTRUCTION

Wage Scale Requirements

1.1 Contractor and its Subcontractors must pay the general prevailing wage rates for building construction for each craft or type of worker or mechanic employed in the execution of any building construction or repair under the Contract in accordance with Chapter 2258 of the Texas Government Code and City of Houston, Texas Ordinance Nos. 85-2070, 2000-1114, 2001-152, 2006-91 and 2006-168, and 2009- 247 all as amended from time to time. City Council has determined the prevailing wage rate in the locality in which the work is being performed, which is set forth in Exhibit "A".

1.2 This prevailing wage rate does not prohibit the payment of more than the rates stated.

1.3 In bidding, Contractor warrants and represents that it has carefully examined the classifications for each craft or type of worker needed to execute the Contract and determined that such classifications in Exhibit "A" include all necessary categories to perform the work under the Contract.

1.4 The wage scale for engineering construction is to be applied to all site work greater than five feet from an exterior wall of new building under construction or from an exterior wall of an existing building.

1.5 If Contractor believes that an additional classification for a particular craft or type of worker is necessary to perform work under the Contract, it must submit with its bid a request to the Contract Compliance Division of the Office Of Business Opportunity ("OBO") to use an additional labor classification not listed in Exhibit "A" and specify the proposed new classification. OBO shall determine whether a proposed classification is already covered in Exhibit "A", and, if it is, specify which classification is appropriate. OBO's decision is conclusive. If OBO decides that a new classification is necessary, it will determine the appropriate prevailing wage rate for any resurveyed, amended, new, or additional craft or type of worker not covered by Exhibit "A". Such determination must be decided in accordance with procedures established by OBO, and in compliance with Chapter 2258 of the Texas Government Code and City of Houston, Texas Ordinance Nos. 85-2070, 2000-1114, 2001-152, 2006-91, 2006-168 and 2009-247 subject to City Council approval.

1.6 Contractor must not use any labor classification not covered by Exhibit "A" until such classification is established and approved for use by OBO.

1.7 A Contractor or Subcontractor who violates Chapter 2258 of the Texas Government Code must pay to the City, $60 per each worker employed for each calendar day or part of the day that the worker is paid less than the wage rates set forth in Exhibit "A".

1.8 The City may withhold money required to be withheld under Chapter 2258 of the Texas Government Code from the final payment to Contractor or earlier payments if City Council makes a determination that there is good cause to believe that Contractor has not complied with these provisions and Chapter 2258 of the Government Code, in which case the City may withhold the money at any time subsequent to the finding by City Council.

1.9 Contractor and Subcontractors must keep records specifying:

(1) the name and classification of each worker employed under the Contract; and

(2) the actual per diem wages paid to each worker, and the applicable hourly rate.

The records must be open at all reasonable hours for inspection by the officers and agents of the City.

1.10 The hourly cost of salary for non-exempt workers for labor in excess of 40 hours per worker per week, shall be calculated at 1.5 times the worker's base pay, plus 1.0 times fringe benefits, for the applicable craft and level.

Certified Payroll Requirements

2.1 Employees are paid weekly and payrolls are submitted weekly using the City of Houston's electronic payroll submission module, unless the prime Contractor has been instructed to do otherwise by the Office of Business Opportunity. When no work is done after a Contractor has started work, the Contractor is required to submit a weekly compliance statement indicating no work was performed. The payrolls must reflect the exact work and classification of the workers, the exact amount that they were paid. Workers must be paid the contracted amount (prevailing wage rates). The Contractor will be penalized $60.00 a day for each employee who is underpaid per Texas Government Code §2258-023 for all contracts.

2.2 Payrolls must be submitted electronically & indicate whether the worker worked inside or outside the building area when both wage rates are applicable to the contract.

2.3 Payrolls must be submitted each week until all work by the contractor is complete and the electronic payroll submission is marked as final in the system.

2.4 Payrolls must cover a seven day period from the start of the work week and must be consecutive seven day periods until all work is complete.

2.5 Payrolls must have employees' names, addresses, last four digits of the social security numbers, and job classifications. The job classifications must be the same as the classifications on the prevailing wage rate schedule.

2.6 A payroll deduction authorization form must be submitted for each employee for any deductions other than Federal and FICA taxes.

2.7 Employees must be paid overtime (time and a half) for all hours worked over 40 hours a week on both federally and City-funded contracts.

2.8 The Contractor has the responsibility to comply with all Internal Revenue Service rules and regulations. Contractors who submit certified payrolls with **Owner Operators (truckers)** must submit a signed tax liability statement from Owner Operator acknowledging their responsibility for Federal Income Tax and FICA reporting obligations.

2.9 If the Contractor wants to use the apprentice wage rates for an employee, the apprenticeship certificates must be submitted to the Office of Business Opportunity in advance of the employee working on the project and appearing on the payroll. You must comply with the listed number of journeymen to apprentices as listed.

2.10 A poster of the Prevailing Wage Rate Schedule should be clearly displayed on each job site from the time the project starts until the work is completed, or in case of annual service agreements, in the Contractor's office.

2.11 The Contractor shall submit the "Certificate from Contractor Appointing Officer or Employee to Supervise Payment of Employees" (Exhibit "B") to the Monitoring Authority listed in Document 00495 prior to final execution of the contract.

2.12 During the course of the work, ALL Subcontractors shall submit the "Certificate from Subcontractor Appointing Officer or Employee to Supervise Payment of Employees" (Exhibit "C") to the Monitoring Authority listed in Document 00495.

2.13 Upon completion of the Project, as part of the contract-awarding department's total clearance process, the Office of Business Opportunity's Contract Compliance Section must review whether the Wage Rate and Payroll Requirements were met and report the results to the department.

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EXHIBIT "A"

LABOR CLASSIFICATIONS AND PREVAILING WAGE RATES FOR
ENGINEERING CONSTRUCTION 2015

CLASSIFICATION	RATE	CLASSIFICATION	RATE
Asphalt Distributor Operator	$14.06	Milling Machine Operator - Fine Grade	$13.53
Asphalt Paving Machine Operator	$14.32	Mixer Operator	$10.33
Asphalt Raker	$12.36	Motor Grader Operator- Rough	$14.23
Asphalt. Shoveler	$11.68	Motor Grader Operator	$15.69
Broom or Sweeper Operator	$12.68	Oiler	$12.12
Bulldozer Operator	$11.81	Painter-Structures	$18.62
Carpenter- Rough	$12.49	Pavement Marking Machine Operator	$11.18
Concrete Finisher- Paving	$12.98	Pile Driverman	$14.95
Concrete Finisher- Structures	$12.98	Pipe Layer	$12.12
Concrete Paving Curbing Machine Operator	$11.71	Reinforcing Steel Setter - Paving	$15.15
Concrete Paving Finishing Machine Operator	$13.07	Reinforcing Steel Setter - Structure	$14.39
Concrete Paving Joint Sealer Operator	$11.00	Roller Operator, Pneumatic - Self-propelled	$11.57
Concrete Paving. Saw Operator	$13.99	Roller Operator, Steel Wheel, Flat Wheel/Tamping	$11.57
Concrete Paving Spreader Operator.	$10.44	Roller Operator, Steel Wheel, Plant Mix Pavement	$11.92
Concrete Rubber . . .	$9.00	Scraper Operator	$13.47
Crane Clamshell Backhoe Derrick, Dragline, Shovel Operator	$12.71	Servicer	$13.97
Crusher and Screening Plant Operator	$11.29	Sign Installer - PGM	$8.54
Electrician * 3 Journeyman 2 Apprentice Allowed	$27.11	Slip Form Machine Operator	$11.07
Flagger	$10.33	Spreader Box Operator	$13.58
Form Builder/Setter- Structures	$12.23	Structural Steel Worker	$14.39
Form Liner- Paving and Curb	$12.34	Tractor Operator - Crawler Type	$13.68
Form Setter- Paving and Curb	$12.34	Tractor Operator- Pneumatic	$10.07
Foundation Drill Operator - Crawler Mounted	$17.43	Transit Mixer Truck Driver	$11.00
Foundation Drill Operator - Truck Mounted	$15.89	Truck Driver, Lowboy-float	$16.03
Front Loader Operator	$13.17	Truck Driver, Single-Axle - Heavy	$11.46
Laborer Common	$11.02	Truck Driver, Single-Axle - Light	$11.48
Laborer- Utility	$11.73	Truck Driver, Tandem Axle Semi-Trailer	$12.27
Manhole Builder	$9.00	Work Zone Barricade Servicer	$11.67
Mechanic	$16.96	eceive rate prescribed for craft performing operation to which welding is incidental	
* Apprentices- must be in an approved USDOL Program and cannot exceed ratios			

Engineering Prevailing Wages Classification Definitions

Asphalt Distributor Operator
Drives distributor truck, sets spray bars and operates valves and levers to control distribution of bituminous material for highway surfacing. May oil, grease or otherwise service and make adjustments to equipment as needed. Performs other related duties.

Asphalt Paving Machine Operator
Operates paving machine that spreads and levels asphaltic concrete on highway subgrade. Controls movement of machine, raises and lowers screed, regulates width of screed. May, oil, grease, service and make adjustments to equipment as needed. Performs other related duties.

Asphalt Raker
Distributes asphaltic materials evenly over road surface by raking and brushing material to correct thickness; directs Laborers when to add or take away material to fill low spots or to reduce high spots. Performs other related duties.

Asphalt Shoveler
A general term used on construction work covering many unskilled classifications requiring work of a physical nature. A laborer works with all crews doing everything from pick and shovel work to cleaning up lumber with hammer, shoveling and placing concrete, uses air tools, cleans concrete joints and fills joints with sealing compound from bucket or with hose and nozzle from a central source, applies coating of oil to inside face of forms, may help set and strip forms, unloads and transports reinforcing steel, cures newly poured concrete, helps lower pipe into ditch for pipelayers, builds fences, works with dirt crew keeping construction layout stakes out of the way of dirt moving equipment.

Broom or Sweeper Operator
Operates a self-propelled machine to sweep and clean roadway surfaces. May oil grease, service and make adjustments to equipment as needed. Performs other related duties.

Bulldozer Operator
Operates a crawler tractor with a bulldozer mounted in front of chassis to level, distribute and push earth or other material. May operate a ripper attachment to break up rock or other hard material. May use a push block on front of tractor to push load scrapers. May oil, grease, or otherwise service and make minor repairs to equipment as needed. Performs other related duties.

Carpenter, Rough
Works from plans to build, assemble, fit together, align, plum, and set in place forms for molding concrete structures. Forms may be wood, steel, aluminum, fiberglass or any other type of material. Checks form while concrete is placed. May install miscellaneous materials integral to concrete structures. May set precast concrete elements. Prepares for slipforming traffic rail and median barrier. May install permanent metal deck forms. May work with power tools Performs other related duties.

Concrete Finisher, Paving
Finishes the exposed surfaces of fresh concrete paving, median barrier and every element of concrete structures to the final grade and contour structures to the final grade and contour with the use of straight edges and steel trowels. Operates bridge deck finishing machine. Finishes concrete curbs and gutters. Finishes exposed surface of concrete after forms have been removed by patching imperfections with fresh concrete, rubbing surface with abrasive stone, and directing others in removing excess or defective concrete with power tools. Performs other related duties.

Concrete Finisher, Structures
A worker semi-skilled in concrete finishing who assists Concrete finisher by performing specific or general duties of lesser skill and keeping Concrete Finisher supplied with materials, tools, and supplies; cleaning working area an equipment; and holding materials and tools. Performs other related duties.

Concrete Paving Curbing Machine Operator
Operates self - propelled machine(s) which may or may not travel on concrete paving forms, spreading and leveling fresh concrete to grade by use of augers and screeds. May oil, grease or otherwise service and make adjustments to equipment as necessary. Performs other related duties.

Concrete Paving Finishing Machine Operator
Operates self - propelled machine(s) which may or may not travel on concrete paving forms, spreading and leveling fresh

concrete to grade by use of augers and screeds. May oil, grease or otherwise service and make adjustments to equipment as necessary. Performs other related duties.

Concrete Paving Joint Sealer Operator
Cleans and seals joints requiring a hot or cold sealing compound in concrete paving, sidewalks, driveway and approach slabs. May oil, grease or make necessary repairs adjustments to equipment as needed. Performs other related duties.

Concrete Paving Saw Operator
Operates a water-cooled power saw with either or an abrasive blade to saw expansion and contraction joints in concrete paving. May also be used to saw asphaltic pavements. May oil grease or otherwise service and make necessary adjustments to equipment as needed. Performs other related duties.

Concrete Paving Spreader Operator
Operates self - propelled machine(s) which may or may not travel on concrete paving forms, spreading and leveling fresh concrete to grade by use of augers and screeds. May oil, grease or otherwise service and make adjustments to equipment as necessary. Performs other related duties.

Concrete Rubber
Finishes the exposed surface of concrete masonry after the forms have been removed by patching holes and broken corners with fresh concrete, rubbing surface with abrasive stone to remove rough spots, and removing high spots and defective concrete with hand chisel and hammer or pneumatic chisel and powered abrasive stone. Performs other related duties.

Crane, Clamshell, Backhoe, Derrick, Dragline, Shovel Operator
A worker who operates a lattice boom type crane can hoist and move materials, raise and lower heavy weights and perform other related operations. May be crawler type or rubber tired. May include placement of rock riprap, clamshell, dragline, pipe and pile driving operations. May oil, grease or otherwise service and make necessary adjustments to equipment as needed. Performs other related duties.

Crusher and Screed Plant Operator
Operates a crusher or screening plant through which rock is run to break it into crushed stone for construction or to control flow of materials not needed. May include minor repairs and may service and make necessary adjustments to equipment as needed. Performs other related duties.

Electrician *3 Journeyman 2 Apprentice
Plans and directs the layout of metal electrical conduit, installs wiring systems, switch-panels, buss bars, works on overhead distribution systems and underground distribution systems. Performs other related duties.

Flagger
A worker who directs traffic in or around a construction site. May use signs or devices to direct traffic. May help assemble, position and clean devices or equipment used to direct traffic. Must be able to effectively communicate with the public. May require certain level of training by TXDOT specifications. Performs other related duties.

Form Builder/Setter, Structures
Fits together, aligns and sets to grade metal and wooden forms for placement of concrete. Forms may be wood, steel, aluminum, fiberglass or any other type of material. Checks forms while concrete is placed. May install miscellaneous materials integral to concrete structures. May set precast concrete elements. Prepares for slipforming traffic rail and median barrier. May install permanent metal deck forms. May work with power tools. Performs other related duties.

Form Liner, Paving & Curb
Fits together, panels align and sets to grade metal and wooden forms for placement of concrete. Works with survey crew to set stringline for panels or moles. Performs other related duties.

Form Setter, Paving & Curb
Fits together, align and set to grade metal and wooden forms for placement of concrete paving and curbs. Works with survey crew to set stringline for paving, curb and gutter curb. Performs other related duties.

Foundation Drill Operator, Crawler Mounted
Operates a hole-drilling machine that is crawler mounted. May include geotechnical operations such as soils nails, rock nails, tiebacks, anchors and jet grouting. May oil, grease or otherwise service and make necessary adjustments to equipment as needed. Performs other related duties.

Foundation Drill Operator, Truck Mounted
Operates a hole drilling machine that is mounted on the rear of a rubber tired vehicle or truck. May include soils nails, rock nails, tiebacks, anchors and jet grouting. Drive truck from location to location or may have laborer who drives truck. May oil, grease or otherwise service and make necessary adjustments to equipment as needed. Performs other related duties.

Front End Loader Operator
Operates a rubber tired, skid steer or crawler type tractor with an attached scoop type bucket on front end. Machine is used to load materials from stockpiles, excavation, charging batch plants, loading and unloading trucks. May be used with attachments in lieu of the bucket. May oil, grease or otherwise service and make necessary adjustments to equipment as needed. Performs other related duties.

Laborer, Common
A general term used on construction work covering many unskilled classifications requiring work of a physical nature. A laborer works with all crews doing everything from pick and shovel work to cleaning up lumber with hammer, shoveling and placing concrete, uses air tools, cleans concrete joints and fills joints with sealing compound from bucket or with hose and nozzle from a central source, applies coating of oil to inside face of forms, may help set and strip forms, unloads and transports reinforcing steel, cures newly poured concrete, helps lower pipe into ditch for pipelayers, builds fences, works with dirt crew keeping construction layout stakes out of the way of dirt moving equipment.

Laborer, Utility
Performs a variety of manual duties, usually working in a utility capacity by working on multiple projects and tasks where demands require workmen with varied experience and ability to work without close direction. Unloads and transports reinforcing steel. May occasionally place and tie reinforcing steel. Directs common laborers in pouring concrete. Erects shoring and bracing. Assists in installation of pipe. Installs, operate and maintains dewatering systems. May assist equipment operators in positioning machines, verifying grades and signaling operators. Directs truck drivers and scraper operators to dumping positions to maintain grades as directed. Uses power tools and air tools. May work as lead man in a labor crew. His performance of a wide variety of construction jobs distinguishes him from a helper assigned to a specific craft. Installs and maintains erosion control. Is more or less a general utility construction worker. May be second step in learning a skill, and may later become a helper in a specific classification. Performs other related duties.

Manhole Builder
Constructs a means of permanent access to water and sewer lines for maintenance purposes. This work consists of laying brick or concrete slab at bottom of ditch up to an approximate grade line near the surface of the ground. Brick or block is normally laid to form a nearly circular manhole. Brick or block is laid in by eyesight and is normally to a plumb line. Chipped or culled brick can be used quite often is. No effort may be made to keep mortar off the face of the brick and joints are not pointed. May apply coating of concrete to interior and exterior surface. Performs other related duties.

Mechanic
Assembles, set up, adjusts and maintains and repairs all types of construction equipment and trucks. He may perform the duties of a welder in repair of equipment. Performs other related duties.

Milling Machine Operator, Fine Grade
Operates a power-driven milling machine that planes material of the to roadbed and discharges the material into a hauling unit or a windrow. May oil, grease or otherwise service and make necessary adjustments to equipment as needed. Performs other related duties.

Mixer Operator
Performs a variety of manual duties, usually working in a utility capacity by working on multiple projects and tasks where demands require workmen with varied experience and ability to work without close direction. Unloads and transports reinforcing steel. May occasionally place and tie reinforcing steel. Directs common laborers in pouring concrete. Erects shoring and bracing. Assists in installation of pipe. Installs, operate and maintains dewatering systems. May assist equipment operators in positioning machines, verifying grades and signaling operators. Directs truck drivers and scraper operators to dumping positions to maintain grades as directed. Uses power tools and air tools. May work as lead man in a labor crew. His performance of a wide variety of construction jobs distinguishes him from a helper assigned to a specific craft. Installs and maintains erosion control. Is more or less a general utility construction worker. May be second step in learning a skill, and may later become a helper in a specific classification. Performs other related duties.

Motor Grader Operator, Rough
Operates a motor grader. Equipment is used to grade excavation and embankment and to lay asphalt, base and other materials. May blade haul roads and do other general motor grader work, but does not perform finish grade work to close

specification tolerances. This operator may be a learner in the first phase of learning the skills of motor grader work. May oil, grease or otherwise service and make necessary adjustments to equipment as needed. Performs other related duties.

Motor Grader Operator
Operates a motor grader. Equipment is used to grade excavation and embankment and to lay asphalt, base and other materials. May blade haul roads and do other general motor grader work, but does not perform finish grade work to close specification tolerances. This operator may be a learner in the first phase of learning the skills of motor grader work. May oil, grease or otherwise service and make necessary adjustments to equipment as needed. Performs other related duties.

Oiler
A learner or semi-skilled worker who under the direction of the watch engineer. May oil and grease or otherwise service all engines and necessary equipment as needed. He may clean and paint engine room as needed. Performs other related duties.

Painter, Structures
Paints and stains structural steel and concrete surfaces of bridges, retaining walls, or other structures. Directs cleaning and abrasive blasting of surfaces prior to painting or staining. Performs other related duties.

Pavement Marking Machine Operator
Operates machine used in laying paint stripes or markers on all types of paving. Loads machine with appropriate materials and may walk or ride on machine. May oil, grease or otherwise service and make necessary adjustments to equipment as needed. Performs other related duties.

Piledriverman
Sets in place, aligns, plumbs directs driving of timber, concrete, steel, pipe and any other type of piling. Sets, drives and pulls steel, concrete and other types of sheet piling. Rigs pile and leads and bracing. Signals operator. Splices piles before and after driving. Directs pile cutoff. May direct jetting or drilling equipment in connection with installing piles to grade. Performs other related duties.

Pipelayer
Installs concrete, clay, steel, ductile iron, plastic, corrugated pipe and any other type of pipe for storm drainage, water lines, gas lines and sanitary sewer lines. Lays underground communication and electrical ducts. May install and set electrical ground boxes, hand holes, manholes, inlets and other structures. Caulks joints, makes threaded and flanged connections. Installs valves and other accessories. Performs other related duties.

Reinforcing Steel Setter, Paving
Works from plans to lay out and install reinforcing steel within forms or in mats of concrete paving. May direct unloading of material. Determines rigging required to complete work. Gives direction to reinforcing steel worker (helper) or common or utility laborers. May install miscellaneous materials integral to concrete structure or paving. May work with power tools. Performs other related duties.

Reinforcing Steel Setter, Structure
Works from plans to lay out and install reinforcing steel within forms or in mats of concrete paving. May direct unloading of material. Determines rigging required to complete work. Gives direction to reinforcing steel worker (helper) or common or utility laborers. May install miscellaneous materials integral to concrete structure or paving. May work with power tools. Performs other related duties.

Roller Operator, Pneumatic, Self-Propelled
Operates a self-propelled machine with either steel wheels pneumatic tires, which is used to compact and smooth all bituminous materials. May oil, grease or otherwise service and make necessary adjustments to equipment as needed. Performs other related duties.

Roller Operator, Steel Wheel, Flat Wheel/Tamping
Operates a self-propelled machine with either steel wheels or pneumatic tires which is used to compact earth fills, subgrade, flexible base and all other types of materials except bituminous. May oil, grease or otherwise service and make necessary adjustments to equipment as needed. Performs other related duties.

Roller Operator, Steel Wheel, Plant Mix Pavement
Operates a self-propelled machine with either steel wheels pneumatic tires, which is used to compact and smooth all bituminous materials. May oil, grease or otherwise service and make necessary adjustments to equipment as needed. Performs other related duties.

Scraper Operator
Operates a self-contained wheeled tractor scraper both self loading or assisted by crawler tractors or other scrapers. Used to excavate and transport earth or other materials. May oil, grease or otherwise service and make necessary adjustments to equipment as needed. Performs other related duties.

Servicer
Drives a truck, which carries various fuels, oils, greases and filters. Must have knowledge of and is responsible for the correct oiling and greasing and changing of filters on equipment according to the manufacturers' specifications. Uses compressed air grease guns, wrenches and other tools. May make adjustments to clutches, brakes and other mechanical items. Keeps record of service preventive maintenance records. May have laborer assisting him. May require CDL if driving truck on public highways. Performs other related duties.

Sign Installer (PGM)
Sets forms, reinforcing steel, anchor bolts and pours concrete for Sign foundations. Fabricates and erects pipe and angle Frameworks by bolting, welding or other means prior to installation of signs that are normally prefabricated. Works from plans in location and drilling holes for proper location and alignment of signs. May direct hoisting of signs into place. Fastens signs to framework by bolting and other means. Locates and sets lighting brackets. May perform other work associated with signing projects. Supervises sign erector helper. Performs other related duties.

Slip Form Machine Operator
Cleans and seals joints requiring a hot or cold sealing compound in concrete paving, sidewalks, driveway and approach slabs. May oil, grease or make necessary repairs adjustments to equipment as needed. Performs other related duties.

Spreader Box operator
Operates spreader box by adjusting hopper and strike off blade so that the gravel, stone or other material may be spread to a specific depth on road surface during seal coat and surface treatment operations. May oil, grease or otherwise service and make necessary adjustments to equipment as needed. Performs other related duties.

Structural Steel Worker
Works from plans to lay out and install reinforcing steel within forms or in mats of concrete paving. May direct unloading of material. Determines rigging required to complete work. Gives direction to reinforcing steel worker (helper) or common or utility laborers. May install miscellaneous materials integral to concrete structure or paving. May work with power tools. Performs other related duties.

Tractor operator, Crawler Type
Operates a crawler tractor with a bulldozer mounted in front of chassis to level, distribute and push earth or other material. May operate a ripper attachment to break up rock or other hard material. May use a push block on front of tractor to push load scrapers. May oil, grease, or otherwise service and make minor repairs to equipment as needed. Performs other related duties.

Tractor Operator, Pneumatic
Operates a gasoline or diesel powered agricultural tractor that tows compaction rollers, plow, disc. water tanks, scrapers and other similar operations. May use other miscellaneous attachments. May oil, grease or otherwise service and make necessary adjustments to equipment as needed. Performs other related duties.

Traveling Mixer Operator
Drives a gasoline or diesel truck upon which is mounted a concrete mixer. Operates concrete mixer and dumps concrete on the grade, into forms or into concrete pumps or buckets. Cleans mixer drum. May require CDL license for on highway use. May service and make necessary adjustments for proper operation of equipment. Performs other related duties.

Truck driver, lowboy-Float
Drives a heavy-duty diesel powered truck to which is attached a trailer upon which heavy equipment is hauled. Driver is often required to operate heavy equipment to load or unload the lowboy. May require CDL license for on highway use. May service and make necessary adjustments for proper operation of equipment. Performs other related duties.

Truck driver, Single Axle, Heavy
Drive a light capacity truck for transporting loads of construction material. The truck is of single rear axle type, may have various kinds of beds attached, such as dump, flat bed, tank, etc. May require CDL license for driving on highway. May services and make necessary adjustments for proper operation equipment. Performs other related duties.

Truck driver, Single Axle-Light
Drive a light capacity truck for transporting loads of construction material. The truck is of single rear axle type, may have

various kinds of beds attached, such as dump, flat bed, tank, etc. May require CDL license for driving on highway. May services and make necessary adjustments for proper operation equipment. Performs other related duties.

Truck Driver, Tandem Axle, Semi-Trailer
Drives a diesel-powered tractor pulling a semi trailer hauling materials. Hauls dirt, rock, aggregates or other material. May require CDL license for driving on highway. May service and make necessary adjustments for proper operation of equipment. Performs other related duties.

Work Zone Barricade Servicer
Fabricates, erects and maintains temporary traffic control devices, including arrow boards, signs, barricades, channelizing devices, barrels and all message boards. May operates a truck during traffic control operations.

WELDERS - Receives rate for craft being performed to which welding is incidental.

EXHIBIT "B"

CERTIFICATE FROM CONTRACTOR APPOINTING OFFICER OR EMPLOYEE TO SUPERVISE PAYMENT OF EMPLOYEES

Project Name _____

_____

Project WBS#:_____Date_____

(I) (We) hereby certify that (I am) (we are) the **Prime Contractor** for _____

_____
(specify type of job)

in connection with construction of the above-mentioned Project, and that (I) (we) have appointed_____, whose signature appears below, to supervise the payment of (my) (our) employees beginning_____, 20___; that he/she is in a position to have full knowledge of the facts set forth in the payroll documents and in the statement of compliance required by the Copeland Act and the City of Houston, which he/she is to execute with (my) (our) full authority and approval until such time as (I) (we) submit to the City of Houston a new certificate appointing some other person for the purposes hereinabove stated.

_____ Phone:_____
(Identifying Signature of Appointee)

Attest: _____
(Name of Firm or Corporation)

By:_____ By:_____
(Signature) (Signature)

_____ _____
(Title) (Title)

NOTE: This certificate must be executed by an authorized officer of a corporation or by a member of a partnership, and shall be executed prior to and be submitted with the first payroll. Should the appointee be changed, a new certificate must accompany the first payroll for which the new appointee executes a statement of compliance required by the Copeland Act and the City of Houston.

EXHIBIT "C"

CERTIFICATE FROM SUBCONTRACTOR APPOINTING OFFICER OR EMPLOYEE TO SUPERVISE PAYMENT OF EMPLOYEES

Project Name _____

_____

Project WBS#:_____Date_____

(I) (We) hereby certify that (I am) (we are) the **Sub Contractor** for _____

_____
(specify type of job)

in connection with construction of the above-mentioned Project, and that (I) (we) have appointed_____, whose signature appears below, to supervise the payment of (my) (our) employees beginning_____, 20___; that he/she is in a position to have full knowledge of the facts set forth in the payroll documents and in the statement of compliance required by the Copeland Act and the City of Houston, which he/she is to execute with (my) (our) full authority and approval until such time as (I) (we) submit to the City of Houston a new certificate appointing some other person for the purposes hereinabove stated.

_____ Phone:_____
(Identifying Signature of Appointee)

Attest: _____
(Name of Firm or Corporation)

By:_____ By:_____
(Signature) (Signature)

_____ _____
(Title) (Title)

NOTE: This certificate must be executed by an authorized officer of a corporation or by a member of a partnership, and shall be executed prior to and be submitted with the first payroll. Should the appointee be changed, a new certificate must accompany the first payroll for which the new appointee executes a statement of compliance required by the Copeland Act and the City of Houston.

END OF DOCUMENT

Document 00821

WAGE SCALE AND PAYROLL REQUIREMENTS FOR BUILDING CONSTRUCTION

Wage Scale Requirements

1.1 Contractor and its Subcontractors must pay the general prevailing wage rates for building construction for each craft or type of worker or mechanic employed in the execution of any building construction or repair under the Contract in accordance with Chapter 2258 of the Texas Government Code and City of Houston, Texas Ordinance Nos. 85-2070, 2000-1114, 2001-152, 2006-91 and 2006-168, and 2009-247 all as amended from time to time. City Council has determined the prevailing wage rate in the locality in which the work is being performed, which is set forth in Exhibit "A".

1.2 This prevailing wage rate does not prohibit the payment of more than the rates stated.

1.3 In bidding, Contractor warrants and represents that it has carefully examined the classifications for each craft or type of worker needed to execute the Contract and determined that such classifications in Exhibit "A" include all necessary categories to perform the work under the Contract.

1.4 The wage scale for building construction is to be applied to work on a building including an area within 5 feet of the exterior wall.

1.5 If Contractor believes that an additional classification for a particular craft or type of worker is necessary to perform work under the Contract, it must submit with its bid a request to the Contract Compliance Division of the Office of Business Opportunity ("OBO") to use an additional labor classification not listed in Exhibit "A" and specify the proposed new classification. OBO shall determine whether a proposed classification is already covered in Exhibit "A", and, if it is, specify which classification is appropriate. OBO's decision is conclusive. If OBO decides that a new classification is necessary, it will determine the appropriate prevailing wage rate for any resurveyed, amended, new, or additional craft or type of worker not covered by Exhibit "A". Such determination must be decided in accordance with procedures established by OBO, and in compliance with Chapter 2258 of the Texas Government Code and City of Houston, Texas Ordinance Nos. 85-2070, 2000-1114, 2001-152, 2006-91, 2006-168, and 2009-247 subject to City Council approval.

1.6 Contractor must not use any labor classification not covered by Exhibit "A" until such classification is established and approved for use by OBO.

1.7 A Contractor or Subcontractor who violates Chapter 2258 of the Texas Government Code must pay to the City, $60 per each worker employed for each calendar day or part of the day that the worker is paid less than the wage rates set forth in Exhibit "A".

1.8 The City may withhold money required to be withheld under Chapter 2258 of the Texas Government Code from the final payment to Contractor or earlier payments if City Council makes a determination that there is good cause to believe that Contractor has not complied with these provisions and Chapter 2258 of the Government Code, in which case the City may withhold the money at any time subsequent to the finding by City Council.

1.9 Contractor and Subcontractors must keep records specifying:

(1) the name and classification of each worker employed under the Contract; and

(2) the actual per diem wages paid to each worker, and the applicable hourly rate.

The records must be open at all reasonable hours for inspection by the officers and agents of the City.

1.10 The hourly cost of salary for non-exempt workers for labor in excess of 40 hours per worker per week, shall be calculated at 1.5 times the worker's base pay, plus 1.0 times fringe benefits, for the applicable craft and level.

Certified Payroll Requirements

2.1 Employees are paid weekly and payrolls are submitted weekly using the City of Houston's electronic payroll submission module, unless the prime Contractor has been instructed to do otherwise by the Office of Business Opportunity. When no work is done after a Contractor has started work, the Contractor is required to submit a weekly compliance statement indicating no work was performed. The payrolls must reflect the exact work and classification of the workers, the exact amount that they were paid. Workers must be paid the contracted amount (prevailing wage rates). The Contractor will be penalized $60.00 a day for each employee who is underpaid per Texas Government Code §2258-023 for all contracts.

2.2 Payrolls must be submitted electronically & indicate whether the worker worked inside or outside the building area when both wage rates are applicable to the project.

2.3 Payrolls must be submitted each week until all work by the contractor is complete and the electronic payroll submission is marked as final in the system.

2.4 Payrolls must cover a seven day period from the start of the work week and must be consecutive seven day periods until all work is complete.

2.5 Payrolls must have employees' names, addresses, last four digits of the social security numbers, and job classifications. The job classifications must be the same as the classifications on the prevailing wage rate schedule.

2.6 A payroll deduction authorization form must be submitted for each employee for

any deductions other than Federal and FICA taxes and court ordered child support.

2.7 Employees must be paid overtime (time and a half) for all hours worked over 40 hours a week on both federally and City-funded contracts.

2.8 The Contractor has the responsibility to comply with all Internal Revenue Service rules and regulations. Contractors who submit certified payrolls with **Owner Operators (truckers)** must submit a signed tax liability statement from each Owner Operator acknowledging their responsibility for Federal Income Tax and FICA reporting obligations.

2.9 If the Contractor wants to use the apprentice wage rates for an employee, the apprenticeship certificates must be submitted to the Office of Business Opportunity in advance of the employee working on the project and appearing on the payroll. Contractor must comply with posted number of journeymen to apprentices or helpers as listed on the wage rate.

2.10 A poster of the Prevailing Wage Rate Schedule should be clearly displayed on each job site from the time the project starts until the work is completed, or in case of annual service agreements, in the Contractor's office.

2.11 The Contractor shall submit the "Certificate from Contractor Appointing Officer or Employee to Supervise Payment of Employees" (Exhibit "B") to the Monitoring Authority listed in Document 00495 prior to final execution of the contract.

2.12 During the course of the work, Subcontractors shall submit the "Certificate from Subcontractor Appointing Officer or Employee to Supervise Payment of Employees" (Exhibit "C") to the Monitoring Authority listed in Document 00495.

2.13 Upon completion of the Project, as part of the contract-awarding department's total clearance process, the Office of Business Opportunity's Contract Compliance Section must review whether the Wage Rate and Payroll Requirements were met and report the results to the department.

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EXHIBIT "A"

CITY OF HOUSTON, TEXAS
LABOR CLASSIFICATIONS AND PREVAILING WAGE RATES
FOR BUILDING CONSTRUCTION 2015

Worker Classification	Ratio	Base Rate	Fringe Benefit	Wage Total
Asbestos Worker/Insulator *	Ratio 1/1 - Apprentice	$20.75	$9.85	$30.60
Asbestos Abatement Worker (ceilings, walls ,floors only)	Ratio 1/3 – Helpers $9.10	$14.00	$0.00	$14.00
Boilermaker *	Ratio 5/1 - Apprentice	$23.14	$21.55	$44.69
Brick Layer * (see Mason Tender Brick)	Ratio 1/3 – Mason Tender Brick	$18.87	$0.00	$18.87
Carpenter * (including acoustical ceiling work)	Ratio 2/1 - Apprentice	$21.97	$7.98	$29.95
Cement Mason/Concrete Finisher *	Ratio 1/3 Mason Tender	$13.93	$0.00	$13.93
Drywall Finisher/Taper *	Ratio 1/3 – Helpers $8.54	$16.27	$3.66	$19.93
Drywall Hanger, * incl. metal studs installation	Ratio 1/3 – Helpers $9.46	$17.44	$3.93	$21.37
Electrician *	Ratio 3/2 - Apprentice	$27.65	$7.70	$35.35
Elevator Mechanic *	Ratio 1/1 - Apprentice	$38.00	$26.79	$64.79
Formbuilder/ Formsetter *	Ratio 1/3 – Helpers $7.67	$12.77	$0.00	$12.77
Glazier *	Ratio 1/3 – Helper $11.51	$14.92	$2.78	$17.70
Insulator * (Batt and Foam)	Ratio 1/3 – Helper $6.50	$14.87	$0.73	$15.60
Ironworker *(Reinforcing)	Ratio 1/3 – Helper $7.83	$12.14	$0.00	$12.14
Ironworker *(Structural)	Ratio 1/3 – Helper $10.19	$22.02	$6.35	$28.37
Lather *	Ratio 1/3 – Helper $13.38	$19.73	$0.00	$19.73
Painter * (Brush, Roller, and Spray)	Ratio 1/3 – Helper $7.42	$17.24	$4.41	$21.65
Pipe Fitter *(**HVAC Pipe only**)	Ratio 1/1 - Apprentice	$29.63	$10.31	$39.94
Pipe Fitter *(**Excluding HVAC**)	Ratio 1/3 – Apprentice $12.40	$29.39	$10.31	$39.70
Plasterer *	Ratio 1/3 Plaster Tenders	$19.42	$1.00	$20.42
Plumber *	Ratio 3/2 - Apprentice	$30.29	$9.50	$39.79
Roofer *	Ratio 1/3 – Helper $7.85	$15.40	$0.00	$15.40
Sheet Metal Worker *(incl. HVAC duct and system install.)	Ratio 2/1 - Apprentice	$25.37	$12.39	$37.76
Sprinkler Fitter * (Fire sprinklers)	Ratio 1/1 – Apprentice	$26.36	$16.52	$42.88
Tile Finisher *	Ratio 1/3 – Helper $8.08	$12.00	$0.43	$12.43
Tile Setter *	Ratio 1/3 – Helper $10.91	$16.17	$0.00	$16.17
Truck Driver		$14.18	$0.00	$14.18
Laborers:				
Common Laborer		$9.29	$0.00	$9.29
Mason Tender (Bricklayer's Helper)		$10.13	$0.00	$10.13
Mason Tender (Cement /Concrete Finisher's Helper)		$9.86	$0.00	$9.86
Pipe Layer		$12.35	$0.00	$12.35
Plaster Tender (Plasterer's helper)		$12.90	$2.51	$15.41
Power Equipment Operator:				
Asphalt Paver		$13.50	$0.25	$13.75
Backhoe – Power Equipment Operator		$12.54	$0.00	$12.54
Crane – Power Equipment Operator		$34.85	$9.85	$44.70
Forklift – Power Equipment Operator		$16.00	$0.00	$16.00
Slab and Wall Saw – Power Equipment Operator		$15.54	$3.83	$19.37
Welders - Receive rate prescribed for craft performing operation in which welding is incidental				

*** When Apprentices are shown, Helpers cannot be utilized. See Definitions for allowable journeymen to apprentice /helpers.**

Building Construction Prevailing Wages Classification Definitions

Asbestos Worker/Insulator * - Ratio 1Journeyman /1 Apprentice (1 Journeyman / 1 Apprentice) (Including application of all insulating materials, protective coverings, coatings and finishing to all type of mechanical systems). Applies insulating material to exposed surfaces of structures, such as air ducts, hot and cold pipes, storage tanks, and cold storage rooms: Reads blueprints and selects required insulation material (in sheet, tubular, or roll form), such as fiberglass, foam rubber, styrofoam, cork, or urethane, based on material's heat retaining or excluding characteristics. Brushes adhesives on or attaches metal adhesive-backed pins to flat surfaces as necessary to facilitate application of insulation material. Measures and cuts insulation material to specified size and shape for covering flat or round surfaces, using tape measure, knife, or scissors. Fits, wraps, or attaches required insulation material around or to structure, following blueprint specifications. Covers or seals insulation with preformed plastic covers, canvas strips, sealant, or tape to secure insulation to structure, according to type of insulation used and structure covered, using staple gun, trowel, paintbrush, or caulking gun.

Asbestos Abatement Worker * (Ceilings, Floors, & Walls only) Ratio 1 Journeyman /3 Helpers
Removes asbestos from ceilings, walls, beams, boilers, and other structures, following hazardous waste handling guidelines: Assembles scaffolding and seals off work area, using plastic sheeting and duct tape. Positions mobile decontamination unit or portable showers at entrance of work area. Builds connecting walkway between mobile unit or portable showers and work area, using hand tools, lumber, nails, plastic sheeting, and duct tape. Positions portable air evacuation and filtration system inside work area. Sprays chemical solution over asbestos covered surfaces, using tank with attached hose and nozzle, to soften asbestos. Cuts and scrapes asbestos from surfaces, using knife and scraper. Shovels asbestos into plastic disposal bags and seals bags, using duct tape. Cleans work area of loose asbestos, using vacuum, broom, and dustpan. Places asbestos in disposal bags and seals bags, using duct tape. Dismantles scaffolding and temporary walkway, using hand tools, and places plastic sheeting and disposal bags into transport bags. Seals bags, using duct tape, and loads bags into truck.

Boilermaker * - Ratio 5 Journeymen /1 Apprentice
Assembles, analyzes defects in, and repairs boilers, pressure vessels, tanks, and vats in field, following blueprints and using hand tools and portable power tools and equipment: Locates and marks reference points for columns or plates on foundation, using master straightedge, squares, transit, and measuring tape, and applying knowledge of geometry. Attaches rigging or signals crane operator to lift parts to specified position. Aligns structures or plate sections to assemble boiler frame, tanks, or vats, using plumb bobs, levels, wedges, dogs, or turnbuckles. Hammers, flame cuts, files, or grinds irregular edges of sections or structural parts to facilitate fitting edges together. Bolts or arc-welds structures and sections together. Positions drums and headers into supports and bolts or welds supports to frame. Aligns water tubes and connects and expands ends to drums and headers, using tube expander. Bells, beads with power hammer, or welds tube ends to ensure leak proof joints. Bolts or welds casing sections, uptakes, stacks, baffles, and such fabricated parts as chutes, air heaters, fan stands, feeding tube, catwalks, ladders, coal hoppers, and safety hatch to frame, using wrench. Installs manholes, hand holes, valves, gauges, and feed water connection in drums to complete assembly of water tube boilers. Assists in testing assembled vessels by pumping water or gas under specified pressure into vessel and observing instruments for evidence of leakage. Repairs boilers or tanks in field by unbolting or flame cutting defective sections or tubes, straightening plates, using torch or jacks, installing new tubes, fitting

and welding new sections and replacing worn lugs on bolts. May rivet and caulk sections of vessels, using pneumatic riveting and caulking hammers.

Bricklayer * (See Mason Tender) - Ratio 1Journeyman /3 Mason Tender Brick
Lays building materials, such as brick, structural tile, and concrete cinder, glass, gypsum, and terra cotta block (except stone) to construct or repair walls, partitions, arches, sewers, and other structures: Measures distance from reference points and marks guidelines on working surface to lay out work. Spreads soft bed (layer) of mortar that serves as base and binder for block, using trowel. Applies mortar to end of block and positions block in mortar bed. Taps block with trowel to level, align, and embed in mortar, allowing specified thickness of joint. Removes excess mortar from face of block, using trowel. Finishes mortar between brick with pointing tool or trowel. Breaks bricks to fit spaces too small for whole brick, using edge of trowel or brick hammer. Determines vertical and horizontal alignment of courses, using plumb bob, gauge line (tightly stretched cord), and level. Fastens brick or terra cotta veneer to face of structures, with tie wires embedded in mortar between bricks, or in anchor holes in veneer brick. May weld metal parts to steel structural members. May apply plaster to walls and ceiling, using trowel, to complete repair work.

Carpenter * (Including Acoustical Ceiling Work) - Ratio 2 Journeymen /1 Apprentice
Constructs, erects, installs, and repairs structures and fixtures of wood, plywood, and wallboard, using carpenter's hand tools and power tools, and conforming to local building codes: Studies blueprints, sketches, or building plans for information pertaining to type of material required, such as lumber or fiberboard, and dimensions of structure or fixture to be fabricated. Selects specified type of lumber or other materials. Prepares layout, using rule, framing square, and calipers. Marks cutting and assembly lines on materials, using pencil, chalk, and marking gauge. Shapes materials to prescribed measurements, using saws, chisels, and planes. Assembles cut and shaped materials and fastens them together with nails, dowel pins, or glue. Verifies trueness of structure with plumb bob and carpenter's level. Erects framework for structures and lays subflooring. Builds stairs and lays out and installs partitions and cabinetwork. Covers sub floor with building paper to keep out moisture and lays hardwood, parquet, and wood-strip-block floors by nailing floors to sub floor or cementing them to mastic or asphalt base. Applies shock-absorbing, sound-deadening, and decorative paneling to ceilings and walls. Fits and installs prefabricated window frames, doors, doorframes, weather stripping, interior and exterior trim, and finish hardware, such as locks, letter drops, and kick plates. Constructs forms and chutes for pouring concrete. Erects scaffolding and ladders for assembling structures above ground level. May weld metal parts to steel structural members.

Cement Mason/Concrete Finisher *(Mason Tender Cement/Concrete) - Ratio 1 Journeyman /3 Mason Tender Cement
Finisher; concrete floater Smooths and finishes surfaces of poured concrete floors, walls, sidewalks, or curbs to specified textures, using hand tools or power tools, including floats, trowels, and screeds: Signals concrete deliverer to position truck to facilitate pouring concrete. Moves discharge chute of truck to direct concrete into forms. Spreads concrete into inaccessible sections of forms, using rake or shovel. Levels concrete to specified depth and workable consistency, using hand held screed and floats to bring water to surface and produce soft topping. Smooths, and shapes surfaces of freshly poured concrete, using straightedge and float or power screed. Finishes concrete surfaces, using power trowel, or wets and rubs concrete with abrasive stone to impart finish. Removes rough or defective spots from concrete surfaces, using power grinder or chisel and hammer, and patches holes with fresh concrete or epoxy compound. Molds expansion joints and edges, using edging tools, jointers, and straightedge. May sprinkle colored stone chips, powdered steel, or coloring powder on concrete to produce prescribed finish. May produce rough concrete surface, using broom. May mix cement, using hoe or concrete-mixing machine. May direct sub

grade work, mixing of concrete, and setting of forms.

Drywall Finisher/Taper - Ratio 1Journeyman /3 Helpers
Wallboard and plasterboard; sheetrock taper; taper and bedder; taper and floater. Seals joints between plasterboard or other wallboards to prepare wall surface for painting or papering; Mixes sealing compound by hand or with portable electric mixer, and spreads compound over joints between boards, using trowel, broad knife, or spatula. Presses paper tape over joint to embed tape into compound and seal joint, or tapes joint, using mechanical applicator that spreads compound and embeds tape in one operation. Spreads and smooth's cementing material over tape, using trowel or floating machine to blend joint with wall surface. Sands rough spots after cement has dried. Fills cracks and holes in walls and ceiling with sealing compound. Installs metal molding at corners in lieu of sealant and tape. Usually works as member of crew. May apply texturing compound and primer to walls and ceiling preparatory to final finishing, using brushes, roller, or spray gun. May countersink nails or screws below surface of wall prior to applying sealing compound, using hammer or screwdriver.

Drywall Hanger - Ratio 1 Journeyman /3 Helpers
Dry-wall installer; gypsum dry-wall systems installer. Plans gypsum drywall installations, erects metal framing and furring channels for fastening drywall, and installs drywall to cover walls, ceilings, soffits, shafts, and movable partitions in residential, commercial, and industrial buildings: Reads blueprints and other specifications to determine method of installation, work procedures, and material, tool, and work aid requirements. Lays out reference lines and points for use in computing location and position of metal framing and furring channels and marks position for erecting metalwork, using chalk line. Measures, marks, and cuts metal runners, studs, and furring channels to specified size, using tape measure, straightedge and hand and portable power cutting tools. Secures metal framing to walls and furring channels to ceilings, using hand and portable power tools.
Measures and marks cutting lines on drywall, using square, tape measure, and marking devices. Scribes cutting lines on drywall, using straightedge and utility knife and breaks board along cut lines. Fits and fastens board into specified position on wall, using screws, hand tools, portable power tools, or adhesive. Cuts openings into board for electrical outlets, vents, or fixtures, using keyhole saw or other cutting tools. Measures, cuts, assembles, and installs metal framing and decorative trim for windows, doorways, and vents. Fits, aligns, and hangs doors and installs hardware, such as locks and kick plates (Includes Installing Metal Studs).

Electrician * Ratio 3 Journeymen /2 Apprentice
Plans layout, installs, and repairs wiring, electrical fixtures, apparatus, and control equipment: Plans new or modified installations to minimize waste of materials, provide access for future maintenance, and avoid unsightly, hazardous, and unreliable wiring, consistent with specifications and local electrical codes. Prepares sketches showing location of wiring and equipment, or follows diagrams or blueprints, ensuring that concealed wiring is installed before completion of future walls, ceilings, and flooring. Measures, cuts, bends, threads, assembles, and installs electrical conduit, using tools, such as hacksaw, pipe threader, and conduit bender. Pulls wiring through conduit. Splices wires by stripping insulation from terminal leads, using knife or pliers, twisting or soldering wires together, and applying tape or terminal caps. Connects wiring to lighting fixtures and power equipment, using hand tools. Installs control and distribution apparatus, such as switches, relays, and circuit-breaker panels, fastening in place with screws or bolts, using hand tools and power tools. Connects power cables to equipment, such as electric range or motor, and installs grounding leads. Tests continuity of circuit to ensure electrical compatibility and safety of components, using testing instruments, such as ohmmeter, battery and buzzer, and oscilloscope. Observes functioning of installed equipment or system to detect hazards and need for adjustments, relocation,

or replacement (Including Pulling Wire and Low Voltage Wiring and Installation of Fire Alarms, Security Systems, Telephones, and Computers).

Elevator Mechanic * - Ratio 1 Journeyman /1 Apprentice
FOOTNOTES: a. - Employer contributes 8% of basic hourly rate for over 5 years' service and 6% of basic hourly rate for 6 months to 5 years' service as Vacation Pay Credit. Paid Holidays: New Year's Day; Memorial Day; Independence Day Labor Day; Thanksgiving Day; Friday after Thanksgiving Day; Christmas Day.

Erector; elevator installer; elevator mechanic. Assembles and installs electric and hydraulic freight and passenger elevators, escalators, and dumbwaiters, determining layout and electrical connections from blueprints: Studies blueprints and lays out location of framework, counterbalance rails, motor pump, cylinder, and plunger foundations. Drills holes in concrete or structural steel members with portable electric drill. Secures anchor bolts or welds brackets to support rails and framework, and verifies alignment with plumb bob and level. Cuts prefabricated sections of framework, rails, and other elevator components to specified dimensions, using acetylene torch, power saw, and disk grinder. Installs cables, counterweights, pumps, motor foundations, escalator drives, guide rails, elevator cars, and control panels, using hand tools. Connects electrical wiring to control panels and electric motors. Installs safety and control devices. Positions electric motor and equipment on top of elevator shaft, using hoists and cable slings.

Formbuilder/Formsetter - Ratio 1Journeyman /3 Helpers
Constructs built-in-place or prefabricated wooden forms, according to specifications, for molding concrete structures: Studies blueprints and diagrams to determine type and dimension of forms to be constructed. Saws lumber to blueprint dimensions, using handsaw or power saw, and nails lumber together to make form panels. Erects built-in-place forms or assembles and installs prefabricated forms on construction site according to blueprint specifications, using hand tools, plumb rule, and level. Inserts spreaders and tie rods between opposite faces of form to maintain specified dimensions. Anchors and braces forms to fixed objects, using nails, bolts, anchor rods, steel cables, planks, and timbers.

Glazier - Ratio 1 Journeyman /3 Helpers
Installs glass in windows, skylights, store fronts, and display cases, or on surfaces, such as building fronts, interior walls, ceilings, and tabletops: Marks outline or pattern on glass, and cuts glass, using glasscutter. Breaks off excess glass by hand or with notched tool. Fastens glass panes into wood sash with glaziers points, and spreads and smoothes putty around edge of panes with knife to seal joints. Installs mirrors or structural glass on building fronts, walls, ceilings, or tables, using mastic, screws, or decorative molding. Bolts metal hinges, handles, locks, and other hardware to prefabricated glass doors. Sets glass doors into frame and fits hinges. May install metal window and doorframes into which glass panels are to be fitted. May press plastic adhesive film to glass or spray glass with tinting solution to prevent light glare. May install stained glass windows.

Insulator (Batt and Foam) - Ratio 1 Journeyman /3 Helpers
Applies batt and form insulation to walls, ceilings and other surfaces according to manufacturers specifications and blue print instructions. May use sealants such as cement plaster or asphalt compound to seal insulation; may spread concrete over floor slabs to form wearing floor: brushes adhesives, cuts insulating materials to specified shape to cover surfaces; uses tape or other sealants to adhere insulation to surfaces. May use staple gun, towel, paintbrushes and caulking guns.

Ironworker (Reinforcing) - Ratio 1 Journeyman/3 Helpers
Positions and secures steel bars in concrete forms to reinforce concrete; places rods in forms, spacing and fastening together with wire and pliers. Cuts bars using hacksaw, bar cutters or acetylene torch. Bends steel rods with hand tools or rod bending machine; reinforces concrete with wire mesh; welds reinforcing bars together.

Ironworker (Structural) - Ratio 1 Journeyman /3 Helpers
Erector; ironworker; steel erector; structural-iron erector; structural-iron worker; structural steel erector. Performs any combination of following duties to raise, place, and unite girders, columns, and other structural-steel members to form completed structures or structure frameworks, working as member of crew: Sets up hoisting equipment for raising and placing structural-steel members. Fastens steel members to cable of hoist, using chain, cable, or rope. Signals worker operating hoisting equipment to lift and place steel member. Guides member, using tab line (rope) or rides on member in order to guide it into position. Pulls, pushes, or pries steel members into approximate position while member is supported by hoisting device. Forces members into final position, using turnbuckles, crowbars, jacks, and hand tools. Aligns rivet holes in member with corresponding holes in previously placed member by driving drift pins or handle of wrench through holes. Verifies vertical and horizontal alignment of members, using plumb bob and level.

Lather - Ratio 1 Journeyman /3 Helpers
Fastens wooden, metal, or rockboard lath to walls, ceilings, and partitions of buildings to provide supporting base for plaster, fireproofing, or acoustical material, using hand tools and portable power tools: Erects horizontal metal framework to which laths are fastened, using nails, bolts, and studgun. Drills holes in floor and ceiling, using portable electric tool, and drives ends of wooden or metal studs into holes to provide anchor for furring or rockboard lath. Wires horizontal strips to furring to stiffen framework. Cuts lath to fit openings and projections, using hand tools or portable power tools. Wires, nails, clips, or staples lath to framework, ceiling joists, and flat concrete surfaces. Bends metal lath to fit corners, or attaches preformed corner reinforcements. Wires plasterer's channels to overhead structural framework to provide support for plaster or acoustical ceiling tile.

Painter (Brush, Roller, and Spray) - Ratio 1Journeyman /3 Helpers
Applies coats of paint, varnish, stain, enamel, or lacquer to decorate and protect interior or exterior surfaces, trimmings, and fixtures of buildings and other structures: Reads work order or receives instructions from supervisor or homeowner regarding painting. Smoothes surfaces, using sandpaper, brushes, or steel wool, and removes old paint from surfaces, using paint remover, scraper, wire brush, or blowtorch to prepare surfaces for painting. Fills nail holes, cracks, and joints with caulk, putty, plaster, or other filler, using caulking gun and putty knife. Selects premixed paints, or mixes required portions of pigment, oil, and thinning and drying substances to prepare paint that matches specified colors. Removes fixtures, such as pictures and electric switchcovers, from walls prior to painting, using screwdriver. Spreads dropcloths over floors and room furnishings, and covers surfaces, such as baseboards, doorframes, and windows with masking tape and paper to protect surfaces during painting. Paints surfaces, using brushes, spray gun, or paint rollers. Simulates wood grain, marble, brick, or tile effects. Applies paint with cloth, brush, sponge, or fingers to create special effects. Erects scaffolding or sets up ladders to perform tasks above ground level.

Pipe fitter * (HVAC Pipe Only) - Ratio 1Journeymen /1 Apprentice (See Schedule included)
Lays out, assembles, installs, and maintains pipe systems, pipe supports, and related hydraulic and pneumatic equipment for steam, hot water, heating, cooling, lubricating, sprinkling, and industrial production and processing systems, applying knowledge of system operation, and following

blueprints: Selects type and size of pipe, and related materials and equipment, such as supports, hangers, and hydraulic cylinders, according to specifications. Inspects work site to determine presence of obstructions and to ascertain that holes cut for pipe will not cause structural weakness. Plans installation or repair to avoid obstructions and to avoid interfering with activities of other workers. Cuts pipe, using saws, pipe cutter, hammer and chisel, cutting torch, and pipe cutting machine. Threads pipe, using pipe threading machine. Bends pipe, using pipe bending tools and pipe bending machine. Assembles and installs variety of metal and nonmetal pipes, tubes, and fittings, including iron, steel, copper, and plastic. Connects pipes, using threaded, caulked, soldered, brazed, fused, or cemented joints, and hand tools. Secures pipes to structure with brackets, clamps, and hangers, using hand tools and power tools. Installs and maintains hydraulic and pneumatic components of machines and equipment, such as pumps and cylinders, using hand tools. Installs and maintains refrigeration and air conditioning systems, including compressors, pumps, meters, pneumatic and hydraulic controls, and piping, using hand tools and power tools, and following specifications and blueprints. Increases pressure in pipe system and observes connected pressure gauge to test system for leaks.

Pipe Fitter * (Excluding HVAC Pipe) – Ratio 1Journeymen /3 Helpers
Lays out, assembles, installs, and maintains pipe systems, pipe supports, and related hydraulic and pneumatic equipment for steam, hot water, heating, cooling, lubricating, sprinkling, and industrial production and processing systems, applying knowledge of system operation, and following blueprints: Selects type and size of pipe, and related materials and equipment, such as supports, hangers, and hydraulic cylinders, according to specifications. Inspects work site to determine presence of obstructions and to ascertain that holes cut for pipe will not cause structural weakness. Plans installation or repair to avoid obstructions and to avoid interfering with activities of other workers. Cuts pipe, using saws, pipe cutter, hammer and chisel, cutting torch, and pipe cutting machine. Threads pipe, using pipe-threading machine. Bends pipe, using pipe bending tools and pipe bending machine. Assembles and installs variety of metal and nonmetal pipes, tubes, and fittings, including iron, steel, copper, and plastic. Connects pipes, using threaded, caulked, soldered, brazed, fused, or cemented joints, and hand tools. Secures pipes to structure with brackets, clamps, and hangers, using hand tools and power tools. Installs and maintains hydraulic and pneumatic components of machines and equipment, such as pumps and cylinders, using hand tools. Installs and maintains refrigeration and air conditioning systems, including compressors, pumps, meters, pneumatic and hydraulic controls, and piping, using hand tools and power tools, and following specifications and blueprints. Increases pressure in pipe system and observes connected pressure gauge to test system for leaks. May weld pipe supports to structural steel members. May observe production machines in assigned area of manufacturing facility to detect machinery malfunctions. May operate machinery to verify repair. May modify programs of automated machinery, such as robots and conveyors, to change motion and speed of machine, using teach pendant, control panel, or keyboard and display screen of robot controller and programmable controller. May be designated Steam Fitter (construction) when installing piping systems that must withstand high pressure

Plasterer * See Plaster Tender - Ratio 1 Journeyman /3 Plaster Tenders
Applies coats of plaster to interior walls, ceilings, and partitions of buildings, to produce finished surface, according to blueprints, architect's drawings, or oral instructions, using hand tools and portable power tools: Directs workers to mix plaster to desired consistency and to erect scaffolds. Spreads plaster over lath or masonry base, using trowel, and smoothes plaster with darby and float to attain uniform thickness. Applies scratch, brown, or finish coats of plaster to wood, metal, or board lath successively. Roughens undercoat with scratcher (wire or metal scraper) to provide bond for succeeding coats of plaster.

Plumber * (Excluding HVAC Pipe) - Ratio 3 Journeymen /2 Apprentice
Assembles, installs, and repairs pipes, fittings, and fixtures of heating, water, and drainage systems, according to specifications and plumbing codes: Studies building plans and working drawings to determine work aids required and sequence of installations. Inspects structure to ascertain obstructions to be avoided to prevent weakening of structure resulting from installation of pipe. Locates and marks position of pipe and pipe connections and passage holes for pipes in walls and floors, using ruler, spirit level, and plumb bob. Cuts openings in walls and floors to accommodate pipe and pipe fittings, using hand tools and power tools. Cuts and threads pipe, using pipe cutters, cutting torch, and pipe-threading machine. Bends pipe to required angle by use of pipe-bending machine or by placing pipe over block and bending it by hand. Assembles and installs valves, pipe fittings, and pipes composed of metals, such as iron, steel, brass, and lead, and nonmetals, such as glass, vitrified clay, and plastic, using hand tools and power tools. Joins pipes by use of screws, bolts, fittings, solder, plastic solvent, and caulks joints. Fills pipe system with water or air and reads pressure gauges to determine whether system is leaking. Installs and repairs plumbing fixtures, such as sinks, commodes, bathtubs, water heaters, hot water tanks, garbage disposal units, dishwashers, and water softeners. Repairs and maintains plumbing by replacing washers in leaky faucets, mending burst pipes, and opening clogged drains.

Roofer - Ratio 1 Journeyman/3 Helpers
Covers roofs with roofing materials other than sheet metal, such as composition shingles or sheets, wood shingles, or asphalt and gravel, to waterproof roofs: Cuts roofing paper to size, using knife, and nails or staples it to roof in overlapping strips to form base for roofing materials. Installs gutters and downs spouts. Aligns roofing material with edge of roof, and overlaps successive layers, gauging distance of overlap with chalk line, gauge on shingling hatchet, or by lines on shingles. Fastens composition shingles or sheets to roof with asphalt, cement, or nails. Punches holes in slate, tile, terra cotta, or wooden shingles, using punch and hammer. Cuts strips of flashing and fits them into angles formed by walls, vents, and intersecting roof surfaces. When applying asphalt or tar and gravel to roof, mops or pours hot asphalt or tar onto roof base. Applies alternate layers of hot asphalt or tar and roofing paper until roof covering is as specified. Applies gravel or pebbles over top layer, using rake or stiff bristled broom.

Sheet metal worker * Ratio 2 Journeymen /1 Apprentice (Including Setting HVAC Duct & System Installs)
Fabricates, assembles, installs and repairs sheet metal products, including sheet metal roof (also see Roofer). Operates soldering and welding equipment to join together sheet metal parts. Seals seams and joints with sealant. Installs roof sheets, trims, flashing, gutters down spouts and other related items. Performs other related duties.

Sprinkler Fitter (Fire) * - Ratio 1 Journeyman /1 Apprentice
Lays out, assembles, installs, and maintains pipe systems, pipe supports, and related hydraulic and pneumatic equipment for steam, hot water, heating, cooling, lubricating, sprinkling, and industrial production and processing systems, applying knowledge of system operation, and following blueprints: Selects type and size of pipe, and related materials and equipment, such as supports, hangers, and hydraulic cylinders, according to specifications. Inspects work site to determine presence of obstructions and to ascertain that holes cut for pipe will not cause structural weakness. Plans installation or repair to avoid obstructions and to avoid interfering with activities of other workers. Cuts pipe, using saws, pipe cutter, hammer and chisel, cutting torch, and pipe cutting machine. Threads pipe, using pipe-threading machine. Bends pipe, using pipe bending tools and pipe bending machine. Assembles and installs variety of metal and nonmetal pipes, tubes, and fittings, including iron, steel, copper, and plastic. Connects pipes, using threaded, caulked, soldered, brazed, fused, or cemented joints, and hand tools. Secures pipes to structure with

brackets, clamps, and hangers, using hand tools and power tools. Installs and maintains hydraulic and pneumatic components of machines and equipment, such as pumps and cylinders, using hand tools. Installs and maintains refrigeration and air conditioning systems, including compressors, pumps, meters, pneumatic and hydraulic controls, and piping, using hand tools and power tools, and following specifications and blueprints. Increases pressure in pipe system and observes connected pressure gauge to test system for leaks. May weld pipe supports to structural steel members. May observe production machines in assigned area of manufacturing facility to detect machinery malfunctions.
May operate machinery to verify repair. May modify programs of automated machinery, such as robots and conveyors, to change motion and speed of machine, using teach pendant, control panel, or keyboard and display screen of robot controller and programmable controller.

Tile Finisher - Ratio 1 Journeyman /3 Helpers
Supplies and mixes construction materials for TILE SETTER (construction) 861.381-054, applies grout, and cleans installed tile: Moves tiles, tile setting tools, and work devices from storage area to installation site manually or using wheelbarrow. Mixes mortar and grout according to standard formulas and request from TILE SETTER (construction), using bucket, water hose, spatula, and portable mixer. Supplies TILE SETTER (construction) with mortar, using wheelbarrow and shovel. Applies grout between joints of installed tile, using grouting trowel. Removes excess grout from tile joints with wet sponge and scrapes corners and crevices with trowel. Wipes surface of tile after grout has set to remove grout residue and polish tile, using nonabrasive materials. Cleans installation site, mixing and storage areas, and installation machines, tools, and equipment, using water and various cleaning tools. Stores tile setting materials, machines, tools, and equipment. May apply caulk, sealers, acid, steam, or related agents to caulk, seal, or clean installed tile, using various application devices and equipment. May modify mixing, grouting, grinding, and cleaning procedures according to type of installation or material used. May assist TILE SETTER (construction) to position and secure metal lath, wire mesh, or felt paper prior to installation of tile. May cut marked tiles to size, using power saw or tile cutter.

Tile Setter - Ratio 1 Journeyman /3 Helpers
Applies tile to walls, floors, ceilings, and promenade roof decks, following design specifications: Examines blueprints, measures and marks surfaces to be covered, and lays out work. Measures and cuts metal lath to size for walls and ceilings with tin snips. Tacks lath to wall and ceiling surfaces with staple gun or hammer. Spreads plaster base over lath with trowel and levels plaster to specified thickness, using screed. Spreads concrete on sub floor, with trowel and levels it with screed.
Spreads mastic or other adhesive base on roof deck, using serrated spreader to form base for promenade tile. Cuts and shapes tile with tile cutters and biters. Positions tile and taps it with trowel handle to affix tile to plaster or adhesive base.

Truck Driver
Drives truck with capacity of more than 3 tons, to transport materials to and from specified destinations: Drives truck to destination, applying knowledge of commercial driving regulations and area roads. Prepares receipts for load picked up. Collects payment for goods delivered and for delivery charges. May maintain truck log, according to state and federal regulations. May maintain telephone or radio contact with supervisor to receive delivery instructions. May load and unload truck. May inspect truck equipment and supplies, such as tires, lights, brakes, gas, oil, and water. May perform emergency roadside repairs, such as changing tires, installing light bulbs, tire chains, and spark plugs. May position blocks and tie rope around items to secure cargo during transit.

Common Laborer
Performs any combination of the following tasks in erecting, repairing and wrecking buildings; dig, spread and level dirt and gravel; lift carry and hold building materials, tools and supplies; clean tools, equipment, materials and work areas; mix, pour and spread concrete, asphalt, gravel and other materials; join, wrap and seal sections of pipe; routine non-machine tasks such as removing forms from set concrete, filling expansion joints with asphalt, and placing culverts in trench. May also signal construction equipment operators; measure distances from grade stakes, drive stakes and stretch lines; bolt, nail align and block up under forms; mix and finish poured concrete, erect scaffolding; spread paint or coating to seal surfaces; caulking compounds to seal surfaces; remove projections from concrete, and mount pipe hangers.

Mason Tender Brick (Bricklayer's Helper)

Mason Tender Cement (Concrete Mason's / Concrete Finisher's Helper)

Pipe layer
Lay pipe for storm or sanitation sewers, drains, and water mains. Perform any combination of the following tasks: grade trenches or culverts, position pipe, or seal joints.

Plaster Tender (Plaster's Helper)
Tends machine that pumps plaster or stucco through spray gun for application to ceilings, walls, and partitions of buildings: Starts and stops machine on signals from PLASTERER (construction). Fills hopper of machine with plaster. Turns valves to regulate pump and compressor. Assists in erecting scaffolds.

Power Equipment Operator:

Asphalt Paver (operator)
Operator; bituminous-paving-machine operator; blacktop-paver operator; blacktop spreader; mechanical-spreader operator; paving-machine operator, asphalt or bituminous. Operates machine that spreads and levels hot-mix bituminous paving material on sub grade of highways and streets: Bolts extensions to screed to adjust width, using wrenches. Lights burners to heat screed. Starts engine and controls paving machine to push dump truck and maintain constant flow of asphalt into hopper. Observes distribution of paving material along screed and controls direction of screed to eliminate voids at curbs and joints. Turns valves to regulate temperature of asphalt flowing from hopper when asphalt begins to harden on screed.

Backhoe (operator)
Operates power-driven machine, equipped with movable shovel, to excavate or move coal, dirt, rock, sand, and other materials: Receives written or oral instructions from supervisor regarding material to move or excavate. Pushes levers and depresses pedals to move machine, to lower and push shovel into stockpiled material, to lower and dig shovel into surface of ground, and to lift, swing, and dump contents of shovel into truck, car, or onto conveyor, hopper, or stockpile. Observes markings on ground, hand signals, or grade stakes to remove material, when operating machine at excavation site.

Crane (operator)
Operates electric-, diesel-, gasoline-, or steam-powered guy-derrick or stiff-leg derrick (mast

supported by fixed legs or tripod), to move products, equipment, or materials to and from quarries, storage areas, and processes, or to load and unload trucks or railroad cars: Pushes and pulls levers and depresses pedals to raise, lower, and rotate boom and to raise and lower load line in response to signals.

Forklift (operator)
Drives gasoline-, liquefied gas-, or electric-powered industrial truck equipped with lifting devices, such as forklift, boom, scoop, lift beam and swivel-hook, fork-grapple, clamps, elevating platform, or trailer hitch, to push, pull, lift, stack, tier, or move products, equipment, or materials in warehouse, storage yard, or factory: Moves levers and presses pedals to drive truck and control movement of lifting apparatus. Positions forks, lifting platform, or other lifting device under, over, or around loaded pallets, skids, boxes, products, or materials or hooks tow trucks to trailer hitch, and transports load to designated area. Unloads and stacks material by raising and lowering lifting device.

Slab & Wall Saw (See Related Power Equipment Operator Above)
Use associated power equipment operators already defined.

Apprentices
Apprentices may be used in any of the crafts listed above where noted, if they are currently certified in a program recognized by the Bureau of Apprenticeship and Training, U.S. Department of Labor, providing the proper ratio between journeyman and apprentice is observed. Apprentice certification certificates must be supplied with the first weekly payroll upon which the apprentice's name appears.

Helper (65% of the journeyman classification)
(Must not exceed 3 helpers to 1 journeyman)
A Helper is a semi-skilled worker (rather than a skilled journeyman) who works under the direction of and assists a journeyman. Under the journeyman's direction and supervision, the helper performs a variety of duties to assist the journeyman such as preparing, carrying, and furnishing equipment, supplies and maintaining them in order; cleaning and preparing work areas; lifting, positioning, and holding materials or tools; and other related semi-skilled tasks as directed by the journeyman. A helper may use the tools of the trade at and under the direction of the journeyman. The particular duties performed by a helper vary according to area practice. The journeyman must work in close proximity to the location of the helpers work area. The helpers wage rate shall be calculated at no less than 65% of the prevailing wage for that journeyman's classification.

Helper who assists more than one journeyman craft should be listed with the notation indicating each journeyman craft classification they assist.

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

Pipe fitters * Apprentice Schedule (Excluding HVAC Pipe)

Journeyma	Indentured Apprentice	Apprentice Applicant	Total
1	1	0	1 to 1
3	2	1	3 to 3
5	3	2	5 to 5
8	4	3	8 to 7
12	5	4	12 to 9
16	6	5	16 to 11
20	7	6	20 to 13
25	8	7	25 to 15
30	9	8	30 to 17
40	10	9	40 to 19
50	11	10	50 to 21

NOTE: Continue after 50 Journeyman — ONE (1) Indentured Apprentice and one (1) Apprentice Applicant for every ten (10) Journeyman

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*** When Apprentices are shown, Helpers cannot be utilized**

APPRENTICES (see definitions)

Registered Apprenticeship Ratios

For All Apprentices

Apprentice duties consist but are not limited to reading blue prints, lay out, fabrication, installation, and assembly. Other duties are the setting up and operation of fabrication machines, using hand tools, power tools, lifting/handling devices, sealing if necessary according to their particular craft. Apprentices also are trained in the preparation process of a job that include but not limited to staging, planning, distribution, and sectioning of materials. Apprentices may be used in any of the crafts listed where noted on the Prevailing Wage Rate Schedule, if they are currently certified in a program recognized by the Bureau of Apprenticeship and Training, U.S. Department of Labor, providing the proper ratio between journeyman and apprentice is observed. Apprentice certification certificates must be supplied with the first weekly payroll upon which the apprentice's name appears. Helpers or Laborers cannot be utilized when Apprentices are shown

Asbestos Worker / Insulator

City of Houston allows the use of 1 Journeyman and 1 Apprentice, the Apprentice can be used with the first Journeyman. No other Apprentices can be added until the 2th Journeyman is added. All Apprentices are to be under the direct supervision of a Journeyman.
1 Journeyman w/ 1 Apprentice
2 Journeymen w/ 2 Apprentices

Boilermakers

City of Houston allows the use of 5 Journeymen and 1 Apprentice, the Apprentice can be used with the first Journeyman. No other Apprentices can be added until the 6th Journeyman is added. All Apprentices are to be under the direct supervision of a Journeyman.
1-5 Journeymen w/ 1 Apprentice
6-10 Journeymen w/ 2 Apprentices

Carpenter

City of Houston allows the use of 2 Journeymen and 1 Apprentice, the Apprentice can be used with the first Journeyman. No other Apprentices can be added until the 4th Journeyman is added. All Apprentices are to be under the direct supervision of a Journeyman.
1-2 Journeymen w/ 1 Apprentice
3-4 Journeymen w/ 2 Apprentices
5-6 Journeymen w/ 3 Apprentices

Electrician

City of Houston allows the use of 3 Journeymen and 2 Apprentices, the Apprentice can be used with the first Journeyman. No other Apprentices can be added until the 3rd Journeyman is added. All Apprentices are to be under the direct supervision of a Journeyman. All Journeymen and Apprentices must hold a current license from the State of Texas.

1 Journeyman w/ 1 Apprentice
2 Journeymen w/ 1 Apprentice
3 Journeymen w/ 2 Apprentices
4 Journeymen w/ 3 Apprentices
5 Journeymen w/ 3 Apprentices
6 Journeymen w/ 4 Apprentices
7 Journeymen w/ 4 Apprentices
8 Journeymen w/ 4 Apprentices
9 Journeymen w/ 4 Apprentices
10 Journeymen w/ 5 Apprentices

Plumbers

City of Houston allows the use of 3 Journeymen and 2 Apprentices, the Apprentice can be used with the first Journeyman. No other Apprentices can be added until the 3rd Journeyman is added. All Apprentices are to be under the direct supervision of a Journeyman. All Journeymen and Apprentices must hold a current license from the State of Texas.

1 Journeyman w/ 1 Apprentice
2 Journeymen w/ 1 Apprentice
3 Journeymen w/ 2 Apprentices
4 Journeymen w/ 3 Apprentices
5 Journeymen w/ 3 Apprentices
6 Journeymen w/ 4 Apprentices
7 Journeymen w/ 4 Apprentices
8 Journeymen w/ 4 Apprentices
9 Journeymen w/ 4 Apprentices
10 Journeymen w/ 5 Apprentices

Sprinkler Fitter

City of Houston allows the use of 1 Journeyman and 1 Apprentice, the Apprentice can be used with the first Journeyman. No other Apprentices can be added until the 2th Journeyman is added. All Apprentices are to be under the direct supervision of a Journeyman.

1 Journeyman w/ 1 Apprentice
2 Journeymen w/ 2 Apprentices
Sheetmetal Worker

City of Houston allows the use of 2 Journeymen and 1 Apprentice, the Apprentice can be used with the first Journeyman. No other Apprentices can be added until the 4th Journeyman is added. All Apprentices are to be under the direct supervision of a Journeyman.

1-2 Journeymen w/ 1 Apprentice
3-4 Journeymen w/ 2 Apprentices
5-6 Journeymen w/ 3 Apprentices

Pipefitter

City of Houston allows the use of 1 Journeymen and 1 Apprentice, the Apprentice can be used with the first Journeyman. No other Apprentices can be added until the 4th Journeyman is added. All Apprentices are to be under the direct supervision of a Journeyman.

1 Journeyman w/ 1 Apprentice
2 Journeymen w/ 1 Apprentice
3 Journeymen w/ 2 Apprentices
4 Journeymen w/ 3 Apprentices
5 Journeymen w/ 3 Apprentices
6 Journeymen w/ 4 Apprentices
7 Journeymen w/ 4 Apprentices
8 Journeymen w/ 4 Apprentices
9 Journeymen w/ 4 Apprentices
10 Journeymen w/ 5 Apprentices

HELPER (see definitions)

(Must not exceed 3 helpers to 1 journeyman)
A Helper is a semi-skilled laborer (rather than a skilled journeyman) who works under the direction of and assists a journeyman. Under the journeyman's direction and supervision, the helper

performs a variety of duties to assist the journeyman such as preparing, carrying, and furnishing equipment, supplies and maintaining them in order; cleaning and preparing work areas; lifting, positioning, and holding materials or tools; and other related semi-skilled tasks as directed by the journeyman. A helper may use the tools of the trade at and under the direction of the journeyman. The particular duties performed by a helper vary according to area practice. The journeyman must work in close proximity to the location of the helpers work area. The helper's wage rate shall be calculated at no less than 65% of the prevailing wage for that journeyman's classification. Helper who assists more than one journeyman craft should be listed with the notation indicating each journeyman craft classification they assist.

Welders
Receive rate prescribed for craft performing operation is which welding is incidental

Pipefitters * Apprentice Schedule (Excluding HVAC Pipe)

NOTE: Continue after 50 Journeyman - ONE (1) Indentured Apprentice and one (1) Apprentice Applicant for every ten (10) Journeyman

Journeyman	Indentured Apprentice	Apprentice Applicant	Total
1	1	0	1 to 1
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8	4	3	8 to 7
12	5	4	12 to 9
16	6	5	16 to 11
20	7	6	20 to 13
25	8	7	25 to 15
30	9	8	30 to 17
40	10	9	40 to 19
50	11	10	50 to 21

When Apprentices are shown, Helpers cannot be utilized

If there are questions as to the classification of a worker, contact the Contract Compliance Officer in writing with a description of the work to be performed. After review the Contract Compliance Officer will respond in writing with the classification and wage rate to be paid the worker in question.

Fringe Benefits

If the worker is not receiving fringe benefits, they must be paid in cash if noted on the prevailing wage schedule along with the base rate. The term wages means the basic hourly rate of pay; any contribution irrevocably made by a contractor or subcontractor to a trustee or to a third person pursuant to a bona fide fringe benefit fund, plan, or program; and the rate of costs to the

contractor or subcontractor which may be reasonably anticipated in providing bona fide fringe benefits to laborers and mechanics pursuant to an enforceable commitment to carry out a financially responsible plan of program, which was communicated in writing to the laborers and mechanics affected. The fringe benefits enumerated in the Davis-Bacon Act include medical or hospital care, pensions on retirement or death, compensation for injuries or illness resulting from occupational activity, or insurance to provide any of the foregoing; unemployment benefits; life insurance, disability insurance, sickness insurance, or accident insurance; vacation or holiday pay; defraying costs of apprenticeship or other similar programs; or other bona fide fringe benefits. Fringe benefits do not include benefits required by other Federal, State, or local law. The prevailing wages (including fringe benefits) as adopted for this contract are based upon a survey performed under the Davis-Bacon Act. Thus determinations in regard to fringe benefits, to the extent practicable, will be based upon the standards set forth in the following federal regulations.

Title 29, Code of Federal Regulations, Part 4
Labor Standards for Federal Service Contracts

(29 CFR 4.169-4.171)

29 CFR 4.170 - Furnishing fringe benefits or equivalents.

(a) General. Fringe benefits required under the Act shall be furnished, separate from and in addition to the specified monetary wages, by the contractor or subcontractor to the employees engaged in performance of the contract, as specified in the determination of the Secretary or his authorized representative and prescribed in the contract documents. Section 2(a)(2) of the Act provides that the obligation to furnish the specified benefits "may be discharged by furnishing any equivalent combinations of fringe benefits or by making equivalent or differential payments in cash under rules and regulations established by the Secretary." The governing rules and regulations for furnishing such equivalents are set forth in Sec. 4.177 of this subpart. An employer cannot offset an amount of monetary wages paid in excess of the wages required under the determination in order to satisfy his fringe benefit obligations under the Act, and must keep appropriate records separately showing amounts paid for wages and amounts paid for fringe benefits.
(b) Meeting the requirement, in general. The various fringe benefits listed in the Act and in Sec. 4.162(a) are illustrative of those which may be found to be prevailing for service employees in a particular locality. The benefits which an employer will be required to furnish employees performing on a particular contract will be specified in the contract documents. A contractor may dispose of certain of the fringe benefit obligations which may be required by an applicable fringe benefit determination, such as pension, retirement, or health insurance, by irrevocably paying the specified contributions for fringe benefits to an independent trustee or other third person pursuant to an existing "bona fide" fund, plan, or program on behalf of employees engaged in work subject to the Act's provisions. Where such a plan or fund does not exist, a contractor must discharge his obligation relating to fringe benefits by furnishing either an equivalent combination of "bona fide" fringe benefits or by making equivalent payments in cash to the employee, in accordance with the regulations in Sec. 4.177.

29 CFR 4.171 – "Bona fide" fringe benefits.

(a) To be considered a ``bona fide" fringe benefit for purposes of the Act, a fringe benefit plan, fund, or program must constitute a legally enforceable obligation, which meets the following criteria:

(1) The provisions of a plan, fund, or program adopted by the contractor, or by contract as a result of collective bargaining, must be specified in writing, and must be communicated in writing to the affected employees. Contributions must be made pursuant to the terms of such plan, fund, or program. The plan may be either contractor-financed or a joint contractor employee contributory plan. For example, employer contributions to Individual Retirement Accounts (IRAs) approved by IRS are permissible. However, any contributions made by employees must be voluntary, and if such contributions are made through payroll deductions, such deductions must be made in accordance with Sec. 4.168. No contribution toward fringe benefits made by the employees themselves, or fringe benefits provided from monies deducted from the employee's wages may be included or used by an employer in satisfying any part of any fringe benefit obligation under the Act.

(2) The primary purpose of the plan must be to provide systematically for the payment of benefits to employees on account of death, disability, advanced age, retirement, illness, medical expenses, hospitalization, supplemental unemployment benefits, and the like.

(3) The plan must contain a definite formula for determining the amount to be contributed by the contractor and a definite formula for determining the benefits for each of the employees participating in the plan.

(4) Except as provided in paragraph (b), the contractor's contributions must be paid irrevocably to a trustee or third person pursuant to an insurance agreement, trust or other funded arrangement. The trustee must assume the usual fiduciary responsibilities imposed upon trustees by applicable law. The trust or fund must be set up in such a way that the contractor will not be able to recapture any of the contributions paid in nor in any way divert the funds to its own use or benefit.

(5) Benefit plans or trusts of the types listed in 26 U.S.C. 401(a) which are disapproved by the Internal Revenue Service as not satisfying the requirements of section 401(a) of the Internal Revenue Code or which do not meet the requirements of the Employee Retirement Income Security Act of 1974, 29 U.S.C. 1001, et seq. and regulations thereunder, are not deemed to be ``bona fide" plans for purposes of the Service Contract Act.

(6) It should also be noted that such plans must meet certain other criteria as set forth in Sec. 778.215 of 29 CFR part 778 in order for any contributions to be excluded from computation of the regular rate of pay for overtime purposes under the Fair Labor Standards Act (Secs. 4.180-4.182).

(b)(1) Unfunded self-insured fringe benefit plans (other than fringe benefits such as vacations and holidays which by their nature are normally unfunded) under which contractors allegedly make "out of pocket" payments to provide benefits as expenses may arise, rather than making irrevocable contributions to a trust or other funded arrangement as required under Sec. 4.171(a)(4), are not normally considered "bona fide" plans or equivalent benefits for purposes of the Act.

(2) A contractor may request approval by the Administrator of an unfunded self-insured plan in order to allow credit for payments under the plan to meet the fringe benefit requirements of the Act. In considering whether such a plan is bona fide, the Administrator will consider such factors as whether it could be reasonably anticipated to provide the prescribed benefits, whether it represents a legally enforceable commitment to provide such benefits, whether it is carried out under a financially responsible program, and whether the plan has been communicated to the employees in writing. The Administrator in his/her discretion may

direct that assets be set aside and preserved in an escrow account or that other protections be afforded to meet the plan's future obligation.

(c) No benefit required by any other Federal law or by any State or local law, such as unemployment compensation, workers' compensation, or social security, is a fringe benefit for purposes of the Act.

(d) The furnishing to an employee of board, lodging, or other facilities under the circumstances described in Sec. 4.167, the cost or value of which is creditable toward the monetary wages specified under the Act, may not be used to offset any fringe benefit obligations, as such items and facilities are not fringe benefits or equivalent benefits for purposes of the Act.

(e) The furnishing of facilities which are primarily for the benefit or convenience of the contractor or the cost of which is properly a business expense of the contractor is not the furnishing of a "bona fide" fringe benefit or equivalent benefit or the payment of wages. This would be true of such items, for example, as relocation expenses, travel and transportation expenses incident to employment, incentive or suggestion awards, and recruitment bonuses, as well as tools and other materials and services incidental to the employer's performance of the contract and the carrying on of his business, and the cost of furnishing, laundering, and maintaining uniforms and/or related apparel or equipment where employees are required by the contractor, by the contractor's Government contract, by law, or by the nature of the work to wear such items. See also Sec. 4.168.

(f) Contributions by contractors for such items as social functions or parties for employees, flowers, cards, or gifts on employee birthdays, anniversaries, etc. (sunshine funds), employee rest or recreation rooms, paid coffee breaks, magazine subscriptions, and professional association or club dues, may not be used to offset any wages or fringe benefits specified in the contract, as such items are not ``bona fide" wages or fringe benefits or equivalent benefits for purposes of the Act.

EXHIBIT "B"

CERTIFICATE FROM CONTRACTOR APPOINTING OFFICER OR EMPLOYEE TO SUPERVISE PAYMENT OF EMPLOYEES

Project Name _____

_____

Project WBS#:_____Date_____

(I) (We) hereby certify that (I am) (we are) the **Prime Contractor** for _____

_____
(specify type of job)

in connection with construction of the above-mentioned Project, and that (I) (we) have appointed_____, whose signature appears below, to supervise the payment of (my) (our) employees beginning_____, 20___; that he/she is in a position to have full knowledge of the facts set forth in the payroll documents and in the statement of compliance required by the Copeland Act and the City of Houston, which he/she is to execute with (my) (our) full authority and approval until such time as (I) (we) submit to the City of Houston a new certificate appointing some other person for the purposes hereinabove stated.

_____ Phone:_____
(Identifying Signature of Appointee)

Attest: _____
(Name of Firm or Corporation)

By:_____ By:_____
(Signature) (Signature)

_____ _____
(Title) (Title)

NOTE: This certificate must be executed by an authorized officer of a corporation or by a member of a partnership, and shall be executed prior to and be submitted with the first payroll. Should the appointee be changed, a new certificate must accompany the first payroll for which the new appointee executes a statement of compliance required by the Copeland Act and the City of Houston.

EXHIBIT "C"

CERTIFICATE FROM SUBCONTRACTOR APPOINTING OFFICER OR EMPLOYEE TO SUPERVISE PAYMENT OF EMPLOYEES

Project Name _____

_____

Project WBS#:_____Date_____

(I) (We) hereby certify that (I am) (we are) the **Sub Contractor** for _____

_____
(specify type of job)

in connection with construction of the above-mentioned Project, and that (I) (we) have appointed_____, whose signature appears below, to supervise the payment of (my) (our) employees beginning_____, 20___; that he/she is in a position to have full knowledge of the facts set forth in the payroll documents and in the statement of compliance required by the Copeland Act and the City of Houston, which he/she is to execute with (my) (our) full authority and approval until such time as (I) (we) submit to the City of Houston a new certificate appointing some other person for the purposes hereinabove stated.

_____ Phone:_____
(Identifying Signature of Appointee)

Attest: _____
(Name of Firm or Corporation)

By:_____ By:_____
(Signature) (Signature)

_____ _____
(Title) (Title)

NOTE: This certificate must be executed by an authorized officer of a corporation or by a member of a partnership, and shall be executed prior to and be submitted with the first payroll. Should the appointee be changed, a new certificate must accompany the first payroll for which the new appointee executes a statement of compliance required by the Copeland Act and the City of Houston.

END OF DOCUMENT

Document 00830

TRENCH SAFETY GEOTECHNICAL INFORMATION

1.0 DOCUMENT INCLUDES

A. Trench Safety Geotechnical Information: Geotechnical information obtained for use in design of the trench safety system is included as an attachment to this document.

2.0 RELATED DOCUMENTS

A. Section 02260 - Trench Safety Systems.

END OF DOCUMENT

GEOTEST ENGINEERING, INC.

Geotechnical Engineers & Materials Testing

5600 Bintliff Drive Houston, Texas 77036 Telephone: (713) 266-0588
Fax: (713) 266-2977

Job No. 1140204601
Trench Safety Report
October 6, 2014

Ms. Yue Sun, P.E., BCEE
Principal Engineer
CDM Smith
3050 Post Oak Blvd, Suite 300
Houston, Texas 77056

Reference: Trench Safety Design Considerations
High Service Pump Station (HSPS) Improvements
At the Northeast Water Purification Plant (NEWPP)
WBS No. S-000066-012A-4
Houston, Texas

Dear Ms. Sun:

We are pleased to present our geotechnical information for trench safety for the referenced project.

For trench excavation, it is essential to maintain the stability of the sides and base and not to disturb the soil below the excavation grade. This is necessary to prevent any damage to adjacent facilities as a result of either vertical or lateral movements of the soil. In addition, a satisfactory excavation procedure must include an adequate construction dewatering system to lower and maintain the water level at least 3 feet below the lowest excavation grade or a minimum of 5 feet below prevailing level of backfill during backfilling. This will minimize the potential for softening or "boiling" of the base support soil.

Excavation Stability. The open excavation may be shored or supported by some other equivalent means used to provide safety for workers and adjacent structures, if any. The excavating operations should be in accordance with OSHA Standards, OSHA 2207, Subpart P, latest revision and the City of Houston Standard Specification.

- Excavation Shallower Than 5 Feet - Excavations that are less than 5 feet deep **(critical height)** should be effectively protected when an indication of dangerous ground movement is anticipated.

- Excavations Deeper Than 5 Feet - Excavations that are deeper than 5 feet should be sloped, shored, sheeted, braced or supported by some other equivalent means or protection such that workers are not exposed to moving ground or cave-ins. The shoring should be in accordance with the trench safety requirements as per OSHA Standards. The following items provide design criteria for excavation stability.

  (i) OSHA Soil Type. Based on the soil conditions revealed by borings drilled for this study and assumed groundwater level at surface, OSHA soil type "C" should be used for determination of allowable maximum slope and/or the design of shoring along the alignment for full proposed depth of open excavation. For shoring deeper than 20 feet (if needed), an engineering evaluation is required and deeper soil borings will be needed.

  (ii) Excavation Support Earth Pressure. Based on the subsurface conditions indicated by our field investigation and laboratory testing results, excavation support earth pressure diagram was developed and is presented on Figure 1. This pressure diagram can be used for the design of temporary trench bracing. For a trench box, a lateral earth pressure resulting from an equivalent fluid with a unit weight of 92 pcf can be used. The effects of any surcharge loads at the ground surface should be added to the computed lateral earth pressures. A surcharge load, q, will typically result in a lateral load equal to 0.5 q. The above value of equivalent fluid pressure is based on assumption that the groundwater level is near the ground surface, since these conditions may exist after a heavy rain or flooding.

  (iii) Bottom Stability. In braced cuts, if tight sheeting is terminated at the base of the cut, the bottom of the excavation can become unstable. The parameters that govern the stability of the excavation base are the soil shear strength and the differential hydrostatic head between the groundwater level within the retained soils and the groundwater level at the interior of the trench excavation. For cut in

cohesive soils as encountered for the proposed excavation depths less than 10 feet, the bottom stability can be evaluated as outlined on Figure 2.

Groundwater Control. Excavations for the proposed pipelines may encounter groundwater seepage to varying degrees depending upon the groundwater conditions at the time of construction and the location and depth of the trench. Based on the soil conditions identified in the boring for the proposed pipeline installation, all the excavation will be in cohesive soils.

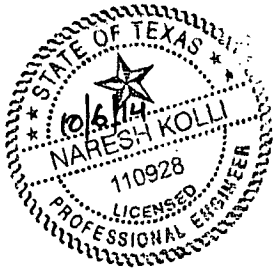
In general for cohesive soils as encountered for the excavation depths of less than 10 feet, the groundwater if encountered may be managed by collection in excavation bottom sumps for pumped disposal. It is recommended that the actual groundwater conditions should be verified by the contractor at the time of construction and that groundwater control should be performed in general accordance with the City of Houston Standard Specifications, Section 01578.

We appreciate this opportunity to be of service to you. If you have any questions regarding the report, or if we can be of further service to you, please call us.

Sincerely,
GEOTEST ENGINEERING, INC.
TBPE Registration No. F-410

K. Naresh

Naresh Kolli, P.E.
Assistant Project Manager



NK\ego
Copies Submitted: (2)
Enclosures: Trench Support Earth Pressure – Figure 1
Stability of Bottom for Braced Cut – Figure 2
Geotechnical Design Parameter Summary: Open-cut Excavation – Table 1
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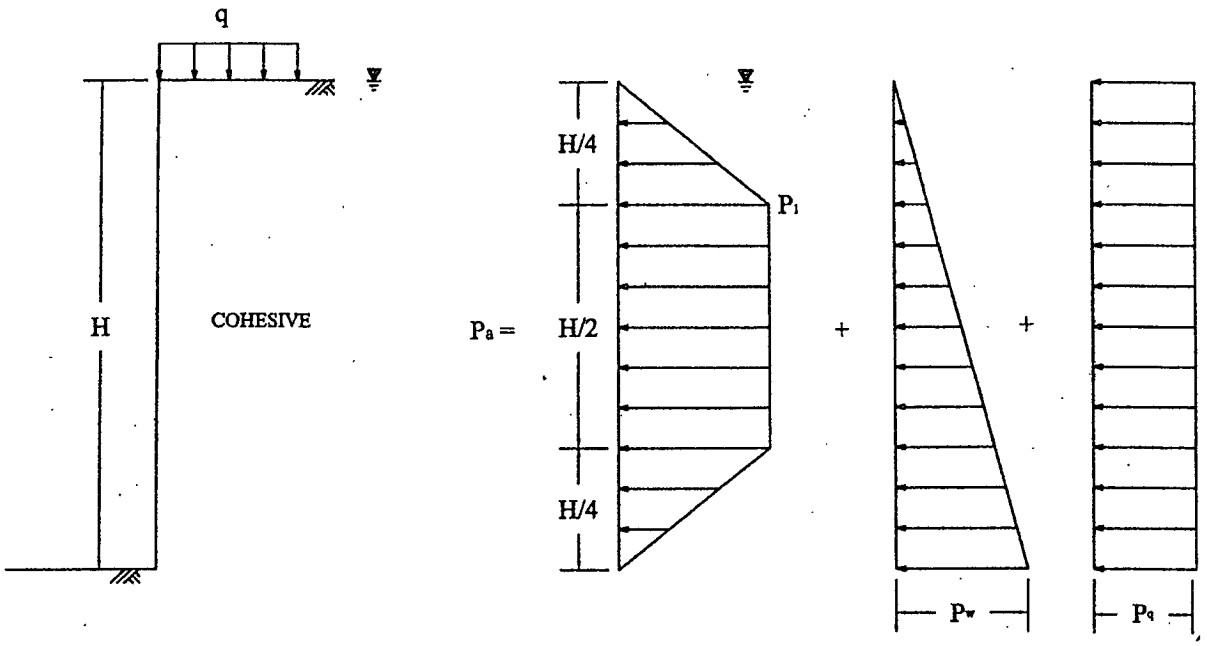
Job No. 1140204601



TYPICAL SOIL PARAMETERS

See Table 1 for typical values of soil parameters

BRACED WALL

For $\gamma H/c \leq 4$

$P_l = 0.3\ \gamma_c' H$
$P_w = \gamma_w H = 62.4\ H$
$P_q = 0.5\ q$

Where:

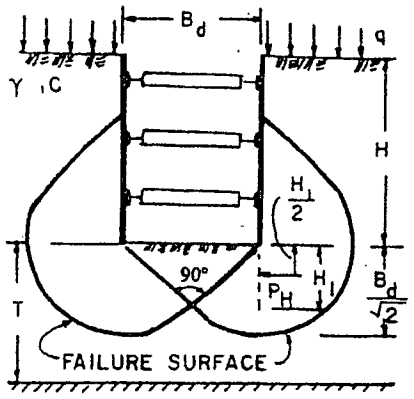
γ_c' = Submerged unit weight of cohesive soil, pcf;
γ_w = Unit weight of water, pcf;
q = Surcharge load at surface, psf;
P_a = Lateral pressure, psf;
P_l = Active earth pressure, psf;
P_q = Horizontal pressure due to surcharge, psf;
P_w = Hydrostatic pressure due to groundwater, psf;
H = Depth of braced excavation, feet
c = Shear strength of cohesion soil, psf;

TRENCH SUPPORT EARTH PRESSURE

SUBMERGED COHESIVE SOIL

Job No. 1140204601

CUT IN COHESIVE SOIL,
DEPTH OF COHESIVE SOIL UNLIMITED ($T > 0.7\ B_d$)
L = LENGTH OF CUT



If sheeting terminates at base of cut:

$$\text{Safety factor, } F_S = \frac{N_C C}{\gamma H + q}$$

N_C = Bearing capacity factor, which depends on dimensions of the excavation : B_d, L and H (use N_C from graph below)

C = Undrained shear strength of clay in failure zone beneath and surrounding base of cut

γ = Wet unit weight of soil (see Table 1)

q = Surface surcharge (assumed q = 500 psf)

If safety factor is less than 1.5, sheeting or soldier piles must be carried below the base of cut to insure stability - (see note)

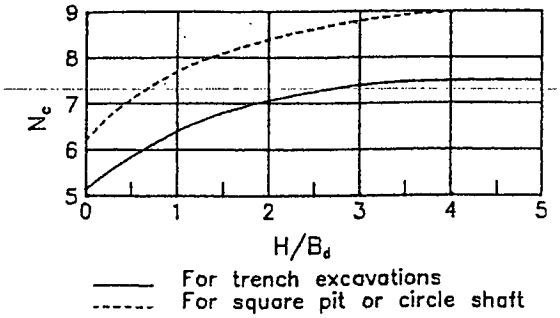
H_1 = Buried length = $\frac{B_d}{2} \geq 5$ feet

Note : If soldier piles are used, the center to center spacing should not exceed 3 times the width or diameter of soldier pile .

Force on buried length, P_H:

If $H_1 > \frac{2}{3}\frac{B_d}{\sqrt{2}}$, $P_H = 0.7\ (\gamma H B_d - 1.4CH - \pi C B_d)$ in lbs/ linear foot

If $H_1 < \frac{2}{3}\frac{B_d}{\sqrt{2}}$, $P_H = 1.5H_1\ (\gamma H - \frac{1.4CH}{B_d} - \pi C)$ in lbs/ linear foot



STABILITY OF BOTTOM
FOR
BRACED CUT

FIGURE 2

TABLE 1

GEOTECHNICAL DESIGN PARAMETER SUMMARY
OPEN-CUT EXCAVATION

Boring Nos.	Stratigraphic Unit	Range of Depths, ft	Wet Unit Weight, γ, pcf	Submerged Unit Weight, γ', pcf	Undrained Cohesion, psf	Internal Friction Angle, φ, degree
GB-1 and GB-2	Cohesive	0-2	120	60	1,500	--
		2-14	120	60	800	--
		14-20	125	63	1,000	--

Note: 1) Cohesive soils include Fat Clay and Lean Clay w/sand.

City of Houston
Pay or Play Program Requirements

I. Pay or Play Program Overview

A. Purpose

The Pay or Play Program was established with Ordinance 2007-534 on July 1, 2007 and is governed by Executive Order 1-7. The Pay or Play Program (POP Program) creates a more level playing field and enhances fairness in the bid process between competing contractors that choose to offer health benefits to their workforce and those who do not. The program also recognizes and accounts for the fact that there are cost associated with health care of the uninsured citizens of the Houston and Harris County area.

B. Program Elements

1. Covered contracts:

I.) Advertised after July 1, 2007 or which is executed on or after the effective date of this Executive Order.
II.) Contracts valued at or above $100,000.00 (contract) and $200,000.00 (sub-contract) including contingencies, amendments, supplemental terms and/or change orders.
III.) Professional Service, Construction, and Service type contracts.

2. Contracts not covered:

I.) Any contract in which the primary purpose is procurement of property, goods, supplies, and or equipment.
II.) An inter-governmental contract, inter-governmental agreement or purchasing cooperative.

3. Covered employees: This program applies to employees of a covered contractor or subcontractor, including contract labor, who are over age 18, work at least 30 hours per week and work any amount of time under a covered city contract or subcontract.

4. Pay or Play Option:

I.) "Pays" by contributing $1.00 per covered employee per regular hour for work performed under the contract with the City; or
II.) "Plays" by providing health benefits to covered employees. Health benefits must meet or exceed the following standards:

- The **employer will contribute no less than $150 per covered employee per month** toward the total premium cost.
- The **employee contribution, if any amount, will be no greater than 50% of the monthly premium cost and no more than $150 per month.**

Note: (1)A contractor is deemed to have complied with section 5.4 of E.O. 1-7 with respect to a covered employee who is not provided health benefits if the employee refuses the benefits and the employee's contribution to the premium is no more than $40 per month. (2) If applicable the contractor has the option to both Pay and Play.

5. **Exemptions/Waivers:** The City of Houston will award a contract to a contractor that neither Pays nor Plays only if the contractor has received an approved waiver (Form POP-4 requested by City departments only).

6. **Administration**: Contractor performance in meeting Pay or Play program requirements will be managed by the contracting department. The Office of Business Opportunity (OBO) has administrative oversight of the program, including audit responsibilities (department compliance). Questions about the program should be referred to the Department POP Liaison an updated contact list is available on http://www.houstontx.gov/obo/popforms.html or call Gracie Orr with the Office of Business Opportunity at 832-393-0633.

II. Documentation and Reporting Requirements

A. Document that must be signed and returned to administering department with the bid/proposal.

1.) City of Houston Pay or Play Program Acknowledgment Form (Form POP-1) acknowledges bidder/proposers' knowledge of the program and its requirements, and the intention to comply.

B. Documents that must be signed and returned to administering department within a period designated by the department's Contract Administrator, upon notification of low bidder or successful proposer status:

1.) Certification of Compliance with Pay or Play Program (Form POP-2)

Note - Contractors that opt to "play" must provide proof of coverage, including document from insurance provider, and names of covered employees.

2.) List of Subcontractors (Form POP-3)

Note- Review the affidavit statement at the bottom of this form for further important POP Compliance information.

C. Contractors reporting requirements:

1.) Contractors that opt to Pay
Provide monthly reports to administering department, detailing names of employees, hours worked, exemptions (if any) and amount owed. (Form POP-5)

2.) Contractors that opt to Play
Provide periodic reports to the contract administrator showing proof of coverage (insurance premium invoice or insurance card) reporting schedule will be determined by administering department based on length of contract. (Form POP-7)

3.) Employee Waiver Request
Contractor may request POP program waiver by submitting the request on POP-8 if the employee is less than 18 years old, employee has other health coverage such as through spouse or parents, or Medicare/Medicaid.

Note proof of coverage must be provided in the form of a copy of the employee's insurance card. (Remove social security numbers if applicable)

4.) Contractors shall submit an initial report with the second invoice to the department. Payments based on monthly reports are due to the contracting department with submission of the following month's invoice. Payments may be made out to the City of Houston preferably via cashier check or business check.

III. Compliance and Enforcement

The Office of Business Opportunity will audit program compliance. Contractors willfully violating or misrepresenting POP program compliance will be subject to corrective and/or punitive action, including but not limited to the assessment of fines and penalties and/or debarment. The Pay or Play Program Requirements Form and all other POP Forms are available for downloading from the City of Houston's Website at http://www.houstontx.gov/obo/popforms.html

Document 00931

REQUEST FOR INFORMATION

1. PROJECT No.: S-000066-012A-4
2. RFI No.: _____
3. PROJECT NAME: Northeast Water Purification Plant Improvements Package No.2 – High Service Pump Station and Miscellaneous Piping Improvements
4. CONTRACTOR: [Contractor Name]
5. CONTRACT No.: _____
6. SPECIFICATION Nos.: _____
7. DRAWING Nos.: _____
8. RESPONSE CODE: [_] CRITICAL [_] ROUTINE 9.DATE RESPONSE REQUIRED: _____
10. INFORMATION REQUIRED:

11. _____ _____ _____
CONTRACTOR (Signature) TITLE DATE

12. RESPONSE:

13. _____ _____
PROJECT MANAGER (Signature) DATE

14. **If Contractor believes the response given in Item 12 requires an adjustment in Contract Price or Contract Time, Contractor shall submit a timely proposal so as not to delay Contractor's Work in accordance with General Conditions, Article 7 - Changes in the Work.**

END OF DOCUMENT

SECTION 01110
SUMMARY OF WORK

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Summary of the Work including Work Covered By Contract Documents, Cash Allowances, Work Sequence, Contract Use Of Premises, Warranty, Minimum Conditions For Substantial Completion, General Construction Notes, and Confidentiality of Contract Documents.

B. Work related to this Section is found in:

1. Section 01114 – Construction Sequence

2. Section 01325 – Construction Schedule

1.02 WORK COVERED BY CONTRACT DOCUMENTS

A. Work of the contract is for the Improvements at the Northeast Water Purification Plant (NEWPP). The project is to provide better pump operation and control to meet variable flow and pressure conditions by installing adjustable speed drives and pump control valves to the plant high service pumps. The project also addresses unbalanced conditions and overstress in the existing piping systems in order to protect city infrastructure and assets, consisting of the following:

1. Mobilization by the Contractor to initiate project start-up, as specified in Section 01502.

2. Installation of stormwater pollution prevention control measures including filter fabric fencing, storm inlet sediment trap, and inlet protection barrier to comply with the requirement of the Storm Water Pollution Prevention Plan, including furnishing all materials and incidentals.

3. Coordination of new CenterPoint easement installation including clearing, grubbing, new electrical service and temporary roadway provisions in the Construction Staging Area, to be utilized for this and subsequent projects.

4. Replacement of existing globe style silent check valves (quantity 8) at the plant High Service Pump Station with new pump control valves and actuators to provide fail-close upon power failure. Provide complete package in place with associated process mechanical demolition, piping modifications, structural, electrical, instrumentation and control improvements.

5. Demolition of two existing hydropneumatic surge tanks and associated piping, fittings, valves, all related electrical and structural foundation. Installation of flush-type hydrant.

6. Demolition and removal of the High Service Pump Station Powerhouse and two 10,000 kVA transformers. These items shall be the Contractors sole possession for Salvage.

7. Installation of duct bank for 12.47kV Medium Voltage feeders and Communications from the 138kV Substation Electrical Building to the proposed Substation Transformers and High Service Electrical Building.

8. Installation of four Medium Voltage 4.16 kV Adjustable Speed Drives (ASDs) with all required electrical, instrumentation and control improvements. Perform a 7-day consecutive demonstration test of the entire High Service Pump Station with all pumps in service and new improvements complete in place and functional. See Specification 16010 for requirements.

9. Construction of a new Electrical Building to house new electrical switchgear, ASDs, PLC control panel and ancillary equipment. Provide all associated building structural, architectural, HVAC, pluming, civil and site improvements.

10. Implementation of new pump operation and optimization software to maximize pump station operation efficiency.

11. Replacement of existing 42-inch distribution flow meter (quantity 2.), existing 8-inch plant potable water (utility water) flow meter, HSPS suction and discharge header pressure indicating transmitters, plant potable water loop pressure indicating transmitter, post-GST1 chlorine analyzer, and associated electrical and instrumentation and control improvements.

12. Miscellaneous piping elements and structural support improvements at the plant High Service Pump Station, Treated Water Flow Meter Station, and UV1 and UV2 Buildings areas as shown on the Drawings and specified herein, including installation of temporary line stops and bypass piping to remove existing Victaulic Depend-O-Lok couplings and replace with new piping connections.

13. Enter equipment data of new material provided on this project into the City's work Management System (WMS) database. Attachment to this Section is a copy of the City's WMS typical equipment data sheet. This activity needs to be coordinated with Drinking Water Operations (DWO) staff for training and data input.

14. All miscellaneous civil and site work including paving, grading, drainage, and utilities as shown on the Drawings and specified herein, including provisions for storm water Inlet and storm water line to connect the existing storm water line.

15. Stormwater quality detention basin cleaning including handling, removing, laboratory testing, transporting, and disposal of vegetation and soil (total quantity 1,000 cu. Yds), and hydromulching the basin.

B. Extra Unit Price Items are included in Section 00410 for use if extra work is encountered.

C. Coordination

1. Coordination and meetings for this project shall be provided as specified in Section 01312.

D. Field Office

1. A field office is required for this project. Refer to Section 01520.

E. General Construction Notes

1. The Contractor shall be responsible for verifying the location(s) of all underground utility lines in the areas on proposed construction before beginning construction.

2. The information contained within the project Drawings with regards to the existing facilities was taken from the original construction plans with the original work shown light and proposed work shown dark. Original work shown light is for the Contractor's information only. Its accuracy is not guaranteed and its use in no way relieves the contractor or others of any responsibility for loss due to inaccuracies. Refer to Specification Section 00330 Existing Conditions for additional detail.

3. Contractor shall be responsible for providing required security to protect his own property, equipment and work in progress as defined in Section 01560.

4. Contractor shall be responsible for adequately protecting existing structures, utilities, trees, shrubs, and other adjoining facilities and repair or replace due to damage caused by Contractor.

5. Contractor shall field verify all dimensions and conditions before commencing work. All landscaping features shall be field verified. It shall be the Contractor's responsibility to report any discrepancies to the Construction Manager in a timely manner.

6. Contractor to keep access road to existing plants open and free of construction related debris at all times. Contractor staging area shall be used for Contractor's personnel, parking, material, and storage. Stockpile, material fabrication and related construction uses will not be allowed to interfere with normal plant operation. Contractor to provide temporary all-weather access roads as needed to maintain access to all unloading areas, throughout the duration of the project.

7. The Contractor to give notice to all authorized inspectors, superintendents or persons in charge of private and public utilities affected by his operations prior to commencement of work.

8. Obtain all required construction permits prior to commencement of work.

9. Plant coordinates shown for proposed structure locations are referenced to outside of face of exterior wall or to centerline of structure, unless otherwise noted on the Drawings.

10. The finished grade elevations shown are intended to provide drainage away from plant facilities. Minor changes may be necessary to provide adequate drainage.

11. Maintain drainage of site during all phases of construction. Do not block drainage from adjacent areas or add flow to adjacent areas.

12. These Drawings, prepared by CDM Smith Inc., do not extend to or include designs or systems pertaining to the safety of the construction Contractor or its employees or agents. CDM Smith Inc.'s registered professional engineer(s) that have sealed these bid documents does not extend to any such safety systems that may now or hereafter be incorporated in these Drawings. The construction Contractor shall prepare or obtain the appropriate safety systems required by Federal, State, and local laws and regulations.

13. The Contractor shall contact the following, a minimum of 48 hours prior to beginning construction:

    Texas One Call 811

14. Contractor shall not operate any existing valves, plant appurtenances or plant equipment. Provide sufficient notification and lead time, in accordance with the requirements of Section 01114, for Plant Operator where it becomes necessary to actuate or de-actuate valves, plant appurtenances, or plant equipment.

15. Plant Manager and Construction Manager to be notified in advance of any existing process equipment "shutdown", as specified in Section 01114.

16. Contractor is responsible for submitting fitting schedule and method of joint restraint where first below-ground fitting will not be flanged.

17. Contractor to provide adequate restrained joints as scheduled or concrete thrust blocking at all tees, wyes, bends, crosses, flushing valves and offsets to withstand test pressure as specified.

18. Contractor shall comply with all Federal, State, and local laws and regulations of utility companies concerning safety and health practices.

19. Contractor shall provide sodding in all areas disturbed as a result of construction operations that are not covered by structures or pavement. Temporary roadways shall be removed at the conclusion of the project, and site will be restored to its original conditions.

20. Piping drawings indicate invert elevations for gravity flow lines. Slope pipe uniformly between elevations shown. No valleys or peaks permitted in gravity flow lines. For other piping, refer to detail sheets for pipe elevations at each structure. Yard piping drawings do not indicate vertical bends and transitions. When necessary, make vertical transitions or furnish and install vertical bends at no extra cost. Do not exceed manufacturer's recommendations for curvature of lines and/or deflection of pipe joints. All vertical transitions and bends to be documented on required "red line drawings."'

21. Yard piping locations shown are approximate. Field verify locations of existing pipe. Arrange new piping as necessary to avoid interference and provide clearance noted. All changes in piping shown, to be documented on required "red line drawings."

22. Maintain minimum clearance of 3 feet from edge of structures to closest edge of pipeline adjacent and parallel to edge of structure unless otherwise noted on plans.

23. The Contractor to provide tape, fittings, plugs, and other devices for use in filling, flushing, testing, etc. (no separate pay).

24. Overhead lines exist along the plant boundary. Contractor to locate them prior to beginning any construction. Texas Law, Session 752, Health and code governing any activities which may cause people or objects to approach live overhead high-voltage lines shall be strictly adhered to. Contractor is legally responsible for safety of construction workers under this law. This law carries both criminal and civil liability.

25. The Contractor shall not operate any equipment or have any persons within 10 feet (vertical and horizontal) of electrical power lines.

26. Contractor shall refer to the latest City of Houston standard detail drawings included in the City of Houston's "Standard Construction Details for Wastewater Collection Systems, Water Lines, Storm Drainage, and Street Paving", for any details not included in the construction drawings.

1.03 CASH ALLOWANCES

A. Include the following specific Cash Allowances in the Contract Price under provision of General Conditions Paragraph 3.11:

1. Building Permit Fee.

2. Center Point Energy Temporary Electrical Service.

1.04 ALTERNATES

A. There are no alternates included in this project.

1.05 CITY-FURNISHED PRODUCTS

A. There are no City Furnished Products in this project.

1.06 WORK SEQUENCE

A. The work sequence for this project is specified in Section 01114.

1.07 CONTRACTOR USE OF PREMISES

A. Comply with procedures for access to the site and Contractor's use of rights-of-way as specified in Section 01145 and Section 01145S – Use of Premises.

B. Construction Operations: Limited to the City's rights-of-way provided by the City and areas shown or described in the Contract documents.

C. Utility Outages and Shutdown: Provide a minimum of 14 calendar days' notice to the City and private utility companies (when applicable) in advance of required utility, equipment, or process

shutdowns. Coordinate all work as required. Contractor shall submit a shutdown plan to the Construction Manager for approval within 30 days of the Notice to Proceed. Thereafter, the Contractor shall update the shutdown plan at a minimum on a monthly basis or more frequently if requested by the Construction Manager. Comply with the requirements of Section 01114.

1.08 STREET CUT ORDINANCE

A. No work will be conducted in City of Houston right-of-way under this Contract.

1.09 WARRANTY

A. Comply with warranty requirements in accordance with Document 00700 – General Conditions.

1.10 CONDITIONS FOR SUBSTANTIAL COMPLETION

A. The conditions for Substantial Completion for this project is specified in Section 01114.

1:11 CONFIDENTIALITY OF CONTRACT DOCUMENTS

A. Contractor shall keep the Plans confidential as provided in this Agreement and shall not make copies of the Plans. Contractor understands that the Plans are confidential information under the Texas Homeland Security Act, Chapter 421 of the Texas Government Code.

B. Contractor shall keep the Plans in a locked secure location. The Company shall keep this location confidential and share this information only with its personnel, subcontractors and designated City staff for the purpose of performing the Work.

C. The Contractor shall require all sub-contractors who use the Plans to sign a confidentiality Agreement acceptable to the Owner.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION – NOT USED

END OF SECTION

Asset Data Sheet

GENERAL INFORMATION	
FACILITY (LOCATION) NAME	
FACILITY DEPARTMENT NUMBER	
ASSET ID NUMBER	
ASSET DESCRIPTION	
ASSET AREA DESCRIPTION	
TAG #	
PART #	
ASSET MANUFACTURER	
ID #	
MODEL #	
SERIAL #	
CATALOG #	
SPEC. #	
YEAR BUILT	
SERVICE LIFE (YEARS)	
ORIGINAL EQUIPMENT VALUE	
MANU. WARR. START	
MANU. WARR. END	
REMARKS	

PUMP INFORMATION	
PUMP SIZE	
IMPELLER TYPE	
IMPELLER DIAMETER	
RPM:	
GPM	
MAX FLOW	
HEAD IN FT	
LUBE TYPE (Seal Water, Grease, Oil)	

MOTOR INFORMATION	
HP	
VOLTS	
AMPS	
HZ	
PHASE	
RPM	
SERVICE FACTOR	
PERFORMANCE FACTOR	
NEMA FRAME	
NEMA DESIGN	
MOUNTING POSITION (Horz, Ver, Other)	
FULL LOAD	
LRA (Load-Rated Amps)	

GENERATOR INFORMATION	
KW	
VOLTS	
AMPS	
HZ	
PHASE	
RPM	
KVA	
PERFORMANCE FACTOR	
ENGINE MANUFACTURER	
ENGINE SERIAL NO.	
ENGINE MODEL NO.	
FUEL TYPE	
FUEL USAGE RATE	

CRANE/HOIST INFORMATION	
CAPACITY (TONS)	

PHOTO

Asset Data Sheet

GENERAL INFORMATION																		PUMP INFORMATION							
FACILITY (LOCATION) NAME	FACILITY DEPARTMENT NUMBER	ASSET ID NUMBER	ASSET DESCRIPTION	ASSET AREA DESCRIPTION	TAG #	PART #	ASSET MANUFACTURER	ID #	MODEL #	SERIAL #	CATALOG #	SPEC. #	YEAR BUILT	SERVICE LIFE (YEARS)	ORIGINAL EQUIPMENT VALUE	MANU. WARR. START	MANU. WARR. END	REMARKS	PUMP SIZE	IMPELLER TYPE	IMPELLER DIAMETER	RPM:	GPM	MAX FLOW	HEAD IN FT	LUBE TYPE (Seal Water, Grease, Oil)

Asset Data Sheet

MOTOR INFORMATION												GENERATOR INFORMATION												CRANE/HOIST INFORMATION
HP	VOLTS	AMPS	HZ	PHASE	RPM	SERVICE FACTOR	PERFORMANCE FACTOR	NEMA FRAME	NEMA DESIGN	MOUNTING POSITION (Horz, Ver, Other)	FULL LOAD	LRA (Load-Rated Amps)	KW	VOLTS	AMPS	HZ	PHASE	RPM	KVA	PERFORMANCE FACTOR	ENGINE MANUFACTURER	ENGINE SERIAL NO.	ENGINE MODEL NO.	FUEL TYPE	FUEL USAGE RATE	CAPACITY (TONS)

Asset	Organization	Type	Status	Production	Department	Description	Class
632711	DWO	Asset	Installed	Yes	56R5	MX-2281 - LIME VERTICAL SHAFT PROCESS MIXERS - MOTOR	0044

↑ Example ↑

Asset	Class	HP	VOLTS	AMPS	HZ	PHASE	RPM	SERVICE FACTOR	PF	NEMA FRAME	NEMA DESIGN
632711	0044	10	230 / 460	22 / 12.5	60	3	1170	1.15		256T	B

↑ Example ↑

Asset	Class	IMPELLER TYPE	IMPELLER DIAMETER	RPM	GPM	MAX FLOW	LUBRICANT
632743	0048	centrifugal	INSIDE : 30.6" - OUTSIDE : 73"	3450	4.403	4.403 GPM	GREASE

↑ Example ↑

Asset	Class	KW	VOLTS	AMPS	HZ	PHASE	RPM	KVA	PF	ENGINE MANUFACTURER	ENGINE SERIAL NO.	ENGINE MODEL NO.	FUEL TYPE	FUEL USAGE
605001	0063	1,100	2,400	331	60	3	1,800	1,375	0.8	Detroit	12VF-03842	8123-7416	61.6 gal/hr est.	Diesel

↑ Example ↑

Asset	Class	CAPACITY
611033	0024	2 TON

↑ Example ↑

SECTION 01112
TIME CRITICAL FOR THE COMPLETION OF THE PROJECT SUBMITTALS

PART 1 GENERAL

1.01 REQUIREMENTS INCLUDED

A. CONTRACTOR shall prepare a complete listing of all submittals required for the project noting the number of each submittal and the date each submittal is to be submitted in accordance with Section 01330. CONTRACTOR shall identify submittals that are time critical to completion of the project. The listing shall be submitted within five (5) days following the Award of Contract and shall be a prerequisite to the first partial payment. The submittals identified as time critical to completion of the project shall be submitted to the ENGINEER within 14 weeks following the Award of Contract. The submittal of Time Critical submittals are a prerequisite to any payment or partial payment for mobilization.

B. The Contractor shall note that there are specific submittal requirements in other sections of the Project Manual.

C. The requirements for all submittals shall be as specified in Section 01330.

1.02 TIME CRITICAL SUMBITTALS INCLUDED

A. At a minimum, the following Time Critical for the completion of the project submittals shall be provided to the ENGINEER within 14 weeks following the Award of Contract plus any additional time critical submittals identified by the CONTRACTOR:

1. Medium Voltage Unit Substation Transformers
2. Medium Voltage Metal Clad Switchgear
3. Medium Voltage Motor Controller Switchgear
4. Medium Voltage Adjustable Speed Drives
5. Pump Control Valve and Actuator System
6. Other as identified by CONTRACTOR

B. The CONTRACTOR is responsible for the construction schedule and timely completion of the project and identifying and submitting all Time Critical submittal regardless of the list provided in paragraph A above. CONTRACTOR shall coordinate with manufacturers of critical equipment to ensure project is complete on schedule.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

Section 01114
CONSTRUCTION SEQUENCE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. The intent of construction phasing as specified herein and as shown on the Drawings is to maintain the maximum possible level of treatment at the Northeast Water Purification Plant (NEWPP) throughout the construction process. All tasks required to maintain the highest possible level of treatment, whether described herein or not, are the responsibility of the Contractor.

B. The NEWPP is an operational potable (drinking) water treatment plant that must remain in service throughout construction and must comply at all times with all applicable state and federal regulations including the Texas Commission on Environmental Quality (TCEQ) Rules and Regulations and the U.S. E.P.A. Safe Drinking Water Act requirements. The City reserves the right to halt construction and/or require the Contractor to place existing facilities back in service if necessary to maintain compliance with those regulations. Contractor shall strictly adhere to the scheduling constraints and requirements specified herein to facilitate Plant operation and compliance.

C. The Work specified herein and any other Contract Work required by the Construction Manager (CM) which may interrupt the normal Plant operations shall be accomplished at such times that will be convenient to the City. The Contractor shall plan to work overtime, including nights, Sundays and holidays, if needed to complete construction of the various project improvements and shall make no claims for extra compensation required to conform to these requirements. The Contractor shall notify the CM in writing and coordinate with the CM and City's Plant personnel at least 30 calendar days prior to any planned work associated with tying into existing facilities and piping or for any shutdown of the Plant or portions of the Plant.

D. Contractor shall review and determine all materials and equipment needed to complete the Work of construction as described herein. Contractor shall begin submittal preparation process as described in Paragraph 1.03A herein.

E. The Contractor shall maintain continuous access for City's Plant personnel to the treatment Plant site and present operations.

F. In the event that underground piping or utilities are encountered which are not shown on the Drawings, such piping or utilities shall not be disturbed without prior approval of the CM.

G. All existing Plant operations shall be performed by NEWPP personnel, coordinated through the CM by the Contractor.

1.02 RELATED WORK

A. Section 01110 – Summary of Work

B. Section 01112 – Time Critical for the Completion of the Project Submittals

C. Section 01325 – Construction Schedule

D. Section 01330 – Submittal Procedures

E. Section 01755 – Starting Systems

F. Section 01770 – Closeout Procedures

G. Section 01782S and Section 01782 – Operations and Maintenance Data

H. Section 01785 – Project Record Documents

1.03 SUBMITTALS

A. The Contractor shall provide the City and CM with a construction sequencing schedule or chart prior to submitting the construction schedule. The construction sequencing schedule shall incorporate all of the Work required by the Contract Documents and shall incorporate all of the constraints listed in paragraphs 1.05 through 1.09 of this section. Submittal shall comply with requirements of Section 01330.

B. For all work which will require a temporary shutdown of Plant operations or entire Plant shutdown, the Contractor shall begin coordinating with the CM and City within the time period specified in Paragraph 1.01C above and shall submit a proposed work plan which indicates the manpower, tools, equipment, and construction procedure to be used at least fourteen days prior to the requested shutdown period.

C. Contractor shall submit notifications for extended daily work hours and/or for work on Saturdays, Sundays and legal holidays as specified herein.

D. Contractor shall formally submit, in accordance with Section 01330, products and materials for all temporary piping, plugs, line stops, sealants, and incidental materials required for execution and completion of any work requiring a temporary shutdown. Additionally, Contractor shall submit a copy of the ANSI/NSF 61 certification from the manufacturing plant for all such temporary piping, plugs, line stops, sealants and incidental materials.

E. Contractor shall submit to the CM for approval a detailed Construction Schedule prior to initiation of site construction. The Schedule shall comply with aspects of the work described herein.

F. Contractor shall update the schedule as required by Section 01325.

1.04 REFERENCE STANDARDS

A. All references listed shall imply to the most recent revision.

1. American National Standards Institute (ANSI): ANSI/NSF 61, Drinking Water System Components – Health Effects.

1.05 CONSTRAINTS ON ANTICIPATED COMPONENT SHUTDOWNS

A. Process Interruption and Partial Shutdowns for High Service Pump Station modifications:

1. For pump control valve installation and piping modifications on Pumps No. 5 through No. 8, only one pump may be taken out of service at a time.

2. For pump control valve installation and piping modifications on Pumps No. 1 through No. 4, only two pumps may be taken out of service at a time.

3. Pump control valves and piping modifications work sequence shall start from Pump No. 5, from west to east, coinciding with associated electrical work.

4. Concurrent improvement work for Item 1 and Item 2 at the same time is not allowed. Upon completion of modifications, each pump control valve system shall be field-tested and demonstrate a successful completion of the required installation, testing, and function before a subsequent pump can be removed from service.

B. Process Interruption and Partial Shutdowns for installation of line stop and temporary bypass system and associated temporary chemical and sampling feed lines, and Victaulic Depend-O-Lok coupling replacements at each UV Building:

1. For each UV Building, only one UV system may be taken out of service at a time. Duration shall be less than 8 hours and coordinated with the CM and City Drinking Water Operations (DWO) for approval prior to commencement of the work.

2. Contractor shall coordination with the CM and City Drinking Water Operations (DWO) to reduce plant flow as required when setting line stop for installation of the temporary bypass piping systems.

C. Process Interruption and Partial Shutdowns for replacement of the new 42-inch distribution flow meters (Qty. 2) and Victaulic Depend-O-Lok couplings at the Treated Water Flow Meter Station:

1. Only one flow meter line can be removed from service at a time. The remaining unit must be maintained in operation.

D. Process Interruption and Shutdowns for installation of line stop and temporary bypass system for replacement of the new 8-inch plant potable water (utility water) flow meter and Victaulic Depend-O-Lok couplings at the Treated Water Flow Meter Station.

E. Process Interruption and Shutdowns for replacement of Victaulic Depend-O-Lok couplings on the 20-inch ground storage tank bypass pipeline near the Treated Water Flow Meter Station.

F. Demolition of the surge tanks can take place only after replacement of all existing pump discharge check valves is complete and new pump control valves are in place and functional.

G. Demolition of Surge Tank No. 2 (east of the HSPS) and the connecting 42-inch treated water pipeline shall not take place until completion of the proposed High Service Electrical Building and all proposed improvements have been powered from the proposed Electrical Building.

H. Contractor may simultaneously perform work in multiple area of the Plant, provided the aforementioned constraints are maintained. Coordinate with the CM and City DWO for approval.

1.06 GENERAL PROJECT CONSTRAINTS

A. All treatment processes must remain fully operational during construction, except as specifically approved by the City of Houston Drinking Water Operations, Plant Manager.

B. Utility Outages and Shutdown: Provide notification to the City a minimum of 14 calendar days in advance of required utility shutdown. Coordinate all work as required.

C. The Contractor is required to protect all equipment, buildings, structures, piping, electrical cables, tanks, underground utilities, and all associated appurtenances during construction.

D. The Contractor is responsible for all temporary supports and bracing for all structural elements including, but not limited to, pumps, piping, walls, and foundations. All proposed temporary bracing and supports must be submitted by the Contractor for approval by the City and must be prepared by a Registered Professional Engineer retained by the Contractor. It is the Contractor's responsibility to maintain the safety and functionality of the piping and associated appurtenances in the intermediate conditions of sequencing between these temporary phase conclusions. Furthermore, should the Contractor feel that any supports or bracing illustrated or depicted within these construction documents present a potential problem in terms of safety or interference with operations, it is the Contractor's responsibility to immediately document these concerns and immediately present this said documentation to the City's attention.

E. Contractor shall maintain existing onsite Plant access roads and parking spaces, to the greatest degree possible, over the course of the Project. When the progression of work disrupts onsite Plant access roads, Contractor shall establish and maintain temporary access roads as required to complete the Project and/or provide alternate access for City's Plant personnel. Contractor's establishment of temporary access roads shall be sufficient to provide a similar level of service, fulfill the City's need and shall not disrupt Plant operations or create any safety hazards.

1.07 WORK COORDINATION

A. Refer to Section 01312 – Coordination and Meetings

B. Coordination with Work provided by Others

1. All costs associated with coordination of work and other contracts shall be included in the base bid unit price.

C. The Contractor shall make every effort to group work in similar areas or work that will affect similar operation together.

D. There is a separate construction contract for improvements to existing Chemical Feed System near the Phase I and Phase II UV Building areas (NEWPP Improvements Package No.1 – Chemical Feed System Improvements, City of Houston WBS No. S-000066-0012-4). It is anticipated that the Package No. 1 construction will start concurrently with the Package No. 2 construction. Upon the Improvement Package No. 2 construction work is authorized by the City, selected Contractor shall coordinate construction activities in the common areas shown on the Drawings with the selected Contractor for Package No. 1.

E. Contractor shall keep CM informed of all work activities, including daily notification of all crews performing work and the locations thereof. To facilitate work planning, Contractor shall submit no later than 3:00 p.m. local time each Friday his work plan for the upcoming week which will identify the work to be performed each day and the location thereof.

F. The Contractor is required to protect all equipment, buildings, structures, piping, electrical cables, tanks, underground utilities, and all associated appurtenances during construction.

G. The Contractor is clearly responsible for all temporary supports and bracing for all structural elements affected by Work including, but not limited to, pumps, piping, walls, and foundations. All proposed temporary bracing and supports must be submitted by the Contractor for approval by the City and must be prepared by a Registered Professional Engineer retained by the Contractor. It is the Contractor's responsibility to insure the safety and functionality of the piping and associated appurtenances in the intermediate conditions of sequencing between these said phase conclusions. Furthermore, should the Contractor feel that any supports or bracing illustrated or depicted within these construction documents present a potential problem in terms of safety or interference with operations, it is the Contractor's responsibility to immediately document these concerns and immediately present this said documentation to the City's attention.

H. Contractor shall provide temporary trailer facilities for use by the Engineer and Construction Management Team for the duration of the project through Construction Closeout Activities. Contractor will be responsible for all utility connections and services.

1.08 SCHEDULE CONSIDERATIONS

A. Contractor shall develop the construction schedule to accommodate all construction sequence requirements identified in this Section.

B. Contractor shall complete the Stormwater Quality Detention Basin cleaning work within 60 days following the award of contract but no later than June 30, 2016.

C. Contractor shall coordinate with manufacturers of critical equipment and submit all time-critical submittals in accordance with Section 01112. The pump control valve and actuator equipment shall be delivered to the site within 24 weeks upon approval of the equipment submittals.

1.09 MINIMUM CONDITIONS FOR SUBSTANTIAL COMPLETION

A. In addition to requirements outlined in document 00700 – General Conditions, for Contractor to be substantially complete with the Work and call for inspection by CM to confirm, the following minimum conditions must be met or completed:

1. All new treatment structures and buildings fully constructed and complete with all utilities connected, tested, in service and operational.

2. All equipment installed, tested, and functional in both Hand and Auto Modes.

3. All site plans, yard piping, electrical and all other site work installed, tested, and complete and accepted by CM.

4. Fully functional SCADA System with fully functional HMI and operator interface panels with all equipment accepted by manufacturer's representative and approved for operation.

5. All programming, control narratives and system startup procedures and equipment interaction fully demonstrated.

6. All testing requirements included in Division 13 shall be completed and accepted by the CM.

7. All SCADA and security equipment shall be installed and tested in accordance with the specification and manufacturer's requirements and shall be accepted by the manufacturer's representative and approved for operation.

8. Final O&M manuals shall be delivered to the CM in hard copy and electronic format. Electronic manuals shall be provided in a format acceptable to the CM.

9. Completion of installations of all required safety structures and equipment, including, but not limited to, guard rails, warning signs, pipe and equipment painting, labeling, and tagging. All safety related systems and equipment shall be installed, accepted by manufacturer's representative and approved for use.

10. All training completed using Draft O&M Manuals.

B. No special condition described in Paragraph 1.09 may be included in Contractor's punch list.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION – NOT USED

END OF SECTION

SUPPLEMENTARY SPECIFICATION

SECTION 01145S
USE OF PREMISES

The following supplement modifies Specification Section 01145. Where a portion of the Specification is modified or deleted by this Supplementary Specification, the unaltered portions of the Specification shall remain in effect.

1. Delete paragraphs 1.02 C. and 1.02 D. and renumber accordingly.

2. Add the following to Paragraph 1.04:

   "H. Obtain approval from Construction Manager/City Engineer prior to impeding or closing roads. It is the Contractor's responsibility to maintain access to all buildings, driveways, and parking lots during construction at all times.

   I. The Contractor will comply with all plant procedures regarding entry, egress, and on-site security for the duration of the contract. This will include, but not be limited to, entry through gates, use of security codes, and limitation of presence to only construction areas.

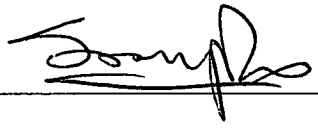
   J. Contractor will be responsible for certifying that all workers on the project (temporary or permanent) have been trained for hazardous chemical spills and evacuation drills per OSHA standards. None of the workers will be allowed on-site by the City Construction Manager unless this certification is provided. Contractor will keep the list of trained employees readily available at the workplace."

   K. The Contractor shall provide all necessary restroom facilities for employees and subcontractors. No plant restroom facilities shall be used by the Contractor. The Contractor is not allowed in buildings other than where work is being done.

3. Delete Paragraph 1.05. and renumber accordingly.

END OF SUPPLEMENT

Approved by:



10/1/15

Sonny Do, P.E.
Acting Assistant Director
Engineering and Construction Division
Department of Public Works and Engineering

Date

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Section 01145

USE OF PREMISES

1.01 SECTION INCLUDES

A. General use of the site including properties inside and outside of rights-of-way, work affecting road, ramps, streets and driveways and notification to adjacent occupants.

1.02 RIGHTS-OF-WAY

A. Confine access, and operations and storage areas to rights-of-way provided by the City as stipulated in Document 00700 - General Conditions; trespassing on abutting lands or other lands in the area is not allowed.

B. Make arrangements, at no cost to the City, for temporary use of private properties. Contractor and Surety shall indemnify and hold harmless the City against claims or demands arising from such use of properties outside of rights-of-way. Submit a copy of agreements between private property owners and Contractor prior to use of the area. Agreements between private property owners and Contractor shall be notarized or bear the signatures of two witnesses.

C. Obtain written permission from City of Houston Parks and Recreation Department for storage of materials on esplanades and other areas within rights-of-way under that department's jurisdiction. Submit copies of written permission prior to use of the area.

D. Restrict total length of distributed materials along the route of construction to 1,000 linear feet unless otherwise approved in writing by City Engineer.

1.03 PROPERTIES OUTSIDE OF RIGHTS-OF-WAY

A. Do not alter the condition of properties adjacent to and along rights-of-way.

B. Do not use ways, means, methods, techniques, sequences, or procedures that result in damage to properties or improvements.

C. Restore damaged properties outside of rights-of-ways at no cost to the city

1.04 USE OF SITE

A. Obtain approvals from governing authorities prior to impeding or closing public roads and streets. Do not close more than two consecutive intersections at one time.

B. Notify Project Manager and Public Works and Engineering Traffic Management Branch at least five working days prior to closing a street or street crossing. Obtain permits for street closures in advance.

C. Maintain 10-foot-wide minimum access lanes for emergency vehicles including access to fire hydrants.

D. Avoid obstructing drainage ditches or inlets. When obstruction is unavoidable due to requirements of the Work, provide grading and temporary drainage structures to maintain unimpeded flow.

E. Locate and protect private lawn sprinkler systems that may exist within the site. Repair or replace damaged systems to condition existing at start of the Work, or better. Test irrigation system prior to construction.

F. Conform to daily clean-up requirements of Article 3 of Document 00700 - General Conditions.

G. Beware of overhead power lines existing in area and in close proximity of the Project. When 10 feet of clearance between energized overhead power line and construction-related activity cannot be maintained, request Center Point Energy (CPE) de-energize or move conflicting overhead power line. Contact CPE representatives at (713) 207-2222. Schedule, coordinate and pay costs associated with de-energizing or moving conflicting overhead power lines. When there is no separate pay item for this effort, include these costs in various items of bid that make such work necessary.

1.05 NOTIFICATION TO ADJACENT OCCUPANTS

A. Notify individual occupants in areas to be effected by the Work of proposed construction and time schedule. Notify not less than 72 hours or more than two weeks prior to work performed within 200 feet of homes or businesses. Follow form and content of sample door hanger provided by Project Manager.

B. Include in notification nature of the Work, and names and telephone numbers of two company representatives for resident contact available on 24-hour call.

C. Submit proposed notification to Project Manager for approval. Consider ethnicity of the neighborhood where English is not the dominant language. Provide notice in an understandable language.

1.06 PUBLIC, TEMPORARY, AND CONSTRUCTION ROADS AND RAMPS

A. Construct and maintain temporary detours, ramps, and roads to provide for normal public traffic flow when it is necessary to close public roads or streets.

B. Provide mats or other means to prevent overloading or damage to existing roadways from tracked equipment, large tandem axle trucks or equipment that will damage the existing roadway surfaces.

C. Construct and maintain access roads and parking areas as specified in Section 01504 - Temporary Facilities and Controls.

1.07 EXCAVATION IN STREETS AND DRIVEWAYS

A. Avoid hindering or inconveniencing public travel on streets or intersecting alleys for more than two blocks at any one time, except by permission of City Engineer.

B. Obtain Traffic Management Branch and City Engineer's approval when nature of the Work requires closure of an entire street. Permits required for street closure are Contractor's responsibility. Avoid unnecessary inconvenience to abutting property owners.

C. Remove surplus materials and debris and open each block for public use, as work in that block is complete.

D. Acceptance of any portion of the Work will not be based on return of street to public use.

E. Avoid obstructing driveways or entrances to private property.

F. Provide temporary crossings or complete excavation and backfill in one continuous operation to minimize duration of obstruction when excavation is required across drives or entrances.

G. Provide barricades and signs in accordance with Section VI of the State of Texas Manual on Uniform Traffic Control Devices.

1.08 TRAFFIC CONTROL

A. Comply with traffic regulation as specified in Section 01555 - Traffic Control and Regulation.

1.09 SURFACE RESTORATION

A. Restore the site including landscaping to the condition existing before construction, or better.

B. Repair paved areas per the requirements of Section 02951 - Pavement Repair and restoration.

C. Repair damaged turf areas, level with bank run sand conforming to Section 02317 - Excavation and Backfill for Utilities, or topsoil conforming to Section 02911 - Topsoil, and re-sod in accordance with Section 02922 - Sodding. Water and level newly sodded areas with adjoining turf using appropriate steel wheel rollers for sodding. Do not use spot sodding or sprigging.

1.10 LIMITS OF CONSTRUCTION

A. Confine operations to lands within construction work limits shown on Drawings. Unless otherwise noted on Drawings adhere to the following:

1. Where utility alignment is within esplanade, and construction limits are shown on Drawings to extend to edge of esplanade, keep equipment, materials, stockpiles a minimum of five feet from back of curb.

2. Where construction limits shown on Drawings extend to property line, keep sidewalks free of equipment, materials, and stockpiles.

1.11 EQUIPMENT AND MATERIAL SALVAGE

A. Upon completion of the Work, carefully remove salvageable equipment and material. Deliver them to City of Houston as directed by Project Manager. Dispose of equipment offsite at no additional cost to the City when Project Manager deems equipment unfit for further use.

PART 2 P R O D U C T S - Not Used

PART 3 E X E C U T I O N - Not Used

END OF SECTION

SECTION 01172
PIPE PENETRATIONS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals required and install pipe penetration assemblies at all floor and wall penetrations as shown on the Drawings.

B. This Section covers materials for the various pipe penetration configurations. Generally, penetration details are called out on the Drawings and referenced on the Standard Mechanical Detail Drawings. Where penetrations are required and not called out, it shall be assumed the most conservative penetration detail shown on the detail sheets shall be utilized as appropriate for the piping type, the wall, or floor construction and the rating of the wall or floor penetrated.

1.02 MEASUREMENT AND PAYMENT

A. No separate payment will be made for work performed under this Section. Include the cost for this work in the lump sum Base Bid.

1.03 RELATED WORK

A. Miscellaneous Metal is included in Section 05580.

B. Steel piping is included in Section 02518.

1.04 SUBMITTALS

A. Submit manufacturers' literature, installation instructions, and where applicable, fire rating and certified test results of the various components on all items to be furnished in accordance with Section 01330.

B. The Contractor shall submit a detailed schedule listing each pipe penetration and mechanical modular seal provided on the project. The schedule shall list process area, process pipeline service, pipe size, contract Drawing reference number, quantity, and materials of construction of all components inclusive of the wall pipe sleeve, mechanical modular seals, hardware, etc.

C. For chemical storage and feed areas submit material compatibility charts for selected materials that may come into contact with pipe sleeve and mechanical sealing element materials.

PART 2 PRODUCTS

2.01 PIPE SLEEVES

A. Unless otherwise shown on the Drawings all pipe sleeves shall be Schedule 40 steel pipe conforming to ASTM A53 and hot dipped galvanized per ASTM A123. Pipe sleeve shall include a 2-inch minimum circumferential water stop welded to exterior of sleeve at its

midpoint; have ends cut and ground smooth and flush with the wall or ceiling; and extend 2-in above finished floors. Sleeves to be sealed with mechanical seals shall be sized in accordance with the seal manufacturer's recommendations. Sleeves to be sealed by caulking and sleeves for insulated piping shall be sized as required.

B. For locations requiring stainless steel; such as submerged service and for penetrations in potable water service, process treatment basins containing treated surface / raw water, chemical storage and feed areas, sludge, or wastewater, fabricate in a similar manner using Schedule 40 Type 316L pipe fabricated in accordance with ASTM A778.

C. External wall penetrations 36–in diameter and less may be made by means of a ductile iron sleeve (ASTM A536) capable of being bolted directly to the formwork. Seal of the annular space between the carrier pipe and the sleeve shall be made by means of a confined rubber gasket and be capable of withstanding 350 psig. Sleeve shall have an integrally cast waterstop of 1/2-in minimum thickness, 2-½–in minimum height. Sleeves shall be by Omni Sleeve as manufactured by Sigma Corporation, or equal.

2.02 WALL CASTINGS

A. Where shown on Drawings unless otherwise noted, wall castings shall be ductile iron conforming to ANSI/AWWA A21.51/C151, thickness Class 53, diameter as required. Flanges and/or mechanical joint bells shall be drilled and tapped for studs where flush with the wall. Castings shall be provided with a 2-in minimum circumferential flange/waterstop integrally cast with or welded to the casting, located as follows: for castings set flush with walls located at the center of the overall length of the casting; for castings which extend through wall located within the middle third of the wall. Interior lining shall be per pipe specification.

2.03 SEALING MATERIALS

A. Mechanical seals shall be modular, adjustable, bolted, mechanical type consisting of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe and sleeve.

B. Link pressure plates shall be molded of glass reinforced nylon. Hardware shall be mild steel with a 60,000 psi minimum tensile strength and 2-part Zinc Dichromate coating per ASTM B-633 and Organic Coating, tested in accordance with ASTM B-117 to pass a 1,470-hour salt spray test. Type 316 Stainless Steel hardware (ASTM F593-95) shall be used for submerged service and for penetrations in potable water service, process treatment basins containing treated surface / raw water, chemical storage and feed areas, sludge, or wastewater.

C. Any drinking water facility/potable water applications shall require use of modular seal element assemblies that are NSF-61 certified.

D. Links shall be colored throughout elastomer for positive material identification. Each link shall have permanent identification of the size and manufacturer's name molded into the pressure plate and sealing element. Completed sealing system shall be duty pressure rated for a minimum of 20 psig differential pressure. Link material shall be EPDM for all services except

fire rated assemblies, fire rated seals shall use silicone link material and shall be single (1-hour) or double seal (3 hour) service to match fire rating of wall, floor, or ceiling.

E. Mechanical seals shall be Link-Seal® as manufactured by GPT, Houston, TX, or pre-approved equal.

2.04 MISCELLANEOUS MATERIALS

A. Bonding compound shall be Sikadur Hi Mod epoxy by Sika Corp.; Euclid Chemical Corp.; Master Builders Company or equal.

B. Fire stop sealant shall be a two part foamed silicone elastomer by Dow Corning Co., Product No. 3-6548 Silicone RTV Foam; 3M™ brand fire barrier products caulk CP 25WB+ and 3M™ Fire Barrier Moldable Putty+; or FlameSafe FS 900+ by Rectorseal. Sealant bead configuration, depth and width shall be in accordance with manufacturer's recommendations

C. Non shrink grout shall be Masterflow 713 by Master Builders Co.; Euco N S by Euclid Chemical Co.; Five Star Grout by U.S. Grout Corp. or equal.

D. Escutcheons plates shall be hot dipped galvanized steel unless otherwise indicated on the Drawings. Prove 316 stainless steel hardware for Treatment Basins and wet submerged areas.

E. All materials in contact with treated surface water shall be NSF-61 listed for contact with potable water.

PART 3 EXECUTION

3.01 INSTALLATION

A. Assemble and install components of pipe penetration assemblies as detailed on the Drawings.

END OF SECTION

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Section 01255

CHANGE ORDER PROCEDURES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Procedures for processing Change Orders, including:

1. Assignment of a responsible individual for approval and communication of changes in the Work;

2. Documentation of change in Contract Price and Contract Time;

3. Change procedures, using proposals and Modifications;

4. Execution of Change Orders;

5. Correlation of Contractor submittals.

1.02 REFERENCES

A. Blue Book is defined as the Rental Rate Blue Book for Construction Equipment (a.k.a. Data Quest Blue Book).

B. Rental Rate is defined as the full-unadjusted base rental rate for the appropriate item of construction equipment.

1.03 RESPONSIBLE INDIVIDUAL

A. Provide a letter indicating the name and address of the individual authorized to execute Modifications, and who will be responsible for informing others in Contractor's employ and Subcontractors of changes to the Work. Provide this information at the pre-construction meeting.

1.04 DOCUMENTATION OF CHANGE IN CONTRACT PRICE AND CONTRACT TIME

A. Maintain detailed records of changes in the Work. Provide full information required for identification and evaluation of proposed changes, and substantiate costs of changes in the Work.

B. Document each proposal for change in Contract Price or Contract Time with sufficient data to allow evaluation of proposal.

C. Include the following minimum information on proposals:

1. Quantities of items in original Document 00410 – Bid Form with additions, reductions, deletions, and substitutions.

2. Quantities and cost of items in original Schedule of Values with additions, reductions, deletions and substitutions.

3. Provide Unit Prices for new items, with supporting information, for inclusion in Schedule of Unit Price Work.

4. Justification for changes in Contract Time.

5. Additional data upon request.

D. For changes in the Work performed on a time-and-material basis, provide the following additional information:

1. Quantities and description of Products.

2. Taxes, insurance and Bonds.

3. Overhead and profit as noted in Document 00700 - General Conditions.

4. Dates, times and by who work was performed.

5. Time records and certified copies of applicable payrolls.

6. Invoices and receipts for Products, rental equipment, and subcontracts, similarly documented.

E. For changes in the Work performed on a time-and-materials basis, rental equipment is paid as follows:

1. Actual invoice cost for duration of time required to complete extra work without markup for overhead and profit. When extra work comprises only a portion of a rental invoice where equipment would otherwise be on site, compute hourly equipment rate by dividing the actual monthly invoice by 176. One day equals eight hours and one week equals 40 hours.

2. Do not exceed estimated operating costs given in Blue Book for items of equipment. Overhead and profit will be allowed on the operating cost.

F. For changes in the Work performed on a time-and-materials basis using Contractor-owned equipment, use Blue Book rates as follows:

1. Contractor-owned equipment will be paid at the Blue Book Rental Rate for the duration of time required to complete extra work without markup for overhead and profit. Utilize lowest cost combination of hourly, daily, weekly or monthly rates. Use 150 percent of Rental Rate for double shifts, one extra shift per day, and 200 percent of Rental Rate for more than two shifts per day. Standby rates shall be 50 percent of the appropriate Rental Rate shown in Blue Book. No other rate adjustments apply.

2. Do not exceed estimated operating costs given in Blue Book. Overhead and profit will be allowed on operating costs. Operating costs will not be allowed for equipment on standby.

1.05 CHANGE PROCEDURES

A. Changes to Contract Price or Contract Time can only be made by issuance of Document 00941 - Change Order. Issuance of Document 00940 - Work Change Directive will be formalized into a Change Order. Changes will be in accordance with requirements of Document 00700 - General Conditions.

B. City Engineer will advise of Minor Changes in the Work as authorized by the Document 00700 - General Conditions by issuing Document 00942 – Minor Change.

C. Request clarification of Drawings, Specifications, Contract documents or other information by using Document 00931- Request for Information. Response by Project Manager to Requests for Information does not authorize Contractor to perform tasks outside scope of the Work. Changes must be authorized as described in this Section.

1.06 PROPOSALS AND CONTRACT MODIFICATIONS

A. Project Manager may issue Document 00932- Request for Proposal, which includes a detailed description of the proposed change with supplementary or revised Drawings and Specifications. Project Manager may also request a proposal in response to a Request for Information. Prepare and submit the proposal within seven days or as specified in request.

B. Submit requests for Contract changes to City Engineer describing proposed change and its full effect on the Work, with a statement describing reason for change and effect on Contract Price and Contract Time including full documentation.

C. Design Consultant may review Change Orders.

1.07 WORK CHANGE DIRECTIVE

A. City Engineer may issue a signed Work Change Directive instructing Contractor to proceed with a change in the Work. Work Change Directive will subsequently be incorporated into a Change Order.

B. Work Change Directives will describe changes in the Work and designate the method of determining change in Contract Price or Contract Time.

C. Proceed promptly to execute changes in the Work in accordance with the Work Change Directive.

1.08 STIPULATED PRICE CHANGE ORDER

A. A Stipulated Price Change Order will be based on an accepted proposal.

1.09 UNIT PRICE CHANGE ORDER

A. Where Unit Prices for affected items of the Work are included in Document 00410 – Bid Form, the Change Order will be based on Unit Prices, subject to Articles 7 and 9 of Document 00700 - General Conditions.

B. Where Unit Prices of the Work are not pre-determined in Document 00410-Bid Form, the Work Change Directive or accepted proposal will specify the Unit Prices to be used.

1.10 TIME-AND-MATERIAL CHANGE ORDER

A. Provide itemized account and supporting data after completion of change, within time limits indicated for claims in Document 00700 - General Conditions.

B. City Engineer will determine the change allowable in Contract Price and Contract Time as provided in Document 00700 - General Conditions.

C. Maintain detailed records for work done on time-and-material basis as specified in Paragraph 1.04 above.

D. Provide full information required for evaluation of changes and substantiate costs for changes in the Work.

1.11 EXECUTION OF CHANGE DOCUMENTATION

A. City Engineer will issue Change Orders, Work Change Directives, or Minor Change in the Work for signatures of Parties as described in Document 00700 - General Conditions.

1.12 CORRELATION OF CONTRACTOR SUBMITTALS

A. For Stipulated Price Contracts, promptly revise Schedule of Values and Application for Payment forms to record authorized Change Orders as separate line item.

B. For Unit Price Contracts, the next monthly estimate of the Work after acceptance of a Change Order will be revised to include new items not previously included with appropriate Unit Prices.

C. Promptly revise progress schedules to reflect change in Contract Time, and to adjust time for other items of work affected by the change, and resubmit for review.

D. Promptly enter changes to on-site and record copies of Drawings, Specifications or Contract documents as required in Section 01785 - Project Record Documents.

PART 2 P R O D U C T S - Not Used

PART 3 E X E C U T I O N - Not Used

END OF SECTION

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SUPPLEMENTARY SPECIFICATION

SECTION 01270S
MEASUREMENT AND PAYMENT

The following supplement modifies Specification Section 01270. Where a portion of the Specification is modified or deleted by this Supplementary Specification, the unaltered portions of the Specification shall remain in effect.

1. Add subparagraph E in Paragraph 1.02 as follows:

   "E. Payment for extra unit price items and unit of measure shall be as defined in the extra unit price schedule in Section 00410."

END OF SUPPLEMENT

Approved by:

Sonny Do, P.E.
Acting Assistant Director
Engineering and Construction Division
Department of Public Works and Engineering

10/1/15
Date

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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 criteria of this Section. In event of conflict, requirements of the Specification section shall govern.

B. Project Manager will take all measurements and compute quantities accordingly.

C. Assist by providing necessary equipment, workers, and survey personnel.

D. Measurement and Payment paragraphs are included only in those Specification sections of Division 01 where direct payment will be made. Include costs in the total bid price for those Specification sections in Division 01 that do not contain Measurement and Payment paragraphs,

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 Project Manager will determine payment as stated in Article 9 of Document 00700 - General Conditions.

B. When actual work requires greater or lesser quantities than those quantities indicated in Document 00410 – Bid Form, provide required quantities at Unit Prices contracted, except as otherwise stated in Article 9 of Document 00700 - General Conditions.

1.04 MEASUREMENT OF QUANTITIES

A. Measurement by Weight: Reinforcing steel, rolled or formed steel or other metal shapes are measured by CRSI or AISC Manual of Steel Construction weights. Welded assemblies are 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 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 item centerline or mean chord.

E. Stipulated Price Measurement: By unit designated in the Agreement.

F. Other: Items measured by weight, volume, area, or linear means or combination, as appropriate, as completed item or unit of the Work.

G. Measurement by Each: Measured by each instance or item provided.

H. Measurement by Lump Sum: Measure includes all associated 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 Document 00410 – Bid Form. Claims for payment as Unit Price work, but not specifically covered in the list of Unit Prices contained in Document 00410 – Bid Form, 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 Document 00800 - Supplementary Conditions.

D. Progress payments will be based on Project Manager's observations and evaluations of quantities incorporated in the Work multiplied by Unit Price.

E. Final payment for work governed by Unit Prices will be made on the basis of actual measurements and quantities determined by Project Manager 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 work, or portions of the Work, not conforming to the Contract documents.

B. When not practical to remove and replace work, City Engineer will direct one of the following remedies:

1. Nonconforming work will remain as is, but Unit Price will be adjusted lower at discretion of City Engineer.

2. Nonconforming work will be modified as authorized by City Engineer, and the Unit Price will be adjusted lower at the discretion of City Engineer, when modified work is deemed less suitable than specified.

C. Specification sections may modify the above remedies or may identify a specific formula or percentage price reduction.

D. Authority of City Engineer to assess 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 an unacceptable manner.

2. Products determined as nonconforming before or after placement.

3. Products not completely unloaded from transporting vehicles.

4. Products placed beyond lines and levels of 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 P R O D U C T S - Not Used

PART 3 E X E C U T I O N - Not Used

END OF SECTION

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Section 01292

SCHEDULE OF VALUES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Preparation and submittal of Schedule of Values for Stipulated Price Contracts or for Major Unit Price Work on Unit Price Contracts.

1.02 PREPARATION

A. For Stipulated Price Contracts, subdivide the Schedule of Values into logical portions of the Work, such as major work items or work in contiguous construction areas. Use Section 01325 - Construction Schedule as a guide to subdivision of work items. Directly correlate Items in the Schedule of Values with tasks in the Construction Schedule. Organize each portion using the Project Manual Table of Contents as an outline for listing value of the Work by Sections. A pro rata share of mobilization, Bonds, and insurance may be listed as separate items for each portion of the Work.

B. For Unit Price Contracts, items should include a proportional share of Contractor's overhead and profit so that total of all items will equal Contract Price.

C. For lump sum equipment items, where submittal of operation and maintenance data and testing are required, include separate items for equipment operation and maintenance data where:

1. submittal of maintenance data is valued at five percent of the lump sum amount for each equipment item and

2. submittal for testing and adjusting is valued at five percent of the lump sum amount for each equipment item.

Round off figures for each item listed to the nearest $100. Set the value of one item, when necessary, to make total of all values equal the Contract Price for Stipulated Price Contracts or the lump sum amount for Unit Price Work.

1.03 SUBMITTAL

A. Submit the Schedule of Values, in accordance with requirements of Section 01330 - Submittal Procedures, at least 10 days prior to processing of the first Certificate for Payment.

B Submit the Schedule of Values in an approved electronic spreadsheet file and an 81/2-inch by 11-inch print on white bond paper.

C. Revise Schedule of Values for items affected by Contract Modifications. After City Engineer has reviewed changes, resubmit at least 10 days prior to the next scheduled Certificate for Payment date.

PART 2 P R O D U C T S - Not Used

PART 3 E X E C U T I O N - Not Used

END OF SECTION

Section 01312

COORDINATION AND MEETINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. General coordination including pre-construction meeting, site mobilization conference, and progress meetings.

1.02 COORDINATION OF DOCUMENTS

A. Coordination is required throughout documents. Refer to Contract documents and coordinate as necessary.

1.03 CONTRACTOR COORDINATION

A. Coordinate scheduling, submittals, and work of various Specification sections to assure efficient and orderly sequence of Installation of interdependent construction elements.

B. Coordinate completion and clean up of the Work prior to the Date of Substantial Completion and for portions of the Work designated for City's partial occupancy.

C. Coordinate access to the site for correction of nonconforming work to minimize disruption of the City's activities where the City is in partial occupancy.

1.04 PRE-CONSTRUCTION MEETING

A. Project Manager will schedule pre-construction meeting.

B. Attendance Required: City representatives, Design Consultant, special consultants as required by Project Manager, Contractor, and major Subcontractors and Suppliers.

C. Agenda:

1. Distribution of Contract documents.

2. Designation of personnel representing the Parties and Design Consultant.

3. Review of insurance.

4. Discussion of formats for Schedule of Values and Construction Schedule.

5. Procedures and processing of Shop Drawings, substitutions, pay estimates or Applications for Payment, Requests for Information, Requests for Proposal, Modifications, and the Contract closeout, other submittals.

6. Scheduling of the Work and coordination with other contractors.

7. Review of Subcontractors and Suppliers.

8. Appropriate agenda items listed for the site mobilization conference, Paragraph 1.05.C, when pre-construction meeting and site mobilization conference are combined.

9. Procedures for testing.

10. Procedures for maintaining record documents.

1.05 SITE MOBILIZATION CONFERENCE

A. When required by Contract documents, Project Manager will schedule a conference at the Project site prior to Contractor mobilization.

B. Attendance Required: City representatives, Design Consultant, special consultants, Superintendent, and major Subcontractors.

C. Agenda:

1. Use of premises by the City and Contractor.

2. Safety and first aid procedures.

3. Construction controls provided by the City.

4. Temporary utilities.

5. Survey and layout.

6. Security and housekeeping procedures.

7. Field office requirements.

1.06 PROGRESS MEETINGS

A. Hold meetings at Project field office or other location designated by Project Manager. Hold meetings at monthly intervals, or more frequently when directed by Project Manager.

B. Attendance Required: Superintendent, major Subcontractors and Suppliers, City representatives, Design Consultant and its subconsultants as appropriate for agenda topics for each meeting.

C. Project Manager will make arrangements for meetings, and for recording minutes.

D. Project Manager will prepare the agenda and preside at meetings.

E. Provide required information and be prepared to discuss each agenda item.

F. Agenda:

1. Review minutes of previous meetings.
2. Review of construction schedule, pay estimates, cash flow curve, payroll and compliance submittals.
3. Field observations, problems, and necessary decisions.
4. Identification of problems that impede planned progress.
5. Review of submittal schedule and status of submittals.
6. Review of RFI and RFP status.
7. Modification status.
8. Review of off-site fabrication and delivery schedules.
9. Maintenance of Construction Schedule.
10. Corrective measures to regain Construction Schedule.
11. Planned progress during the succeeding work period.
12. Coordination of projected progress.
13. Maintenance of quality and work standards.

14. Effect of proposed Modifications on Construction Schedule and coordination.

15. Review Project Record Contract Drawings.

16. Other item relating to the Work.

PART 2 P R O D U C T S - Not Used

PART 3 E X E C U T I O N - Not Used

END OF SECTION

Section 01321

CONSTRUCTION PHOTOGRAPHS

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Photographic requirements for construction photographs and submittals.

1.02 DEFINITIONS

A. Pre-construction Photographs: Photographs taken, in sufficient numbers and detail, prior to Date of Commencement of the Work, to show original construction site conditions.

B. Progress Photographs: Photographs, taken throughout the duration of construction at regular intervals and from fixed vantage points, pre-approved by the City, that document progress of the Work.

C. Finished Photographs: Photographs, taken by a professional photographer near Date of Substantial Completion and before City Council's acceptance of the Work, that are suitable for framing and for use in brochures or on the Internet

1.03 SUBMITTALS

A. Refer to Section 01330, Submittal Procedures, for submittal requirements.

B. Format and Media. Film or digital photography may be used. Submit color photographs, unless otherwise specified.

1. Prints. Submit each Progress or Pre-construction Photograph print in a three-hole plastic pocket or sleeve, bound in a three-ring notebook. Produce prints on photographic-quality paper approved by Project Manager. Minimum size for Pre-construction Photograph prints shall be 3-inches by 5-inches. Progress Photograph prints shall be 8-inches by 10-inches.

2. Film. Use 35mm or larger color film. Submit negatives used to make submitted photographs, in 3-hole 8-1/2 inch by 11-inch plastic sheets with sleeves for negatives.

3. Digital Photography. Use 2.1 megapixel density or greater for photographs. Scanned photographs must equal or exceed 400 dots

per inch when scanned from 8-inch by 10-inch prints. Submit digital photographic files on computer disks. Format disks for MS-DOS (Microsoft Disk Operating System) filing system and in JPEG (Joint Photographic Experts Group) format.

C. Submittal Quantities and Frequencies.

1. Pre-construction Photographs:
   a. For Stipulated Price Contracts, submit two sets of Pre-construction Photographs, if required, prior to first Application for Payment.
   b. For Unit Price Contracts, submit two sets of Pre-construction Photographs prior to start of construction operations.

2. Progress Photographs:
   a. For Stipulated Price Contracts, submit three sets of Progress Photographs with each Application for Payment at the times established for submittal of Applications for Payment. Monthly Applications for Payment shall be deemed incomplete if not accompanied by the required Progress Photographs. Contractor's failure or election to not submit a monthly Application for Payment shall not affect the requirement for monthly Progress Photographs.
   b. Progress Photographs are not required for Unit Price Contracts unless otherwise specified.

3. Finished Photographs: For Stipulated Price Contracts submit two sets of Finished Photographs, if required, after Date of Substantial Completion and prior to final payment. Each set shall contain one 11-inch by 14-inch matte finish color photographic print from each of the two vantage points pre-approved by the City. Vantage points for Finished Photographs will be approved separately from vantage points approved for Progress Photographs. Finished Photographs are not required for Unit Price Contracts unless otherwise specified.

D. Labeling. Place a label on the back of each photographic print, applied so as to not to show through on the front. Labels shall contain the following information:

1. Name of Project, address of Project and GFS Number.

2. Name and address of Contractor.

3. Date photograph was taken.

4. Location photo was taken from and short description of photo subject.

5. Name and address of professional photographer who took the photograph, if applicable.

E. Hand-deliver or transmit prints in standard photographic mailers marked "Photographs - Do Not Bend".

F. Photographic prints, negatives, photographic files and disks become the property of the City. Do not be publish photographs without written consent by the City.

1.04 QUALITY ASSURANCE

A. Contractor shall be responsible for the quality of and timely execution and submittal of photographs.

B. For Finished Photographs, Contractor shall use a professional photographer, with five years minimum professional experience in the Houston area. Contractor shall submit name, address and credentials of professional photographer for Project Manager's review and approval.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION

3.01 PRE-CONSTRUCTION PHOTOGRAPHS

A. Prior to commencement of construction operations, photograph the site to include initial construction corridor, detour routes, and staging or storage areas.

1. For Stipulated Price Contracts, unless specified as a requirement in other Sections, these photographs are optional for Contractor, but are highly recommended for areas bounded by other property owners.

2. Pre-construction photographs are required for Unit Price Contracts. For line projects with scheduled construction segments, take Pre-construction Photographs prior to commencement of work on each segment.

B. Prepare Pre-construction Photographs as follows:

1. Show the following information on a non-reflective chalkboard placed within the picture frame:
   a. Job number.
   b. Project Number.
   c. Date and time photographs were taken (Automatic date/time in negative is acceptable).
   d. Baseline station, direction of view (i.e. N, S, NW, etc.) and house number or street address and street name.

2. Pre-construction Photographs shall indicate condition of the following:
   a. Esplanades and boulevards.
   b. Yards (near side and far side of street).
   c. House walks and sidewalks.
   d. Curbs.
   e. Areas between walks and curbs.
   f. Particular features (e.g. yard lights, shrubs, fences, trees).

3. Show date photographs were taken on negatives.

C. Show the location of vantage points and direction of shots on a key plan of the site.

3.02 PROGRESS PHOTOGRAPHS

A. Progress Photographs document monthly advancement of the Work. Select vantage points for each shot so as to best show status of construction and progress since last photograph submittal. Select camera stations that will require little or no movement or adjustment over the duration of construction.

B. Take monthly Progress Photographs at regular intervals to coincide with cutoff dates associated with each Application for Payment.

3.03 FINISHED PHOTOGRAPHS

A. Finished Photographs shall be "staged" and taken by a professional photographer to depict the most flattering images of a finished facility. Two vantage points, from which Finished Photographs will be taken, shall be agreed to in advance by the City. Photographer shall consider lighting, time of day, height of eye, landscaping and placement of vehicles, people and other props in each picture. Filters and post-photography processing may be utilized to achieve a finished product acceptable to the City.

3.04 LOCATION

A. Vantage points, times and conditions for camera stations and photography for Progress and Finished Photographs shall be mutually agreed upon by the City, Contractor and Photographer. Progress Photograph vantage points may be changed by mutual agreement as the Work progresses, at no additional cost to the City.

END OF SECTION

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Section 01325

CONSTRUCTION SCHEDULE

PART 1 GENERAL

1.01 GENERAL

A. Provide Construction Schedules for the Work included in this Contract in accordance with requirements in this Section. Create Construction Schedule using Critical Path Method (CPM) computer software capable of mathematical analysis of Precedence Diagramming Method (PDM) plan. Provide printed activity listings and bar charts in formats described in this Section.

B. Combine activity listings and bar charts with narrative report to form Construction Schedule submittal for Project Manager.

1.02 SCHEDULING STAFF

A. Employ or retain services of individual experienced in CPM scheduling for duration of the Contract. Individual shall cooperate with Project Manager and update schedule monthly as required to indicate current status of the Work.

1.03 SUBMITTALS

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

B. During preconstruction meeting, as described in Section 01312 - Coordination and Meetings, provide sample bar charts and activity listings produced from scheduling software proposed. Scheduling software is subject to review by Project Manager and must meet requirements provided in this Section. Project Manager will provide review of samples within seven days of submittal.

C. Within 21 days of receipt of approval of Contractor's format, or 30 days of Notice to Proceed, whichever is later, submit proposed Construction Schedule for review. Base Construction Schedule submittal on the following:

1. Level of detail and number of activities required in schedule are dependent on project type.
   a. For wastewater projects, categorize work type and area code in schedule.
      1) For wastewater rehabilitation projects, there are six work-type categories. An area code will be assigned for each

Meter Service Area or Basin. Include at least one activity for each unique combination of work type and area code. Normal schedules of wastewater rehabilitation projects contain between 35 and 100 activities, depending on number of basins and work types involved in each basin.

2) For wastewater relief projects (line work), area codes will be assigned geographically.

3) For wastewater plant or facility work, other criteria may apply to assignment of area codes, such as a combination of geographical and craft categories.

b. For projects with multiple types of tasks within scope, indicate types of work separately within schedule.

c. For projects with work at different physical locations or service areas, or different facilities within a site, indicate each location or facility separately within schedule. Show work on each floor of multi-story building as separate tasks.

d. For projects with multiple crafts or significant Subcontractor components, indicate elements separately within schedule. Unless permitted by Project Manager, tasks shall consist of work covered by only one division of Project Manual.

2. Unless permitted by Project Manager, each scheduled task shall be same as Schedule of Values line item, and vice versa.

3. For projects with Major Unit Price Work, indicate Shop Drawing submittal and review, purchase, delivery, and Installation dates on Project schedule. Include activities for testing, adjustment, and delivering O&M manuals.

4. No task except the acquisition of Major Unit Price Work shall represent more than one percent of Original Contract Price for facility projects and three percent of Original Contract Price for other projects. Duration of tasks may not exceed 40 calendar days.

5. For projects where operating facilities are involved, identify each period of work that will impact any process or operation in the schedule and that must be agreed to by Project Manager and facility operator prior to starting work in the area.

D. Construction Schedule submittals shall include:

1. printed bar charts that meet criteria outlined in this Section and are produced by Contractor's approved scheduling software;

2. activity listings that meet criteria outlined in this Section and are produced by Contractor's approved scheduling software; and

3. a predecessor/successor listing sorted by Activity ID that meets criteria outlined in this Section and is produced by Contractor's scheduling software.

4. A logic network diagram is required with the first Construction Schedule submittal for facilities projects.

5. Prepare and submit graphic or tabular display of estimated monthly billings (i.e. a cash flow curve for the Work) with the first schedule submittal. This information is not required in monthly updates, unless significant changes in work require re-submittal of schedule for review. Display shall allocate units indicated in bid schedule or Schedule of Values to Construction Schedule activities. Weighted allocations are acceptable, where appropriate. Dollar value associated with each allocated unit will be spread across the duration of that activity on a monthly basis. Total for each month and cumulative total will be indicated. These monthly forecasts are only for Project Manager's planning purposes. Monthly payments for actual work completed will be made in accordance with Document 00700 - General Conditions.

6. Narrative Report that provides the information outlined in this Section.

E. No payment will be made until Project Manager approves Construction Schedule and billing forecast.

F. If Contractor desires to make changes in its method of operating and scheduling, after Project Manager has reviewed original schedule, notify Project Manager in writing, stating reasons for changes. When Project Manager considers these changes to be significant, Contractor may be required to revise and resubmit for review all or affected portion of Contractor's Construction Schedule to show effect on the Work.

G. Upon written request from Project Manager, revise and submit for review all or any part of Construction Schedule submittal to reflect changed conditions in the Work or deviations made from original schedule.

H. Updated Construction Schedule with actual start and actual finish dates, percent complete, and remaining duration of each activity shall be submitted monthly. Data date used in updating monthly Construction Schedule shall be the same date as used in monthly Payment Application. Monthly update of Construction Schedule is required for monthly Payment Application to be processed for payment.

1.04 SCHEDULING COMPUTER SOFTWARE REQUIREMENTS

A. Contractor's scheduling software shall be capable of creating bar charts and activity listings, which can be sorted by various fields (i.e. Activity ID, Early Start, Total Float, Area Code, Specification Section number, and Subcontractor). Use software capable of producing logic network diagram.

B. Use scheduling software capable of producing activity listings and bar charts with the following information for each activity in the schedule:

1. Activity ID
2. Activity Description
3. Estimated (Original) Duration
4. Remaining Duration
5. Actual Duration
6. Early Start Date
7. Late Start Date
8. Early Finish Date
9. Late Finish Date
10. Free Float
11. Total Float
12. Activity Codes (such as Area Code, Work Type, Specification Section, Subcontractor)

C. Use scheduling software capable of printing calendars using mathematical analysis of schedule, indicating standard workdays of week and scheduled holidays.

D. Use scheduling software capable of printing activity listing that indicates predecessors and successors, lag factors and lag relationships used in creating logic of the schedule.

E. Use scheduling software to provide monthly time in Bar Chart format and scale with 12-month scale not to exceed one page width. Bar charts may be

printed or plotted on 8-1/2 by 11-inch, 8-1/2 by 14-inch or 11 by 17-inch sheet sizes. Over-size plots are not acceptable.

1.05 NARRATIVE SCHEDULE REPORT

A. Narrative schedule report shall list activities started this month, activities completed this month, activities continued this month, activities scheduled to start or complete next month, problems encountered this month, and actions taken to solve these problems.

B. Narrative schedule report shall describe changes made to Construction Schedule logic (i.e. changes in predecessors and lags), activities added to schedule, activities deleted from schedule, any other changes made to the schedule other than addition of actual start dates and actual finish dates and changes of data date and remaining durations for re-calculation of mathematical analysis.

PART 2 P R O D U C T S - Not Used

PART 3 E X E C U T I O N - Not Used

END OF SECTION

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Section 01330

SUBMITTAL PROCEDURES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Submittal procedures for:

1. Schedule of Values
2. Construction Schedules and Cash Flow Curve (billing forecast).
3. Shop Drawings, Product Data and Samples
4. Operations and Maintenance (O&M) Data
5. Manufacturer's Certificates
6. Construction Photographs
7. Project Record Documents and monthly certification.
8. Video Tapes
9. Design Mixes

1.02 SUBMITTAL PROCEDURES

A. Scheduling and Handling:

1. Submit Shop Drawings, data and Samples for related components as required by Specifications and Project Manager.
2. Schedule submittals well in advance of need for construction Products. Allow time for delivery of Products after submittal approval.
3. Develop submittal schedule that allows sufficient time for initial review, correction, resubmission and final review of all submittals. Allow a minimum of 30 days for initial review. Project Manager will review and return submittals to Contractor as expeditiously as possible but time required for review will vary depending on complexity and quantity of data submitted.

4. Project Manager's review of submittals covers only general conformity to Drawings, Specifications and dimensions that affect layout. Contractor is responsible for quantity determination. No quantities will be verified by Project Manager. Contractor is responsible for errors, omissions or deviations from Contract requirements; review of submittals does not relieve Contractor from the obligation to furnish required items in accordance with Drawings and Specifications.

5. Submit five copies of documents unless otherwise specified.

6. Revise and resubmit submittals as required. Identify all changes made since previous submittal.

7. Assume risk for fabricated Products delivered prior to approval. Do not incorporate Products into the Work, or include payment for Products in periodic progress payments, until approved by Project Manager.

B. Transmittal Form and Numbering:

1. Transmit each submittal to Project Manager with Transmittal letter which includes:
   a. Date and submittal number
   b. Project title and number
   c. Names of Contractor, Subcontractor, Supplier and manufacturer
   d. Identification of Product being supplied
   e. Location of where Product is to be Installed
   f. Applicable Specification section number

2. Identify deviations from Contract documents clouding submittal drawings. Itemize and detail on separate 8-1/2 by 11-inch sheets entitled "DEVIATIONS FOR _____." When no deviations exist, submit a sheet stating no deviations exist.

3. Have design deviations signed and sealed by an appropriate design professional, registered in the State of Texas.

4. Sequentially number transmittal letters beginning with number one. Use original number for resubmittals with an alphabetic suffix (i.e., 2A for the first resubmittal of submittal 2, or 15C for third resubmittal of submittal 15, etc.). Show only one type of work or Product on each submittal. Mixed submittals will not be accepted.

C. Contractor's Stamp:

1. Apply Contractor's Stamp certifying that the items have been reviewed in detail by Contractor and that they comply with Contract requirements, except as noted by requested variances.

2. As a minimum, Contractor's Stamp shall include:
   a. Contractor's name
   b. Job number
   c. Submittal number
   d. Certification statement Contractor has reviewed submittal and it is in compliance with the Contract
   e. Signature line for Contractor

D. Submittals will be returned with one of the following Responses:

1. "ACKNOWLEDGE RECEIPT" when no response and resubmittal is required.

2. "NO EXCEPTION" when sufficient information has supplied to determine that item described is accepted and that no resubmittal is required.

3. "EXCEPTIONS AS NOTED" when sufficient information has been supplied to determine that item will be acceptable subject to changes, or exceptions, which will be clearly stated. When exceptions require additional changes, the changes must be submitted for approval. Resubmittal is not required when exceptions require no further changes.

4. "REJECTED-RESUBMIT" when submittal does not contain sufficient information, or when information provided does not meet Contract requirements. Additional data or details requested by Project Manager must be submitted to obtain approval.

1.03 MANUFACTURER'S CERTIFICATES

A. When required by Specification sections, submit manufacturers' certificate of compliance for review by Project Manager.

B. Place Contractor's Stamp on front of certification.

C. Submit supporting reference data, affidavits, and certifications as appropriate.

D. Product certificates may be recent or from previous test results, but must be acceptable to Project Manager.

1.04 DESIGN MIXES

A. When required by Specification sections, submit design mixes for review.

B. Place Contractor's Stamp, as specified in this section, on the front of each design mix.

C. Mark each mix to identify proportions, gradations, and additives for each class and type of mix submitted. Include applicable test results from samples for each mix. Perform tests and certifications within 12 months of the date of the submittal.

D. Maintain copies of approved mixes at mixing plant.

1.05 CHANGES TO CONTRACT

A. Changes to Contract may be initiated by completing a Request for Information form. Project Manager will provide a response to Contractor by completing the form and returning it to Contractor.

1. If Contractor agrees that the response will result in no increase in cost or time, a Minor Change in the Work will be issued by City Engineer.

2. If Contractor and Project Manager agree that an increase in time or cost is warranted, Project Manager will forward the Request for Proposal for negotiation of a Change Order.

PART 2 P R O D U C T S - Not Used

PART 3 E X E C U T I O N - Not Used

END OF SECTION

Section 01340

SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Methods, schedules, and processes to be followed for Shop Drawings, Product Data and Sample submittals.

1.02 REQUIREMENT

A. Submit Shop Drawings, Product Data and Samples as required by Document 00700 - General Conditions and Specification sections, using procedures specified in Section 01330 - Submittal Procedures and the requirements of this Section.

B. Shop Drawings, Product Data and Samples are not considered Contract documents.

1.03 SHOP DRAWING/SUBMITTAL SCHEDULE

A. Submit a separate Shop Drawing submittal schedule at same time the Construction Schedule is submitted. List Products for which Shop Drawings and other submittals are required in the order that they appear in Specifications. Include Product Data and Sample submittals in the schedule. Payment Applications or Certificates for Payment will not be processed until Project Manager has approved the Shop Drawing submittal schedule.

1.04 SHOP DRAWINGS

A. Submit a minimum of seven sets of Shop Drawings and Product Data in a form and quality suitable for microfilming. Review and sign Shop Drawings indicating compliance with the Contract.

B. Place Contractor's Stamp on each drawing as described in Section 01330 - Submittal Procedures.

C. Show the following accurately and distinctly:

1. Field and erection dimensions;

2. Arrangement and section views;

3. Relation to adjacent materials or structure, including complete information for making connections between the Work and work under other contracts;

4. Types of Products and finishes;

5. Parts list and descriptions;

6. Assembly drawings of equipment components and accessories showing respective positions and relationships to the complete equipment package;

7. Identify details by referencing drawing sheet and detail numbers, schedule or room numbers as shown on the Contract drawings, where necessary for clarity.

D. Scale drawings to provide a true representation of the specific equipment or item Furnished.

E. Coordinate and submit components, necessary for Project Manager to adequately review submittal, as a complete package. Reproduction of the Drawings for use in Shop Drawings is not allowed.

F. For major changes to original documents, submit Computer-Aided Design (CAD) drawings on a media acceptable to Project Manager.

1.05 PRODUCT DATA

A. Submit Product Data for review as required in Specifications.

B. Place Contractor's stamp, on each data item submitted, as described in Section 01330 - Submittal Procedures.

C. Mark each copy to identify applicable Products, models, and options to be used in the Work. Where required by Specifications, supplement manufacturers' standard data to provide information unique to the Work.

D. Give manufacturers, trade name, model or catalog designation and applicable reference standard for Products specified only by reference standards.

E. Pre-approved and Pre-qualified Products.

1. For "pre-approved", "pre-qualified" and "approved" Products named in the City standard products list, provide an 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 that the proposed Products meet the level of quality and performance criteria of the "approved" product.

1.06 SAMPLES

A. Submit Samples for review as required by Specifications. Have Samples reviewed and signed by a Registered Professional.

B. Place Contractor's stamp on each Sample or firmly attach a sheet of paper with Contractor's stamp, as described in Section 01330 - Submittal Procedures.

C. Submit the number of Samples specified in Specifications; Project Manager will retain one.

D. Reviewed Samples that may be used in the Work are identified in Specifications.

PART 2 P R O D U C T S - Not Used

PART 3 E X E C U T I O N - Not Used

END OF SECTION

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Section 01410

TPDES REQUIREMENTS

1.01 SECTION INCLUDES

A. Documentation to be prepared and signed by Contractor/Operator before conducting construction operations, in accordance with the Texas Pollutant Discharge Elimination System (TPDES) Construction General Permit Number TXR 150000 issued February 15, 2008 (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 appropriate practices shown on the Drawings or specified elsewhere in the Contract.

C. Review of the Storm Water Pollution Prevention Plan (SWP3) implementation in a meeting with Project Manager 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 excavation activities, as well as other construction related activities (e.g., stock piling of fill material, demolition).

B. Large Construction Activity: Project that:o

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:

Operator - The person or persons associated with a large or small construction activity that is either a primary or secondary as defined below:

Primary Operator – the person or persons associated with a large or small construction activity that meets either of the following two criteria:

(a) the persons have operational control over construction plans and specifications, including the ability to make modifications to those plans and specifications; or

(b) the person or persons have day-to-day operational control of those activities at a construction site that are necessary to ensure compliance with a storm water pollution prevention plan (SWP3) for the site or other permit conditions (e.g., they are authorized to direct workers at a site to carry out activities required by the SWP3 or comply with other permit conditions).

Secondary Operator – The person whose operational control is limited to the employment of other operators or to the ability to approve or disapprove changes to plans and specifications. A secondary operator is also defined as a primary operators if there are no other operators if there are no other operators at the construction site.

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 (SWP3)

A. Prepare a SWP3 following Part III of the Construction General Permit and the Storm Water Management Handbook for Construction Activities issued under City Ordinance Section 47-695(b). If conflicts exist between the Construction General Permit and the handbook, the more stringent requirements will apply.

B. Update or revise the SWP3 as needed during the construction following Part III, Section E of the Construction General Permit.

C. Submit the SWP3 and any updates or revisions to Project Manager 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 (03/05/2008) 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 (03/05/2008), along with a $325.00 check, made out to Texas Commission on Environmental Quality, and the completed Payment Submittal Form to Project Manager.

C. Project Manager will complete a separate TCEQ Form 20022 (03/05/2008) 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 if mailing is required a minimum of seven days before Commencement of Construction Activities.

3.03 CONSTRUCTION SITE NOTICE FOR SMALL CONSTRUCTION ACTIVITY

A. Fill out, sign, and date the 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 Project Manager at least seven days prior to Commencement of Construction Activity.

3.04 CERTIFICATION REQUIREMENTS

A. Fill out TPDES Operator's Information form, **ATTACHMENT 3** of this Section 01410, including 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. Use multiple copies as required to document full information.

B. Contractor and Subcontractors shall sign and date the Contractor's / Subcontractor's Certification for TPDES Permitting, **ATTACHMENT 4** of this Section 01410. Include this certification with other Project certification forms.

C. Submit properly completed certification forms to Project Manager for review before beginning construction operations.

D. 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 City of Houston Storm Water Pollution Prevention Plan, Construction Site Inspection Report, **ATTACHMENT 5** of this Section 01410 to record maintenance inspections and repairs.

3.05 RETENTION OF RECORDS

A. Keep a copy of this document and the SWP3 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 SWP3 implementation shall have a copy of the SWP3 available at a central location, on-site, for the use of all operators and those identified as having responsibilities under the SWP3. Upon submission of the NOT, submit all required forms and a copy of the SWP3 with all revisions to Project Manager.

3.06 REQUIRED NOTICES

A. Post the following notices from effective date of the SWP3 until date of final site stabilization as defined in the Construction General Permit:

1. Post the TPDES permit number for Large Construction Activity, with a signed TCEQ Construction Site Notice for large or 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 where it is safely and readily available for viewing by General Public, Local, State, and Federal Authorities. Post name and telephone number of Contractor's local contact person, brief project description and location of the SWP3.

    a. If posting near a main entrance is not feasible due to safety concerns, coordinate posting of notice with Project Manager 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 notice 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 access 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 SWP3.

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 SWP3.

3.08 NOTICE OF TERMINATION

A. Submit a NOT, **ATTACHMENT 7** of this Section 01410, to Project Manager 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 SWP3, or transferred to a new operator if the new operator has sought permit coverage.

B. Project Manager will complete City's NOT and submit Contractor and City's notices to the TCEQ and MS4 entities.

END OF SECTION

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ATTACHMENT 1

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

For help completing this application, read the TXR150000 NOI Instructions (TCEQ-20022-Instructions).

TCEQ Office Use Only
TPDES Permit Number: TXR15__ __ __ __ - NO
GIN Number: __ __ __ __ __ __ __ __

A. Construction Site Operator ☐ New ☐ No Change Customer Reference Number: CN_____
Name:_____
Mailing Address:_____ City:_____ State:____ Zip Code:_____
Country Mailing Information (*if outside USA*) Territory:_____ Country Code:_____ Postal Code:_____
Phone Number:_____ Extension:_____ Fax Number:_____
E-mail Address:_____
Type of Operator: ☐ Individual ☐ Sole Proprietorship - D.B.A. ☐ Partnership ☐ Corporation ☐ Federal Government ☐ State Government ☐ County Government ☐ City Government ☐ Other:_____
Independent Operator? ☐ Yes ☐ No Number of Employees: ☐ 0-20 ☐ 21-100 ☐ 101-250 ☐ 251-500 ☐ 501 or higher
Federal Tax ID:_____ State Franchise Tax ID Number:_____ DUNS Number:_____

B. Billing Address
Name:_____
Mailing Address:_____ City:_____ State:____ Zip Code:_____
Country Mailing Information (*if outside USA*) Territory:_____ Country Code:_____ Postal Code:_____

C. Project / Site Information ☐ New ☐ No Change Regulated Entity Reference Number: RN_____
Name:_____
Mailing Address:_____ City:_____ State:____ Zip Code:_____
Physical Address:_____ City:_____ County:_____ Zip Code:_____
Location Access Description:_____
Latitude:___°___'___" N Longitude:___°___'___" W Degrees (°), Minutes ('), and Seconds (")
Latitude:_____ Longitude: -_____ Decimal Form
Standard Industrial Classification (SIC) code:_____ Also, describe the construction activity at this site *(do not repeat the SIC code)*:
_____
Has a storm water pollution prevention plan been prepared as specified in the general permit (TXR150000)? ☐ Yes ☐ No
Estimated area of land disturbed (to the nearest acre):_____ Is the project / site located on Indian Country Lands? ☐ Yes ☐ No
Does this project / site discharge storm water into a municipal separate storm sewer system (MS4)? ☐ Yes ☐ No
If yes, provide the name of the MS4 operator:_____
Provide the name or segment number of the water body that receives storm water from this project / site:_____

D. Contact - If the TCEQ needs additional information regarding this application, who should be contacted?
Name:_____ Title:_____
Phone Number:_____ Extension:_____ Fax Number:_____
E-mail Address:_____

E. Payment Information - Check / Money Order Number:_____ Name on Check / Money Order:_____

F. Certification
I certify under penalty of law that this document was 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

Construction Site Operator:
Prefix:_____ First:_____ Middle:_____
Last:_____ Suffix:_____ Title:_____
Signature:_____ Date:_____

If you have questions on how to fill out this form or about the storm water program, please contact us at (512) 239-4671.
Individuals are entitled to request and review their personal information that the agency gathers on its forms. They may also have any errors in their information corrected. To review such information, contact us at (512) 239-3282.

The completed NOI must be mailed to the following address. Use the attached document to submit the $100 application fee. Please note that the NOI and application fee are submitted separately to different addresses.

Texas Commission on Environmental Quality
Storm Water & General Permits Team; MC - 228
P.O. Box 13087
Austin, Texas 78711-3087

TCEQ-20022 (05/03) Page 1 of 2

ATTACHMENT 1

Texas Commission on Environmental Quality
Payment Submittal Form

The storm water application fee shall be sent under separate cover to the Texas Commission on Environmental Quality.

This form must be used to submit your Storm Water Application Fee. Please complete the following information, staple your check in the space provided at the bottom of this document, and mail it 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

Storm Water General Permit: TXR150000

Check / Money Order No: _____ Amount of Check/Money Order: _____

Date of Check or Money Order: _____

Name on Check or Money Order: _____

Facility / Site Name: _____

Facility / Site Physical Address: _____

City: _____ Zip Code: _____

Staple Check In This Space

ATTACHMENT 1

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

A. Construction Site Operator Information

Check boxes and Customer Reference Number
These boxes designate the operator's status as a TCEQ "customer"—in other words, an individual or business that is involved in an activity that we regulate. We assign each customer a number that begins with "CN." followed by nine digits. ***This is not a permit number, registration number, or license number.*** In the remainder of this section, we will use "this customer" to mean the operator for Part A of the form.

- If this customer has not been assigned a Customer Reference Number or if this number is unknown, check "New" and 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 and:
  - Check "No Change" if all the remaining customer information is the same as previously reported. However, you must still complete most blanks in this form for this notice of intent to be valid.
  - If this customer's information has changed since the last time it was reported to the TCEQ, check neither box and complete the remainder of this notice of intent.
- ***Do not enter a permit number, registration number, or license number in place of the Customer Reference Number.***

Name
Enter the legal name of this customer as authorized to do business in Texas. Include any abbreviations (LLC, Inc., etc.)

Mailing Address
Enter a central and general mailing address for this customer to receive mail from the TCEQ. For example, if this customer is a large company, this address might be the corporate or regional headquarters. On the other hand, for a smaller business, this address could be the same as the site address.

If this is a street address, please follow US Postal Service standards. In brief, these standards require this information in this order.

- the "house" number—for example, the 1401 in 1401 Main St
- if there is a direction before the street name, the one- or two-letter abbreviation of that direction (N, S, E, W, NE, SE, SW, or NW)
- the street name (if a numbered street, do not spell out the number—for example, 6th St, not Sixth St)
- an appropriate abbreviation of the type of street—for example, St, Ave, Blvd, Fwy, Exwy, Hwy, Cr, Ct, Ln
- if there is a direction after the street name, the one- or two-letter abbreviation of that direction (N, S, E, W, NE, SE, SW, or NW)
- if there is a room number, suite number, or company mail code

City, State, *and* ZIP Code
Enter the name of the city, the two-letter USPS abbreviation for the state (for example, TX), and the ZIP Code. (Enter the full ZIP+4 if you know it.)

Country Mailing Information
If this address is ***outside*** the United States, enter the territory name, country code, and any non-ZIP mailing codes or other non-U.S. Postal Service features here. If this address is ***inside*** the United States, leave these spaces blank.

Phone Number *and* Extension
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.

Fax Number
This number should correspond to this customer's mailing address given earlier. Enter the area code and fax number here.

E-mail Address
As with the mailing address, this should be a general address that is appropriate for e-mail to this customer's central or regional headquarters, if applicable.

If "No Change" was checked for this customer, you may skip the rest of the fields in this part of the form and continue to the next part of the NOI.

Type of Operator
Check ***only one*** box.

Check ...	*If this customer ...*
Individual	is a person and has not established a business to do whatever causes them to be regulated by us.
Sole Proprietorship—D.B.A.	is a business 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 business that is established as a partnership as defined by the Texas Secretary of State's Office
Corporation	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
Federal, state, county, or city government (as appropriate)	is either an agency of one of these levels of government or the governmental body itself (If a utility district, water district, tribal government, college district, council of governments, or river authority, check "Other" and write in the specific type of government.)
Other	fits none of the above descriptions. Enter a short description of the type of customer in the blank provided.

Independent Operator?
Check "No" if this customer is a subsidiary or part of a larger company. Otherwise, check "Yes."

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 this NOI.***

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

State Franchise Tax ID
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.

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. Billing Address

We will mail the annual fee invoice for this site to the address entered in this section.

Name
Enter the legal name of the person or business to which we should mail this site's fee invoice each year.

Mailing Address
Enter the specific mailing address to which we should mail this site's fee invoice each year. If this is a street address, please follow the US Postal Service standards as described under "A. Construction Site Operator Information" on page 1 of these instructions.

City, State, *and* ZIP Code
Enter the name of the city, the two-letter USPS abbreviation for the state (for example, TX), and the ZIP Code. (Enter the full ZIP+4 if you know it.)

Country Mailing Information
If this address is ***outside*** the United States, enter the territory name, country code, and any non-ZIP mailing codes or other non-U.S. Postal

ATTACHMENT 1

Service features here. If this address is ***inside*** the United States, leave these spaces blank.

C. Project / Site Information

Check boxes *and* Regulated Entity Reference Number
These boxes designate this site's status as a TCEQ "regulated entity"—in other words, a location where an activity that we regulate occurs. We assign each regulated entity a number that begins with "RN," followed by nine digits. ***This is not a permit number, registration number, or license number.***

- If this site has not been assigned a Regulated Entity Reference Number or if this number is unknown, check "New" and leave the space for the Regulated Entity Reference Number blank.
- If this site has already been assigned this number, enter the Regulated Entity Reference Number and:
  - Check "No Change" if all the remaining information is the same as previously reported. However, even if there has been no change, you must complete this section at least through "E-mail Address" for this NOI to be valid.
  - If this site's information has changed since the last time it was reported to the TCEQ, check neither box and complete the remainder of this notice of intent.
- ***Do not enter a permit number, registration number, or license number in place of the Regulated Entity Reference Number.***

Name
Enter the name by which you want this site to be known to the TCEQ.

Mailing Address
Enter the specific mailing address for this site. If this is a street address, please follow the US Postal Service standards as described under "A. Construction Site Operator Information" on page 1 of these instructions. If the project / site's mailing address is the same as what is provided in Section A, you may enter "Same as Section A".

City, State, *and* ZIP Code
Enter the name of the city, the two-letter USPS abbreviation for the state (for example, TX), and the ZIP Code. (Enter the full ZIP+4 if you know it.)

Physical Address
Enter the physical address of the site itself. TCEQ staff should be able to use this address to find the site. Please follow the US Postal Service standards as described under "A. Construction Site Operator Information" on page 1 of these instructions. If the project / site does not have a physical address, enter "No Address".

City, County, *and* ZIP Code
Enter the name of the city, the county, and the ZIP Code. (Enter the full ZIP+4 if you know it.) This information must be provided even if you have entered "No Address" in the previous field.

Location Access Description
Enter a physical description of the location of the site based on highway intersections and/or permanent landmarks.

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:
http://www.tnrcc.state.tx.us/gis/drgview.html

Standard Industrial Classification (SIC) Code and Activity Description

Provide the SIC code that best describes the construction activity being conducted at the site.

For help with SIC codes, go to:
http://www.osha.gov/oshstats/sicser.html

In addition to the SIC code, you must also provide a description of the construction activity being conducted at the site. This may include such descriptions as: "Apartment Building Construction" or "Shopping Center Construction."

Storm Water Pollution Prevention Plan
This plan identifies the areas and activities that could produce contaminated runoff at your site and then tells how you will ensure that this contamination is mitigated. For example, in describing your mitigation measures, your site's plan might identify the devices that collect and filter storm water, tell how those devices are to be maintained, and tell how frequently that maintenance is to be carried out. ***You must develop this plan before you complete this NOI.*** This plan must be available for a TCEQ investigator to review on request. Specific requirements for the development of the plan can be found in the *Texas Pollutant Discharge Elimination System Construction General Permit (TXR150000)*.

Estimated Area of Land Disturbed
Provide the approximate number of acres that the construction site will disturb. It is appropriate to enter a value less than 5, only if the project is part of a larger common plan that disturbs five or more acres. If the acreage is less than 1, enter 1. "Disturb" means any clearing, grading, excavating, or other similar activities.

Is the site located on Indian Country Lands?
Check "Yes" only if the site is on a reservation or other areas designated by the federal government as Indian Country Lands. If not, check "No."

Destination of Storm Water Discharge
The storm water from your site eventually reaches a receiving water body such as a local stream or lake, possibly via a drainage ditch. The discharge may initially be into a municipal separate storm sewer system (MS4). Check the appropriate boxes for whether storm water is discharged into an MS4. If you checked "Yes" to "An MS4?", then enter the name of the entity that operates the storm sewer—often a city, town, or utility district, but possibly another form of government.

You must also provide the name of the water body that receives the discharge from the construction site (a local stream or lake). Storm water may be discharged directly to a receiving stream or via a storm sewer system. If known, please include the segment number if the discharge is to a classified water body.

For a map that includes segment numbers, go to:
http://www.tnrcc.state.tx.us/water/quality/data/index.html

D. Contact

Give all the relevant information for the person whom TCEQ can contact if there are questions about any of the information on this form—perhaps the same person who completed the form.

E. Payment Information

Provide the number and account holder name from the check or money order used to pay the $100 application fee.

F. Certification

The operator must sign and date this statement to validate this NOI. Be sure to enter the full legal name of the person signing the form and the relevant title—for example, "Operator," "Vice-President," or "Partner." Use the "Prefix" blank for such titles as Dr., Mr., or Ms., as desired. Use the "Suffix" blank for such designations as Ph.D., Jr., Sr., III, or J.D., if applicable.

For a corporation, the application shall be signed by a responsible corporate officer. 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 applications may provide for assignment or delegation to applicable corporate positions rather than to specific individuals.

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

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 application, 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 United States Environmental Protection Agency).

Questions?

If you have questions about any of the information on this form, contact our Storm Water Program at 512/239-4671 or look for "Storm Water" on our Web site.

www.tceq.state.tx.us

ATTACHMENT 2

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.D.2.** of the TCEQ General Permit Number TXR150000 for discharges of storm water runoff from construction sites. Additional information regarding the TCEQ storm water permit program may be found on the internet at:
www.tnrcc.state.tx.us/permitting/waterperm/wwperm/tpdestorm

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

For Construction Sites Authorized Under Part II.D.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.D.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 implemented according to permit requirements. A copy of this signed notice is supplied to the operator of the MS4 if discharges enter an MS4 system. 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

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ATTACHMENT 3

TPDES OPERATOR'S INFORMATION

Owner's Name and Address: City of Houston

Mr. _____
(City Official)

_____
(Department)
P. O. Box 1562
Houston, Texas 77251-1562
(713) 247-1000

Contractors' Names and Addresses:

General Contractor: _____

Telephone: _____

Site Superintendent: _____

Telephone: _____

Erosion Control and
Maintenance Inspection: _____

Telephone: _____

Subcontractors' Names and Addresses:

_____ _____

_____ _____

_____ _____

_____ _____

Phone: _____ Phone: _____

Note: Insert name, address, and telephone number of person or firms

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ATTACHMENT 4

CONTRACTOR'S / SUBCONTRACTOR'S

CERTIFICATION FOR TPDES PERMITTING

I certify under penalty of law that I understand the terms and conditions of TPDES General Permit No. TXR150000 and the Storm Water Pollution Prevention Plan for the construction site identified as part of this certification.

Signature: _____

Name: (printed or typed) _____

Title: _____

Company: _____

Address: _____

Date: _____

Signature: _____

Name: (printed or typed) _____

Title: _____

Company: _____

Address: _____

Date: _____

Signature: _____

Name: (printed or typed) _____

Title: _____

Company: _____

Address: _____

Date: _____

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ATTACHMENT 5

EPA NPDES Construction Inspection Form

The following inspection is being performed in compliance with Part IV.D.4. of the NPDES Region 6 Storm Water Construction General Permit [63 Fed. Reg. 36502] and being retained in accordance with Part V of the Permit. 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 at least 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 Texas and New Mexico. Permittees on Indian Country lands in Oklahoma, Louisiana and Arkansas and some oil and gas facilities in Oklahoma may use this form if they are eligible for this permit. 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 (301)495-4145. 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 http://www.epa.gov/region6/6wq/sw/. Any person with a complaint about the operation of this facility in regards to this permit should contact EPA Region 6 at (214)665-7112.

Permit Number(s) covered by this inspection (e.g. owners, developers, general contractor, builders)	
Signature and Certification in accordance with Part VI.G of the permit:	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 gathered and evaluated 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. Signature_____ Date_____
Date of Inspection	
Inspector Name	
Is there a copy of the permit language with the SWPPP?	❒ YES ❒ NO
Is the inspector qualified and are the qualifications documented in the SWPPP?	❒ YES ❒ NO
Is an NPDES storm water construction sign posted at the entrance for all permittees?	❒ YES ❒ NO

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/earth1r6/6en/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 IV.C. of the permit.

Revision 4, March 1, 2000

ATTACHMENT 5

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 wether 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).

ATTACHMENT 6

City of Houston

Storm Water Pollution Prevention Plan
Construction Site Inspection Report

TPDES/EPA Permit Number _____

COH Storm Water Quality Permit Number _____

DATE _____

No exceptions noted.

The following must be corrected prior to continuing work:

Public Notice improperly posted

Initial Construction Site Inspection Report information requires updating

Copy of NOI not on site

Storm water pollution prevention plan not on site

Erosion and sediment controls improperly installed

Erosion and sediment control devices improperly maintained

Fueling or washout areas not properly protected

Portocan or other sanitary facilities not properly protected

Self-inspection and maintenance records incomplete

Sediment from site outside area of construction

Other (see description below)

_____

_____

Please contact the Storm Water Quality Engineer at
611 Walker, RA-257, Houston TX 77002
713-837-7383 fax 713-837-0570

Once the above items have been corrected, call to arrange for reinspection. No further inspections for any construction related activity shall be made until the above items have been corrected.

_____ Inspector's Signature

_____ Contractor's Signature

_____ Inspector's Name

_____ Contractor's Name

not present

Distribution Stormwater Quality Engineer, Code Enforcement, Inspector, Operator
(Operator is Contractor)

Form _____ (10-01-01)

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ATTACHMENT 7

Notice of Termination (NOT) for Storm Water Discharges Associated with Construction Activity under the TPDES Construction General Permit (TXR150000)

TCEQ Office Use Only
TPDES Permit Number: TXR15-__|__|__|__| - NO
GIN Number: __|__ __|__ __|__|__|

For help completing this application, read the TXR150000 NOI Instructions (TCEQ-20023-Instructions).

A. TPDES Permit Number: TXR15_____

B. Construction Site Operator Customer Reference Number: CN_____
Name:_____
Mailing Address:_____
City:_____ State:_____ Zip Code:_____
Country Mailing Information (*if outside USA*) Territory:_____ Country Code:_____ Postal Code:_____
Phone Number:_____ Extension:_____ Fax Number:_____
E-mail Address:_____

C. Project / Site Information Regulated Entity Reference Number: RN_____
Name:_____
Physical Address:_____
Location Access Description:_____
City:_____ County:_____ Zip Code:_____

D. Contact - If the TCEQ needs additional information regarding this termination, who should be contacted?
Name:_____ Title:_____
Phone Number:_____ Extension:_____ Fax Number:_____
E-mail Address:_____

E. Certification

I certify under penalty of law that authorization under the TPDES Construction General Permit (TXR150000) is no longer necessary based on the provisions of the general permit. I understand that by submitting this Notice of Termination, I am no longer authorized to discharge storm water associated with construction activity under the general permit TXR150000, and that discharging pollutants in storm water associated with construction activity to waters of the U.S. is unlawful under the Clean Water Act where the discharge is not authorized by a TPDES permit. I also understand that the submittal of this Notice of Termination does not release an operator from liability for any violations of this permit or the Clean Water Act.

Construction Site Operator Representative:

Prefix:_____ First:_____ Middle:_____
Last:_____ Suffix:_____
Title:_____

Signature:_____ Date:_____

If you have questions on how to fill out this form or about the storm water program, please contact us at (512) 239-4671. Individuals are entitled to request and review their personal information that the agency gathers on its forms. They may also have any errors in their information corrected. To review such information, contact us at (512) 239-3282.

The completed NOT must be mailed to the following address:

Texas Commission on Environmental Quality
Storm Water & General Permits Team; MC - 228
P.O. Box 13087
Austin, Texas 78711-3087

TCEQ - 20023 (02/03) Page 1 of 1

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ATTACHMENT 7

Completing the Notice of Termination for Storm Water Discharges Associated with Construction Activity under the TPDES Construction General Permit (TXR150000)

Who May File a Notice of Termination (NOT) Form
Permittees disturbing 5 acres or more (or part of a larger common plan of development or sale disturbing 5 acres or more) who are presently covered under the Texas Pollutant Discharge Elimination System (TPDES) Construction General Permit must submit a Notice of Termination (NOT) when final stabilization has been achieved on all portions of the site that is the responsibility of the permittee; or another permitted operator has assumed control over all areas of the site that have not been finally stabilized and all silt fences and other temporary erosion controls have either been removed, scheduled for removal as defined in the SWP3, or transferred to a new operator if the new operator has sought permit coverage. Erosion controls that are designed to remain in place for an indefinite period, such as mulches and fiber mats, are not required to be removed or scheduled for removal.

Final Stabilization occurs when either of the following conditions are met:

(a) All soil disturbing activities at the site have been completed and a uniform (e.g, evenly distributed, without large bare areas) perennial vegetative cover with a density of 70% of the native background vegetative cover for the area has been established on all unpaved areas and areas not covered by permanent structures, or equivalent permanent stabilization measures (such as the use of riprap, gabions, or goetextiles) have been employed.

(b) For individual lots in a residential construction site by either:

(1) the homebuilder completing final stabilization as specified in condition (a) above; or

(2) the homebuilder establishing temporary stabilization for an individual lot prior to the time of transfer of the ownership of the home to the buyer and after informing the homeowner of the need for, and benefits of, final stabilization.

(c) For construction activities on land used for agricultural purposes (e.g. pipelines across crop or range land), final stabilization may be accomplished by returning the disturbed land to its preconstruction agricultural use. Areas disturbed that were not previously used for agricultural activities, such as buffer strips immediately adjacent to a surface water and areas which are not being returned to their preconstruction agricultural use must meet the final stabilization conditions of condition (a) above.

A. TPDES Permit Number
Provide the TPDES permit number assigned to the operator of the construction site.

B. Construction Site Operator Information
Customer Reference Number
This number designates the operator's status as a TCEQ "customer"—in other words, an individual or business that is involved in an activity that we regulate. We assign each customer a number that begins with "CN," followed by nine digits. ***This is not a permit number, registration number, or license number.*** In the remainder of this section, we will use "this customer" to mean the operator for Part B of the form.

- 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.
- ***Do not enter a permit number, registration number, or license number in place of the Customer Reference Number.***

Name
Enter the legal name of this customer as authorized to do business in Texas. Include any abbreviations (LLC, Inc., etc.).

Mailing Address
Enter a central and general mailing address for this customer to receive mail from the TCEQ. For example, if this customer is a large company, this address might be the corporate or regional headquarters. On the other hand, for a smaller business, this address could be the same as the site address.

If this is a street address, please follow US Postal Service standards. In brief, these standards require this information in this order:

- the "house" number—for example, the 1401 in 1401 Main St
- if there is a direction before the street name, the one- or two-letter abbreviation of that direction (N, S, E, W, NE, SE, SW, or NW)
- the street name (if a numbered street, do not spell out the number—for example, 6th St, not Sixth St)
- an appropriate abbreviation of the type of street—for example, St, Ave, Blvd, Fwy, Exwy, Hwy, Cr, Ct, Ln
- if there is a direction after the street name, the one- or two-letter abbreviation of that direction (N, S, E, W, NE, SE, SW, or NW)
- if there is a room number, suite number, or company mail code

City, State, *and* ZIP Code
Enter the name of the city, the two-letter USPS abbreviation for the state (for example, TX), and the ZIP Code. (Enter the full ZIP+4 if you know it.)

ATTACHMENT 7

Country Mailing Information
If this address is ***outside*** the United States, enter the territory name, country code, and any non-ZIP mailing codes or other non–U.S. Postal Service features here. If this address is ***inside*** the United States, leave these spaces blank.

Phone Number *and* Extension
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.

Fax Number
This number should correspond to this customer's mailing address given earlier. Enter the area code and fax number here.

E-mail Address
As with the mailing address, this should be a general address that is appropriate for e-mail to this customer's central or regional headquarters, if applicable.

C. Project / Site Information

Regulated Entity Reference Number
This number designates this site's status as a TCEQ "regulated entity"—in other words, a location where an activity that we regulate occurs. We assign each regulated entity a number that begins with "RN," followed by nine digits. ***This is not a permit number, registration number, or license number.***

- If this site has not been assigned a Regulated Entity Reference Number, leave the space for the Regulated Entity Reference Number blank.
- If this site has already been assigned this number, enter the Regulated Entity Reference Number.
- ***Do not enter a permit number, registration number, or license number in place of the Regulated Entity Reference Number.***

Name
Enter the name by which you want this site to be known to the TCEQ.

Physical Address
Enter the physical address of the site itself. TCEQ staff should be able to use this address to find the site.

Location Description
Enter a physical description of the location of the site based on highway intersections and/or permanent landmarks.

City, County, *and* ZIP Code
Enter the name of the city, the county, and the ZIP Code. (Enter the full ZIP+4 if you know it.)

D. Contact

Give all the relevant information for the person whom TCEQ can contact if there are questions about any of the information on this form—perhaps the same person who completed the form.

E. Certification

The operator must sign and date this statement to validate this NOI. Be sure to enter the full legal name of the person signing the form and the relevant title—for example, "Operator," "Operator's attorney," or "Senior Site Manager." Use the "Prefix" blank for such titles as Dr., Mr., or Ms., as desired. Use the "Suffix" blank for such designations as Ph.D., Jr., Sr., III, or J.D., if applicable.

For a corporation, the application shall be signed by a responsible corporate officer. 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 applications may provide for assignment or delegation to applicable corporate positions rather than to specific individuals.

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

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 application, 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 United States Environmental Protection Agency).

Questions?

If you have questions about any of the information on this form, contact our Storm Water Program at 512/239-4671 or look for "Storm Water" on our Web site:

www.tceq.state.tx.us

Section 01422

REFERENCE STANDARDS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Section includes general quality assurance as related to Reference Standards and a list of references.

1.02 QUALITY ASSURANCE

A. For Products or workmanship specified by association, trade, or Federal Standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.

B. Conform to reference standard by date of issue current on the date as stated in the General Conditions.

C. Request clarification from Project Manager before proceeding should specified reference standards conflict with Contract documents.

1.03 SCHEDULE OF REFERENCES

AASHTO	American Association of State Highway and Transportation Officials 444 North Capitol Street, N.W. Washington, DC 20001
ACI	American Concrete Institute P.O. Box 9094 Farmington Hills, MI 48333-9094
AGC	Associated General Contractors of America 333 John Carlyle Street Alexandria, VA 22314
AI	Asphalt Institute Research Park Drive P.O. Box 14052 Lexington, KY 40512

AITC	American Institute of Timber Construction 7012 S. Revere Parkway, Suite 140 Englewood, CO 80112
AISC	American Institute of Steel Construction One East Wacker Dr. Chicago, IL 60601
AISI	American Iron and Steel Institute 1101 17th Street NW, Suite 1300 Washington, DC 20036
ASME	American Society of Mechanical Engineers Three Park Avenue New York, NY 10016
ANSI	American National Standards Institute 1819 L Street NW Sixth Floor Washington, D.C. 20036
APA	American Plywood Association Box 11700 Tacoma, WA 98411
API	American Petroleum Institute 1220 L Street, N.W. Washington, DC 20005
AREA	American Railway Engineering and Maintenance-of-Way-Association 8201 Corporate Drive, Suite 1125 Landover, Maryland 20785
ASTM	American Society for Testing and Materials 100 Barr Harbor Drive West Conshohocken, PA 19428
AWPA	American Wood-Preservers' Association P.O. Box 5690 Granbury, TX 76049
AWS	American Welding Society 550 NW 42nd Avenue Miami, FL 33126

AWWA	American Water Works Association 6666 West Quincy Avenue Denver, CO 80235
COH	City of Houston P.O. Box 1562 Houston, TX 77251-1562
CLFMI	Chain Link Fence Manufacturers Institute 9891 Broken Land Parkway, Suite 300 Columbia, MD 21046
CRSI	Concrete Reinforcing Steel Institute 933 Plum Grove Road Schaumburg, IL 60173-4758
EJMA	Expansion Joint Manufacturers Association 25 North Broadway Tarrytown, NY 10591
FS	Federal Standardization Documents General Services Administration Specifications Unit (WFSIS) 7th and D Streets, S.W. Washington, DC 20406
ICEA	Insulated Cable Engineer Association P.O. Box 440 S. Yarmouth, MA 02664
IEEE	Institute of Electrical and Electronics Engineers 445 Hoes Lane P.O. Box 440 Piscataway, NJ 08855-459
ISA	International Society of Arboriculture P.O. Box 3129 Champaign, IL 61826-3129
MIL	Military Specifications General Services Administration Specifications Unit (WFSIS) 7th and D Streets, S.W. Washington, DC 20406

NACE	National Association of Corrosion Engineers 1440 South Creek Drive Houston, TX 77084-4906
NEMA	National Electrical Manufacturers' Association 1300 North 17th Street, Suite 1847 Rosslyn, VA 22209
NFPA	National Fire Protection Association 1 Batterymarch Park P.O. Box 9101 Quincy, MA 02269-9101
OSHA	Occupational Safety Health Administration U.S. Department of Labor Office of Public Affairs – Room N3647 Washington, DC 20210
PCA	Portland Cement Association 5420 Old Orchard Road Skokie, IL 60077-1083
PCI	Prestressed Concrete Institute 209 W. Jackson Blvd. Chicago, IL 60606
SDI	Steel Deck Institute P.O. Box 25 Fox River Grove, IL 60021
SSPC	Society for Protective Coatings (Steel Structures Painting Council) 40 24th Street, Sixth Floor Pittsburgh, PA 15222
TAC	Texas Administrative Code Texas Water Resources Conservation Commission P. O. Box 13087 Library MC-196 Austin, TX 78711-3087
TxDOT	Texas Department of Transportation 125 East 11th Street Austin, TX 78701-2483

UL	Underwriters' Laboratories, Inc. 333 Pfingston Road Northbrook, IL 60062
UNI-BELL	UNI-BELL Pipe Association 2655 Villa Creek Drive, Suite 155 Dallas, TX 75234

PART 2 P R O D U C T S - Not Used

PART 3 E X E C U T I O N - Not Used

END OF SECTION

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Section 01450

CONTRACTOR'S QUALITY CONTROL

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Quality assurance and control of Installation and manufacturers' field services and reports.

1.02 QUALITY ASSURANCE AND CONTROL OF INSTALLATION

A. Monitor quality control over Suppliers, manufacturers, Products, services, site conditions and workmanship, to produce work of specified quality at no additional cost to the City.

B. Comply fully with manufacturers' Installation instructions, including each step in sequence.

C. Request clarification from Project Manager before proceeding when manufacturers' instructions conflict with the Contract.

D. Comply with specified standards as minimum requirements for the Work except when more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.

E. Perform the Work by persons qualified to produce a specified level of workmanship.

1.03 REFERENCES

A. Obtain copies of standards and maintain at job site when required by individual Specification sections.

1.04 MANUFACTURERS' FIELD SERVICES AND REPORTS

A. When specified in individual Specification sections, or as required by Project Manager, provide Product suppliers' or manufacturers' technical representative to observe site conditions, conditions of surfaces and Installation, quality of workmanship, start-up of equipment, operator training, testing, adjusting and balancing of equipment as applicable and to initiate required operation. Conform to minimum time requirements for start-up operations and operator training when provided in Specification sections.

B. At Project Manager's request, submit qualifications of manufacturers' representative to Project Manager 15 days in advance of required representatives' services. Representative is subject to approval by Project Manager.

C. Manufacturer's representatives shall report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to a manufacturer's written instructions. Submit report within 14 days of observation to Project Manager for review.

PART 2 P R O D U C T S - Not Used

PART 3 E X E C U T I O N - Not Used

END OF SECTION

Section 01452

INSPECTION SERVICES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Inspection services and references

1.02 INSPECTION

A. City Engineer will appoint an Inspector to represent the City and perform inspections, tests, and other services specified in individual Specification sections.

B. City Engineer may also appoint, employ, and pay an independent firm to provide additional inspection or construction management services as indicated in Section 01454 - Testing Laboratory Services.

C. The independent firm will submit reports to Project Manager, indicating observations and results of tests and indicating compliance or noncompliance with Contract requirements.

D. Contractor shall assist and cooperate with the Inspector; furnish samples of materials, design mix, equipment, tools, and storage.

E. Contractor shall notify Project Manager 24 hours prior to expected time for operations requiring services.

F. Contractor shall sign and acknowledge reports for Inspector.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION - Not Used

END OF SECTION

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Section 01454

TESTING LABORATORY SERVICES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Testing laboratory services and Contractor responsibilities related to those services.

1.02 REFERENCES

A. ASTM C 1077 - Standard Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation.

B. ASTM D 3666 - Standard Specification for Minimum Requirements for Agencies Testing and Inspecting Bituminous Paving Materials.

C. ASTM D 3740 - Standard Practice for Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction.

D. ASTM E 329 - Standard Specification for Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction.

E. ISO/TEC Guide 25 - General Requirements for the Competence of Calibration and Testing Laboratories.

1.03 SELECTION AND PAYMENT

A. The City will select, employ, and pay for services of an independent testing laboratory to perform inspection and testing identified in Part 3 of individual Specification sections.

B. Contractor shall employ and pay for services of an independent testing laboratory or laboratories to perform inspection and testing identified in Part 2 of individual Specification sections.

C. Employment of a testing laboratory by the City shall not relieve Contractor of its obligation to perform work in accordance with requirements of Contract documents.

D. The City will deduct a minimum two-hour charge for testing laboratory time from periodic progress payment when operations requiring testing or inspection are canceled without prior notification.

E. The City will deduct cost of retesting from periodic progress payment whenever failed work is removed, replaced and retested.

1.04 QUALIFICATION OF LABORATORY

A. Meet laboratory requirements of ASTM E 329 and applicable requirements of ASTM C 1077, ASTM D 3666, and ASTM D 3740.

B. Meet ISO/TEC Guide 17025 conditions for accreditation by the American Association for Laboratory Accreditation (A2LA) in specific fields of testing required in individual Specification sections.

C. If laboratory subcontracts are part of the testing services, such work will be placed with a laboratory complying with the requirements of this Section.

1.05 LABORATORY REPORTS

A. Testing laboratory shall provide and distribute copies of laboratory reports to the distribution list Project Manager provides at the pre-construction conference.

B. Keep one copy of each laboratory report distributed or faxed at the site field office for duration of the Work.

C. Laboratory will fax material supplier, Contractor and Project Manager reports that indicate failing test results by no later than close of business on the working day following test completion and review.

1.06 LIMITS ON TESTING LABORATORY AUTHORITY

A. Laboratory may not release, revoke, alter, or enlarge requirements of the Contract.

B. Laboratory may not approve or accept any portion of the Work.

C. Laboratory may not assume Contractor duties.

D. Laboratory has no authority to stop the Work.

1.07 CONTRACTOR RESPONSIBILITIES

A. Provide safe access to the Work and to manufacturer's facilities for Project Manager and for testing laboratory personnel.

B. Provide testing laboratory with a copy of the Construction Schedule and a copy of each update to Construction Schedule.

C. Notify Project Manager and testing laboratory during normal working hours of the day previous to expected time for operations requiring inspection and testing services. When Contractor fails to make timely prior notification, do not proceed with the operations requiring inspection and testing services.

D. Notify Design Consultant 24 hours in advance when Specification requires presence of Design Consultant for sampling or testing.

E. Request and monitor testing as required to provide timely results and to avoid delays to the Work. Provide samples to laboratory in sufficient time to allow required test to be performed in accordance with specified test methods before intended use of the Product.

F. Cooperate with laboratory personnel in collecting samples on site. Provide incidental labor and facilities for safe access to the Work to be tested, to obtain and handle samples at site or at source of Products to be tested, and to facilitate tests and inspections including storage and curing of test samples.

G. Make arrangements with laboratory through Project Manager. Payment for additional testing will be made in accordance with Document 00700 - General Conditions:

1. Re-testing required for failed tests.

2. Re-testing for nonconforming work.

3. Additional sampling and tests requested beyond specified requirements.

4. Insufficient notification of cancellation of tests for work scheduled but not performed.

PART 2 P R O D U C T S - Not Used

PART 3 EXECUTION

3.01 CONDUCTING TESTING

A Conform to laboratory sampling and testing methods specified in individual Specification sections to the latest issues of ASTM standards, TxDOT methods, or other recognized test standards as approved by Project Manager.

B Requirements of this Section shall also apply to those tests for approval of materials, for mix designs, and for quality control of materials as performed by employed testing laboratories.

END OF SECTION

Section 01502

MOBILIZATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Mobilization of construction equipment and facilities onto the site.

1.02 MEASUREMENT AND PAYMENT

A. Unit Price Contracts. If Contract is Unit Price Contract, measurement for mobilization is on a lump sum basis.

B. Stipulated Price (Lump Sum) Contract. If Contract is Stipulated Price Contract, payment for Work in this Section is included in total Stipulated Price.

C. Mobilization payments will be included in monthly payment estimates upon written application by Contractor subject to the following provisions:

1. Authorization for payment of 50 percent of that portion of Contract Price designated for mobilization will be made upon receipt and approval by Project Manager of the following items, as applicable:

a. Safety Program (Document 00700, Paragraph 10.1.1).

b. Site Utilization Plan (Section 01145).

c. Schedule of Values (Section 01292), if any.

d. Initial Construction Photographs (Section 01321), if needed.

e. Preliminary Construction Schedule and Billing Forecast (Section 01325).

f. Construction Schedule (Section 01325 or Section 01326, as applicable).

g. Submittal Schedule (Section 01330).

h. Site specific Storm Water Pollution Prevention Plan (SWPPP) and Notice of Intent (NOI) along with storm water application fee (Section 01410), if required.

i. Contractor's Quality Control Plan (Section 01450), if required.

j. Establishment of a Field Office for Project Manager meeting requirements of Section 01520 - Temporary Field Office.

k. Traffic Control Plan (Section 01555), if required.

l. Plan for Control of Ground and Surface Water (Section 01578), if required.

m. Project Signs Submittal (Section 01580).

n. Trench Safety Program (Section 02260), if required.

o. Dewatering plan, when required.

2. Authorization for payment of the balance of that portion of Contract Price designated for mobilization will be made upon completion of the Work amounting to five percent of Original Contract Price. The amount of Contract Price designated for mobilization may not be applied in computing whether or not five percent of the Original Contract Price has been obtained.

3. Mobilization payments will be subject to retainage amounts stipulated in Document 00700 – General Conditions.

PART 2 P R O D U C T S -Not Used

PART 3 E X E C U T I O N -Not Used

END OF SECTION

Section 01504

TEMPORARY FACILITIES AND CONTROLS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Temporary facilities and necessary controls for the Project, including utilities, telephone, sanitary facilities, storage sheds and building, safety requirements, first aid equipment, fire protection, security measures, protection of the Work and property, access roads and parking, environmental controls, pest and rodent control and disposal of trash, debris and excavated material.

B. Facilities and controls specified in this section are considered minimum for the Project. Provide additional facilities and controls for proper execution of the Work and to meet Contractor's responsibilities for protection of persons and property.

1.02 MEASUREMENT AND PAYMENT

A. UNIT PRICES

1. No separate payment will be made for any temporary facilities and controls required under this section. Include cost of such work in contract price listed for mobilization.

1.03 CONTRACTOR'S RESPONSIBILITY

A. Comply with applicable requirements specified in other sections of Specifications.

1. Maintain and operate temporary facilities and systems to assure continuous service.

2. Modify and extend systems as the Work progress requires.

3. Completely remove temporary materials and equipment when no longer required.

4. Restore existing facilities used for temporary services to specified or original condition.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 TEMPORARY UTILITIES

A. Obtaining Temporary Service:

1. Make arrangements with utility service companies for temporary services.

2. Abide by rules and regulations of the utility service companies or authorities having jurisdiction.

3. Be responsible for utility service costs until Date of Substantial Completion. Included are fuel, power, light, heat, and other utility services necessary for execution, completion, testing, and initial operation of work.

B. Water:

1. Provide water required for and in connection with work to be performed and for specified tests of piping, equipment, devices, or for other use as required for proper completion of the Work.

2. Water to be drawn from public fire hydrants. Obtain transit meter from City of Houston, Department of Public Works and Engineering, Taps and Meters Section. Pay required deposit based on rates established by latest ordinance.

3. Provide and maintain an adequate supply of potable water for domestic consumption by Contractor personnel, Project Manager and representatives of the City.

C. Electricity and lighting:

1. Provide electric power service required for the Work including required testing, lighting, operation of equipment, and other Contractor use.

2. Electric power service includes temporary power or generators required to maintain plant operations during scheduled shutdowns.

3. Minimum lighting level shall be 10 foot-candles for open areas; 20-foot-candles for stairs and shops. Provide a minimum of one 300-watt lamp for each 200 square feet of work area.

D. Temporary Heat and Ventilation:

1. Provide temporary heat necessary for protection or completion of the Work.

2. Provide temporary heat and ventilation to assure safe working conditions; maintain enclosed areas at a minimum of 50 degrees F.

E. Telephone:

1. Provide emergency telephone service at Project site for use by Contractor personnel and others performing work or furnishing services at the site.

2. Provide Houston-Metro lines, allowing unlimited calls, without charge in Greater Houston Metropolitan area with "call waiting" and "call forwarding" options. Provide one telephone answering machine with beeperless remote message retrieval capability.

F. Sanitary Facilities:

1. Provide and maintain sanitary facilities for persons on the site; comply with regulations of State and local departments of health.

2. Enforce use of sanitary facilities by construction personnel at site. Enclose sanitary facilities. Pit-type toilets are not permitted. No discharge will be allowed from these facilities. Collect and store sewage and waste so as not to cause nuisance or health problems. Haul sewage and waste off-site and properly dispose in accordance with applicable regulations.

3. Locate toilets near the Work site and secluded from view insofar as possible. Keep toilets clean and supplied throughout the course of the Work.

3.02 STORAGE SHEDS AND BUILDINGS

A. Provide adequately ventilated, watertight storage facilities with floor above ground level for Products susceptible to weather damage.

B. Storage of Products not susceptible to weather damage may be on blocks off the ground.

C. Store Products in a neat and orderly manner. Place Products to permit easy access for identification, inspection and inventory.

D. Fill and grade site for temporary structures to provide drainage away from temporary and existing buildings.

3.03 SAFETY REQUIREMENTS

A. Submit a safety program at the pre-construction meeting and follow the program in accordance with Document 00700 – General Conditions. Include documented response to trench safety requirements of Section 02260 - Trench Safety System.

B. Conduct operations in strict accordance with applicable Federal, State and local safety codes and statutes and with good construction practice. Establish and maintain procedures for safety of all work, personnel and equipment involved in the Work.

C. Observe and comply with Texas Occupational Safety Act (Art. 5182a, V.C.S.) and with all safety and health standards promulgated by Secretary of Labor under Section 107 of Contract Work Hours and Standards Act, published in 29 CFR Part 1926 and adopted by Secretary of Labor as occupational safety and health standards under Williams-Steiger Occupational Safety and Health Act of 1970, and to other legislation enacted for safety and health of Contractor employees. Safety and health standards apply to Subcontractors and Suppliers as well as to the Contractor.

D. Observance of and compliance with safety regulations is Contractor's responsibility without reliance or superintendence of or direction by Project Manager. Immediately advise Project Manager of investigation or inspection by Federal Safety and Health inspectors of Contractor's or Subcontractor's work or place of work on site under the Contract, and after investigation or inspection, advise Project Manager of results. Submit one copy of accident reports to Project Manager within 10 days of occurrence.

E. Protect areas occupied by workmen using the best available devices for detection of lethal and combustible gases. Test devices frequently to assure functional capability. Constantly observe infiltration of liquids into the Work area for visual or odor evidence of contamination, and immediately take appropriate steps to seal off entry of contaminated liquids to the Work area.

F. Implement safety measures, including but not limited to safety personnel, first-aid equipment, ventilating equipment and other safety equipment specified or detailed on Drawings.

G. Maintain required coordination with City Police and Fire Departments during entire period covered by the Contract.

H. Include Project safety analysis in safety plan. Itemize major tasks and potential safety hazards. Plan to eliminate hazards or protect workers and public from each hazard.

3.04 FIRST AID EQUIPMENT

A. Provide a first aid kit throughout the construction period. List telephone numbers for physicians, hospitals, and ambulance services in each first aid kit.

B. Have at least one person thoroughly trained in first aid and CPR procedures present on the site when work is in progress. Contractor to conform to protocols and requirements for training and protection against "blood borne pathogens".

3.05 FIRE PROTECTION

A. Conform to specified fire protection and prevention requirements established by Federal, State, or local governmental agencies and as provided in Safety Program.

3.06 SECURITY MEASURES

A. Protect the Work, materials, equipment, and property from loss, theft, damage, or vandalism. Protect City property used in performance of the Contract.

B. If existing fencing or barriers are breached or removed for purposes of construction, provide and maintain temporary security fencing equal to existing.

3.07 PROTECTION OF UTILITIES AND PIPELINES

A. Prevent damage to existing public utilities during construction. Approximate locations of known utilities are shown on Drawings, but all lines may not be shown. Excavate with caution and repair lines damaged by construction operations.

B. Use the Utility Coordinating Committee One Call System, telephone number, (713) 223-4567, which must be called 48 hours in advance. The toll free telephone number is 1-800-669-8344, Texas One Call System.

C. Before excavating, locate underground utilities by appropriate means including the use of metal detection equipment, and probes, or by excavation or surveys. Repair damage caused by investigative work and by failure to locate or to preserve underground utilities.

D. Give utility owners a minimum five days notice before commencing excavation to allow time to locate utilities and make adjustments or

relocations when they conflict with the Work. Include cost for temporary relocation of water, wastewater, and storm drainage lines, necessary to accommodate construction, in unit prices for utility construction unless otherwise noted. Bypassing of sanitary waste to storm drainage facilities is not allowed.

E. Prior to excavation near pipelines, request a representative of the pipeline company to meet with Contractor and Project Manager at the site to discuss procedures to be used. Request pipeline company's representative to locate the pipelines in at least three locations: at each side and at centerline of proposed excavation of proposed utility. Also request representative and Project Manager to be present to observe Contractor operations when excavation is conducted within 15 feet of pipeline.

F. Utility service lines are not shown on the construction document drawings. Contractor should anticipate that such service lines exit and should exercise extreme caution during construction. The utility service lines should be repaired and restored immediately as per the specification, if damaged due to any construction activities. No separate payment will be made for this repair and restoration work. Include payment in unit price for work in appropriate sections.

G. Prior to abandonment of utility, make appropriate arrangements with City and owner of utility to terminate service, remove meters, tranformers, and poles as may be required by site conditions.

3.08 PROTECTION OF THE WORK AND PROPERTY

A. Preventive Actions

1. Take necessary precautions and actions to prevent damage, injury, or loss to the Work or public and private property, including:

   a. Storage of apparatus, supplies, and Products in an orderly, safe manner to limit interference with progress of the Work or work of other contractors, utility service companies, or the City's operations.

   b. Suitable storage for Products subject to damage by exposure to weather, theft, breakage, etc.

   c. Limitation of loading pressures imposed upon portions of the Work.

   d. Frequent clean up of refuse, scrap materials, and debris from construction operations, necessary to maintain the site in a safe and orderly condition.

e. Provision of barricades and guard rails to protect pedestrian and traffic around openings, scaffolding, temporary stairs and ramps, excavations, elevated walkways, and other hazardous areas.

2. Protect public and private property adjacent to the site. Obtain written consent before entering or occupying privately-owned land except on easements provided for construction. Restore property damaged by construction operations to condition equal to or better than that existing before the damage.

B. Barricades and Warning Systems

1. Where work is performed on or adjacent to roadways, rights-of-ways, or public land, provide barricades, fences, lights, warning signs, danger signals, and other precautionary measures necessary for protection of persons or property and for protection of the Work.

a. Erect sufficient barricades to keep vehicles and pedestrians from entering the Work. Paint barricades to be visible at night. From sunset to sunrise, provide at least one light at each barricade.

b. Maintain barricades, signs, lights, and provide watchmen until Project Manager approves removal. Whenever work creates encroachment onto public roadways, station flagmen to manage traffic flow in accordance with approved traffic control plan.

c. Conform to requirements of section 01555 – Traffic Control and regulation.

C. PROTECTION OF EXISTING STRUCTURES

1. Underground Facilities

a. Known Underground Facilities are shown on the Drawings but all Facilities may not be shown. Explore sufficiently ahead of trenching and excavation work to locate Underground Facilities in order to prevent damage to them and to prevent interruption of utility services. Restore damage to Underground Facilities to original condition at no additional cost to the City.

b. If necessary to avoid unanticipated Underground Facilities, Project Manager may make changes in location of the Work.

c. If permanent relocation of an Underground Facility is required

and not provided for in the Contract documents, City Engineer will direct Contractor in writing to perform the Work under Modification provisions in Document 00700 - General Conditions.

2. Surface Structures include buildings, tanks, walls, bridges, roads, dams, channels, open drainage, piping, poles, wires, posts, signs, markers, curbs, walks, guard cables, fencing, and other facilities that are visible above the ground level.

3. Protection of Underground Facilities and Surface Structures:

   a. Support in place and protect Underground Facilities and Surface Structures located within or adjacent to the limits of the Work from damage. Install supports as required by the owner of the structure. Satisfy Project Manager that the owner of the facility or structure has approved methods and procedures before installing structure supports.

   b. Avoid moving or changing public utility or private corporation property without prior written consent of a responsible official of the facility or structure. Allow representatives of utilities to enter the construction site for maintenance and repair purposes or to make necessary changes.

   c. Notify utility and pipeline owners and operators of the nature of construction operations and dates when operations will be performed. When construction operations are required in immediate vicinity of existing structures, pipelines, or utilities, give a minimum of five working days advance notice. Probe and flag location of Underground Facilities prior to commencement of excavation. Keep flags in place until construction operations uncover the facility.

   d. Assume risk for damages and expenses to Underground Facilities and Surface Structures within or adjacent to the Work.

D. Employ a structural engineer to ensure protection measures are adequate for the safety and integrity of structures and facilities.

E. PROTECTION OF INSTALLED PRODUCTS:

1. Provide protection of Installed Products to prevent damage from subsequent operations. Remove protection facilities when no longer needed, prior to completion of the Work.

2. Control traffic to prevent damage to Products and surfaces.

3. Provide coverings to protect Products from damage. Cover projections, wall corners, jambs, sills, and exposed sides of openings in areas used for traffic and passage of materials in subsequent work.

3.09 ROADS AND PARKING

A. Prevent interference with traffic and operations of the City on existing roads.

B. Designate temporary parking areas to accommodate construction and City personnel. When site space is not adequate, provide additional off-site parking. Locate as approved by Project Manager.

C. Minimize use by construction traffic on existing streets and driveways.

D. Do not allow heavy vehicles or construction equipment in existing parking areas.

3.10 ENVIRONMENTAL CONTROLS

A. Use methods, equipment, and temporary construction necessary for control of environmental conditions at the site and adjacent areas.

B. Comply with statutes, regulations, and ordinances relating to prevention of environmental pollution and preservation of natural resources including National Environmental Policy Act of 1969, PL 91-190, Executive Order 11514.

C. Minimize impact to the surrounding environment. Do not use construction procedures that cause unnecessary excavation and filling of terrain, indiscriminate destruction of vegetation, air or stream pollution, or harassment or destruction of wildlife.

D. Limit disturbed areas to boundaries established by the Contract. Do not pollute on-site streams, sewers, wells, or other water sources.

E. Do not burn rubbish, debris or waste materials.

3.11 POLLUTION CONTROL

A. Provide methods, means, and facilities necessary to prevent contamination of soil, water or the atmosphere by discharge of Pollutants from construction operations.

B. Provide equipment and personnel to perform emergency measures to contain spillage, and to remove contaminated soils or liquids. Excavate and dispose of contaminated earth off-site in accordance with laws and regulations, and

replace with suitable compacted fill and topsoil.

C. Provide systems necessary for control of Pollutants.

1. Prevent toxic concentrations of chemicals.

2. Prevent harmful dispersal of Pollutants into the environment.

D. Use equipment that conforms to current Federal, State, and local laws and regulations.

3.12 PEST AND RODENT CONTROL

A. Provide rodent and pest control as necessary to prevent infestation of construction or storage areas.

B. Employ methods and use materials that will not adversely affect conditions at site or on adjoining properties.

3.13 NOISE CONTROL

A. Provide vehicles, equipment, and use construction activities that minimize noise to the greatest degree practicable. Conform to noise levels of Chapter 30 –Noise and Sound Level Regulation, City Code of Ordinances, and latest OSHA standards. Do not permit noise levels to interfere with the Work or create a nuisance to surrounding areas.

B. Conduct construction operations during daylight hours except as approved by Project Manager.

C. Select construction equipment that operates with minimum noise and vibration. When directed by Project Manager, correct objectionable noise or vibration produced by operation of equipment at no additional cost to the City. Sound Power Level (PWL) of equipment shall not exceed 85 dbA (re: 10^{-12} watts) measured five feet from the equipment, or at a lower level if prescribed by City Ordinances. Equipment noise requirements are contained in equipment specifications.

3.14 DUST CONTROL

A. Use water or other methods approved by Project Manager to control amount of dust generated by vehicle and equipment operations.

3.15 WATER RUNOFF AND EROSION CONTROL

A. Comply with requirements of section 01410 – TPDES Requirements.

B. Conduct fill, grading and ditching operations and provide adequate methods necessary to control surface water, runoff, subsurface water, and water from excavations and structures in order to prevent damage to the Work, the site, or adjoining properties.

1. Plan and execute construction and earthwork by methods that control surface drainage from cuts and fills, and from borrow and waste disposal areas.

2. Minimize area of bare soil exposed at one time.

3. Provide temporary control measures, such as berms, dikes, and drains.

4. Provide, operate, and maintain equipment and facilities of adequate size to control surface water.

5. Construct fill and waste areas by selective placement of materials to eliminate erosion of surface silts or clays that may erode.

6. Direct water away from excavations, pits, tunnels, and other construction areas to prevent erosion, sedimentation or damage.

7. Maintain existing drainage patterns adjacent to the site by constructing temporary earth berms, sedimentation basins, retaining areas, and temporary ground cover.

8. Dispose of drainage water in a manner to prevent flooding, erosion, or other damage to the site or adjoining areas, in conformance with environmental requirements.

9. Inspect earthwork periodically to detect any evidence of erosion. Take corrective measures as required to control erosion.

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Section 01520

TEMPORARY FIELD OFFICE

PART 1 GENERAL

1.01 SECTION INCLUDES

A Temporary field office building and associated parking area.

1.02 FACILITY DESCRIPTION

A Temporary field office to be utilized by authorized representatives of the City to coordinate and monitor daily construction activities performed by Contractor.

B. Field office shall be a non-smoking facility.

PART 2 PRODUCTS

2.01 FIELD OFFICE

A General:

1. Locate office in vicinity of the Work at a location approved by Project Manager or where indicated on Drawings.

2. Furnish, Install and maintain field office for exclusive use of authorized representatives of the City. Provide sufficient room for Project meetings and Inspector's office.

3. Provide office within 10 days of Date of Commencement of the Work.

4. Construct two all-weather, hard surfaced parking spaces for exclusive use of authorized representatives of the City. Provide all-weather surfaced walk between parking spaces and field office.

B. Minimum Construction:

1 Structurally sound foundation and superstructure.

Weather tight with insulated roof, walls and 7-foot ceiling (minimum).

3. Stairs or walkway with handrail and covered entrance platform (minimum 4 feet by 4 feet) with mud scraper at door.

4. Resilient floor covering.

5. Screened windows with area equal to approximately 10 percent of floor area sufficient for light, view of the site, and ventilation. Provide each window with operable sash and burglar bars.

6. Secure exterior doors with dead-bolt cylinder locks and burglar bars.

C. Minimum Services:

1. Exterior entrance light.

2. Interior lighting of 75 foot-candles minimum at desktop height

3. Automatic heating to maintain 65 degrees F in winter.

4. Automatic cooling to maintain 75 degrees F in summer.

5. Electric power service.

6. Three telephone service lines one for voice, one for data, and one for fax, for exclusive use of authorized representatives of the City.

7. Sanitary facilities in field office with one water closet, one lavatory, and one medicine cabinet for exclusive use of authorized representatives of the City.

D. Minimum Furnishings:

1. One 5-drawer desk

2. Two swivel desk chairs with casters.

3. One plan table.

4. One drawing plan rack.

5. One 4-drawer legal file cabinet complete with fifty legal-size hanging folders and two full-sized carriers.

6. One marker board with cleaner and markers.

7. Two waste baskets.

8. One 30-inch by 36-inch tack board.

9. One all-purpose fire extinguisher.

10. Six protective helmets (hard hats) with ratchet adjustment for exclusive use of authorized representatives of the City.

11. Conference table and chairs to accommodate 10 persons.

12. All in one printer, copier, plain paper fax machine.

13. Telephone instrument separate from fax machine.

E. Provide adequate space for one set of Contract documents for ready reference.

PART 3 EXECUTION

3.01 MAINTENANCE

A Maintain all-weather surface driveway and parking areas, buildings, walkways, stairs and required furnishings and equipment for duration of the Contract.

B. Provide janitorial services for duration of the Contract consisting of twice weekly sweeping and mopping floors, trash removal, weekly restroom cleaning, and weekly dusting of furniture and equipment.

C. Provide soap, paper towels, toilet paper, cleansers and other necessary consumables.

D. Immediately repair damage, leaks or defective service.

3.02 PROJECT CLOSEOUT

A Remove temporary field office and signs and restore site as specified in Section 01770 - Closeout Procedures.

END OF SECTION

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Section 01555

TRAFFIC CONTROL AND REGULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Requirements for signs, signals, control devices, traffic barriers, flares, lights and traffic signals; construction parking control, designated haul routes, and bridging of trenches and excavations.

B. Qualifications and requirements for use of flagmen.

1.02 MEASUREMENT AND PAYMENT

A. Unit Price Contracts.

1. Traffic control and regulation. Payment for traffic control and regulation is on a lump sum basis. Include preparation and submittal of traffic control plan if different than shown on Drawings, and provision of traffic control devices, equipment, and personnel necessary to protect the Work and public. Payment will be based on Contractor's Schedule of Values for traffic control and regulation.

2. Payment for traffic control will be authorized by Project Manager in three (3) parts. Partial payment will be made according to following schedule:

   a. Payment of 25 percent of traffic control amount will be authorized when permanent control devices and necessary temporary markings, sufficiently deployed along job site as required to maintain progress of work, are installed at job site and approved. This limiting percentage will be prorated based upon extent of Contractor's setup.

   b. A payment of 50 percent of traffic control amount will be authorized when pavement replacement commences. This limiting percentage will be prorated based upon linear footage, as measured along centerline axis of water main, of pavement replaced.

   c. A payment of 25 percent of traffic control amount will be authorized when permanent pavement markings are restored and all unnecessary permanent and temporary control devices removed. This limiting percentage will be prorated based upon the extent of restoration.

3. Flagmen: Measurement is on a lump sum basis for flagmen as required for the project. The amount invoiced shall be determined based on the schedule of value submitted for flagmen.

4. New Portable Concrete Low Profile Traffic Barrier Provided. Payment is on a unit price basis for each linear foot of low profile traffic barrier provided, installed with hardware assemblies and connected together in accordance with the approved traffic control plan.

5. Portable Concrete Low Profile Traffic Barrier picked up from City of Houston Stockpile. Payment is on a unit price basis for each linear foot of low profile traffic barrier picked up from designated stockpile, moved onto the project, set at location and connected together.

6. Portable Concrete Low Profile Traffic Barrier Installed. Payment is on a unit price basis for each linear foot of low profile traffic barrier delivered to the project location, installed with hardware assemblies and connected together in accordance with the approved traffic control plan.

7. Portable Concrete Low Profile Traffic Barrier Moved and Reset. Payment is on a unit price basis for each linear foot of low profile traffic barrier disassembled, moved on the project, reset at the new locations and connected together. Include cost to repair roadway in the unit price.

8. Portable Concrete Low Profile Traffic Barrier Removed. Payment is on a unit price basis for each linear foot of low profile traffic barrier removed from the project, including hardware assemblies, and stockpiling at location listed in Section 01110 – Summary of Work. Include cost to repair roadway in the unit price.

9. Refer to Section 01270 - Measurement and Payment for unit price procedures.

B. Stipulated Price Contracts. Include payment for work under this section in the total Stipulated Price.

1.03 REFERENCES

A. Texas Manual on Uniform Traffic Control Devices (TMUTCD)

B. Article 4413 (29bb), commonly referred to as Private Investigators and Private Security Agencies Act, and Article 2.12, Texas Code of Criminal Procedure.

C. Code of Ordinances, City of Houston, Texas.

1. Chapter 10 Buildings And Neighborhood Protection, Article X Cleanup After Demolition Or Removal Of Structures

2. Chapter 40 Streets and Sidewalks, Article XVII Pedestrian Way Impairments

1.04 SUBMITTALS

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

B. Traffic control plan:

1. If using traffic control plan contained in the Contract without modification, submit a letter confirming use of the plan.

2. If using a different traffic control plan, submit the plan for approval. The plan must conform to TMUTCD requirements and be sealed by a Registered Texas Professional Engineer.

C. Submit copies of approved lane closure permits issued by City Traffic Engineering Branch.

D. Submit Schedules of Values for traffic control plan and flagmen within 30 days following Notice to Proceed.

E. Submit records verifying qualifications of Uniformed Peace Officers and Certified Flagmen proposed for use on the Work.

F. When working in the central business district, submit copies of approved Pedestrian Way permits issued by the City's Traffic Engineering Branch.

1.05 FLAGMEN

A. Use Uniformed Peace Officers and Certified Flagmen to control movement of vehicular and pedestrian traffic when construction operations encroach on public traffic lanes. Unless otherwise approved by Project Manager, use Uniformed Peace Officer for work along major thoroughfares, schools, churches, hospitals and Work at signalized intersections.

B. Uniformed Peace Officer: Individual employed full-time as a peace officer who receives separate compensation as a privately employed flagman. Private employment may be an employee-employer relationship or on an individual basis. Flagman may not be in the employ of another peace officer nor be a reserve peace officer.

1. Uniformed Peace Officers may be:

   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.

2. The Uniformed Peace Officer must be a full-time peace officer, must work a minimum average of 32 paid hours per week, and must be paid a rate not less than the prevailing minimum hourly wage rate set by the federal Wage and Hour Act. The individual must be entitled to vacation, holidays, and insurance and retirement benefits.

C. Certified Flagman: Individual who receives compensation as a flagman and meets the following qualifications:

1. Formally trained and certified in traffic control procedures by the City s E. B. Cape Center.

2. Speaks English. Ability to speak Spanish is desirable but not required.

3. Paid for flagman duty at an hourly rate not less than the wage rate set for Rough Carpenter under the City's Wage Scale for Engineering Construction.

D. Certified Flagmen must wear a distinctive uniform, bright-colored vest, and be equipped with appropriate flagging and communication devices while at the Work site. They must also have in their possession while on duty, a proof of training identification card issued by the appropriate training institute.

PART 2 P R O D U C T S

2.01 SIGNS, SIGNALS, AND DEVICES

A. Comply with TMUTCD requirements.

B. Traffic cones and drums, flares and lights: Conform to local jurisdictions' requirements.

C. When working in the Central business district, provide pedestrian pathway

signage approved by the City's Traffic Engineering Branch.

2.02 PORTABLE LOW PROFILE CONCRETE BARRIERS

A. The low profile concrete barrier is a patented design. Information concerning this barrier may be obtained from Texas Transportation Institute, Texas A&M University System, College Station, Texas 77843-3135, (409) 845-1712.

PART 3 E X E C U T I O N

3.01 PUBLIC ROADS

A. Submit requests forms for lane closure and sidewalk closure to the City's Traffic Engineering Branch at least three working days prior to need for blocking vehicular lanes or sidewalks. Do not block lanes or sidewalks without approved permits. Obtain application from the City's Traffic Engineering Branch at 611 Walker, 5th floor or at the following internet address: http://www.ci.houston.tx.us/pwe/mrow/laneclosure.htm.

B. Follow laws and regulations of governing jurisdictions when using public roads. Pay for and obtain permits from jurisdiction before impeding traffic or closing lanes. Coordinate activities with Project Manager.

C. Give Project Manager one-week notice before implementing approved traffic control phases. Inform local businesses of impending traffic control activities.

D. Notified police department, fire department, METRO, and local schools, churches, and businesses in writing a minimum of five business days prior to beginning work.

E. Maintain 10-foot wide all-weather lanes adjacent to the Work for emergency vehicle use. Keep all-weather lanes free of construction equipment and debris.

F. Do not to obstruct 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 Project Manager.

G. Maintain local driveway access to residential and commercial properties adjacent to work areas at all times. Use all-weather materials approved by Project Manager to maintain temporary driveway access to commercial and residential driveways.

H. Keep streets entering and leaving job site free of excavated material, debris, and foreign material resulting from construction operations in compliance with

applicable ordinances.

I. Remove existing signage and striping that conflict with construction activities or that may cause driver confusion.

J. Provide safe access for pedestrians along major cross streets.

K. Alternate closures of cross streets so that two adjacent cross streets are not closed simultaneously.

L. Do not close more than two consecutive esplanade openings at a time without prior approval from Project Manager.

3.02 CONSTRUCTION PARKING CONTROL

A. Control vehicular parking to prevent interference with public traffic and parking, access by emergency vehicles, and the City's operations.

B. Monitor parking of construction 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 HAUL ROUTS

A. Utilize haul routes designated by authorities or shown on drawings for construction traffic.

B. Confine construction traffic to designated haul routes.

C. Provide traffic control at critical areas of haul routes to regulate traffic and minimize interference with public traffic.

3.05 TRAFFIC SIGNS AND SIGNALS

A. Construct necessary traffic control devices for temporary signals required to complete the Work including loop detectors, traffic signal conduits, traffic signal wiring and crosswalk signals. Notify the City's Traffic Engineering Branch a minimum of 60 days in advance of need for control boxes and switchgear. The City will perform necessary service, programming or adjustments, to signal boxes and switchgear if required during construction.

B. Install and operate traffic control signals to direct and maintain orderly traffic flow in areas under Contractor's control affected by Contractor's operations. Post notices, signs and traffic controls before moving into next phase of traffic control.

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

D. Unless otherwise approved by Project Manager, provide driveway signs with name of business that can be accessed from each crossover. Use two signs for each crossover.

E. Replace existing traffic control devices in Project area.

F. Project Manager may direct Contractor to make minor adjustments to traffic control signage to eliminate driver confusion and maintain orderly traffic flow during construction at no additional cost to the City.

3.06 BRIDGING TRENCHES AND EXCAVATIONS

A. When necessary, construct bridges over trenches and excavation to permit an unobstructed flow of traffic across construction areas and major drives. Use steel plates of sufficient thickness to support H-20 loading and install to operate with minimum noise.

B. Shore trench or excavation to support bridge and traffic.

C. Secure bridging against displacement with adjustable cleats, angles, bolts or other devices when:

1. bridging is placed over existing bus routes,

2. more than five percent of daily traffic is comprised of commercial or truck traffic,

3. more than two separate plates are used for bridging, and

4. when bridge is to be used for more than five consecutive days.

D. Extend steel plates used for bridging a minimum of 1 foot beyond edges of trench or excavation. Use temporary paving materials such as premix to feather edges of plates to minimize wheel impact on secured bridging.

3.07 REMOVAL

A. Remove equipment and devices when no longer required.

B. Repair damage caused by installation.

C. Remove post settings to a depth of 2 feet.

3.08 TRAFFIC CONTROL, REGULATION AND DIRECTION

A. Use Flagmen to control, regulate and direct an even flow and movement of vehicular and pedestrian traffic, for periods of time as may be required to provide for public safety and convenience, where:

1. multi-lane vehicular traffic must be diverted into single lane vehicular traffic,

2. vehicular traffic must change lanes abruptly,

3. construction equipment must enter or cross vehicular traffic lanes and walks,

4. construction equipment may intermittently encroach on vehicular traffic lanes and unprotected walks and crosswalk,

5. traffic regulation is needed due to rerouting of vehicular traffic around the Work site, and

6. where construction activities might affect public safety and convenience.

B. Use of Flagmen to assist in the regulation of traffic flow and movement does not relieve Contractor of responsibility to take other means necessary to protect the Work and public.

3.09 INSTALLATION STANDARDS

A. Place temporary pavement for single lane closures, in accordance with TMUTCD.

B. Reinstall temporary and permanent pavement markings as approved by Project Manager. When weather conditions do not allow application according to manufacturer's requirements, alternate markings may be considered. Submit proposed alternate to Project Manager for approval prior to installation. No additional payment will be made for use of alternate markings.

3.10 MAINTENANCE OF EQUIPMENT AND MATERIAL

A. Submit name, address and telephone number of individual designated to be

responsible for maintenance of traffic handling at construction site to Project Manager. Individual must be accessible at all times to immediately correct deficiencies in equipment and materials used to handle traffic including missing, damaged, or obscured signs, drums, barricades, or pavement markings.

B. Inspect signs, barricades, drums, lamps and temporary pavement markings daily to verify that they are visible, in good working order, and conform with traffic handling plans as approved by Project Manager. Immediately repair, clean, relocate, realign, or replace equipment or materials that are not in compliance.

C. Keep equipment and materials, signs and pavement markings, clean and free of dust, dirt, grime, oil, mud, or debris.

D. Obtain approval of Project Manager to reuse damaged or vandalized signs, drums, and barricades.

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SECTION 01560
SITE SECURITY

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Contractor shall be responsible for protection of the site, and all Work, materials, equipment, and existing facilities hereon, from actions of the Contractor, and his employees, including all sub-contractors and suppliers, whether engaged in the execution of the Work under this Contract, or engaged in any other activity while present on the site.

B. Contractor shall also be responsible for loss protection and protecting all of the Contractor's property, equipment, assets and employees while on the work site.

C. No claim shall be made against Owner by reason of any act of an employee or trespasser.

D. Contractor shall comply with all security measures required by the Owner, including access badging requirements, background security checks, vehicle searches, and all other security measures, either required in this Section or as appropriate on the job site. Owner reserves the right to permanently exclude from the site, at any time, any personnel proposed by the Contractor for security reasons, including, but not limited to, failure to comply with City security measures.

E. Contractor shall be solely responsible for all security and loss prevention within the Temporary Field Office Area and Work Area throughout the duration of the Contract.

1.02 MEASUREMENT AND PAYMENT

A. No separate payment will be made for any site security provided by the Contractor under this Section. Include the cost for all site security required under this Section in the lump sum base bid item.

1.03 MANDATORY BACKGROUND CHECKS AND CITY OF HOUSTON BADGING REQUIREMENTS

A. All Contractor employees and subcontractors must be a U.S. Citizen or have a legal work permit. Each person must also present a valid unexpired U.S. state driver's license or photo identification card. A U.S. issued resident alien card, with photo, passport, or other U.S. state or U.S. federal photo documentation is acceptable to present for identification purposes.

B. Contractor shall conduct background security checks, to include criminal records and driving records, on all employees at time of hiring and periodically thereafter and provide copies to PUD Security prior to first day of work for each employee.

C. The City of Houston/PUD Security Group will also conduct a criminal background check on all Contractor and subcontractor employees assigned to work on the site. Attachment A to this Section is a copy of the City's "Disclosure and Consent for Release of Information" form which

must be completed and submitted to the City for each employee of the Contractor and its subcontractors before they are granted access to the work site.

D. Each employee of the Contractor and its subcontractors will be required to apply for, and receive, a City of Houston identification card/access badge before being granted access to the work site. Attachment B to this Section is a copy of the City's "Badging/ Access Information Sheet" which must be completed and submitted to the City at the time the Contractor or subcontractor employee is photographed for the identification card/access badge. The City of Houston photo identification office is located at 611 Walker Street in Houston, Texas on the 3rd floor of the annex (832-395-5175 phone 832-395-5187 fax). The badge office hours are Tuesday and Thursday from 8:00 am to 3:00 pm.

E. Equipment vendors or manufacturer's representatives who will be required to be on-site for more than four (4) consecutive working days, or cumulatively more than eight (8) working days will be required to comply with background check and badging requirements in Paragraphs C. and D. of this Section.

F. Identification cards/access badges will only be issued by the City once a background check has been completed for the Contractor of subcontractor employee, and clearance has been granted by the City.

G. All construction employees must show a valid identification card upon request while working on site.

H. The Contractor shall provide City of Houston/PUD Security a weekly list of current contractor and subcontractor employees. This list shall be updated immediately by the Contractor as changes occur.

I. Lost cards are disabled and replacement cost is $50.00.

1.04 CONTRACTOR / SUBCONTRACTOR HARDHAT IDENTIFICATION

A. Each Contractor employee, including subcontractors, must wear a hard hat with proper identification. Each hardhat shall display a distinctive corporate logo to identify the responsible company.

1.05 VEHICLE IDENTIFICATION/PARKING PASS

A. The Contractor shall provide the Owner with a list of the following information for their vehicles: year, make, model, color, state, license plate number, company that employs the driver, and the driver's name. Any changes shall be forwarded to the Owner within 24 hours of becoming aware of the need for a change.

B. Contractor personal vehicles may be parked only in the areas designated for such parking. Any vehicle found to be in violation of parking requirements is subject to being towed from the site at the risk and expense of the vehicle owner.

C. Contract company-owned and/or leased vehicles entering City of Houston/PUD facilities must have company logos displayed on both sides of the vehicle. Company logos must be displayed on the body of the vehicle.

D. Contract personnel utilizing their personal vehicles for company business inside a City of Houston/PUD facility must also display company logos. They may display their company logo on each side of their rear side windows. If the vehicle is a pickup truck the logo may be placed in the back glass. The logo must not be smaller than 5" X 8" in size and must be easily read from a distance of not less than 100 feet. Logos must remain on the vehicle while inside the City of Houston/PUD facility and may not be removed until the vehicle exits the gate.

E. All equipment on rubber tires, such as mobile cranes, backhoes, air compressors, welding machines, etc must also display company logos while being operated inside a City of Houston/PUD facility.

F. All deliveries are subject to random inspections by security personnel.

1.06 DELIVERIES

A. All Contractor deliveries shall occur only during scheduled Contractor working hours, including work time scheduled on Sundays, legal holidays and/or outside of the normal working hours specified in the Supplementary Conditions. No unscheduled, after-hour deliveries are permitted without prior approval of the Construction Manager. No deliveries shall be permitted at any time that the Contractor is not scheduled to work and on-site.

B. The Contractor shall provide a list of all anticipated deliveries to the Construction Manager each Monday morning and/or Friday afternoon with updates provided each day in the morning if required due to scheduling changes.

1.07 VISITOR ACCESS

A. The Contractor shall provide a list of all anticipated, un-badged site visitors, including drivers license number, to the Construction Manager and the City's Security Contractor each Monday morning and/or Friday afternoon with updates provided each day in the morning if required due to scheduling changes.

B. Contractor shall provide the Construction Manager with twenty-four (24) hours advance notice of the scheduled arrival of any un-badged visitor, including drivers license number, who is requesting access to Work Site Area.

C. Only un-badged visitors with a material interest in the Work may be granted authorized access to the site, at the discretion of the Construction Manager and the City's Security Contractor.

D. In addition to delivery vehicles described in Paragraph 1.6 above, visitors with a material interest in the Work may include manufacturer's representatives, equipment vendors, testing laboratory personnel, and other personnel whom the Construction Manager and the City's Security Contractor determine have a material interest in the Work.

E. No visitor shall be allowed into Work Site without a temporary badge issued by the City's Security Contractor.

F. Visitors who are expected to be on-site for more than four (4) consecutive work days, or eight (8) cumulative work days shall comply with the background check and badging requirements listed in Paragraph 1.03 above. The Construction Manager and the City's Security Contractor may require repeat visitors who exceed eight (8) cumulative work days on-site to comply with background check and badging requirements prior to granting further authorization to access Work Site.

1.08 CONTRACTOR'S WORK SITE SECURITY

A. The Contractor must store all equipment and materials only in those areas designated by the Owner for this purpose. The Owner is neither responsible nor liable for any equipment, materials, or other property of the Contractor.

B. The Contractor may choose, at his expense, to provide additional security elements as desired to adequately protect his assets on the job site.

1.09 INTERVIEWING

A. Contractor shall not conduct any interviews of potential employees on the plant site. All interviews must be conducted off-site.

1.10 INSPECTIONS AND SUPERVISION

A. The Construction Manager and/or the City of Houston/PUD Security Section will, at their discretion, inspect the security facilities and review operations and will report, in writing, to the Contractor the results of such inspections. Upon request of the Construction Manager and/or the City of Houston/PUD Security Section, the Contractor shall, within two working days of receipt of the report, identify, in writing, the corrective actions to be taken to address any deficiencies or problems with the work noted in the report. The corrective actions shall be implemented by the Contractor immediately upon direction of the Construction Manager.

1.11 DOCUMENTATION AND REPORTING REQUIREMENTS

A. The Contractor shall maintain copies of records, including but not limited to, each of the following items using forms provided by or approved by the Construction Manager.

1. A regularly maintained and updated list of all authorized Contractor and Subcontractor personnel and all Contractor and Subcontractor vehicles authorized by the City for use on the site.

2. A list of all scheduled site visitors and deliveries associated with the Contractor's Work.

3. A complete record of all reported incidents of injury, fire, or emergency.

4. A complete record of all reported incidents of theft or vandalism.

5. A complete record of all infractions of the Project Rules and Regulations.

1.12 VEHICLES AND/OR MOBILE EQUIPMENT

A. Entry on site for vehicles and mobile equipment and drivers shall be entirely at risk of Contractor, Subcontractors and/or individual seeking such entry.

B. All vehicles and equipment requested to be site permitted shall be duly inspected, licensed and covered by insurance as required by the Contract Documents, before Contractor and Subcontractors request permission for their entry on site.

C. Drivers/operators shall be fully and currently licensed and/or certified to drive the type of vehicle or to operate the type of equipment brought on-site.

D. Drivers shall observe and obey all Texas Laws at all times.

E. The maximum permissible speed on site is 20 MPH, however, speeds much lower than this may be the maximum safe speeds and it is the direct responsibility of the diver to drive at a safe speed in any area at any given time according to the circumstances existing at that time and place.

F. The movement and parking of vehicles and equipment on site shall be kept to the minimum necessary to meet construction requirements.

G. Vehicles not directly associated with the performance of the Work shall not be granted entry to site.

H. All vehicles and loads shall be subject to search by City security personnel, CM, or other authorized personnel at any location on site at any time.

I. Vehicles may only be driven or parked in construction areas, or access roads only when directly engaged in deliveries to that area and subject to regulations stated herein. No vehicle or mobile equipment shall be left unattended when in construction areas or access roads or in operating plant areas.

J. No vehicle or equipment shall be parked or placed on any road on site as to hinder or prevent clear passage of other vehicles thereof, unless the requirements of the Work so necessitate, in which case the prior written approval of CM for such hindrance shall have been obtained. Comply with Section 01555.

K. Movement of heavy mobile equipment on plant paved roads shall be performed in a manner which precludes damage to the pavement and related structures. The Contractor shall be wholly responsible for the protection and safety of life and property including roadways, structures and other equipment while such movement is in progress and shall repair all damage caused thereby at no additional cost to the City.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION – NOT USED

END OF SECTION

Section 01562

TREE AND PLANT PROTECTION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Tree and plant protection.

B. Minimum qualifications of Arborist and Urban Forester.

1.02 MEASUREMENT AND PAYMENT

A. Payment for Tree Protection, including tree pruning or tree removal, shall be paid as a Lump Sum basis that shall include all items specified in this section unless payment is specified otherwise in this section

B Payment for Zero Curb Cutback will be on a per linear foot basis.

C. Payment for Checker Plate will be on a square foot basis.

D. Refer to Section 01270-Measurement and Payment for unit price procedures.

1.03 SUBMITTALS

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

B. Submit name and experience of qualified Arborist, proposed for use on the Work, to Project Manager.

1.04 PROJECT CONDITIONS

A. Preserve and protect existing trees and plants to remain from foliage, branch, trunk, or root damage that could result from construction operations.

B. Prevent following types of damage:

1. Compaction of root zone by foot or vehicular traffic, or material storage.

2. Trunk damage from equipment operations, material storage, or from nailing or bolting.

3. Trunk and branch damage caused by ropes or guy wires.

4. Root or soil contamination from spilled solvents, gasoline, paint, lime slurry, and other noxious materials.

5. Branch damage due to improper pruning or trimming.

6. Damage from lack of water due to:

   a. Cutting or altering natural water migration patterns near root zones.

   b. Failure to provide adequate watering

7. Damage from alteration of soil pH factor caused by depositing lime, concrete, plaster, or other base materials near roots zones.

8. Cutting of roots larger than one inch in diameter.

1.05 DAMAGE ASSESSMENT

A. When trees other than those designated for removal are destroyed or damaged as result of construction operations, remove and replace with same size, species, and variety up to and including 8 inches in trunk diameter. Trees larger than 8 inches in diameter shall be replaced with an 8 inch diameter tree of the same species and variety and total contract amount will be reduced by an amount determined from the following formula and paid to Tree Fund 0.7854 x D2 x $13.25 where D is diameter in inches of tree or shrub trunk measured 12 inches above grade for that portion of the tree which is greater than 8 inches in diameter. A permit must be applied for and approved by the City of Houston, Urban Forestry Division prior to removal of any tree not scheduled for removal in the tree treatment schedule. Contractor shall contact City of Houston, Urban Forestry, at 832-395-8459 to apply for tree removal permit when needed.

PART 2 PRODUCTS

2.01 MATERIALS

A. Pruning Paint: Black latex, water based paint, free of all petroleum products.

B. Fertilizer: Fertilizer shall be a root stimulant that contains at a minimum the following ingredients: Ectomycorrhizal Fungi, VA Mycorrhizal (VAM) Fungi, Rhizosphere Bacillus spp., Kelp Meal Humic Acid, and Soluble Yucca.

C. Tree Protection Fencing: Orange, plastic mesh fenching, 4 feet in height with 6 feet high "t" bar posts installed 10 feet on centers as per drawings.

D. Plastic Root/Soil Protection: Clear polyethylene sheeting, minimum 6 mil, thickness.

PART 3 EXECUTION

3.01 PROTECTION OF EXISTING TREES AND SHRUBS

A. Site preparation work and/or construction work shall not begin in any area where tree preservation measures have not been completed and approved.

B. Protect exposed roots and root zone areas from contamination from stabilization materials and concrete using polyethylene.

C. Cover exposed roots within 4 hours to reduce damage caused by desiccation. Roots may be covered with soil, mulch, polyethylene, or wet burlap to help protect them from drying.

D. Designate limited areas as concrete washout areas. Locate concrete washout areas away from root zones.

E. Install root pruning trenching where designated in tree treatment schedule and shown on the tree protection drawings. Trees scheduled for root pruning are called out specifically in the treatment schedule. Trench shall be located 2 ft. from the edge of proposed waterline or sanitary sewer for trees called out for root pruning for water or fittings, or sanitary sewer in the treatment schedule, 2 ft. from edge of proposed storm sewer pipe for trees called out for root pruning for storm in the treatment schedule, 30" back of proposed curb for trees called out for root pruning for street, and at edge of sidewalk for trees called out for root pruning for sidewalk. Root pruning shall not be performed where there is not adequate space to be located sufficiently away from tree to prevent damage. All pruning must be evaluated by Contractor's Certified Arborist and reviewed and approved by City Forester before being performed. Trench locations shown on tree preservation plan are drawn to scale and should be located in field as drawn on plan. Exact locations shall be approved in the field by engineer and/or project urban forester prior to installation. Trenching depth shall be a minimum of 2 ft. deep and a maximum of 6 inches wide for water, fittings, sanitary sewer, storm, and street. Trenching depth shall be to the anticipated bottom of sidewalk and base material for sidewalk root pruning, roots lower than sidewalk shall not be pruned. All roots shall be cut by trencher, chainsaw, or handsaw to the specified depth. Roots shall be cut cleanly, and or not ripped, torn, or chopped. Trench shall be backfilled and compacted immediately after trenching. Trench shall be installed prior to any clearing and grubbing, excavation for underground, or any other site work.

F. Install tree protection fencing around each tree to be preserved as indicated in the tree treatment schedule and on the tree protection plan.

1. Each tree to be preserved shall be protected with a tree protection fence. The fencing shall be continuous between posts, shall be pulled taut prior to securing to posts, and shall be firmly attached to the posts with a minimum of 4 wire ties.

2. All tree protection fencing shall be installed prior to site work or construction activity. The fence shall be placed in a continuous alignment as shown on the tree protection plan. Fences shown on tree protection plan are drawn to scale and shall be installed as drawn, in the field. In general fences shall be placed 30" back of existing curb or edge of pavement where root pruning or zero curb cutback is not specified, and 6" back of root pruning trench where root pruning is specified and immediately back of curb where zero curb cutback is specified. Exact locations shall be approved by the project urban forester and/or engineer in the field. The Fences shall be placed to protect roots, trunks, and foliage. The contractor shall not remove or relocate tree protection fencing and shall not operate within the limits shown without direct approval of the project urban forester. In areas where the proposed waterline is located in the existing road side ditch and where tree protection fencing can not be installed across the ditch, the fencing shall be installed at the top of outside ditch bank and no bore pits, peep holes, service taps, or any excavation should occur in the area immediately in front of the tree protection fencing for trees called out with "bore" in the Tree Treatment Schedule. The "bore" limits shall be the same as the limits of the tree protection fencing.

3. Storage of equipment or materials will not be allowed inside a fence. Entryways and access into a protected area shall not be provided unless approved by the project urban forester.

4. Damage to tree fences occurring during the progress of the work shall be repaired immediately at no additional cost to owner. Workmen shall be clearly instructed to exercise caution in performance of work near trees being preserved.

5. Tree protection fencing shall be removed by contractor, at no additional costs, upon completion of all construction activity in each work zone area. Tree protection fencing materials used in the first two work zone areas shall be removed and utilized in subsequent work zone areas. Materials and labor shall be paid for each linear foot of fencing installed in first two work areas. All fencing installed in subsequent work zone areas shall be paid for labor only.

G. Boring/Auguring of water lines or sanitary sewer lines

1. Water line or sanitary sewer line shall be bored/augured/ horizontally drilled under

critical root zones areas of trees designated with auger or bore in the tree treatment schedule. The entire area protected with tree protection fencing shall be bored. No bore pits, come through holes, peep holes, push pits, or long or short side service taps shall be allowed in the areas protected by tree protection fencing. The tree protection plan takes into consideration the limits of augering equipment, there should be room for adequately spaced bore pits, peep holes, come through holes, and push pits. Any changes to the location of the tree protection fencing shall be authorized by the project Urban Forester and City Engineer.

H. Hand digging of Service taps and leads

1. Trees called out for Hand dig short side service tap are located in very close proximity to existing short side water meters. Excavating the service tap with machinery would significantly impact the tree and be in violation of the City of Houston's Street Tree Ordinance. These short side service taps shall be excavated with manual labor to expose any roots 1" in diameter and larger. The first 24" of excavation shall be completed manually to expose the roots. Any root 1" in diameter and larger shall remain undamaged, the roots shall not be cut , nor shall the bark and cambium layer be scraped or damaged. Once the roots are exposed, if there is adequate room to utilize a mini-excavator without damaging the roots, the mini-excavator can be utilized to complete the excavation down to the water line. 1" plywood shall be placed on grade to provide root protection in the area of access of the mini-excavator. If roots 1" diameter or larger are cut or damaged, responsible party will be subject to a citation under the Street Tree Ordinance, and may also be required to incur the cost of tree removal and replacement of damaged tree on an inch for inch basis, if required by City of Houston Urban Forestry Division.

2. Trees called out for Hand dig short side or long side service lead are located in very close proximity to existing water meters. Excavating the service lead with machinery would significantly impact the tree and be in violation of the City of Houston's Street Tree Ordinance. Short side leads shall be excavated with manual labor to expose any roots 1" in diameter and larger from the service tap of the meter. Come out hole and excavation required for long service leads shall be excavated with manual labor to expose roots 1" in diameter and larger, from the come out hole to the meter. In each case, all roots 1" in diameter and larger shall remain undamaged, the roots shall not be cut, nor shall the bark and cambium layer be scraped or damaged. If roots 1" diameter or larger are cut or damaged, responsible party will be subject to a citation under the cost of tree removal and replacement of damaged tree on an inch by inch basis, if required by City of Houston Urban Forestry Division.

3. Trees called out for Hand dig sanitary stub up are located in very close proximity to proposed service lead. Excavating the service lead with machinery would significantly impact the tree and be in violation of the City of Houston's Street Tree

Ordinance. Excavation for sanitary stub up shall be completed with manual labor to expose any roots 1" in diameter and larger. The lead shall be bored from face of curb to stub up hole when called out in the tree treatment schedule. Come out and stub up holes shall be excavated with manual labor to expose roots 1" in diameter and larger. In case, all roots 1" in diameter and larger shall remain undamaged, the roots shall not be cut, nor shall the bark and cambium layer be scraped or damaged. If roots 1" diameter or larger are cut or damaged, responsible party will be subject to a citation under the Street Tree Ordinance, and may be required to incur the cost of tree removal and replacement of damaged tree on an inch by inch basis, if required by City of Houston Urban Forestry Division.

4. Long side service taps shall not be located in an area specified to be bored in the tree treatment schedule. Should it be absolutely necessary to locate a long side service tap in an area specified to be bored, the excavation shall be completed as specified in paragraph 1 of this section-Hand digging short side service taps.
5. All water meters and sanitary service leads called out on P&P drawings and visible in the field have been addressed in the Tree Protection Plan. Should any additional meters or lead be found during construction, or in any new meters or leads installed beneath the canopy of any tree, fenced for tree protection, the excavation shall be completed as specified in paragraph 1 and/or 2 of this section and paid for at the unit cost for each included in contract.

I. Pruning of Trees

1. Trees shall be pruned in accordance with the American National Standard for tree pruning, ANSI A300 (Part 1) – 2001 Pruning Revision of ANSI A300-1995 Tree, Shrub and Other Woody Plant Maintenance – Standard Practices. Pruning shall be completed by professional arborists who has received training in proper pruning techniques.

2. Clearance prune designated trees for public streets, sidewalks, and construction areas. Provide minimum 14 feet and maximum of 18 feet of vertical clearance over proposed water trunk lines. Provide minimum of 14 feet and maximum of 16 feet of vertical clearance over proposed street construction, from 24" back of curb on one side to 24" back of curb on the other side. Provide 20' of vertical clearance over proposed storm sewer up to 38" in size, and 30' of vertical clearance for storm sewer larger than 38" in size. Pruning to be installed prior to any construction activity. Contractor shall notify property owner prior to trimming or pruning any trees with trunks located on private property. Exceptions will be made for trees determined to be arboriculturally significant by City of Houston Urban Forestry. Pruning of trees identified will be completed with approval and supervision of City of Houston Urban Forestry.

3. All cuts should be made sufficiently close to the parent limb or trunk without cutting into the branch collar or leaving a protruding stub, so that closure can readily start under normal conditions. All lateral cuts shall be made to a lateral that is least 1/3 the diameter of the parent limb. Clean cuts shall be made at all times.

4. Trees shall be pruned in a manner that will not destroy or alter the natural shape and character of the tree. Apply black latex paint to all fresh wounds on Oak (Quercus) species immediately after each cut is made.

5. Crown cleaning prune designated trees shall include selective removal of dead, diseased, and/or broken limbs.

J. Tree Removal

1. Trees scheduled for removal shall be sawed down and debris hauled from the site the same day. The stump shall be ground to 6" below grade and excess grindings shall be hauled from the site the same day, so that a pile of grindings is not left where the stump was ground. Enough grindings should be left so that an open hole does not remain.

2. Only those trees called out for removal in the Tree Treatment Schedule shall be removed, or otherwise damaged. Should it be determined that any additional trees must be removed, a permit must be applied for and approved from the City of Houston Urban Forestry Division prior to removal. Contractor shall contact Urban Forestry at 832-395-8459.

K. Root Stimulation

1. Deep root stimulate designated trees. Mix fertilizer with wetting agent per label instructions.

2. Stimulate entire root zone area within the dripline of the tree and continue 10 feet beyond the dripline, leaving out areas of anticipated root loss (construction areas).

3. Mixture shall be injected into the top 10 inches of soil under pressure of 150 to 200 psi as soil conditions warrant.

4. Mix in a tank with agitation capability per label instructions. Inject the mixture on a 2.5 ft. square grid at 4 lbs, actual nitrogen per 1,000 sq. ft.

L. Regularly water trees which have received root damage, to eliminate additional stress caused by lack of moisture. Water during periods without adequate rainfall. For example, should 1.0" of rain not be received within a week period, the trees should be thoroughly watered.

March through September, water once every two weeks. October through February, water every three weeks. Water thoroughly to saturate the entire root zone area.

M. Chemically treat tree trunks with evidence of borer activity with the appropriate approved insecticide mixed and applied per the manufacturer's product application recommendations. Trees shall be sprayed within 24 hours after observance of borer activity.

N. Grading and filling around trees.

1. Maintain existing grade within the dripline of trees, unless otherwise indicated.

2. Where existing grade around trees is above new finish grade, under supervision of project urban forester, carefully hand excavate within the dripline to make transition to new finish grade.

3. Where existing grade is below new finish grade, place clean bank sand in a single layer to make the transition to new grade. Do not compact; hand grade to required elevation. Specifically to areas where proposed curb is higher than existing and backfill will be required.

O. Demolition, Forming and Pouring Sidewalks (Sidewalk on Grade)

1. Demolition of existing sidewalks, located in or adjacent to the limits of tree protection fencing, shall be completed without disturbing, cutting, or otherwise damaging tree roots and soil located beneath them.

2. The new sidewalk shall be formed at or above the elevation of the existing sidewalk, without disturbing, cutting or otherwise damaging tree roots. Every effort has been made to address tree root and sidewalk elevation issues with information available in the field and on plan and profile sheets. The elevation of every tree root was not available, if tree roots are found to be in conflict with proposed sidewalk, project engineer and urban forester shall be consulted as to how to install sidewalks with minimal impacts to adjacent trees.

3. Checkerplate shall be installed in areas called out only if tree root elevations prohibit construction of ADA compliant sloped concrete sidewalks. Checkerplate shall be installed per detail.

P. Zero curb cutback

1. Disturbance of tree roots or soil behind the existing and/or proposed curb within root zones of trees designated for zero curb cutback shall be prohibited. If the curb can not be removed without disturbing soil or damaging roots back of curb when using

equipment for demolition, the curb shall be broken using a hand held jackhammer and removed by hand.

2. The exposed roots and soil shall be covered immediately after demolition with 6 mil polyethylene in order to avoid desiccation, and contamination by the lime used for road bed stabilization. The polyethylene shall be placed so that it covers the vertical face of soil back of curb and laid back onto the grade 12 inches back of curb. The polyethylene should remain in place, across the entire area specified for zero curb cutback, from the time the existing curb is demolished until the time when the new curb is formed and backfilled. The polyethylene can be pulled up from the vertical face while the road bed is being graded or mixed, to avoid catching the plastic with machinery, but shall be replaced immediately after equipment has completed. The vertical face shall not be exposed for more than 8 hours in any 24 hour period.

3. There shall be no stabilization back of curb in the zero curb cutback areas, or forming with steel forms. The existing grade and roots back of existing curb shall not be disturbed. This may require forming of the new street with wooden forms with stakes inside forms, which may require leaving the forms in place after the street is poured. Should wooden forms be utilized, the wood shall be at minimum a 2x6. The new curb may require hand finishing, as a slip curb machine may not have adequate clearance without disturbing the roots that are to be protected with the zero curb cutback.

4. Roots extending into the street, or on top of the existing curb, in areas to paved shall be cut and removed by hand prior to disturbance or removal with equipment. Roots shall be pruned flush with the proposed back of curb. Roots one inch in diameter and larger shall be cut in a manner to provide a smooth, clean cut surface. Cuts shall be made with the appropriate pruning shears or pruning saws. Roots shall not be chopped or broken.

5. In areas where proposed curb will be may be lower than existing top of curb and tree roots 2" diameter or larger are present, the soil and roots shall not be graded or laid back. The existing elevation shall be maintained and the curb formed to meet elevation or a short elevation difference roots and top of curb maintained.

Q. Demolition, Forming and Pouring of Drive Way Approaches

1. Demolition of existing driveway approaches located beneath the dripline of any tree shall be completed without disturbing, cutting, or otherwise damaging tree roots and soil located beneath them.

2. The new approach shall be formed at or above the elevation of the existing approach where tree roots 2" diameter or larger are present, without disturbing, cutting or

otherwise damaging tree roots. Maximum drive slopes may be needed at bottom of apron to allow forming of drive over tree roots at top of drive. As with sidewalks, the elevation of every tree roots was not available in design. If tree roots are found to be in conflict with proposed approach, project engineer and urban forester shall be consulted as to how to install drive way with minimal impacts to adjacent trees.

R. Replacement Trees for Tree Removals under Ordinance

1. Location, species, and size of replacement trees are indicated on the drawings. Contractor shall layout individual trees at locations shown on drawings. Contractor shall layout individual trees at locations shown on drawings and be responsible for utility locate requirements. In case of conflicts, notify City Engineer and City Urban Forestry before proceeding with work. Trees shall be laid out and locations approved by City Engineer prior to planting.

2. Trees shall meet and be planted according to City of Houston Standard Specification 02915.

S. Arborist and Urban Forester Qualifications

1. Arborist – Employ qualified arborist acceptable to City's Parks and Recreation Department to complete all tree treatments. Arborist shall be normally engaged in the field and have a minimum of 5 years experience. Qualifications of the selected arborist shall be submitted for review and approval by the project engineer and City of Houston.

2. Urban Forester – An Urban forester shall be hired to monitor and assist with field layout (exact locations of fencing, root pruning, and zero curb cutback) of the tree preservation program during demolition and construction to ensure tree protection procedures and techniques are practiced as specified to address concerns and conditions which occur in the field. At a minimum, the individual responsible for monitoring and field layout of the tree protection shall have a minimum of 5 years of experience as a consultant, and shall not be affiliated with a tree care contractor in the Houston area. Qualifications of the selected urban forester shall be submitted for review and approval by the project engineer and City of Houston Urban Forestry Department.

END OF SECTION

Section 01570

STORM WATER POLLUTION PREVENTION CONTROL

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Implementation of Storm Water Pollution Prevention Plans (SWP3) described in Section 01410 – TPDES Requirement.

B. Installation, maintenance and removal, 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 Barriers:

1. Type 1: Temporary filter fabric barrier for erosion and sediment control in non-channelized flow areas.

2. Type 2: Temporary reinforced filter fabric barrier for erosion and sediment control in channelized flow areas.

D. Hay Bale Fence.

E. Drop Inlet Basket

F. Inlet Sediment Traps

G. Brush Berm

H. Sand Bag Barrier

I. Bagged Gravel Barrier

J. Sediment Basin

K. Inlet Protection Barrier

1.02 MEASUREMENT AND PAYMENT

A. UNIT PRICES

1. Payment for filter fabric barrier is on a linear foot basis measured between limits of beginning and ending of stakes.

2. Payment for reinforced filter fabric barrier 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 include 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 hay 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 bagged gravel barrier, if included in Document 00410 - Bid Form, is on a linear foot basis measured between limits of beginning and ending of bagged gravel barrier, if not include in cost of storm water pollution prevention controls.

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

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 (600kN-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 Barrier 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 Barriers to remain in proper position and configuration at all times.

B. Hay Bale Fence: Install to allow surface runoff percolation through hay in sheet-flow manner and to retain and accumulate sediment. Maintain Hay 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.

F. Sand Bags: Are used during construction activities in unstabilized minor swales, ditches, or streambeds when the contributing drainage area is no greater than 2 acres. It is also sediment barrier for stage one Inlet.

G. Bagged Gravel Barrier: Are used during construction activities in unstabilized minor swales, ditches, or streambeds when the contributing drainage area is no greater than 2 acres. It is also sediment barrier for stage two Inlet.

H. Drop Inlet Insert Basket: Is a temporary barrier placed within a storm drain inlet (Lower Portion of Stage I and Upper Portion of Stage II Inlets) consisting of a filter fabric supported by a metal frame work to prevent sediment and other pollutants from entering convey system.

I. Brush Berm: Brush Berm is constructed at the perimeter of a distribute site within the developing area.

1.05 SUBMITTALS

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

B. Submit manufacturer's literature for product specifications and installation instructions.

C. Submit manufacturers 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 P R O D U C T S

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 F.

D. Mirafi, Inc., Synthetic Industries, or equivalent

2.05 BARRIER

A. Wire Barrier: Woven galvanized steel wire, 14 gauge by 6-inch square mesh spacing, minimum 24 inch roll or sheet width of longest practical length.

B. Barrier Stakes: Nominal 2 by 2 inch moisture-resistant treated wood or steel posts (min. 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 lbs in any principal direction (ASTM D4632)

3. Mullen burst strength exceeding 300 lbs (ASTM D4833).

4. Ultraviolet stability exceeding 70 percent. After 500 hours of exposure (ASTM 4355).

5. Size: Length:18 to 24 inches. Width: 12 to 18 inches. Thickness: 6 to 8 inches. Weight: Approximately 40 to 50 pounds not to exceed 75 pounds.

2.07 Bagged gravel Barrier

1. Minimum unit weight of four ounces per square yard.

2. Minimum grab strength of 100 lbs in any principal direction (ASTM D4632)

3. Mullen burst strength exceeding 300 lbs (ASTM D4833).

4. Ultraviolet stability exceeding 70 percent. After 500 hours of exposure (ASTM 4355).

5. Size: Length:18 to 24 inches. Width: 12 to 18 inches. Thickness: 6 to 8 inches. Weight: Approximately 40 to 50 pounds not to exceed 75 pounds.

2.08 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.

2.09 HAY BALE

A. Hay: Standard-baled agricultural hay bound by wire, nylon, or polypropylene rope. Do not use jute or cotton binding.

B. Hay 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 E X E C U T I O N

3.01 PREPARATION, INSTALLATION AND MAINTEINANCE

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 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 BARRIER CONSTRUCTION METHODS

A. Fence Type 1: Filter Fabric: Barrier

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. Barrier Type 2: Reinforced Filter Fabric Barrier

1. Layout barrier 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.

8. 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.

9. Trench in toe of filter fabric barrier 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.

10. Filter fabric fence shall have a minimum height of 18 inches and a maximum height of 36 inches above natural ground.

11. 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.

12. 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.

C. Triangular Filter Fabric Barrier 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 barrier 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 barrier 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.

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 for Stage I, Bagged gravel for Stage II and filter fabric barriers at locations shown on the SWP3. Maintain to allow minimal inlet in flow restrictions / blockage during storm event.

3.10 DROP INLET BASKET CONSTRUCTION METHODS

A. Fit inlet insert basket into inlet without gaps around insert at locations shown on the SWP3.

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 HAY 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 Hay 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 hay 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 access, 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 access. 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 waterways 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. Follow environment requirements.

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. 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.

E. 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.

F. Construct fill and waste areas by selective placement to eliminate surface silts or clays which will erode.

G. Inspect earthwork periodically to detect start of erosion. Immediately apply corrective measures as required to control erosion.

H. Dispose of sediments offsite, not in or adjacent to waterways or floodplains, nor allow sediments to flush into streams or drainage ways. Assume responsibility for offsite disposal location.

I. 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.

J. Prohibit equipment and vehicles from maneuver 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.

K. 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 01505-Temporary Facilities.

END OF SECTION

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Section 01575

STABILIZED CONSTRUCTION ACCESS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Installation and removal of erosion and sediment control for stabilized construction access used during construction and prior to final development of site, as shown in City of Houston Standard Construction details, DWG No. 01571-01.

1.02 MEASUREMENT AND PAYMENT

A. Unit Price Contracts. If Contract is Unit Price Contract, payment for work in this Section will be based on the following:

1. Stabilized construction roads, parking areas, access and wash areas: per square yard of aggregate/recycled concrete without reinforcing placed in 8-inch layers. No separate payment will be made for street cleaning necessary to meet TPDES requirements. Include cost of work for street cleaning under related Specification section.

B. Stipulated Price (Lump Sum) Contracts. If the Contract is a Stipulated Price Contract, include payment for work under this Section in the total Stipulated Price.

1.03 SUBMITTALS

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

B. Submit manufacturers catalog sheets and other Product Data on geotextile fabric.

C. Submit sieve analysis of aggregates conforming to requirements of this Specification.

1.04 REFERENCES

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

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

PART 2 PRODUCTS

2.01 GEOTEXTILE FABRIC

A. Provide woven or non-woven geotextile fabric made of polypropylene, polyethylene, ethylene, or polyamide material.

B. Geotextile fabric: Minimum grab strength of 200 lbs in any principal direction (ASTM D-4632) and equivalent opening size between 50 and 140.

C. Geotextile and threads: Resistant to chemical attack, mildew, and rot and contain ultraviolet ray inhibitors and stabilizers to provide minimum of six months of expected usable life at temperature range of 0 to 120 degrees F.

D. Representative Manufacturers: Mirafi, Inc. or equal.

2.02 COARSE AGGREGATES

A. Coarse aggregate: Crushed stone, gravel, crushed blast furnace slag, or combination of these materials. Aggregate shall be composed of clean, hard, durable materials free from adherent coatings of, salt, alkali, dirt, clay, loam, shale, soft or flaky materials, or organic and injurious matter.

B. Coarse aggregates to consist of open graded rock 2" to 8" in size.

PART 3 EXECUTION

3.01 PREPARATION AND INSTALLATION

A. Provide stabilized construction roads and access at construction, staging, parking, storage,
and disposal areas to keep street clean of mud carried by construction vehicles and equipment. Construct erosion and sediment controls in accordance with Drawings and Specification requirements.

B. Do not clear grub or rough cut until erosion and sediment control systems are in place, unless approved by Project Manager to allow soil testing and surveying.

C. Maintain existing construction site erosion and sediment control systems until acceptance of the Work or until removal of existing systems is approved by Project Manager.

D. Regularly inspect, repair or replace components of stabilized construction access. Unless otherwise directed, maintain stabilized construction roads and

access until the City accepts the Work. Remove stabilized construction roads and access promptly when directed by Project Manager. Discard removed materials off-site.

E. Remove and dispose of sediment deposits at designated spoil site for Project. If a spoil site is not designated on Drawings, dispose of sediment off-site at a location not in or adjacent to stream or flood plain. Assume responsibility for off-site disposal.

F. Spread compacted and stabilized sediment evenly throughout site. Do not allow sediment to flush into streams or drainage ways. Dispose of contaminated sediment in accordance with existing federal, state, and local rules and regulations.

G. Prohibit equipment and vehicles from maneuvering on areas outside of dedicated rights-of-way and easements for construction. Immediately repair damage to erosion and sediment control systems caused by construction traffic.

H. Conduct construction operations in conformance with erosion control requirements of Specification 01570 – Storm Water Pollution Control.

3.02 CONSTRUCTION MAINTENANCE

A. Provide stabilized access roads, subdivision roads, parking areas, and other on-site vehicle transportation routes where shown on Drawings.

B. Provide stabilized construction access and vehicle washing areas, when approved by Project Manager, of sizes and at locations shown on Drawings or as specified in this Section.

C. Clean tires to remove sediment on vehicles leaving construction areas prior to entering public right-of-ways. Construct wash areas needed to remove sediment. Release wash water into drainage swales or inlets protected by erosion and sediment control measures.

D. Details for stabilized construction access are shown on Drawings. Construct other stabilized areas to same requirements. Maintain minimum roadway widths of 14 feet for one-way traffic and 20 feet for two-way traffic and of sufficient width to allow ingress and egress. Place geotextile fabric as a permeable separator to prevent mixing of coarse aggregate with underlaying soil. Limit exposure of geotextile fabric to elements between laydown and cover to a maximum 14 days to minimize potential damage.

E. Grade roads and parking areas to provide sufficient drainage away from stabilized areas. Use sandbags, gravel, boards, or similar materials to prevent sediment from entering public right-of-ways, waterways or

storm water conveyance systems.

F. Inspect and maintain stabilized areas daily. Provide periodic top dressing with additional coarse aggregates to maintain required depth. Repair and clean out damaged control systems used to trap sediment. Immediately remove spilled, dropped, washed, or tracked sediment from public right-of-ways.

G. Maintain lengths of stabilized areas as shown on Drawings or a minimum of 50 feet. Maintain a minimum thickness of 8 inches. Maintain minimum widths at all points of ingress or egress.

H. Stabilize other areas with the same thickness, and width of coarse aggregate required for stabilized construction access, except where shown otherwise on Drawings.

I. Stabilized areas may be widened or lengthened to accommodate truck washing areas when authorized by Project Manager.

J. Clean street daily before end of workday. When excess sediments have tracked onto streets, Project Manager may direct Contractor to clean street as often as necessary. Remove and legally dispose of sediments.

K. Use other erosion and sediment control measures to prevent sediment runoff during rain periods and non-working hours and when storm discharges are expected.

END OF SECTION

SUPPLEMENTARY SPECIFICATION

SECTION 01576S
WASTE MATERIAL DISPOSAL

The following supplement modifies Specification Section 01576. Where a portion of the Specification is modified or deleted by this Supplementary Specification, the unaltered portions of the Specification shall remain in effect.

1. Add the following to Paragraph 1.02:

   "F. Submit records of volume of vegetation and soil disposed of including manifests, volumes, location of site, associated TCLP Test Number and lab name. Hard copy shall be submitted and the complete record for the project submitted in Excel, Lotus or equal after all vegetation and soil has been disposed of."

2. Add Paragraph 1.03:

   " 1.03 MEASUREMENT AND PAYMENT

   A. No separate payment will be made under this Section for handling, removing, laboratory testing, transporting, and disposal of 1,000 cu. Yds of vegetation and soil from the stormwater quality detention basin. Include the cost for this work in the lump sum base bid.

   B. Payment for extra vegetation and soil handling, removal, laboratory testing, transporting, and disposal in excess of the amount listed in the Lump Sum Base Bid shall be made on the basis of per cubic yard (CY) as verified and documented by the City Construction Manager representative in the field. Payment shall include all related cost for handling, removal, laboratory testing, transporting and disposal of extra vegetation and soil from the stormwater quality detention basin, including repair of damages occurring as a result of vegetation and soil removal operation. Volumes shall be established by measurement of the trailer or truck empty and with load before leaving. "

3. Add the following paragraph:

   "3.03 VEGETATION AND SOIL REMOVAL FOR STORMWATER QUALITY DETENTION BASIN CLEANING

   A. Vegetation and soil shall be removed from stormwater quality detention basin by means the contractor chooses, allowing excess water to drain out of basin, loading into truck or trailer for ultimate disposal, and transportation to disposal site.

B. Vegetation and soil removal shall include arrangement of a TCLP test, a paint filter test, and other required tests to be performed by an NELAP-accredited laboratory.

C. Included under this contract are provisions for removal, hauling, and disposal of vegetation and soil removed from basin in a licensed site.

D. Provide trucks with dumps, roll off dumps or dump trailers that are watertight and comply with Federal, State and local regulations for grit transport. Provide maintenance of the trucks and trailers as well as all required licenses, insurance, and inspections.

E. The Contractor shall be completely familiar with, and shall enforce all City, State of Texas and Federal OSHA regulations and requirements as applicable for all services performed under this Contract.

F. The Contractor shall consider all trash and debris resulting from their activities as their property. The Contractor shall remove and dispose of discarded materials in a manner that meets all Federal, State and local regulations.

G. The Contractor shall be responsible for the repair and cost thereof, of all damages to City property caused by carelessness or neglect on the part of the Contractor, his agent or employees."

END OF SUPPLEMENT

Approved by: 10/1/15

Sonny Do, P.E. Date
Acting Assistant Director
Engineering and Construction Division
Department of Public Works and Engineering

Section 01576

WASTE MATERIAL DISPOSAL

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Disposal of waste material and salvageable material.

1.02 SUBMITTALS

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

B. Submit copy of approved "Development Permit", as defined in Chapter 19 of Flood Plain Ordinance (City Ordinance Number 81-914 and Number 85-1705), prior to disposal of excess material in areas designated as being in "100-year Flood Hazard Area" within the City. Contact the City of Houston Flood Plain Manager, 3300 Main Street, at (713) 525-7605 for flood plain information.

C. Obtain and submit disposal permits for proposed disposal sites, if required by local ordinances.

D. Submit copy of written permission from property owner, with description of property, prior to disposal of excess material adjacent to Project. Submit written and signed release from property owner upon completion of disposal work.

E. Describe waste materials expected to be stored on-site and a description of controls to reduce Pollutants from these materials, including storage practices to minimize exposure of materials to storm water; and spill prevention and response measures in the Project's Storm Water Pollution Prevention Plan (SWPPP). Refer to Section 01410 – TPDES Requirements.

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 location or locations shown on Drawings outside limits of Project.

B. Base, Surface, and Bedding Material: Load shell, gravel, bituminous, or other base and surfacing material designated for salvage into City trucks.

C. Pipe Culvert: Load culverts designated for salvage into City trucks.

D. Other Salvageable Materials: Conform to requirements of individual Specification Sections.

E. Coordinate loading of salvageable material on City trucks with Project Manager.

3.02 EXCESS MATERIAL

A. Remove and legally dispose of vegetation, rubble, broken concrete, debris, asphaltic concrete pavement, excess soil, and other materials not designated for salvage from job site.

B. Excess soil may be deposited on private property adjacent to Project when written permission is obtained from property owner. See Paragraph 1.02 D above.

C. Verify flood plain status of any proposed disposal site. Do not dispose of excavated materials in area designated as within 100-year Flood Hazard Area unless "Development Permit" has been obtained. Remove excess material placed in "100-year Flood Hazard Area" within the City, without "Development Permit", at no additional cost to the City.

D. Remove waste materials from site daily, in order to maintain site in neat and orderly condition.

END OF SECTION

Section 01578

CONTROL OF GROUND AND SURFACE WATER

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Dewatering, depressurizing, draining, and maintaining trenches, shaft excavations, structural excavations and foundation beds in stable condition, and controlling ground water conditions for tunnel excavations.

B. Protecting work against surface runoff and rising floodwaters.

C. Trapping suspended sediment in the discharge form the surface and ground water control systems.

1.02 MEASUREMENT AND PAYMENT

A. UNIT PRICES

1. When noted, dewatering of trench or excavation during course of project shall be measured per linear foot and paid for at contract unit prices for dewatering, when directed to perform such work by Project Manager. Dewatering must be fully detailed in submittal and submittal must be approved prior to performing dewatering work before payment will be made for dewatering. No payment will be made for work unless directed to perform work by Project Manager.

2. Presence of a pump on project does not constitute dewatering for payment under bid item "Ground Water Control for Open Cut Construction."

3. Dewatering required during course of project to lower water table for other utility installation less than 24 inches in diameter, construction of structures, removal of standing water, surface drainage seepage, or to protect against rising waters or floods shall be considered incidental to Work unless otherwise noted.

4. No separate payment will be made for groundwater control associated with augering, tunnels or casing. Include cost in unit price for augering.

5. Refer to Section 01270 - Measurement and Payment for unit price procedures.

B. Stipulated Price (Lump Sum) Contract. If the Contract is a Stipulated Price Contract, include payment for work under this section in the total Stipulated

Price.

1.03 REFERENCES

A. ASTM D 698 - Standard Test Methods for Laboratory Compaction of Soils Using Standard Effort (12,400 ft-lbf/ft3 (600kN-m/m3)

B. Federal Regulations, 29 CFR Part 1926, Standards-Excavation, Occupational Safety and Health Administration (OSHA)

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

1.04 DEFINITIONS

A. Ground water control system: system used to dewater and depressurize water-bearing soil layers.

1. Dewatering: lowering the water table and intercepting seepage that would otherwise emerge from slopes or bottoms of excavations, or into tunnels and shafts; and disposing of removed water. Intent of dewatering is to increase stability of tunnel excavations and excavated slopes, prevent dislocation of material from slopes or bottoms of excavations, reduce lateral loads on sheeting and bracing, improve excavating and hauling characteristics of excavated material, prevent failure or heaving of bottom of excavations, and to provide suitable conditions for placement of backfill materials and construction of structures and other installations.

2. Depressurization: includes reduction in piezometric pressure within strata not controlled by dewatering alone, necessary to prevent failure or heaving of excavation bottom or instability of tunnel excavations.

B. Excavation drainage: includes keeping excavations free of surface and seepage water.

C. Surface drainage: includes use of temporary drainage ditches and dikes and installation of temporary culverts and sump pumps with discharge lines necessary to protect Work from any source of surface water.

D. Monitoring facilities for ground water control system: includes piezometers, monitoring wells and flow meters for observing and recording flow rates.

1.05 PERFORMANCE REQUIREMENTS

A. Conduct subsurface investigations to identify groundwater conditions and to

provide parameters for design, installation, and operation of groundwater control systems. Submit proposed method and spacing of readings for review prior to obtaining water level readings.

B. Design ground water control system, compatible with requirements of Federal Regulations 29 CFR Part 1926 and Section 02260 - Trench Safety Systems, to produce following results:

1. Effectively reduce hydrostatic pressure affecting:

   a. Excavations

   b. Tunnel excavation, face stability or seepage into tunnels

2. Develop substantially dry and stable subgrade for subsequent construction operations

3. Preclude damage to adjacent properties, buildings, structures, utilities, installed facilities and other work

4. Prevent loss of fines, seepage, boils, quick condition, or softening of foundation strata

5. Maintain stability of sides and bottom of excavations

C. Provide ground water control systems that include single-stage or multiple-stage well point systems, eductor and ejector-type systems, deep wells, or combinations of these equipment types.

D. Provide drainage of seepage water and surface water, as well as water from other sources entering excavation. Excavation drainage may include placement of drainage materials, crushed stone and filter fabric, together with sump pumping.

E. Provide ditches, berms, pumps and other methods necessary to divert and drain surface water from excavation and other work areas.

F. Locate ground water control and drainage systems so as not to interfere with utilities, construction operations, adjacent properties, or adjacent water wells.

G. Assume sole responsibility for ground water control systems and for any loss or damage resulting from partial or complete failure of protective measures and settlement or resultant damage caused by ground water control operations. Modify ground water control systems or operations if they cause or threaten to cause damage to new construction, existing site improvements, adjacent property, adjacent water wells, or potentially contaminated areas. Repair damage caused by ground water control systems or resulting from

failure of system to protect property as required.

H. Install an adequate number of piezometers installed at proper locations and depths, necessary to provide meaningful observations of conditions affecting excavation, adjacent structures and water wells.

I. Install environmental monitoring wells at proper locations and depths necessary to provide adequate observations of hydrostatic conditions and possible contaminant transport from contamination sources into work area or ground water control system.

1.06 SUBMITTALS

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

B. Submit Ground Water and Surface Water Control Plan for review by Project Manager prior to start of excavation work. Include the following:

1. Results of subsurface investigations and description of extent and characteristics of water bearing layers subject to ground water control

2. Names of equipment Suppliers and installation Subcontractors

3. Description of proposed ground water control systems indicating arrangement, location, depth and capacities of system components, installation details and criteria and operation and maintenance procedures

4. Description of proposed monitoring facilities indicating depths and locations of piezometers and monitoring wells, monitoring installation details and criteria, type of equipment and instrumentation with pertinent data and characteristics

5. Description of proposed filters including types, sizes, capacities and manufacturer's application recommendations

6. Design calculations demonstrating adequacy of proposed systems for intended applications. Define potential area of influence of ground water control operation near contaminated areas.

7. Operating requirements, including piezometric control elevations for dewatering and depressurization

8. Excavation drainage methods including typical drainage layers, sump pump application and other means

9. Surface water control and drainage installations

10. Proposed methods and locations for disposing of removed water

C. Submit following records upon completion of initial installation:

1. Installation and development reports for well points, eductors, and deep wells

2. Installation reports and baseline readings for piezometers and monitoring wells

3. Baseline analytical test data of water from monitoring wells

4. Initial flow rates

D. Submit the following records weekly during control of ground and surface water operations:

1. Records of flow rates and piezometric elevations obtained during monitoring of dewatering and depressurization. Refer to Paragraph 3.02, Requirements for Eductor, Well Points, or Deep Wells.

2. Maintenance records for ground water control installations, piezometers and monitoring wells

1.07 ENVIRONMENTAL REQUIREMENTS

A. Comply with requirements of agencies having jurisdiction.

B. Comply with Texas Commission on Environmental Quality regulations and Texas Water Well Drillers Association for development, drilling, and abandonment of wells used in dewatering system.

C. Obtain necessary permits from agencies with jurisdiction over use of groundwater and matters affecting well installation, water discharge, and use of existing storm drains and natural water sources. Since review and permitting process may be lengthy, take early action to obtain required approvals.

D. Monitor ground water discharge for contamination while performing pumping in vicinity of potentially contaminated sites.

PART 2 P R O D U C T S

2.01 EQUIPMENT AND MATERIALS

A. Select equipment and materials necessary to achieve desired results for dewatering. Selected equipment and materials are subject to review by Project Manager through submittals required in Paragraph 1.06, Submittals.

B. Use experienced contractors, regularly engaged in ground water control system design, installation, and operation, to furnish and install and operate educators, well points, or deep wells, when needed

C. Maintain equipment in good repair and operating condition.

D. Keep sufficient standby equipment and materials available to ensure continuous operation, where required.

E. Portable Sediment Tank System: Standard 55-gallon steel or plastic drums, free of hazardous material contamination.

1. Shop or field fabricate tanks in series with main inlet pipe, inter-tank pipes and discharge pipes, using quantities sufficient to collect sediments from discharge water.

PART 3 EXECUTION

3.01 GROUND WATER CONTROL

A. Perform necessary subsurface investigation to identify water bearing layers, piezometric pressures and soil parameters for design and installation of ground water control systems. Perform pump tests, if necessary to determine draw down characteristics. Present results in the Ground Water and Surface Water Control Plan. submittal

B. Provide labor, material, equipment, techniques and methods to lower, control and handle ground water in manner compatible with construction methods and site conditions. Monitor effectiveness of installed system and its effect on adjacent property.

C. Install, operate, and maintain ground water control systems in accordance with the Ground Water and Surface Water Control Plan. Notify Project Manager in writing of changes made to accommodate field conditions and changes to Work. Provide revised drawings and calculations with notification.

D. Provide continuous system operation, including nights, weekends, and holidays. Arrange appropriate backup if electrical power is primary energy source for dewatering system.

E. Monitor operations to verify systems lower ground water piezometric levels at rate required to maintain dry excavation resulting in stable subgrade for

subsequent construction operations.

F. Depressurize zones where hydrostatic pressures in confined water bearing layers exist below excavations to eliminate risk of uplift or other instability of excavation or installed works. Define allowable piezometric elevations in the Ground Water and Surface Water Control Plan.

G. Removal of ground water control installations.

1. Remove pumping system components and piping when ground water control is no longer required.

2. Remove piezometers, including piezometers installed during design phase investigations and left for Contractor's use, upon completion of testing, as required in accordance with Part 3 of applicable specification.

3. Remove monitoring wells when directed by Project Manager.

4. Grout abandoned well and piezometer holes. Fill piping that is not removed with cement-bentonite grout or cement-sand grout.

H. During backfilling, maintain water level a minimum of 5 feet below prevailing level of backfill. Do not allow the water level to cause uplift pressures in excess of 80 percent of downward pressure produced by weight of structure or backfill in place. Do not allow water levels to rise into cement-stabilized sand until at least 48 hour after placement.

I. Provide uniform pipe diameter for each pipe drain run constructed for dewatering. Remove pipe drains when no longer required. If pipe removal is impractical, grout connections at 50-foot intervals and fill pipe with cement-bentonite grout or cement-sand grout after removal from service.

J. The extent of ground water control for structures with permanent perforated underground drainage systems may be reduced, for units designed to withstand hydrostatic uplift pressure. Provide a means to drain affected portions of underground systems, including standby equipment. Maintain drainage systems during construction operations.

K. Remove systems upon completion of construction or when dewatering and control of surface or ground water is no longer required.

L. Compact backfill to not less than 95 percent of maximum dry density in accordance with ASTM D 698.

M. Foundation Slab: Maintain saturation line at least 3 feet below lowest elevations where concrete is to be placed. Drain foundations in areas where

concrete is to be placed before placing reinforcing steel. Keep free from water for 3 days after concrete is placed.

3.02 REQUIREMENTS FOR EDUCTOR, WELL POINTS, OR DEEP WELLS

A. For aboveground piping in ground water control system, include a 12-inch minimum length of clear, transparent piping between each eductor well or well point and discharge header to allow visual monitoring of discharge from each installation.

B. Install sufficient piezometers or monitoring wells to show that trench or shaft excavations in water bearing materials are pre-drained prior to excavation. Provide separate piezometers for monitoring of dewatering and for monitoring of depressurization. Install piezometers and monitoring wells for tunneling as appropriate for selected method of work.

C. Install piezometers or monitoring wells at least one week in advance of the start of associated excavation.

D. Dewatering may be omitted for portions of under drains or other excavations, where auger borings and piezometers or monitoring wells show that soil is pre-drained by existing systems and that ground water control plan criteria are satisfied.

E. Replace installations that produce noticeable amounts of sediments after development.

F. Provide additional ground water control installations, or change method of control if, ground water control plan does not provide satisfactory results based on performance criteria defined by plan and by specifications. Submit revised plan according to Paragraph 1.06B.

3.03 SEDIMENT TRAPS

A. Install sediment tank as shown on approved plan.

B. Inspect daily and clean out tank when one-third of sediment tank is filled with sediment.

3.04 SEDIMENT SUMP PIT

A. Install sediment sump pits as shown on approved plan.

B. Construct standpipe by perforating 12 inch to 24-inch diameter corrugated metal or PVC pipe.

C. Extend standpipe 12 inches to 18 inches above lip of pit.

D. Convey discharge of water pumped from standpipe to sediment trapping device.

E. Fill sites of sump pits, compact to density of surrounding soil and stabilize surface when construction is complete.

3.05 EXCAVATION DRAINAGE

A. Use excavation drainage methods if well-drained conditions can be achieved. Excavation drainage may consist of layers of crushed stone and filter fabric, and sump pumping, in combination with sufficient ground water control wells to maintain stable excavation and backfill conditions.

3.06 MAINTENANCE AND OBSERVATION

A. Conduct daily maintenance and observation of piezometers or monitoring wells while ground water control installations or excavation drainage is operating at the site, or water is seeping into tunnels, and maintain systems in good operating condition.

B. Replace damaged and destroyed piezometers or monitoring wells with new piezometers or wells as necessary to meet observation schedules.

C. Cut off piezometers or monitoring wells in excavation areas where piping is exposed, only as necessary to perform observation as excavation proceeds. Continue to maintain and make specified observations

D. Remove and grout piezometers inside or outside of excavation area when ground water control operations are complete. Remove and grout monitoring wells when directed by Project Manager.

3.07 MONITORING AND RECORDING

A. Monitor and record average flow rate of operation for each deep well, or for each wellpoint or eductor header used in dewatering system. Also, monitor and record water level and ground water recovery. Record observations daily until steady conditions are achieved and twice weekly thereafter.

B. Observe and record elevation of water level daily as long as ground water control system is in operation, and weekly thereafter until Work is completed or piezometers or wells are removed, except when Project Manager determines more frequent monitoring and recording are required. Comply with Project Manager's direction for increased monitoring and recording and

take measures necessary to ensure effective dewatering for intended purpose.

3.08 SURFACE WATER CONTROL

A. Intercept surface water and divert it away from excavations through use of dikes, ditches, curb walls, pipes, sumps or other approved means. Requirement includes temporary works required to protect adjoining properties from surface drainage caused by construction operations.

B. Divert surface water and seepage water into sumps and pump it into drainage channels or storm drains, when approved by agencies having jurisdiction. Provide settling basins when required by agencies.

END OF SECTION

Section 01580

PROJECT IDENTIFICATION SIGNS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Project identification sign description.

B. Project sign installation.

C. Maintenance and removal of Project sign.

1.02 SYSTEM DESCRIPTION

A. Sign Construction: Construct signs of new materials in accordance with Standard Detail provided at the Pre-construction Conference.

B. Appearance: Maintain signs to present a clean and neat look throughout contract duration.

C. Sign Manufacturer: Experienced professional sign company.

D. Sign Placement: At locations shown in Drawings unless otherwise specified by Project Manager at pre-construction meeting.

1. Provide one sign at each end of a linear Project involving paving, overlay, sewer line, storm drainage, or water main construction located in rights-of-ways.

2. Provide one sign for site or building construction Contracts

3. Provide one sign at each site for Contracts with multiple sites.

4. Sign Relocation: As work progresses, relocate signs if directed by Project Manager in writing. Include cost for one relocation of post-mounted signs in Contract Price. Subsequent relocations, if directed by Project Manager in writing, will be subject to Change Order.

E. Skid-mounted signs: Use for projects with noncontiguous locations where work progresses from one location to another. Design skid structure to withstand a 60 mile-per-hour wind load to the face or back of sign using stakes, straps, or ballast. Contractor shall be responsible for security of signs at each site.

1.03 SUBMITTALS

A. Submit Shop Drawings under provisions of Section 01330 - Submittal procedures.

B. Show content, layout, lettering style, lettering size, and colors. Make sign and lettering to scale, clearly indicating condensed lettering, if used.

PART 2 P R O D U C T S

2.01 SIGN MATERIALS

A. Structure and Framing: Use new sign materials.

1. Sign Posts: 4-inch by 4-inch pressure treated wood posts, 9 feet long for skid mounting and 12 feet long minimum for in-ground mounting.

2. Skid Bracing: 2-inch by 4-inch wood framing material.

3. Skid Members: 2-inch by 6-inch wood framing material.

4. Fasteners:
   a. Galvanized steel.
   b. Attach sign to posts with 1/2-inch by 5-1/2 inch button head carriage bolts and secure with nuts and flat head washers.
   c. Cover button heads with white reflective film or paint to match sign background.
   d. Use metal brackets and braces and 3/4-inch wood screws to attach sign header.

B. Sign and Sign Header: 3/4-inch thick marine plywood. Use 4-foot by 8 -foot sheet for the sign and a single piece for the header to minimize joints. Do not piece wood sheets to fabricate sign face.

C. Paint and Primers: White industrial grade, fast-drying, oil-based paint with gloss finish for structural and framing members, sign, and sign header material surfaces. Paint all sign surfaces prior to adding adhesive applications.

D. Colors:

1. Sign Background: Reflective white 3M Scotchlite Engineer Grade, Pressure Sensitive Sheeting (White), or approved equal.

2. Border: For red border around area, which designates project name and project amount, use reflective red 3M Scotchlite Engineer Grade, Pressure Sensitive Sheeting (Red), or approved equal.

3. Sign Film: 3M Scotchcal Pressure Sensitive Films, or approved equal for legends, symbols, lettering, and artwork. Match colors to 3M Scotchcal Pressure Sensitive Films.

a.	Lettering Below Seal:	Black
b.	Lettering Above Project Name:	Vivid Blue
c.	Lettering on Blue Background:	White
d.	Background Behind Project Name:	Vivid Blue

E. City Seal: Project Manager will provide City seals to Contractor, as needed.

2.02 SIGN LAYOUT

A. Lettering:

1. Style, Size, and Spacing: Helvetica Regular lettering.

2. Condensed Style: Text may be condensed if needed to maintain sign composition.

B. Composition:

1. Lines with Standard Text
   a. Top line shall read "BUILDING TOGETHER FOR THE FUTURE".
   b. Use lower left below City Seal to list names and titles for Mayor, Controller and Council Members. Place as shown on Drawings with indicated size and spacing.
   c. Center telephone number of the Customer Response Center, "311", near the bottom of the area with the blue background.

2. Lines with Variable Text. Use blue background space for Project name and dollar amount.
   a. Project Manager will provide Project name and dollar amount of Project for preparation of sign. Center name on one or two lines, and dollar amount immediately below Project name, in area with blue background. Use condensed lettering if necessary.

2.03 LAYOUT AND COMPOSITION FOR HEADER

A. City of Houston Seal:
1. A space of approximately 24 inches in diameter is provided for the City seal, the top 6 inches of which extends above the sign on the sign header.

2. Construct sign header of same material as sign face. Cut material to match curve of the City seal.

3. Project Manager will provide the seal to be affixed to the sign by sign maker.

PART 3 E X E C U T I O N

3.01 INSTALLATION

A. Install Project identification signs within seven days after Date of Commencement of the Work.

B. Erect signs at locations shown in Drawings unless otherwise designated by Project Manager at pre-construction meeting. Position sign so it is fully visible and readable to general public.

C. Erect sign level and plumb.

D. If mounted on posts, sink posts 3 to 4 feet below grade and stabilize posts to minimize lateral motion. Leave a minimum of 8 feet of post above existing grade for mounting of sign.

E. Erect sign so that top edge of sign is at a nominal 8 feet above existing grade.

3.02 MAINTENANCE AND REMOVAL

A. Keep signs and supports clean. Repair deterioration and damage.

B. Remove signs, framing, supports, and foundations to a depth of at least 2 feet upon completion of Project. Restore area to a condition equal to or better than before construction.

PROJECT No.: (FILE NO:)	CONTRACT No.:	REVIEWED BY:

*INSTRUCTIONS TO SIGN MAKER (LIST COMPANY NAME):	
QTY.	ACTION ITEMS:
	Make new sign(s)
	Follow City standards attached
	Provide submittal (drawing) to the City for project sign showing content, layout, lettering style, lettering size, and colors

VARIABLE TEXT		
Line 1	Project Name:	
Line 2	Project Amount (rounded to nearest $1000):	

ATTACHMENTS INCLUDED	
QTY.	SEALS / LOGOS
	City of Houston - 24" diameter
	STANDARDS
	Standard Specification Section 01580 - Project Identification Signs
	Standard Detail 01580-03 Construction Sign

(Instructions on reverse.)

INSTRUCTIONS

Contractor produces this form. Contractor shall insert the information and provide the form to the sign maker with Contractor's purchase order.

List PROJECT No., (FILE No.), CONTRACT No., and name of City's Project Manager REVIEWED BY.

INSTRUCTIONS TO SIGN MAKER:

- Give COMPANY NAME of sign maker.
- Indicate QUANTITY of new signs to be made.
- Direction for sign maker to follow City Standards in making signs.
- Require submittals from sign maker, who provides Shop Drawing of Project sign showing content, layout, lettering style, lettering size, and colors.

VARIABLE TEXT:

- Give PROJECT NAME. Write it out in all caps and suggest line break. Lines are required.
- Give Project amount to be listed on sign. Round off to nearest $1000.

ATTACHMENTS INCLUDED:

- **Seals**

  City provides the quantity of City seals required one for each Project sign.

- **Standards**

  Contractor provides set of Standards to sign maker, including (Specification Section 01580 - Project Identification Signs, and Standard Detail No. 01580-03 - Construction Sign.

Section 01610

BASIC PRODUCT REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Requirements for transportation, delivery, handling, and storage of Products.

1.02 PRODUCTS

A. Products: Defined in Document 00700 – General Conditions. Does not include machinery and equipment used for preparation, fabrication, conveying and erection of the Work. Products may also include existing materials or components designated for reuse.

B. For material and equipment specifically indicated or specified to be reused in the work:

1. Use special care in removal, handling, storage and reinstallation, to assure proper function in completed work.

2. Arrange for transportation, storage and handling of products which require off-site storage, restoration or renovation. Include cost in unit price for related items.

C. When contract documents require that installation of work comply with manufacturer's printed Instructions, obtain and distribute copies of such instructions to parties involved in installation, including two copies to Project Manager. Maintain one set of complete instructions at job site during installation until completion.

D. Provide Products from the fewest number of manufacturers as practical, in order to simplify spare parts inventory and to allow for maximum interchangeability of components. For multiple components of the same size, type or application, use the same make and model of component throughout the Work.

1.03 TRANSPORTATION

A. Make arrangements for transportation, delivery, and handling of Products required for timely completion of the Work.

B. Transport and handle Products in accordance with manufacturer's instructions.

C. Consign and address shipping documents to proper party giving name of the Project and its complete street address. Shipments shall be delivered to

Contractor.

1.04 DELIVERY

A. Arrange deliveries of Products to accommodate short-term site completion schedules and in ample time to facilitate inspection prior to Installation. Avoid deliveries that cause lengthy storage or overburden of limit storage space.

B. Coordinate deliveries to avoid conflict with the Work and conditions at the site and to accommodate the following:

1. Work of other contractors or the City.

2. Limitations of storage space.

3. Availability of equipment and personnel for handling Products.

4. The City's use of premises.

C. Have Products delivered to the site in manufacturer's original, unopened, labeled containers.

D. Immediately upon delivery, inspect shipment to assure:

1. Product complies with requirements of the Contract.

2. Quantities are correct.

3. Containers and packages are intact; labels are legible.

4. Products are properly protected and undamaged.

1.05 PRODUCT HANDLING

A. Coordinate off-loading of Products delivered to the site. If necessary during construction, move and relocate stored Products at no additional cost to the City.

B. Provide equipment and personnel necessary to handle Products, including those provided by the City, by methods to prevent damage to Products or packaging.

C. Provide additional protection during handling as necessary to prevent breaking, scraping, marring, or otherwise damaging Products or surrounding areas.

D. Handle Products by methods to prevent over-bending or overstressing.

E. Lift heavy components only at designated lifting points.

F. Handle Products in accordance with manufacturer's recommendations.

G. Do not drop, roll, or skid Products off delivery vehicles. Hand-carry or use Suitable materials handling equipment.

1.06 STORAGAE OF PRODUCTS

A. Store and protect Products in accordance with manufacturer's recommendations and requirements of these Specifications.

B. Make necessary provisions for safe storage of Products. Place Products so as to prevent damage to any part of the Work or existing facilities and to maintain free access at all times to all parts of the Work and to utility service company installations in the vicinity of the Work. Keep Products neatly and compactly stored in locations that will cause minimum inconvenience to other contractors, public travel, adjoining owners, tenants, and occupants. Arrange storage in a manner so as to provide easy access for inspection.

C. Restrict storage to areas available on the site for storage of Products as shown on Drawings or approved by Project Manager.

D. Provide off-site storage and protection when on-site storage is not adequate. Provide addresses of, and access to, off-site storage locations for inspection by Project Manager.

E. Do not use lawns, grass plots, or other private property for storage purposes without written permission of owner or other person in possession or control of premises.

F. Protect stored Products against loss or damage.

G. Store in manufacturers' unopened containers.

H. Neatly, safely, and compactly stack Products delivered and stored along the line of the Work to avoid inconvenience and damage to property owners and general public, and maintain at least 3 feet clearance around fire hydrants. Keep public, private driveways and street crossings open.

I. Repair or replace damaged lawns, sidewalks, streets or other improvements to satisfaction of Project Manager. Total length that Products may be distributed along route of construction at one time is 1000 linear feet, unless otherwise approved in writing by Project Manager.

PART 2 P R O D U C T S - Not Used

PART 3 E X E C U T I O N - Not Used

END OF SECTION

Section 01630

PRODUCT SUBSTITUTION PROCEDURES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Options for making Product or process selections.

B. Procedures for proposing equivalent Products or processes, including pre-approved, pre-qualified, and approved Products or processes.

1.02 DEFINITIONS

A. Product: As defined in Document 00700 – General Conditions. Product does not include machinery and equipment used for production, fabrication, conveying, and erection of the Work. Products may also include existing materials or components designated for reuse.

B. Process: Any proprietary system or method for installing system components resulting in an integral, functioning part of the Work. For this Section, the word Products includes Processes.

1.03 SELECTION OPTIONS

A. Pre-approved Products: Construction products of certain manufacturers or Suppliers designated in Specifications as "pre-approved." The City maintains a list of pre-approved products. Pre-approved Products for this Project are designated as pre-approved in Specifications. Products of other manufacturers or suppliers are not acceptable for this Project and will not be considered under the submittal process for approving alternate products.

B. Pre-qualified Products: Construction products of certain manufacturers or Suppliers designated in Specifications as "pre-qualified." Pre-qualified Products for this Project are designated as pre-qualified in Specifications. Products of other manufacturers or suppliers are not acceptable for this Project and will not be considered under the submittal process for approving alternate products.

C. Approved Products: Construction products of certain manufacturers or Suppliers designated in Specifications followed by words "or approved equal." Approval of alternate products not listed in Specifications may be obtained through provisions for product options and substitutions in Document 00700 - General Conditions, and by following submittal procedures specified in

Section 01330- Submittal Procedures. The procedure for approval of alternate products is not applicable to pre-approved or pre-qualified products.

D. Product Compatibility: To the maximum extent possible, provide Products that are of the same type or function from a single manufacturer, make, or source. Where more than one choice is available, select Product that is compatible with other Products already selected, specified, or in use by the City.

1.04 CONTRACTOR'S RESPONSIBILITY

A. Responsibility related to Product options and substitutions is defined in Document 00700 - General Conditions.

B. Furnish information Project Manager deems necessary to judge equivalency of alternate Product.

C. Pay for laboratory testing, as well as any other review or examination costs, needed to establish equivalency between products in order to obtain information upon which Project Manager can base a decision.

D. If Project Manager determines alternate product is not equal to that named in Specifications, Furnish one of the specified Products.

1.05 CITY REVIEW

A. Use alternate Products only when approved in writing by Project Manager. Project Manager's determination regarding acceptance of proposed alternate Product is final.

B. Alternate Products shall be accepted if Products are judged by Project Manager to be equivalent to specified Product or to offer substantial benefit to the City.

C. The City retains the right to accept any Product deemed advantageous to the City, and similarly, to reject any product deemed not beneficial to City.

1.06 SUBSTITUTION PROCEDURE

A. Collect and assemble technical information applicable to the proposed Product to aid in determining equivalency as related to the approved Product specified.

B. Submit a written request for a construction Product to be considered as an alternate Product.

C. Submit Product information after the effective date of the Contract and within the time period allowed for substitution submittals given in Document 00700 - General Conditions. After the submittal period has expired, requests for alternate Products shall be considered only when specified Product becomes unavailable because of conditions beyond Contractor's control.

D. Submit five copies of each request for alternate Product approval. Include the following information:

1. Complete data substantiating compliance of proposed substitution with the Contract.

2. For Products:
   a. Product identification, including manufacturer's name and address.
   b. Manufacturer's literature with Product description, performance and test data, and reference standards.
   c. Samples, as applicable.
   d. Name and address of similar projects on which Product was used and date of installation. Include names of Owner, design consultant, and installing contractor.

3. For construction methods:
   a. Detailed description of proposed method.
   b. Drawings illustrating methods.

4. Itemized comparison of proposed substitution with Product or method specified.

5. Data relating to changes in Construction Schedule.

6. Relation to separate contracts, if any.

7. Accurate cost data on proposed substitution in comparison with Product or method specified.

8. Other information requested by Project Manager.

E. Approved alternate Products will be subject to the same review process as the specified Product would have been for Shop Drawings, Product Data, and Samples.

PART 2 P R O D U C T S - Not Used

PART 3 E X E C U T I O N - Not Used

END OF SECTION

Section 01725

FIELD SURVEYING

PART 1 GENERAL

1.01 QUALITY CONTROL

A. Conform to State of Texas laws for surveys requiring licensed surveyors. Employ a surveyor acceptable to Project Manager if required by the Contract.

1.02 MEASUREMENT AND PAYMENT

A. UNIT PRICES

1. No separate payment will be made for field surveying. Include cost in unit price for related items.

1.03 SUBMITTALS

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

B. Submit name, address, and telephone number of Surveyor to Project Manager before starting survey work.

C. Submit documentation verifying accuracy of survey work on request.

D. Submit certificate signed by Surveyor, that elevations and locations of the Work are in conformance with the Contract.

1.04 PROJECT RECORD DOCUMENTS

A. Maintain a complete and accurate log of control and survey work as it progresses.

B. Prepare a certified survey setting forth dimensions, locations, angles, and elevations of construction and site work upon completion of foundation walls and major site improvements.

C. Submit record documents under provisions of Section 01785 - Project Record Documents.

1.05 EXAMINATION

A. Verify locations of survey control points prior to starting the Work.

B. Notify Project Manager immediately if any discrepancies are discovered.

1.06 SURVEY REFERENCE POINTS

A. The City will establish survey control datum as provided in Document 00700 - General Conditions and as indicated on Drawings. Inform Project Manager in Advance of time horizontal and vertical control points will be established so

verification deemed necessary by Project Manager may be done with minimum inconvenience to the City or Contractor.

B. Locate and protect survey control points prior to starting site work; preserve permanent reference points during construction.

C. Notify Project Manager a minimum of 48 hours before relocation of reference points is needed due to changes in grades or other reasons.

D. Promptly report loss or destruction of reference points to Project Manager.

E. Reimburse the City for cost of reestablishment of permanent reference points disturbed by construction operations.

1.07 SURVEY REQUIREMENTS

A. Utilize recognized engineering survey practices.

B. Establish a minimum of two permanent benchmarks on site, referenced to established control points. Record horizontal and vertical location data on Project record documents.

C. Establish elevations, lines and levels to provide quantities required for measurement and payment and for appropriate controls for the Work. Locate and lay out the following with appropriate instruments:

1. Site improvements including grading, fill and topsoil placement, utilities, and footings and slabs

2. Grid or axis for structures

3. Building foundation, column locations, and ground floor elevations

D. Periodically verify layouts.

PART 2 P R O D U C T S - Not Used

PART 3 . E X E C U T I O N - Not Used

END OF SECTION

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Section 01731

CUTTING AND PATCHING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Cutting, patching and fitting of the Work or work under construction. Coordinating Installation or connection of the Work to existing facilities, or uncovering work for access, inspection or testing and related submittals.

1.02 MEASUREMENT AND PAYMENT

A. UNIT PRICES

1. No separate payment will be made for cutting and patching. Include cost in unit price for related items.

1.03 CUTTING AND PATCHING

A. Perform activities to avoid interference with facility operations and work of others in accordance with Document 00700 - General Conditions of Contract.

B. Execute cutting and patching, including excavation, backfill and fitting to:

1. Remove and replace defective work or work not conforming to Drawings and Specifications;

2. Take samples of installed work as required for testing;

3. Remove construction required to provide for specified alterations or additions to existing work;

4. Uncover work to allow inspection or reinspection by Project Manager or regulatory agencies having jurisdiction;

5. Connect uninstalled work to completed work in proper sequence;

6. Remove or relocate existing utilities and pipes that obstruct work;

7. Make connections or alterations to existing or new facilities;

8. Provide openings, channels, chases and flues and cut, patch, and finish; if required; or

9. Provide protection for other portions of the Work.

C. Restore existing work to a condition equal to or better than that which existed Prior to cutting and patching, and to standards required by Specifications.

D. Support, anchor, attach, match, trim and seal materials to work of others. Unless otherwise specified, Furnish and Install sleeves, inserts, and hangers required for execution of the Work.

E. Provide shoring, bracing and support necessary to maintain structural integrity and to protect adjacent work from damage during cutting and patching. Request written approval from Project Manager, before cutting structural members such as beams, anchors, lintels, or other supports. Follow approved submittals, as applicable.

F. Match new materials to existing materials by bonding, lapping, mechanically tying, anchoring or other effective means in order to prevent cracks and to minimize evidence of patching. Conceal effects of demolition and patching by blending new construction to existing surfaces. Avoid obvious breaks, joints or changes of surface appearance unless shown on Drawings or authorized by Project Manager.

1.04 SUBMITTALS

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

B. Submit a written request to Project Manager for consent to proceed, before conducting cutting operations that might affect structural integrity, design function, City operations, or work of another contractor.

C. Include the following in submittal:

1. Identification of Project

2. Description of affected work

3. Necessity for cutting

4. Effect on other work and on structural integrity

5. Describe the proposed work including:
   a. Scope of cutting and patching
   b. Contractor, Subcontractor or Supplier who will execute the work
   c. Proposed Products
   d. Extent of refinishing
   e. Schedule of operations

6. Alternatives to cutting and patching

D. When work conditions or schedules dictate the need for change of materials or methods, submit a written recommendation to Project Manager that includes:

1. conditions necessitating the change;

2. recommendations for alternative materials or methods; and

3. submittals required for proposed substitutions

E. Notify Project Manager in writing when work will be uncovered for observation. Do not begin cutting or patching operations until authorized by Project Manager.

1.05 CONNECTIONS TO EXISTING FACILITIES

A. Perform construction operations necessary to complete connections and tie-ins to existing facilities. Keep existing facilities in continuous operation unless otherwise permitted in the Specifications or approved in writing by Project Manager.

B. Coordinate interruption of service requiring connection to existing facilities with Project Manager. Do not bypass wastewater or sludge to waterways. Provide temporary pumping facilities to handle wastewater if necessary. Use temporary bulkheads to minimize disruption. Provide temporary power and piping to facilitate construction where necessary.

C. Submit a detailed schedule of proposed connections, including shut-downs and tie-ins. Include proposed time and date as well as anticipated duration of work. Coordinate the connection schedule with the construction schedule.

1. Submit specific times and dates to Project Manager at least 48 hours in advance of proposed work.

D. Procedures and Operations:

1. Operate existing pumps, valves and gates in required sequence under supervision of Project Manager. Do not operate valves, gates or other items of equipment without Project Manager's knowledge.

2. If possible, test equipment under operating conditions before making final tie-ins to connect equipment to existing facility.

3. Coordinate work and schedules. Notify Project Manger at least 48 Hours before shutdowns or bypasses are required.

PART 2 P R O D U C T S Not Used

PART 3 E X E C U T I O N Not Used

END OF SECTION

Section 01732

PROCEDURE FOR WATER VALVE ASSISTANCE

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Operation of valves. City of Houston employees will operate existing valves. Contractor's employees may operate new valves included in the Project prior to acceptance by the City.

1.02 PROCEDURE

A. Perform activities listed in Exhibit A attached to this Section.

1.03 SUBMITTALS

A. Submit request for work order planning meetings in accordance with Exhibit A. Include information listed in Step 1 of Exhibit A, attached to this Section.

1.04 CANCELLATION

A. Contractor, Project Manager, or Public Utilities Division may cancel a scheduled valve assistance appointment at no extra cost or payment to Contractor. Contractor shall notify City's appointed Project Inspector ("Inspector") 24 hours in advance of cancellation. Inspector shall notify Central Operation Service (COS) immediately upon receipt of cancellation notice. Cancellation may be caused by bad weather, preparation work taking longer than anticipated, or unforeseen delays by one or more of the three parties.

PART 2 P R O D U C T S - Not Used

PART 3 E X E C U T I O N - Not Used

END OF SECTION

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EXHIBIT A

PROCEDURE FOR VALVE ASSISTANCE

The following procedure will be used by Utility Maintenance Branch personnel when completing a service request from individual Contractors, through Inspector, for operation of existing water valves.

ROUTINE VALVE ASSISTANCE REQUEST (NON-EMERGENCY JOBS):

Step 1. a. When notified by Contractor, Inspector will schedule a work order planning meeting by calling Central Operation Service (COS) at **(713) 295-5521** and providing information shown below. The work order planning meeting shall be conducted a minimum of three days after the request; excluding weekends, holidays, inclement weather days, and the day of the call.

Location of Work (Street Intersection)	Project #
Project Description	Contractor (Company Name)
Job Superintendent's Name	Superintendent's Office #/Mobile #/Pager #
Contractor's Emergency Information	Name and Phone #/Mobile #/Pager #
Inspector/Senior Inspector	Name, Phone #/Mobile #/Pager #
Date & Time assistance is requested	

b. COS will create a work order for each wet connection, cut and plug, etc. that will be designated as a "Code 40" (Private Contractor).

c. COS will give Inspector the work order number. This work order number must be used as a reference in all communications regarding this request for Valve Assistance.

d. Valve personnel must have the work order number on their route sheet. When valve personnel arrive at the job site for the Work Order Planning Meeting between Inspector, Contractor, and Utility Maintenance valve personnel, they will verify the street intersection and work order number with the Inspector before beginning Work Order Planning Meeting.

e. During Work Order Planning Meeting, the work to be performed will be outlined and the actual date work will be performed will be mutually determined by Inspector, Contractor and City's Utility Maintenance Division valve personnel, based upon relevant factors such as preparatory work needed, customer requirements, etc.

f. Valve personnel will perform work specifically outlined in the work order requested. Also, Utility Maintenance Branch valve personnel will only operate existing water valves. Inspector must contact COS and request a new work order for additional work.

g. Valve personnel will contact the dispatcher and advise when the job is complete. Valve personnel will list all appropriate information on the Crew Activity Report.

Step 2. Should valve personnel not be able to keep an appointment to provide valve assistance, Utility Maintenance Branch will provide notification to appropriate Inspector by phone at least 24 hours prior, with that fact and rescheduling information, if available.

Step 3. Inspector will notify COS if valve personnel have not arrived at the site within 30 minutes of scheduled appointment. If Contractor is not ready when valve operator arrives to provide valve assistance, the City shall charge Contractor $50.00 per hour, starting 15 minutes after the scheduled appointment time, minimum one hour charge.

Step 4. Contractor will not be due delay claims or downtime if Utility Maintenance Branch has notified Inspector that they will not be able to provide valve assistance as scheduled.

Step 5. Test installed new valves in the presence of Inspector before substantial completion inspection is scheduled. Place new valves in open position on or before the Date of Substantial Completion.

Step 6. Project Manager will notify, in writing, Utility Maintenance Branch two months before the warranty expires to report any problems they have with new water lines. Project Manager will notify Contractor about these problems.

EMERGENCY REQUEST FOR VALVE ASSISTANCE PROCEDURE:

Step 1. When notified by Contractor, Inspector will request emergency Valve Assistance due to a broken line/service, etc. by calling COS at **(713) 295-5521** and providing the following information:

Location of Work (Street Intersection)
Project Description
Contractor (Company Name)
Job Superintendent's Name
Contractor's Emergency Information
Inspector/Senior Inspector
Date & Time assistance is requested
Project #
Superintendent's Office #/Mobile #/Pager #
Name and Phone #/Mobile #/Pager #
Name, Phone #/Mobile #/Pager #

Step 2. COS will create an emergency work order number and describe the work to be performed.

Step 3. COS will give Inspector the emergency work order number. Reference work order number in all communications regarding request for Valve Assistance.

Step 4. COS will contact designated valve personnel and assign emergency work order. Dispatcher will follow standard COS procedures if this situation occurs after normal working hours.

Step 5. Valve personnel must have the emergency work order number on the route sheet. When valve personnel arrive at the job site for emergency work, they will verify the street intersection and emergency work order number with Inspector prior to beginning work requested for operating existing water valves. Valve personnel will coordinate verification of street intersection and work order number with Inspector prior to performing work.

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Section 01740

SITE RESTORATION

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Restoration of site affected by the Work in public or private property, including pavement, esplanades, sidewalks, driveways, fences, lawns and landscaping.

1.02 MEASUREMENT AND PAYMENT

A. Unit Prices.

1. Payment for restoration of Project site disturbed by utility construction operations is on a linear foot basis. Measurement will be as provided for corresponding utility in each Specification section. No separate payment made for branch pipe, valves and, other associated work for utilities. Measurement for restoration with multiple utilities within the same right-of-way will be on a linear foot basis for only one utility.

2. No separate payment made for facility or roadway projects. Include cost in the surface improvements associated with the facility or roadway construction.

3. Payment includes required site restoration within the right-of-way or easement regardless of size or type of pipe, method of construction, paved or unpaved areas or thickness and width of pavement.

4. No separate payment made for site restoration for service connections under this Section. Include cost in appropriate utility section.

5. Refer to Section 01270 – Measurement and Payment for Unit Price procedures.

B. Stipulated Price (Lump Sum) Contracts. If Contract is Stipulated Price Contract, include payment for work under this section in total Stipulated Price.

1.03 DEFINITIONS

A. Phase: Locations identified on the plans and listed in Section 1110 – Summary of Work under Work Sequence.

B. Site Restoration: Replacement or reconstruction of Site Improvements located in rights-of-way, easements, public property, and private property affected or altered by the Work.

C. Site Improvement: Includes pavement, curbs and gutters, esplanades, sidewalks, driveways, fences, lawns, irrigation systems, landscaping, and other improvements in existence at the Project site before commencement of construction operations.

1.04 SUBMITTALS

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

B. Schedule of testing, service connections, abandonment, backfill, and site restoration.

C. Sample of notices to residents outlining their responsibility for maintenance of site improvements adjacent to the Project that are not disturbed by construction operations

1.05 SCHEDULING

A. Schedule testing, service connections, abandonment, backfill and site restoration immediately following completion of pipe laying work or paving within each block or line segment.

B. Phased Construction:

1. Commencement of subsequent Phase will follow scheduling of site restoration of prior Phase. Limit work to a maximum of two Phases of the project.

C. Construction of Projects with no Phases listed in Section 01110- Summary of Work:

1. Complete site restoration prior to disturbing over 50% of total project linear feet or 2,000 linear feet, whichever is greater, of right-of-way or easement.

2. Limit work to a maximum of 50% of total project linear feet or 2,000 linear feet, whichever is greater, of right-of-way and easement. Commence work in additional right-of-way or easement after completion of site restoration.

PART 2 PRODUCTS

2.01 MATERIALS

A. Pavement, Sidewalks and Driveways: Materials specified in Section 02951 - Pavement Repair and Resurfacing.

B. Seeding and Sodding: Sod specified in Section 02922 - Sodding and Seed specified in Section 02921 - Hydromulch Seeding.

C. Trees, Shrubs and Plantings: Conform to requirements of Section 01562 – Tree and Plant Protection.

PART 3 EXECUTION

3.01 Preparatory Work

A. Provide cleanup and restoration crews to work closely behind pipe laying and roadway construction crews, and where necessary, during testing, service restoration, abandonment, backfill and surface restoration.

B. Water Lines: Unless otherwise approved by Project Manager, comply with the following:

1. Once Project Manager approves work within a Phase, immediately begin preparatory work for disinfection effort.

2. No later than three days after completing disinfection preparatory work, submit to City appropriate request for disinfection.

3. If City fails to perform initial disinfection of lines in accordance with Section 2514 - Disinfection of Water Lines, within seven days from submission of appropriate request, and if approved by Project Manager, pipe laying operations may continue beyond approved limits until the City responds.

4. Immediately after transfer of services, begin abandonment of old water lines and site restoration.

C. Wastewater Lines:

1. Once Project Manager approves work within a Line Segment, immediately begin preparatory work for testing effort.

2. No later than three days after completing preparatory work for testing, initiate testing work.

3. Immediately after transfer of service connections, begin abandonment of old wastewater lines, and site restoration.

D. Street Construction and Paving Projects

1. Once Project Manager approves work within a Line Segment or block, immediately begin preparatory work for testing effort.

2. No later than three days after completing preparatory work for testing, initiate testing work.

3. Immediately after testing begin site restoration.

E. Street Construction and Paving Projects

1. Once Project Manager approves work within a block, immediately begin preparatory work for sidewalk construction, sodding and hydromulching and tree planting.

2. No later than seven days after completing preparatory work, initiate construction.

3.02 CLEANING

A. Remove debris and trash to maintain a clean and orderly site in accordance with requirements of General Conditions and Section 01576 - Waste Material Disposal.

3.03 LANDSCAPING AND FENCES

A. Seeding and Sodding.

1. Remove construction debris and level area with bank sand so that new grass surface matches level of existing grass and maintains pre-construction drainage patterns. Level and fill minor ruts or depressions caused by construction operations with bank sand, where grass is still viable.

2. Restore previously existing turfed areas with sod and fertilize in accordance with Section 02922 - Sodding. Sod to match existing turf.

3. Restore unpaved areas not requiring sodding with hydromulch seeding conforming to Section 02921 - Hydromulch Seeding.

B. Trees, Shrubbery and Plants.

1. Remove and replant trees, shrubs, and plants in accordance with requirements of Section 01562 – Tree and Plant Protection.

C. Fence Replacement.

1. Replace removed or damaged fencing to equal or better condition than existed prior to construction, including concrete footings and mow strips. Provide new wood posts, top and bottom railing and panels. Metal fencing material, not damaged by the Work, may be reused.

2. Remove and dispose of damaged or substandard material.

3.04 MAINTENANCE

A. Maintain shrubs, plantings, sodded areas and seeded areas.

B. Replace shrubs, plantings and seeded or sodded areas that fail to become established.

C. Refer to Section 01562 - Tree and Plant Protection, Section 02921 - Hydromulch Seeding and Section 02922 - Sodding for maintenance requirements.

END OF SECTION

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Section 01755

STARTING SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Starting systems.

B. Demonstration and instructions.

C. Testing, adjusting and balancing.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION

3.01 PREPARATION

A. Coordinate schedule for start-up of various equipment and systems.

B. Notify Project Manager seven days prior to startup of each item.

C. Verify each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, or other damage-causing conditions.

D. Verify tests, meter readings, and specified electrical characteristics agree with those required by equipment or system manufacturer.

E. Verify wiring and support components for equipment are complete and tested.

F. Execute start-up under supervision in accordance with manufacturer's instructions.

G. When specified in individual Specification sections, require manufacturer to provide an authorized representative to be present at the site to inspect, check and approve equipment or system installation prior to start-up, and to supervise placing equipment or system in operation.

H. Submit written report indicating that equipment or system has been properly installed and is functioning correctly.

3.02 DEMONSTRATION AND INSTRUCTIONS

A. Demonstrate operation and maintenance of Products to Project Manager two weeks prior to Date of Substantial Completion.

B. Utilize O&M Manuals as the basis for instruction. Review contents of manual with Project Manager in detail to explain aspects of operation and maintenance.

C. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shutdown of each item of equipment at agreed-upon times, at the equipment location.

D. Prepare and insert additional data in O&M Manuals when the need for additional data becomes apparent during instruction.

E. At a minimum, Contractor will demonstrate the following:

1. Products and procedures to be used in maintaining various surfaces, e.g., counter tops, toilet partitions, tile floors and carpeting;

2. procedures to set and maintain landscape irrigation system;

3. procedures to set and maintain security and fire alarm systems; and

4. procedures to set and maintain HVAC systems.

3.03 TESTING, ADJUSTING AND BALANCING

A. Contractor shall appoint, employ and pay for the services of an independent firm to perform testing, adjusting and balancing.

B. Submit reports by the independent firm to Project Manager describing observations and results of tests and signifying compliance or non-compliance with specified requirements and requirements of the Contract.

END OF SECTION

Section 01770

CLOSEOUT PROCEDURES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Procedures to establish Date of Substantial Completion.

B. Closeout procedures for final submittals, O&M data, warranties, spare parts and maintenance materials.

C. Texas Department of Licensing and Regulation (TDLR) inspection for Texas Accessibility Standards (TAS) compliance.

1.02 SUBSTANTIAL COMPLETION

A. Comply with Document 00700 - General Conditions regarding Date of Substantial Completion when Contractor considers the Work, or portion thereof designated by Project Manager, to be substantially complete.

B. Insure the following items have been completed when included in the Work, prior to presenting a list of items to be inspected by Project Manager for issuance of a Certificate of Substantial Completion:

1. cutting, plugging, and abandoning of water, wastewater, and storm sewer lines, as required by Contract documents for each item;

2. construction of, and repairs to, pavement, driveways, sidewalks, and curbs and gutters;

3. sodding and hydromulch seeding, unless waived by Project Manager in writing;

4. general clean up including pavement markings, transfer of services, successful testing and landscape;

5. additional requirements contained in Section 01110 - Summary of Work.

C. Assist Project Manager with inspection of Contractor's list of items and complete or correct the items, including items added by Project Manager, within specified time period.

D. Should Project Manager's inspection show failure of Contractor to comply with requirements to obtain Date of Substantial Completion, including those items in Paragraph 1.02 B. of this section, Contractor shall complete or correct the items, before requesting another inspection by Project Manager.

1.03 CLOSEOUT PROCEDURES

A. Comply with Document 00700 - General Conditions regarding final completion and final payment when the Work is complete and ready for Project Manager's final inspection.

B. Provide Project Record Documents in accordance with Section 01785 - Project Record Documents.

C. Complete or correct items on punch list, with no new items added. Address new items during warranty period.

D. The City will occupy portions of the Work as specified in other sections.

1.04 FINAL CLEANING

A. Execute final cleaning prior to final inspection.

B. For facilities, clean interior and exterior glass and surfaces exposed to view; remove temporary labels, stains and foreign substances, polish transparent and glossy surfaces, vacuum carpeted and soft surfaces.

C. Clean equipment and fixtures to sanitary condition.

D. Clean or replace filters of operating equipment.

E. Clean debris from roofs, gutters, down spouts, and drainage systems.

F. Clean site; sweep paved areas, and rake clean landscaped surfaces.

G. Remove waste and surplus materials, rubbish, and temporary construction facilities from site following final test of utilities and completion of the Work.

1.05 ADJUSTING

A. Adjust operating equipment to ensure smooth and unhindered operation. Value of this testing and adjusting is five percent of Lump Sum Price in the Schedule of Values for item being tested.

1.06 OPERATION AND MAINTENANCE DATA

A. Submit O&M data as noted in Section 01330 - Submittal Procedures.

B. Five percent of lump sum amount of each piece of equipment as indicated in Schedule of Unit Price Work or Schedule of Values will be paid after the required O&M data submittals are received and approved by Project Manager.

1.07 WARRANTIES

A. Provide one original of each warranty from Subcontractors, Suppliers, and manufacturers.

B. Provide Table of Contents and assemble warranties in a 3-ring/D binder with durable plastic cover.

C. Submit warranties prior to final progress payment.

D. Warranties shall commence in accordance with the requirements in Document 00700 - General Conditions.

1.08 SPARE PARTS AND MAINTENANCE MATERIALS

A. Provide Products, spare parts, maintenance and extra materials in quantities specified in individual Specification sections.

B. Deliver to a location within the City limits as directed by Project Manager. Applicable items must be delivered prior to issuance of a final Certificate for Payment.

PART 2 P R O D U C T S - Not Used

PART 3 E X E C U T I O N - Not Used

END OF SECTION

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SUPPLEMENTARY SPECIFICATION

SECTION 01782S
OPERATION AND MAINTENANCE DATA

The following supplement modifies Specification Section 01782. Where a portion of the Specification is modified or deleted by this Supplementary Specification, the unaltered portions of the Specification shall remain in effect.

1. Delete Paragraph 1.03 B. and replace with the following:

   "B. Submit three (3) copies for review and eight (8) copies final. Return a minimum of five (5) copies to the City. All drawings larger than 11 inches x 17 inches shall include reproducible sepia for review, mark-up and reproduction. Submit all documents in a 3-ring binder with durable plastic covers except for sepias. Provide a cover page that has minimum of 75% of the space available for approval stamps and comments."

2. Delete Paragraphs 1.03 F, G and H and replace with the following:

   "F. Within one month prior to scheduling training of the owner's staff and prior to placing the equipment in service, submit three (3) copies of O&M manual and parts for review.

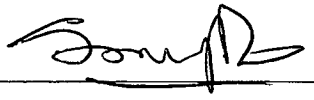
   G. The Contractor is responsible for producing an O&M manual both written format and in electronic format on a CD ROM Drive. O&M print manual and CD ROM should be in latest version of Microsoft Word and on other industry standard software for viewing charts, graphics on other material that are not compatible with Microsoft Word. Contractor to supply the additional software other than Microsoft Word. Price of manuals and hours is included in the lump sum bid.

   H. Revise and resubmit eight (8) final volumes within 10 days after final inspection.

   The Contractor shall include as part of the O&M manual a video of the training, equipment maintenance, repair and service procedures. This video shall be provided on the CD ROM for viewing with all necessary software."

END OF SUPPLEMENT

Approved by:



10/1/15

Sonny Do, P.E.
Acting Assistant Director
Engineering and Construction Division
Department of Public Works and Engineering

Date

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Section 01782

OPERATIONS AND MAINTENANCE DATA

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Submittal requirements for equipment and facility Operations and Maintenance (O&M) Manuals

1.02 MEASUREMENT AND PAYMENT

A. Measurement for equipment O&M Manuals is on a lump sum basis equal to five percent of the individual equipment value contained in Schedule of Unit Prices or Schedule of Values. The lump sum amount may be included in the first Progress Payment following approval of the O&M Manuals by Project Manager.

1.03 SUBMITTALS

A. Conform to requirements of Section 01330 - Submittal Procedures. Submit a list of O&M Manuals and parts manuals for equipment to be incorporated into the Work.

B. Submit documents with 8-1/2 x 11-inch text pages, bound in 3-ring/D binders with durable plastic covers.

C. Print "OPERATION AND MAINTENANCE INSTRUCTIONS", Project name, and subject matter of binder on covers when multiple binders are required.

D. Subdivide contents with permanent page dividers, logically organized according to the Table of Contents, with tab titling clearly printed under reinforced laminated plastic tabs.

E. O&M Manual contents: Prepare a Table of Contents for each volume, with each Product or system description identified.

1. Part 1 - Directory: Listing of names, addresses, and telephone numbers of Design Consultant, Contractor, Subcontractors, and major equipment Suppliers.

2. Part 2 - O&M instructions arranged by system. For each category, identify names, addresses, and telephone numbers of Subcontractors and Suppliers and include the following:
   a. Significant design criteria.
   b. List of equipment.
   c. Parts list for each component.
   d. Operating instructions.
   e. Maintenance instructions for equipment and systems.
   f. Maintenance instructions for special finishes, including recommended cleaning methods and materials and special precautions identifying detrimental agents.

3. Part 3 - Project documents and certificates including:
   a. Shop Drawings and relevant data.
   b. Air and water balance reports.
   c. Certificates.
   d. Photocopies of warranties.

F. Submit two copies of O&M Manuals and parts manuals, for review, within one month prior to placing the equipment or facility in service.

G. Submit one copy of completed volumes in final form 10 days prior to final inspection. One copy with Project Manager comments will be returned after final inspection. Revise content of documents based on Project Manager's comments prior to final submittal.

H. Revise and resubmit three final volumes within 10 days after final inspection.

1.04 EQUIPMENT O&M DATA

A. Furnish O&M Manuals, prepared by manufacturers for all equipment. Manuals must contain, as a minimum, the following:

1. Equipment functions, normal operating characteristics, and limiting conditions.

2. Assembly, Installation, alignment, adjustment, and checking instructions.

3. Operating instructions for start-up, normal operation, regulation and control, normal shutdown, and emergency shutdown.

4. Detailed drawings showing the location of each maintainable part and lubrication point with detailed instructions on disassembly and reassembly of the equipment.

5. Troubleshooting guide.

6. Spare parts list, predicted life of parts subject to wear, lists of spare parts recommended to be on hand for both initial start-up and for normal operating inventory, and local or nearest source of spare parts availability.

7. Outline, cross-section, and assembly drawings with engineering data and wiring diagrams.

8. Test data and performance curves.

B. Furnish parts manuals for all equipment, prepared by the equipment manufacturer, which contain, as a minimum, the following:

1. Detailed drawings giving the location of each maintainable part.

2. Spare parts list with predicted life of parts subject to wear, lists of spare parts recommended on hand for both initial start-up and for normal operating inventory, and local or nearest source of spare parts availability.

PART 2 P R O D U C T S - Not Used

PART 3 E X E C U T I O N - Not Used

END OF SECTION

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Section 01785

PROJECT RECORD DOCUMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Maintenance and submittal of record documents and Samples.

1.02 MAINTENANCE OF DOCUMENTS AND SAMPLES

A. Maintain one record copy of documents at the site in accordance with Document 00700 - General Conditions.

B. Store record documents and Samples in field office, if a field office is required by the Contract, or in a secure location. Provide files, racks, and secure storage for record documents and Samples.

C. Label each document "PROJECT RECORD" in neat, large, printed letters.

D. Maintain record documents in a clean, dry, and legible condition. Do not use record documents for construction purposes. Do not use permit drawings to record Modifications to the Work.

E. Keep record documents and Samples available for inspection by Project Manager.

F. Bring record documents to progress review meetings for viewing by Project Manager and, if applicable, Design Consultant.

1.03 RECORDING

A. Record information legibly with red ink pen on a set of blueline opaque drawings, concurrently with construction progress. Maintain an instrument on site at all times for measuring elevations accurately. Do not conceal work until required information is recorded

B. Contract Drawings and Shop Drawings: Mark each item to record completed Modifications, or when minor deviations exist, the actual construction including:

1. Measured depths of elements of foundation in relation to finish first floor datum.
2. Measured horizontal locations and elevations of Underground Facilities and appurtenances, referenced to permanent surface improvements.

3. Elevations of Underground Facilities referenced to City of Houston benchmark utilized for the Work.

4. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work.

5. Dimensions and details of field changes

6. Changes made by Modifications.

7. Details not on original Drawings.

8. References to related Shop Drawings and Modifications.

C. Survey all joints of water mains at the time of construction. Record on Drawings, water main invert elevation, elevation top of manway, and centerline horizontal location relative to baseline.

D. For large diameter water mains, mark specifications and addenda to record:

1. Manufacturer, trade name, catalog number and Supplier of each Product actually Installed.

2. Changes made by Modification or field order.

3. Other matters not originally specified.

E. Annotate Shop Drawings to record changes made after review.

1.04 SUBMITTALS

A. At closeout of the Contract, deliver Project record documents to Project Manager.

PART 2 P R O D U C T S - Not Used

PART 3 E X E C U T I O N - Not Used

END OF SECTION

SECTION 02050
DEMOLITION AND MODIFICATIONS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals required to demolish, modify, remove, and dispose of work shown on the Drawings and as specified herein.

B. Work specified herein includes, but is not limited to, demolition, modifications, and removal of existing materials and equipment necessary to install new work, as shown on the Drawings and as specified herein, and to connect new work with existing work in an approved manner.

C. Demolition, modifications, and removals which may be specified under other Sections shall conform to requirements of this Section.

D. Demolition, modifications, and removal of existing equipment include, but are not limited to, the following equipment and process units:

1. Demolition of the existing High Service Pump Station (HSPS) Electrical Switchgear Building (Powerhouse) and all electrical equipment inside the building.

2. Demolition of the two existing 10,000 kVA transformers and transformer pads.

3. Demolition of two existing surge tanks and all associated piping, fittings and valves to the work limit as shown on the Drawings.

4. Demolition of existing air compressor system that currently serves the surge tanks and all associated electrical, air piping, fittings, and valves. Move the air compressor and receiver to a location as designated by City DWO within the plant site.

5. Removal of the existing eight (8) globe style silent pump check valves and replacement with new pump control valves and associated valve actuators.

6. Removal of the electrical operators on the existing pump discharge butterfly valves (qty. 8) and replacement with new hand-wheel actuated manual operators.

7. Removal of existing Victaulic Depend-O-Lok (DOL) couplings inside the High Service Pump Station, at the Treated Water Flow Meter Station, at the UV1 Building, and at the UV2 Building as shown on the Drawings.

8. Removal of existing 42-inch distribution water flow meters (qty. 2) and replacement with new. Removal of existing 8-inch plant potable water flow meter and replacement with new.

9. Removal of existing HSPS suction and discharge header pressure indicating transmitters and replacement with new. Removal of existing plant potable water pressure indicating transmitters and replacement with new.

10. Miscellaneous demolition of mechanical piping and appurtenances, electrical conduits and wires, instrumentation and control related to above work as shown on the Drawings and specified herein.

1.02 MEASUREMENT AND PAYMENT

A. No separate payment will be made for demolition and modifications and related work under this section. Include the cost for this work in the lump sum base bid.

1.03 RELATED WORK

A. Summary of Work is included in Section 01110.

B. Submittals are included in Section 01330.

C. Construction Schedule is included in Section 01325.

D. Removing existing pavement and structures is included in Section 02221.

E. Clearing and grubbing is included in Section 02233.

F. Excavation and Backfill is included in Section 02317 and 02318.

1.04 SUBMITTALS

A. Submit, in accordance with Section 01330, the proposed methods and operations of demolition of the structures and modifications prior to the start of work. Include in the schedule the coordination of shutoff, capping and continuation of utility service as required.

B. Furnish a detailed sequence of demolition and removal work to ensure the uninterrupted progress of the Owner's operations. Sequence shall be compatible with sequence of construction and shutdown coordination requirements as specified in Section 01110.

C. Before commencing demolition work, all modifications necessary to bypass the affected structure shall be completed. Actual work shall not begin until the Engineer has inspected and approved the modifications and authorized commencement of the demolition work in writing.

1.05 JOB CONDITIONS

A. Protection

1. Execute the demolition and removal work to prevent damage or injury to structures, occupants thereof and adjacent features which might result from falling debris or other causes, and so as not to interfere with the use, and free and safe passage to and from adjacent structures.

2. Closing or obstructing of roadways, sidewalks and passageways adjacent to the work by the placement or storage of materials will not be permitted and all operations shall be conducted with a minimum interference to traffic on these ways.

3. Erect and maintain barriers, lights, sidewalk sheds and other required protective devices.

4. Only owner's staff shall operate existing valves unless emergency conditions warrant.

B. Scheduling

1. Carry out operations so as to avoid interference with operations and work in the existing facilities.

C. Notification

1. At least 48 hours prior to commencement of a demolition or removal, notify the Engineer and the Plant Electrical Foreman in writing of proposed schedule. Owner shall inspect the existing equipment and to identify and mark those items which are to remain the property of the Owner. No removals shall be started without the permission of the Engineer.

D. Conditions of Structures

1. The Owner and the Engineer assume no responsibility for the actual condition of the structures to be demolished or modified.

2. Conditions existing at the time of inspection for bidding purposes will be maintained by the Owner insofar as practicable. However, variations within a structure may occur prior to the start of demolition work.

E. Repairs to Damage

1. Promptly repair damage caused to adjacent facilities by demolition operation when directed by Engineer and at no additional cost to the Owner. Repairs shall be made to a condition at least equal to that which existed prior to construction.

F. Plant Access and Driveways

1. Conduct demolition and modification operations and the removal of equipment and debris to ensure minimum interference with plant access roadways to ensure minimum interference with daily plant operations, chemical delivery, and sludge hauling operations.

2. Special attention is directed towards maintaining safe and convenient access to the existing facilities by plant personnel and plant associated vehicles.

3. Do not close or obstruct plant access roadways or other occupied or used facilities without permission from the Engineer. Furnish alternate routes around closed or obstructed traffic in access ways.

1.06 RULES AND REGULATIONS

1. The Building Code of the City of Houston, shall control the demolition, modification, or alteration of the existing buildings or structures.

2. No building or structure, or any part thereof, shall be demolished until an application has been filed with the Building Inspector and a permit issued. The fee for this permit is covered in Section 01110.

1.07 DISPOSAL OF MATERIAL

A. The City shall have first right of refusal to retain all items shown to be demolished and/or removed in the drawings except for items listed in paragraph B. below which become the property of the Contractor. Prior to initiating demolition, the Contractor and City CM shall make a joint inspection of each site to identify all items to be retained by the City. The Contractor shall relocate items, to be retained by the City, to locations within the City limits to be determined by the City CM at time of the inspection. All other items shown to be demolished and/or removed, which are not retained by the City, shall become the property of the Contractor. The Contractor shall remove these items from City property and dispose of these items in accordance with Federal, State and Local regulations.

B. Removed and/or abandoned equipment which becomes the property of the Contractor is listed below. The below listed items become the Contractors property in addition to all items refused during site walks prior to demolition.

1. The complete High Service Pump Station Powerhouse with all electrical equipment.

2. The two High Service Pump Station 10,000 kVA transformers.

C. The storage or sale of removed items on the site will not be allowed.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION

3.01 GENERAL

A. All materials and equipment removed from existing work shall become the property of the Contractor, except for those which the Owner has identified and marked for his/her use. All materials and equipment marked by the Owner to remain shall be carefully removed, so as not to be damaged, cleaned and stored on or adjacent to the site in a protected place specified by the Engineer or loaded onto trucks provided by the Owner.

B. Dispose of all demolition materials, equipment, debris and all other items not marked by the Owner to remain, off the site and in conformance with all existing applicable laws and regulations.

C. Pollution Controls

1. Use water sprinkling, temporary enclosures and other suitable methods to limit the amount of dust and dirt rising and scattering in the air to the lowest practical level. Comply with governing regulations pertaining to environmental protection.

a. Do not use water when it may create hazardous or objectionable conditions such as ice, flooding and pollution.
b. Clean adjacent structures, facilities, and improvements of dust, dirt and debris caused by demolition operations. Return adjacent areas to conditions existing prior to the start of the work.

D. Building Demolition

1. Unless otherwise approved by Engineer, proceed with demolition from the top of the structure to the ground. Complete demolition work above each floor or tier before disturbing supporting members of lower levels.

2. Demolish concrete and masonry in small sections.

3. Remove structural framing members and lower to ground by means of hoists, derricks, or other suitable methods.

4. Break up and remove foundations and slabs on grade, unless otherwise shown to remain.

5. Locate demolition equipment throughout the structure and remove material so as to not impose excessive loads to supporting walls, floors or framing.

3.02 STRUCTURAL REMOVALS

A. Remove structures to the lines and grades shown unless otherwise directed by the Engineer. Where no limits are shown, the limits shall be 4 in outside the item to be installed. The removal of masonry beyond these limits shall be at the Contractor's expense and these excess removals shall be reconstructed to the satisfaction of the Engineer with no additional compensation to the Contractor.

B. All concrete, brick, tile, concrete block, roofing materials, reinforcement, structural or miscellaneous metals, plaster, wire mesh and other items contained in or upon the structure shall be removed and taken from the site, unless otherwise approved by the Engineer. Demolished items shall not be used in backfill adjacent to structures or in pipeline trenches.

C. After removal of parts or all of masonry walls, slabs and like work which tie into new work or existing work, the point of junction shall be neatly repaired so as to leave only finished edges and surface exposed.

3.03 MECHANICAL REMOVALS

A. Mechanical removals shall consist of dismantling and removing of existing equipment's and associated piping and fittings as specified, shown, or required for the completion of the work. It shall include cutting, capping, and plugging as required, except that the cutting of existing piping for the purpose of making connections thereto will be included under Division 15.

B. Existing piping not required for the new work shall be removed where shown or where it will interfere with new work. Piping not indicated to be removed or which does not interfere with

new work shall be removed to the nearest solid support, capped and left in place. Where piping that is to be removed passes through existing walls, it shall be cut off and properly capped on each side of the wall.

C. When underground piping is to be altered or removed, the remaining piping shall be properly capped. Abandoned underground piping may be left in place unless it interferes with new work or is shown or specified to be removed.

D. Supply new gaskets, hardware, required adaptors/transition pieces of proper size, rating, and joint type.

E. Carefully test connections as acceptable to Engineer.

F. Any changes to potable water piping and other plumbing and heating system work shall be made in conformance with all applicable codes and under the same requirements as other underground piping. All portions of the potable water system that have been altered or opened shall be pressure tested and disinfected in accordance with Section 02514 and local codes. Other plumbing piping and heating piping shall be pressure tested only.

3.04 ELECTRICAL REMOVALS

A. Electrical removals shall consist of the removal of existing distribution switchboards, control panels, motors, conduits and wires, poles and overhead wiring, panelboards, lighting fixtures and miscellaneous electrical equipment all as shown on the Drawings, specified herein, or required to perform the work. Instrumentation devices, racks, supports, anchors, conduit and conductors shall be considered Electrical with regard to Demolition and Removal.

B. All existing electrical equipment and fixtures to be removed shall be removed with such care as may be required to prevent unnecessary damage, to keep existing systems in operation and to maintain the integrity of the grounding systems.

C. Conduits and wires shall be abandoned or removed where shown. All wires in abandoned conduits shall be removed, salvaged and stored. Abandoned conduits concealed in floor or ceiling slabs or in walls, shall be cut below finish of the slab or wall at the point of entrance. The conduits shall be suitable plugged and the area repaired in a flush, smooth and approved manner. Exposed conduits, supports and anchors shall be disassembled and removed from the site. Repair all areas of work to prevent rust spots on exposed surfaces.

D. Where shown or otherwise required, wiring in the underground duct system shall be removed. All such wiring shall be salvaged and stored as specified. Verify the function of all wiring before disconnection and removing it. Ducts which are not to be reused shall have a "jet line" pull string provided and be plugged where they enter buildings and made watertight.

E. Where shown, direct burial cable shall be abandoned. Such cable shall be disconnected at both ends of the run. Where it enters a building or structure the cable shall be cut back to the point of entrance. All opening in buildings for entrance of abandoned direct burial cable shall be patched and made watertight.

F. Poles and overhead wiring shall be abandoned as shown and specified. Existing substation and poles owned by the power company will be removed by the power company. Poles not owned by the power company shall be completely removed from the site. The overhead wires shall be salvaged and stored. Perform this work after the proposed service has been completed and energized, and in accordance with the approved schedule.

G. Lighting fixtures shall be removed or relocated as shown. Fixtures not relocated shall be removed from the site. Relocated fixtures shall be carefully removed from their present location and rehung where shown.

H. Wall switches, receptacles, starters and other miscellaneous electrical equipment, shall be removed and disposed of off the site as required. Care shall be taken in removing all equipment so as to minimize damage to architectural and structural members. Any damage incurred shall be repaired.

3.05 CLEAN UP

A. Remove from the site all debris resulting from the demolition operations as it accumulates. Upon completion of the work, all materials, equipment, waste and debris of every sort shall be removed and premises shall be left, clean, neat and orderly.

END OF SECTION

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Section 02081

CAST-IN-PLACE CONCRETE MANHOLES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Cast-in-place concrete manholes for sanitary sewers, water lines and storm sewers, including box sewers.

B. Pile-supported concrete foundation used for unstable subgrade treatment for manhole base.

1.02 MEASUREMENT AND PAYMENT

A. Unit Prices.

1. Payment for manholes is on a unit price basis for each manhole installed.

2. Payment for Type C manhole with BB inlet top is on a unit price basis for each.

3. Payment for pile-supported concrete foundation used for unstable subgrade treatment for manhole base is on a unit price basis for each foundation installed.

4. Refer to Section 01270 - Measurement and Payment for unit price procedures.

B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for Work in this Section is included in total Stipulated Price.

1.03 REFERENCES

A. ASME B 16.1 - Cast Iron Pipe Flanges and Flanged Fittings.

B. ASTM A 307 - Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile.

C. ASTM C 270 - Standard Specification for Mortar for Unit Masonry.

D. ASTM C 923 - Standard Specifications for Resilient Connectors Between Reinforced Concrete Manhole Structures and Pipes.

E. ASTM C 1107 - Standard Specification for Packaged Dry, Hydraulic - Cement Grout (Non-shrink).

F. ASTM D 698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lb/ft^3).

G. ASTM D 2665 - Standard Specification for Poly Vinyl Chloride (PVC) Plastic Drain, Waste and Vent Pipe, and Fittings.

H. ASTM D 2996 - Standard Specification for Filament-wound Fiberglass (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe.

I. ASTM D 2997 - Standard Specification for Centrifugally Cast Fiberglass (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe.

J. ASTM F 2306 – Standard Specification for 12 to 60 in. [300 to 1500 mm] Corrugated profile – Wall Polyethylene (PE) Pipe Fittings for Gravity-Flow Storm Sewer and Subsurface Drainage Applications.

K. ASTM F 2510 – Standard Specification for Resilient Connectors Between Concrete Manhole Structures and Corrugated High Density Polyethylene Drainage Pipes.

L. AWWA C 213 - Standard for Fusion Bonded Epoxy Coating for Interior and Exterior of Steel Water Pipelines.

1.04 SUBMITTALS

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

B. Submit proposed design mix and test data for each type and strength of concrete.

C. Submit manufacturer's data and details of following items for approval:

1. Frames, grates, rings, and covers.

2 Materials to be used in fabricating drop connections.

3. Materials to be used for pipe connections at manhole walls.

4. Materials to be used for stubs and stub plugs.

5. Plugs to be used for sanitary sewer hydrostatic testing.

6. Installation instructions for forms.

PART 2 PRODUCTS

2.01 CONCRETE

A. Conform to requirements of Section 03315 - Concrete for Utility Construction.

B. Provide Class A concrete with minimum compressive strength of 4000 psi unless otherwise indicated on Drawings.

2.02 REINFORCING STEEL

A. Conform to requirements of Section 03315 - Concrete for Utility Construction.

2.03 MORTAR

A. Conform to requirements of Section 04061 - Mortar

2.04 MISCELLANEOUS METALS

A. Provide cast-iron frames, grates, rings, and covers conforming to requirements of Section 02084 - Frames, Grates, Rings, and Covers.

2.05 DROP CONNECTIONS AND STUBS

A. Provide drop connections and stubs conforming to same pipe material requirements used in main pipe, unless otherwise indicated on Drawings.

2.06 PIPE CONNECTIONS

A. Sanitary Sewers.

1. Provide resilient connectors conforming to requirements of ASTM C 923. Use the following materials for metallic mechanical devices as defined in ASTM C 923:

a. External clamps: Type 304 stainless steel

b. Internal, expandable clamps on Standard manholes: Type 304 stainless steel, 11 gauge minimum

c. Internal, expandable clamps on corrosion-resistant manholes:

(1) Type 316 stainless steel, 11 gauge minimum
(2) Type 304 stainless steel, 11 gauge minimum, coated with minimum 16 mil fusion-bonded epoxy conforming to AWWA C213

2. Where rigid joints between pipe and cast-in-place manhole base are specified or shown on Drawings, provide polyethylene-isoprene waterstop meeting physical

property requirements of ASTM C 923, such as Pres-Seal WS Series, or approved equal.

B. Storm Sewers: Use non-shrink grout for storm sewer pipe connections to concrete manholes, unless otherwise shown on Drawings. Grout pipe penetration in place on both inside and outside of manhole.

C. Water Lines

1. Where smooth exterior pipes, i.e., steel, ductile iron, or PVC pipes are connected to manhole base or barrel, seal space between pipe and manhole wall with assembly consisting of rubber gasket or links mechanically compressed to form a watertight barrier. Assemblies: Press-Wedge, Pres-Seal, Thunderline, Link-Seals, or approved equal. See Drawings for placement of assembly in manhole sections.

2. When connecting concrete or cement mortar coated steel pipes, or as option for connecting exterior pipes to manhole base or barrel, space between pipe and manhole wall may be sealed with an assembly consisting of a stainless steel power sleeve, stainless steel take-up clamp and a rubber gasket. Take-up clamp: Minimum of 9/16 inch wide. Provide PSX positive seal gasket system by Press-Seal Gasket Corporation or approved equal.

2.07 SEALANT MATERIALS

A. Provide sealing materials between precast concrete adjustment ring and manhole cover frame, such as Adeka Ultraseal P 201, or approved equal.

B. Provide external sealing material from Canusa Wrapid Seal manhole encapsulation system, or approved equal.

C. Butyl Sealant: Provide Press-Seal EZ Stick, or equal, for HDPE rings.

2.08 CORROSION-RESISTANT MANHOLE MATERIALS

A. Where corrosion-resistant manholes are indicated on the Drawings, refer to City of Houston Approved Product List for liner and/or coating materials.

2.09 BACKFILL MATERIALS

A. Conform to the requirements of Section 02317 - Excavation and Backfill for Utilities.

2.10 NON-SHRINK GROUT

A. Provide prepackaged, inorganic, flowable, non-gas-liberating, non-metallic, cement-based non-shrink grout requiring only addition of water.

B. Provide grout meeting requirements of ASTM C 1107 and having minimum 28-day compressive strength of 7000 psi.

2.11 VENT PIPES

A. Provide external vent pipes for manholes where indicated on Drawings.

B. Buried Vent Pipes: Provide 3 inch or 4 inch PVC DWV pipe conforming to ASTM D 2665. Alternatively, provide FRP pipe as specified for vent outlet assembly.

C. Vent Outlet Assembly: Provide vent outlet assembly as shown on Drawings, constructed of following specified materials:

1. FRP Pipe: Provide filament-wound FRP conforming to ASTM D 2996 or centrifugally cast FRP conforming to ASTM D 2997. Seal cut ends in accordance with manufacturer's recommendations.

2. Joints and Fittings: Provide epoxy- bodied fittings and join pipe to fittings with epoxy adhesive, according to pipe manufacturer's instructions.

3. Flanges: Provide socket-flange fittings for epoxy adhesive bonding to pipe ends where shown on Drawings. Meet bolt pattern and dimensions for ASME B 16.1, 125-pound flanges. Use Type 304 stainless steel or hot-dip zinc coated, conforming to ASTM A 307, Class A or B flange bolts.

4. Coating: Provide 2-component, aliphatic polyurethane coating, using primer or tie coat recommended by manufacturer. Provide two or more coats to yield dry film thickness of at least 3 mils. Provide Amershield, Tnemec 74, or approved equal. Project Manager selects color from manufacturer's standard colors.

2.12 MANHOLE LADDER FOR WATERLINE MANHOLES

A. Manhole Ladder: Fiberglass with 300-lb rating at appropriate length; conform to requirements of Occupational Safety and Health Standards (OSHA), U.S. Department of Labor except where shown on Drawings.

1. Use components, including rungs, made of fiberglass, fabricated with nylon or aluminum rivets and/or epoxy. Apply non-skid coating to ladder rungs. Mount ladder using manufacturer's recommended hardware.

2. Provide ladder as manufactured by Saf-Rail or approved equal. Locate ladder as shown on Drawings.

3. Fiberglass: Premium type polyester resin, reinforced with fiberglass; constructed to provide complete wetting of glass by resin; resistant to rot, fungi, bacterial growth and adverse effects of acids, alkalis and residential and industrial waste; yellow in color.

4. Provide approved petroleum-based tape encapsulating bolts in access manhole.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify lines and grades are correct.

B. Determine if subgrade, when scarified and recompacted, can be compacted to 95 percent of maximum Standard Proctor Density at ±3% optimum moisture content according to ASTM D 698 prior to placement of material and base section. If it does not meet the moisture-density requirement, condition the subgrade until the required moisture-density requirement is met or treat as an unstable subgrade.

C. Do not build manholes in ditches, swales, or drainage paths unless approved by Project Manager.

3.02 MANHOLES

A. Construct manholes to dimensions shown on Drawings. Commence construction as soon as possible after pipes are laid. On monolithic sewers, construct manholes at same time sewer is being constructed.

B. Unstable Subgrade Treatment: When unstable subgrade is encountered, notify Project Manager for examination of subgrade to determine if subgrade has heaved upwards after being excavated. When heaving has not occurred, over-excavate subgrade to allow for 24-inch-thick layer of crushed stone wrapped in filter fabric as foundation material under manhole base. When there is evidence of heaving, provide pile-supported concrete foundation, as detailed on Drawings, under manhole base.

C. Cast manhole foundations and walls monolithically. Use cold joint with approved waterstop when manhole flow line depth exceeds 12 feet. No other joints will be allowed unless shown on Drawings. Wrap cold joints with external sealing material, minimum 6-inch with.

D. For concrete containing micro silica admixtures, place, finish, and cure concrete for manholes following procedures in Section 03315 - Concrete for Utility Construction

E. Top of manhole elevations shown on Drawings are approximate, based on current pavement and natural ground conditions as determined from elevations measured on 50-foot spacing. No additional payment will be made if final elevation of manhole ring and cover is higher or lower due to requirements of finished grade or replaced pavement surface.

F. For water lines place concrete for manhole base on 12" thick (minimum) foundation of cement stabilized sand. Compact cement stabilized sand in accordance with requirements of 02321 – Cement Stabilized Sand.

G. For manholes located over large diameter water lines, place base on a foundation of cement stabilized sand extending from bottom of manhole to bottom of trench. Manhole base is to be a minimum of 12-inches above water line.

3.03 PIPE CONNECTIONS

A. Install approved resilient connectors at each pipe entering and exiting water line and sanitary sewer manholes in accordance with manufacturer's instructions.

B. Grout storm sewer connections to manhole unless otherwise shown on Drawings. Grout pipe penetrations both inside and outside of manhole.

C. Ensure no concrete, cement stabilized sand, fill, or other solid material is allowed to enter space between pipe and edge of wall opening at and around resilient connector on interior or exterior of manhole. When necessary, fill space with compressible material to ensure resilient connector will maintain full flexibility where evidence of reduced flexibility is encountered.

D. Where new manhole is to be constructed on existing sewer, a rigid joint pipe may be used. Install waterstop gasket around existing pipe at center of cast-in-place wall. Join ends of split waterstop material at pipe spring line using adhesive recommended and supplied by waterstop manufacturer.

E. Do not construct joints on sanitary sewer pipe within wall sections of manholes. Use approved connection material.

F. Construct pipe stubs with resilient connectors for future connections at locations and with material indicated on Drawings. Install approved stub plugs at interior of manhole.

G. Test connection for watertight seal before backfilling.

3.04 INVERTS FOR SANITARY SEWERS

A. Construct invert channels to provide smooth flow transition waterway with no disruption of flow at pipe-manhole connections. Conform to following criteria:

1. Slope of invert bench: 1 inch per foot minimum; 1 1/2 inch per foot maximum.

2. Depth of bench to invert:

   a. Pipes smaller than 15 inches: one-half of largest pipe diameter

   b. Pipes 15 to 24 inches: three-fourths of largest pipe diameter

   c. Pipes larger than 24 inches: equal to largest pipe diameter

3. Invert slope through manhole: 0.10 foot drop across manhole with smooth transition of flow at pipe-manhole connections. Conform to following criteria.

B. Form invert channels with Class A concrete if not integral with manhole base. For direction changes of mains, construct channels tangent to mains with maximum possible radius of curvature. Provide curves for side inlets and smooth invert fillets for flow transition between pipe inverts.

3.05 DROP CONNECTIONS FOR SANITARY SEWERS

A. Backfill drop assembly with crushed stone wrapped in filter fabric, cement-stabilized sand, or Class A concrete to form solid mass. Extend cement stabilized sand or concrete encasement minimum of 4 inches outside bells.

B. Install connection when sewer line enters manhole higher than 24 inches above invert of manhole.

3.06 STUBS FOR FUTURE CONNECTIONS

A. In manholes where future connections are indicated on Drawings, install resilient connectors and pipe stubs with approved watertight plugs.

3.07 ADJUSTMENT RINGS AND FRAME

A. Combine precast concrete or HDPE adjustment rings so elevation of installed casting cover matches pavement surface. Seal between concrete adjustment ring and precast top section with non-shrink grout; do not use mortar between adjustment rings. Apply latex-based bonding agent to precast concrete surfaces to be joined with non-shrink grout. Set cast iron frame on adjustment ring in a bed of approved sealant material. Install a sealant bed consisting of two beads of sealant, each bead having minimum dimensions of 1/2-inch and 1/2-inch wide.

B. Wrap manhole frame and adjustment rings with external sealing material, minimum 3 inches beyond joint between ring and frame, and ring and precast section.

C. For manholes in unpaved areas, set top of frame minimum of 6 inches above existing ground line unless otherwise indicated on Drawings. Encase manhole frame in mortar or non-shrink grout placed flush with face of manhole ring and top edge of frame. Provide rounded corner around perimeter.

3.08 BACKFILL

A. After concrete obtains adequate strength, place and compact backfill materials in area of excavation surrounding manholes in accordance with requirements of Section 02317 - Excavation and Backfill for Utilities. Use embedment zone backfill material for adjacent utilities, as shown in City of Houston Standard Details over each pipe connected to manhole. Provide trench zone backfill, as specified for adjacent utilities, above embedment zone backfill.

B. Where rigid joints are used for connecting existing sewers to manhole, backfill under existing sewer up to spring line of pipe with Class B concrete or flowable fill.

C. In unpaved areas, provide positive drainage away from manhole frame to natural grade. Provide minimum of 4 inches of topsoil conforming to requirements of Section 02911 - Topsoil. Seed in accordance with Section 02921 - Hydro-mulch Seeding, or sod disturbed areas in accordance with Section 02922 - Sodding.

3.09 FIELD QUALITY CONTROL

A. Conduct leakage testing of Sanitary Sewer manholes in accordance with requirements of Section 02533 - Acceptance Testing for Sanitary Sewers.

3.10 PROTECTION

A. Protect manholes from damage until subsequent work has been accepted. Repair or replace damaged elements of manholes at no additional cost to City.

END OF SECTION

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Section 02221

REMOVING EXISTING PAVEMENTS, STRUCTURES, WOOD, AND DEMOLITION DEBRIS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Removing concrete paving, asphaltic concrete pavement, brick pavement and base courses.

B. Removing concrete curbs, concrete curbs and gutters, sidewalks and driveways.

C. Removing pipe culverts, sewers, and sewer leads.

D. Removing waterlines and water services lines including asbestos cement pipe per OSHA guidelines.

E. Removing existing inlets and manholes.

F. Removing and disposing of pre-stressed concrete beams and drill shafts.

G. Removing miscellaneous structures of concrete or masonry.

H. Removing existing bridge.

I. Removing existing wood and demolition debris.

1.02 MEASUREMENT AND PAYMENT

A. Unit Prices.

1. Payment for removing and disposing of asphaltic surfacing with or without base, regardless of thickness encountered, is on square yard basis measured between lips of gutters.

2. Payment for removing and disposing of reinforced concrete pavement, with or without asphalt overlay, regardless of its thickness, is on square yard basis measured from back-to-back of curbs. Payment includes concrete pavement, esplanade curbs, curbs and gutters, and paving headers.

3. Payment for removing and disposing of cement stabilized shell base course, with or without asphaltic surfacing, is on square yard basis.

4. Payment for removing and disposing of concrete sidewalks and driveways is on square yard basis.

5. Payment for removing asphaltic pavement surface by milling shall be in accordance with Section 2960.

6. Payment for removing and disposing of miscellaneous concrete and masonry is on cubic yard basis of structure in place.

7. Payment for removing and disposing of pipe culverts, sewers, and sewer leads, is on linear foot basis for each diameter and each material type of pipe removed.

8. Payment for removing and disposing of waterlines and water service lines including asbestos cement pipe is on linear foot basis for each diameter pipe and each material type of pipe removed.

9. Payment for removing and disposing of existing inlets is on unit price basis for each inlet removed.

10. Payment for removing and disposing of prestressed concrete piles and drill shafts is on linear foot basis.

11. Payment for removing and disposing of existing bridge, including piles and abutments to minimum of 4 feet below ground level, is on a lump sum basis.

12. Payment for removing and disposing of existing manholes is on unit price basis for each manhole removed.

13. Payment for removing and disposing of miscellaneous wood and demolition debris is on cubic yard basis.

14. No payment for saw cutting of pavement, curbs, or curbs and gutters will be made under this section. Include cost of such work in unit prices for items listed in bid form requiring saw cutting.

15. No payment will be made for work outside maximum payment limits indicated on Drawings, or for pavements or structures removed for Contractor's convenience.

    a. For utility installations: Match actual pavement replaced but no greater than maximum pavement replacement limits shown on Drawings. Limits of measurement will be as shown on Street Cut Pavement Replacement Rules.

16. Refer to Section 01270 - Measurement and Payment for unit price procedures

B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.1.03 REGULATORY REQUIREMENTS

A. Conform to applicable codes for disposal of debris.

B. Coordinate removal work with utility companies.

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 PREPARATION

A. Obtain advance approval from Project Manager for dimensions and limits of removal work.

B. Identify known utilities below grade. Stake and flag locations.

3.02 PROTECTION

A. Protect following from damage or displacement:

1. Adjacent public and private property.

2. Trees, plants, and other landscape features designated to remain.

3. Utilities designated to remain.

4. Pavement and utility structures designated to remain.

5. Bench marks, monuments, and existing structures designated to remain.

3.03 REMOVALS

A. Remove pavements and structures by methods that will not damage underground utilities. Do not use drop hammer near existing underground utilities.

B. Minimize amount of earth loaded during removal operations.

C. Where existing pavement is to remain, make straight saw cuts in existing pavement to provide clean breaks prior to removal. Do not break concrete pavement or base with drop hammer unless concrete or base has been saw cut to minimum depth of 2 inches.

D. When street and driveway saw cut location is greater than one-half of pavement lane width, remove pavement for full lane width or to nearest longitudinal joint as directed by Project Manager.

E. Remove sidewalks and curbs to nearest existing dummy, expansion, or construction joint.

F. Where existing end of pipe culvert or end of sewer is to remain, install 8-inch-thick masonry plug in pipe end prior to backfill in accordance with requirements of Section 02316 - Excavation and Backfill for Structures.

3.04 BACKFILL

A. Backfill of removal areas shall be in accordance with requirements of Section 02316 - Excavation and Backfill for Structures.

3.05 DISPOSAL

A. Inlet frames, grates, and plates; and manhole frames and covers, may remain City property. Disposal shall be in accordance with requirements of Section 01576 - Waste Material Disposal.

B. Remove from site, debris resulting from work under this section in accordance with requirements of Section 01576 - Waste Material Disposal.

END OF SECTION

Section 02233

CLEARING AND GRUBBING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Removing surface debris and rubbish.

B. Clearing site of plant life and grass.

C. Removing trees and shrubs.

D. Removing root system of trees and shrubs.

E. Fence removal.

1.02 MEASUREMENT AND PAYMENT

A. Unit Prices.

1. Payment for clearing and grubbing is on per acre basis.

2. No separate payment will be made for clearing and grubbing of wastewater projects, include payment in unit prices for related items.

3. Refer to Section 01270 - Measurement and Payment for unit price procedures.

B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.03 REGULATORY REQUIREMENTS

A. Conform to applicable codes for disposal of debris.

B. Coordinate clearing work with utility companies.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION

3.01 PREPARATION

A. Verify that existing plant life and features designated to remain are identified and tagged.

3.02 PROTECTION

A. Protect following from damage or displacement:

1. Living trees located 3 feet or more outside of intersection of side slopes and original ground line.

2. Plants other than trees and landscape features designated to remain.

3. Utilities designated to remain.

4. Bench marks, monuments, and existing structures designated to remain.

3.03 CLEARING

A. Remove stumps, main root ball, and root system to:

1. Depth of 24 inches below finished subgrade elevation in area bounded by lines two feet behind back of curbs.

2. Depth of 24 inches below finished surface of required cross section for other areas.

B. Clear undergrowth and deadwood without disturbing subsoil.

C. Remove vegetation from top soil scheduled for reuse.

3.04 REMOVAL

A. Remove debris, rubbish, and extracted plant material life from site in accordance with requirements of Section 01576 - Waste Material Disposal.

B. Remove on site fences. Materials generated from removal of fences become property of Contractor. Properly dispose of in accordance with applicable local, state and federal laws.

END OF SECTION

Section 02260

TRENCH SAFETY SYSTEM

PART GENERAL

1.01 SECTION INCLUDES

A. Trench safety system for the construction of trench excavations.

B. Trench safety system for structural excavations which fall under provisions of State and Federal trench safety laws.

C. This Standard Specification Section replaces previously published Section 01561-Trench Safety System.

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 under this section for trench safety systems for structural excavations, tunnel shafts, auger pits, or excavation for trenchless installations, and also for any necessary non trenchless installations included in the aforementioned methods of construction unless included as a bid item in Documents 00410 – Bid Form. Include payment for trench safety systems in applicable structural or utility 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 these 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.

D. Trench Safety Program is the safety procedures governing the presence and activities of individuals working in and around trench excavations.

1.04 SUBMITTALS

A. Submittals shall conform to requirements of Section 01330 - 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 29CFR 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.

E. Submit certification that trench safety system will not be subjected to loads exceeding those which the system was designed to withstand according to the available construction and geotechnical information.

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, 29CFR, 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).

D. Reference materials, if developed for a specific project, will be issued with the Bid Documents, including the following:

1. Document 00830 - Trench Safety Geotechnical Information: Geotechnical information obtained for use in design of the trench safety system.

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 PRODUCTS - Not Used

PART EXECUTION

3.01 INSTALLATION

A. Install and maintain trench safety systems in accordance with provisions of OSHA 29CFR.

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 conditions.

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 29CFR 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 the 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 02315

ROADWAY EXCAVATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Excavation and compaction of materials for roadways.

B. Excavation and compaction of materials for roadside ditches.

1.02 MEASUREMENT AND PAYMENT

A. Unit Prices.

1. Payment for roadway excavation, with or without subgrade, is on cubic yard basis. Unless specified otherwise under the borrow (off-site) material or embankment fill work item, measurement for payment shall be based on the cut quantity shown on the drawing.

2. No payment will be made for material excavated under the following conditions:

   a. More than 2 feet outside of vertical planes behind back of curbs

   b. For portion within limits of trench for utilities 24-inch and greater constructed by open-cut methods

   c. As indicated otherwise on Drawings.

3. Measurement for the bid item "Regrade Ditches" is on a linear foot basis. No separate payment will be made for reshaping and regrading roadway ditch shoulder slope and side slope adjacent to installed temporary pavement upon removal of temporary pavement.

4. If specified, off-site borrow material including placement and compaction will be paid by final in-place quantity on cubic yard basis.

5. If specified and shown on the drawing, embankment fill including placement and compaction will be paid by final in-place quantity on cubic yard basis.

6. Refer to Section 01270 - Measurement and Payment for unit price procedures.

B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.03 REFERENCES

A. ASTM D 698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12.44 ft-lbf/ft^3).

B. ASTM D 2216 - Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass.

C. ASTM D 2922 - Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).D. ASTM D 3017 - Standard Test Method for Water content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).

E. ASTM D 4318 - Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

PART 2 PRODUCTS

2.01 MATERIALS

A. Provide topsoil conforming to requirements of Section 02911 - Topsoil.

B. Provide backfill which is excavated material, graded free of roots, lumps greater than 6 inches, rocks larger than 3 inches, organic material, and debris.

C. Provide structural backfill which is select material meeting following requirements:

1. Plasticity index: not less than 12 nor more than 20.

2. Maximum liquid limit: 45

PART 3 EXECUTION

3.01 PREPARATION

A. Identify required lines, levels, and datum. Coordinate with Section 01725 - Field Surveying.

B. Identify and flag surface and aerial utilities.

C. Notify utility companies to remove or relocate utilities.

D. Identify, stake, and flag known utility locations below grade. Make temporary or permanent relocation of underground pipes, ducts, or utilities where indicated on Drawings.

E. Upon discovery of unknown or badly deteriorated utilities, or concealed conditions, discontinue work. Notify Project Manager and obtain instructions before proceeding in such areas.

F. Obtain approval of top soil quality before excavating and stockpiling.

3.02 PROTECTION

A. Protect following from damage or displacement:

1. Trees, shrubs, lawns, existing structures, and other features outside of grading limits.

2. Utilities either above or below grade, which are to remain.

3.03 TOPSOIL REMOVAL

A. Strip off topsoil from area to be excavated to minimum depth of 6 inches, unless indicated otherwise on Drawings.

B. Stockpile topsoil in designated location for reuse. Stockpile topsoil to depth not exceeding 8 feet. Cover to protect from erosion.

3.04 SOIL EXCAVATION

A. Excavate to lines and grades shown on Drawings.

B. Remove unsuitable material not meeting specifications. Backfill with embankment materials and compact to requirements of Section 02330 - Embankment.

C. Record location and plug and fill inactive water and oil wells. Conform to Texas Department of Health, Texas Natural Resource Conservation Commission, and Texas Railroad Commission requirements. Notify Project Manager prior to plugging wells.

D. At intersections, grade back at minimum slope of one inch per foot. Produce smooth riding junction with intersecting street. Maintain proper drainage.

E. When area is inadvertently over excavated, fill area in accordance with requirements of Section 02330 - Embankment at no additional cost to City.

F. Remove material not qualified for use and excess soil not being reused from site in accordance with requirements of Section 01576 - Waste Material Disposal.

3.05 COMPACTION

A. Maintain optimum moisture content of subgrade to attain required density.

B. Compact to following minimum densities at moisture content of optimum to 3 percent above optimum as determined by ASTM D 698, unless otherwise indicated on 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 in 16-foot length.

3.07 FIELD QUALITY CONTROL

A. Testing will be performed under provisions of Section 01454 - Testing Laboratory Services.

B. Test and analysis of soil materials will be performed in accordance with ASTM D 4318, ASTM D 2216, and ASTM D 698.

C. Compaction testing will be performed in accordance with ASTM D 698 or ASTM D 2922 and ASTM D 3017.

D. A minimum of three tests will be taken for each 1000 linear feet per lane of roadway.

E. When tests indicate work does not meet specified compaction requirements, recondition, recompact, and retest at no additional cost to City.

3.08 PROTECTION

A. Prevent erosion at all times. Maintain ditches and cut temporary swales to allow natural drainage in order to avoid damage to roadway. Do not allow water to pond.

B. Distribute construction traffic evenly over compacted areas, where practical, to aid in obtaining uniform compaction. Protect exposed areas having high moisture content from wheel loads that cause rutting.

C. Maintain excavation and embankment areas until start of subsequent work. Repair and recompact slides, washouts, settlements, or areas with loss of density.

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 Contract is Stipulated Price Contract, payment for work in this Section is included in 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 required density due to gradation, plasticity, or moisture content.

3. Materials that contain large clods, aggregates, stones greater than 4 inches in any dimension, debris, vegetation, waste or any other deleterious materials.

4. Materials that are contaminated with hydrocarbons or other chemical contaminants.

B. Suitable Material: Suitable soil materials are those meeting specification requirements. Unsuitable soils meeting specification requirements for suitable soils after treatment with lime or cement shall be considered suitable, unless otherwise indicated.

C. Select Material: Material as defined in Section 02320 - Utility Backfill Materials.

D. Backfill: 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 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. Foundation base provides smooth, level working surface for construction of concrete foundation.

G. Foundation Subgrade: Foundation subgrade is surface of natural soil which has been excavated and prepared to support foundation base or foundation backfill, where needed.

H. Ground Water Control Systems: Installations external to excavation 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 excavation, and depressurization to prevent failure or heaving of 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 excavation. Remove rain water and surface water which accidentally enters excavation as part of excavation drainage.

J. Excavation Drainage: Removal of surface and seepage water in excavation by sump pumping and using French drains surrounding foundation to intercept water.

K. Over-Excavation and Backfill: Excavation of subgrade soils with unsatisfactory bearing capacity or composed of otherwise unsuitable materials below foundation as shown on Drawings, and backfilled with foundation backfill material.

L. Shoring System: Structure that supports sides of an excavation to maintain stable soil conditions and prevent cave-ins.

1.04 REFERENCES

A. ASTM D 698 - Standard Test Methods for Laboratory Compaction of Soil Using Standard Effort (12,400 ft-lbf/ft^3 (600kN-m/m^3)).

B. ASTM D 1556 - Standard Test Method for Density of Soil in Place by Sand-Cone Method.

C. ASTM D 2922 - Standard Test Methods for Density of Soil and Rock in Place by Nuclear Methods (Shallow Depth).

D. ASTM D 3017 - Standard Test Method for Water Content of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depths).

E. ASTM D 4318 - Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

F. TxDOT Tex-101-E - Preparing Soil and Flexible Base Materials for Testing.

G. TxDOT Tex-110-E - Particle Size Analysis of Soils.

H. Federal Regulations, 29 CFR, Part 1926, Standards - Excavation, Occupational Safety and Health Administration (OSHA).

1.05 SUBMITTALS

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

B. Submit work plan for excavation and backfill for each structure with complete written description which identifies details of proposed method of construction and sequence of operations for construction relative to excavation and backfill activities. Use descriptions, with supporting illustrations, sufficiently detailed to demonstrate to Project Manager that procedures meet requirements of Specifications and Drawings.

C. Submit excavation safety system plan.

1. Submit excavation safety system plan in accordance with applicable OSHA requirements for excavations.

2. Submit excavation safety system plan in accordance with requirements of Section 02260 - Trench Safety System, for excavations that fall under State and Federal trench safety laws.

D. Submit ground and surface water control plan in accordance with requirements in this Section and Section 01578 - Control of Ground Water and Surface Water.

E. Submit backfill material sources and product quality information in accordance with requirements of Section 02320 - Utility Backfill Materials.

F. Submit project record documents under provisions of Section 01785 - Project Record Documents. Record location of utilities, as installed, referenced to survey benchmarks. Include location of utilities encountered or rerouted. Give horizontal dimensions, elevations, inverts and gradients.

1.06 TESTS

A. Testing and analysis of backfill materials for soil classification and compaction during construction will be performed by an independent laboratory provided by City in accordance with requirements of Section 01454 - Testing Laboratory Services and as specified in this Section.

B. Perform embedment and backfill material source qualification testing in accordance with requirements of Section 02320- Utility Backfill Materials.

PART 2 PRODUCTS

2.01 EQUIPMENT

A. Perform excavation with equipment suitable for achieving requirements of this Specification.

B. Use equipment which will produce degree of compaction specified. Compact backfill within 3 feet of walls with hand operated equipment. Do not use equipment weighing more than 10,000 pounds closer to walls than a horizontal distance equal to depth of 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. Use backfill materials conforming to classifications and product descriptions of Section 02320 - Utility Backfill Materials. Use classification or product description for backfill applications as shown on 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 construction work is considered hazardous to traffic movements.

C. Perform work in accordance with OSHA standards. Employ an excavation safety system as specified in Section 02260 - 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 grading limits as designated on 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 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 City.

3.03 EXCAVATION

A. Perform excavation work so that 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 absolute minimum necessary. No additional payment will be made for excess excavation not authorized by Project Manager.

B. Upon discovery of unknown utilities, badly deteriorated utilities not designated for removal, or concealed conditions, discontinue work at that location. Notify Project Manager and obtain instructions before proceeding in such areas.

C. Immediately notify agency or company owning any line which is damaged, broken or disturbed. Obtain approval from Project Manager 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 dirt nuisance in streets. Verify that truck beds are sufficiently tight and loaded in such a manner such 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 Work.

H. Provide sheeting, shoring, and bracing where required to safely complete Work, to prevent excavation from extending beyond limits indicated on Drawings, and to protect Work and

adjacent structures or improvements. Use sheeting, shoring, and bracing to protect workmen and public conforming to requirements of Section 02260 - Trench Safety Systems.

I. Prevent voids from forming outside of sheeting. Immediately fill voids with grout, cement stabilized sand, or other material approved by Project Manager and compact to 95 percent standard density.

J. After completion of structure, remove sheeting, shoring, and bracing unless shown on Drawings to remain in place or directed by Project Manager 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 Work and adjacent structures or improvements.

K. Immediately fill and compact voids left or caused by removal of sheeting with cement stabilized sand or other material approved by Project Manager and compact to 95 percent standard density.

3.04 HANDLING EXCAVATED MATERIALS

A. Classify excavated materials. Place material which is suitable for use as backfill in orderly piles at 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 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 minimum of 2 feet below bottom of foundation base.

C. Maintain ground water control as directed by Section 01578 - Control of Ground Water and Surface Water and until structure is sufficiently complete to provide required weight to resist hydrostatic uplift with minimum safety factor of 1.2.

3.06 FOUNDATION EXCAVATION

A. Notify Project Manager at least 48 hours prior to planned completion of foundation excavations. Do not place foundation base until excavation is accepted by Project Manager.

B. Excavate to elevations shown on Drawings, as needed to provide space for foundation base, forming level undisturbed surface, free of mud or soft material. Remove pockets of soft or otherwise unstable soils and replace with foundation backfill material or material as directed by Project Manager. Prior to placing material over it, recompact subgrade where indicated on

Drawings, scarifying as needed, to 95 percent of maximum Standard Dry Density according to ASTM D 698. If specified level of compaction cannot be achieved, moisture condition subgrade and recompact until 95 percent is achieved, over-excavate to provide minimum layer of 24 inches of foundation backfill material, or other means acceptable to Project Manager.

C. Fill unauthorized excessive excavation with foundation backfill material or other material as directed by Project Manager.

D. Protect open excavations from rainfall, runoff, freezing groundwater, or excessive drying so as to maintain foundation subgrade in satisfactory, undisturbed condition. Keep excavations free of standing water and completely free of water during concrete placement.

E. Remove soils which become unsuitable due to inadequate dewatering or other causes, after initial excavation to required subgrade, and replace with foundation backfill material, as directed by Project Manager, at no additional cost to City.

F. Place foundation base, or foundation backfill material where needed, over subgrade on same day that excavation is completed to final grade. Where base of excavations are left open for longer periods, protect them with seal slab or cement-stabilized sand.

G. Use filter fabric as specified in Section 02621 - Geotextile to separate crushed aggregate, and other free draining Class I materials from native soils or select material backfill. Overlap fabric minimum of 12 inches beyond where another material stops contact with soil.

H. Place crushed aggregate, and other Class I materials, in uniform layers of 8-inch maximum thickness. Perform compaction by means of at least two passes of vibratory compactor.

3.07 FOUNDATION BASE.

A. Place foundation base after subgrade is properly prepared, including placement of foundation backfill where needed. Use foundation base consisting of 12-inch layer of crushed stone aggregate or cement stabilized sand. Alternately, seal slab with minimum thickness of 4 inches may be placed. Extend foundation base minimum of 12 inches beyond edge of structure foundation, unless shown otherwise on Drawings.

B. Where foundation base and foundation backfill are of 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. Remove forms, lumber, trash and debris from structures. Deposit backfill in uniform layers and compact each layer as specified.

1. Unless otherwise shown on Drawings, for structures under pavement or within one foot back of curb, use cement stabilized sand up to the top of the proposed structure. Use suitable on-site material (random backfill) up to 12 inches below pavement base

or subgrade. Place minimum of 12 inches of select backfill below pavement base or subgrade.

2. Unless otherwise shown on Drawings, for structures not under pavement, use random backfill of suitable material up to the surface.

B. Do not place backfill against concrete walls or similar structures until laboratory test breaks indicate that concrete has reached minimum of 85 percent of specified compressive strength. Where walls are supported by slabs or intermediate walls, do not begin backfill operations until 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 backfill material at no less than 2 percent below nor more than 2 percent above optimum moisture content, unless otherwise approved by Project Manager. Place fill material in uniform 8-inch maximum loose layers. Compact fill to at least 95 percent of maximum Standard Proctor Density according to ASTM D 698 below paved areas. Compact fill to at least 90 percent around structures below unpaved areas.

E. Where backfill is placed against sloped excavation surface, run compaction equipment across boundary of cut slope and backfill to form compacted slope surface for placement of 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 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 following frequencies and conditions:

1. Minimum of one test for every 50 to 100 cubic yards of compacted backfill material as directed by Project Manager.

2. A minimum of three density tests for each full work shift.

3. Density tests will be performed in all placement areas.

4. Number of tests will be increased when inspection determines that soil types or moisture contents are not uniform or when compacting effort is variable and not considered sufficient to attain uniform density.

5. Identify elevation of test with respect to natural ground.

6. Record approximate depth of lift tested.

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. Perform additional moisture-density relationship test once a month or whenever there is noticeable change in material gradation or plasticity.

E. When 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.

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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 unit price for installed underground piping, sewer, conduit, or duct work.

2. When Project Manager directs Contractor to over excavate trench bottom, Contractor will be paid by unit price bid per linear foot under bid item - 6" Over Excavation of Trench Bottom.

   a. No payment will be paid if Project Manager does not direct Contractor to over excavate trench bottom.

   b. No over excavation will be measured or paid when unsuitable conditions result from dewatering system not in conformance with Section 01578 - Control of Ground Water and Surface Water.

3. No additional payment will be made for performing Critical Location exploratory excavation. Include cost in unit price for installed underground piping, sewer, conduit, or duct work.

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 DEFINITIONS

A. Pipe Foundation: Suitable and stable native soils that are exposed at trench subgrade after excavation to depth of bottom of bedding as shown on Drawings, or foundation backfill material placed and compacted in over-excavations.

B. Pipe Bedding: Portion of trench backfill that extends vertically from top of foundation up to level line at bottom of pipe, and horizontally from one trench sidewall to opposite sidewall.

C. Haunching: 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: Portion of trench backfill that extends vertically from springline of pipe (top of haunching) up to level line 12 inches above top of pipe, and horizontally from one trench sidewall to opposite sidewall.

E. Pipe Embedment: Portion of trench backfill that consists of bedding, haunching and initial backfill.

F. Trench Zone: 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 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. Materials mixed with lime, fly ash, or cement that can be compacted to required density and meeting requirements for suitable materials may be considered suitable materials, 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 part of excavation drainage.

L. Excavation Drainage: Removal of surface and seepage water in trench by sump pumping and using drainage layer, as defined in ASTM D 2321, placed on foundation beneath pipe bedding or thickened bedding layer of Class I material.

M. Trench Conditions are defined with regard to 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 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 embedment zone in combination with ground water control in predominately sandy or silty soils.

3. Unstable Trench: Unstable trench conditions exist in 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. Sub-trench: Sub-trench is special case of benched excavation. Sub-trench 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 sub-trench depends upon trench stability and safety as determined by Contractor.

O. Trench Dam: Placement of low permeability material in pipe embedment zone or foundation to prohibit ground water flow along 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 bedding.

Q. Foundation Bedding: Natural soil or manufactured aggregate of controlled gradation, and geotextile filter fabrics as required, to control drainage and material separation. Foundation bedding is placed and compacted as backfill to provide stable support for bedding. Foundation bedding 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): Portable worker safety structure moved along trench as work proceeds, used as protective system and designed to withstand forces imposed on it by cave in, thereby protecting persons within trench. Trench shields may be stacked if so designed or placed in series depending on depth and length of excavation to be protected.

T. Shoring System: Structure that supports sides of an excavation to maintain stable soil conditions and prevent cave-ins, or to prevent movement of ground affecting adjacent installations or improvements.

U. Special Shoring: Shoring system meeting special shoring as specified in Paragraph 1.08, Special Shoring Design Requirements, for locations identified on Drawings.

V. Vacuum Excavation: An excavation technique performed by an experienced subcontractor in which water or air jetting is used to slough off and vacuum away soil.

W. Large Diameter Water Line (LDWL): Water line that is 24-inches in diameter or larger.

X. Emergency Action Plan (EAP): The EAP document should include a discussion of procedures for timely and reliable detection, classification (level of emergency) and response procedure to a potential emergency condition associated with a large diameter water line.

Y. Subsurface Utility Exploration (SUE): Non-destructive excavation, unless otherwise approved by project manager.

1.04 REFERENCES

A. ASTM C 12 - Standard Practice for Installing Vitrified Clay Pipe Lines.

B. ASTM D 558 - Standard Test Methods for Moisture-Density Relations of Soil Cement Mixtures.

C. ASTM D 698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lb/ft).

D. ASTM D 1556 - Standard Test Method for Density and Unit Weight of Soil in Place by 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 - Standard Classification of Soils for Engineering Purposes.

G. ASTM D 2922 - Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).

H. ASTM D 3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).

I. ASTM D 4318 - Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

J. TxDOT Tex-101-E - Preparing Soil and Flexible Base Materials for Testing.

K. TxDOT Tex-110-E - Particle Size Analysis of Soils.

L. Federal Regulations, 29 CFR Part 1926, Standards-Excavation, Occupational Safety and Health Administration (OSHA).

M. ASTM C76- Standard Specification for Reinforced Concrete Culverts, Storm Drain, and Sewer Pipe.

1.05 SCHEDULING

A. Schedule work so that pipe embedment can be completed on same day that acceptable foundation has been achieved for each section of pipe installation, manhole, or other structures.

B. For proposed utility adjacent to or across existing LDWL:

1. Conduct a meeting between contractor, Drinking Water Operations and Utility Maintenance Branch prior to beginning excavation to coordinate the EAP in the event a water line shut down becomes necessary.

2. Notify Drinking Water Operations a minimum of 1 week prior to beginning construction activities.

3. Notify Drinking Water Operations a minimum of 48 hours prior to beginning SUE work near LDWL.

4. Unless otherwise approved by City Engineer, perform construction activities between 7 AM and 7 PM, Monday through Friday. No work permitted around a LDWL on weekends or City Holiday.

5. A City Inspector must be present during SUE or construction activities occurring within four feet or one diameter of the LDWL, whichever is greater, from a LDWL or appurtenance.

1.06 SUBMITTALS

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

B. Submit planned typical method of excavation, backfill placement and compaction including:

1. Trench widths.

2. Procedures for foundation and pipe zone bedding placement, and trench backfill compaction.

3. Procedures for assuring compaction against undisturbed soil when pre-manufactured trench safety systems are proposed.

C. Submit backfill material sources and product quality information in accordance with requirements of Section 02320 - Utility Backfill Materials.

D. Submit trench excavation safety program in accordance with requirements of Section 02260 - Trench Safety System. Include designs for special shoring meeting requirements defined in Paragraph 1.08, Special Shoring Design Requirements contained herein.

E. 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.

F. Submit 11 inch by 17 inch or 12 inch by 18 inch copy of Drawing with plotted utility or obstruction location titled "Critical Location Report" to Project Manager.

G. For installation of proposed utility adjacent to or across existing LDWL, prepare and submit the following to Drinking Water Operations prior to beginning construction activities. Obtain approval from Drinking Water Operations prior to commencing prelocate or utility work near LDWL.

1. Trench details, shoring system designs, installation sequences, and flowable fill mix designs.

2. Emergency Action Plan (EAP) to address contingency plans in the event of damage to or failure of LDWL. Include the following:

   a. Contact personnel and agencies including primary and secondary telephone numbers,

   b. Contractor's hierarchy of responsible personnel,

   c. Traffic control measures, and

   d. Identification of resources to be available on or near project site in event of damage to or failure of LDWL.

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 City in accordance with requirements of Section 01454 - Testing Laboratory Services and as specified in this Section.

B. Perform backfill material source qualification testing in accordance with requirements of Section 02320- Utility Backfill Materials.

1.08 SPECIAL SHORING DESIGN REQUIREMENTS

A. Have special shoring designed or selected by Contractor's Professional Engineer to provide support for sides of 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 Contractor's Professional Engineer to meet project site requirements based on manufacturer's standard design.

PART 2 PRODUCTS

2.01 EQUIPMENT

A. Perform excavation with hydraulic excavator or other equipment suitable for achieving requirements of this Section.

B. Use only hand-operated tamping equipment until 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 1.08, Special 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 and Section 02321 – Cement Stabilized Sand.

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.

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 standard practice and requirements of this Section, this Section governs.

B. Install rigid pipe to conform to standard practice described in ASTM C 12 or C76 as applicable, and as described in this Section. Where an apparent conflict occurs between standard practice and requirements of this Section, this Section governs.

3.02 PREPARATION

A. Establish traffic control to conform to requirements of Section 01555 - Traffic Control and Regulation. Maintain barricades and warning lights for streets and intersections affected by Work, and are considered hazardous to traffic movements.

B. Perform work to conform to applicable safety standards and regulations. Employ trench safety system as specified in Section 02260 - Trench Safety Systems.

C. Immediately notify agency or company owning any existing utility line which is damaged, broken, or disturbed. Obtain approval from Project Manager and agency for any repairs or relocations, either temporary or permanent.

D. Remove existing pavements and structures, including sidewalks and driveways, to conform to requirements of Section 02221 - Removing Existing Pavements and Structures, as applicable.

E. Install and operate necessary dewatering and surface-water control measures to conform to Section 01578 - Control of Ground Water and Surface Water. Provide stable trench to allow installation in accordance with Specifications.

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 CRITICAL LOCATION INVESTIGATION

A. Horizontal and vertical location of various underground lines shown on Drawings, including but not limited to water lines, gas lines, storm sewers, sanitary sewers, telecommunication lines, electric lines or power ducts, pipelines, concrete and debris, are based on best information available but are only approximate locations. Unless otherwise approved by Project Manager, at Critical Locations shown on Drawings, perform vacuum excavation to field verify horizontal and vertical locations of such lines within a zone 2 feet vertically and 4 feet horizontally of proposed work exclude water jetting at PCCP water line.

1. Verify location of existing utilities minimum of 7 working days in advance of pipe laying activities based on daily pipe laying rate or prior to beginning installation of auger pit or tunnel shaft. Use extreme caution and care when uncovering utilities designated by Critical Locate.

2. Notify Project Manager in writing immediately upon identification of obstruction. In event of failure to identify obstruction in minimum of 7 days, Contractor will not be entitled to extra cost for downtime including, but not limited to, payroll, equipment, overhead, demobilization and remobilization, until 7 days has passed from time Project Manager is notified of obstruction.

B. Notify involved utility companies of date and time that investigation excavation will occur and request that their respective utility lines be marked in field. Comply with utility or pipeline company requirements that their representative be present during excavation. Provide Project Manager with 48 hours notice prior to field excavation or related work.

C. Survey vertical and horizontal locations of obstructions relative to project baseline and datum and plot on 12 inch by 18 inch copy of Drawings. For large diameter water lines, submit to Project Manager for approval, horizontal and vertical alignment dimensions for connections to existing lines, tied into project baseline, signed and sealed by R.P.L.S.

D. LDWL Prelocate Requirements:

1. Field-locate LDWL, appurtenances and laterals connected directly to LDWL through use of non-probing method such as a vacuum truck (non-water jetting method) at no greater than 50 foot intervals. Locate upstream and downstream of proposed work or utility installation.

2. Record crown and side of LDWL adjacent to proposed work or utility installation. Record LDWL locations horizontally and vertically using same coordinate system employed on proposed utility drawings.

3. Tie horizontal and vertical coordinates into project baseline. Submit recordings performed by R.P.L.S to City a minimum of 14 days prior to mobilizing to site

3.04 PROTECTION

A. Protect trees, shrubs, lawns, existing structures, and other permanent objects outside of grading limits and within grading limits as designated on 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 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, re-compact, and pave those areas at no additional cost to City.

E. Contingency plans for proposed work or utility installation adjacent to or across a LDWL:

1. Conduct on-site emergency drill prior to commencing proposed utility installation, and at three month intervals to assure EAP is current.

2. In the event a LDWL shut down becomes necessary, secure site and provide assistance to City personnel to access pipe and isolation valves as needed.

3.05 EXCAVATION

A. Except as otherwise specified or shown on 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 Drawings. Avoid disturbing surrounding ground and existing facilities and improvements.

C. Determine trench excavation widths using following schedule as related to pipe outside diameter (O.D.). Excavate trench so that pipe is centered in trench.

Nominal Pipe Size, Inches	Minimum Trench Width, Inches
Less than 18	O.D. + 18
18 to 30	O.D. + 24
36 to 42	O.D. + 36
Greater than 42	O.D. + 48

Do not obstruct sight distance for vehicles utilizing roadway or detours with stockpiled materials.

D. Use sufficient trench width or benches above embedment zone for installation of well point headers or manifolds and pumps where depth of trench makes it uneconomical or impractical to pump from 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 Project Manager and obtain instructions before proceeding.

F. Shoring of Trench Walls.

1. Install Special Shoring in advance of trench excavation or simultaneously with trench excavation, so that soils within full height of trench excavation walls will remain laterally supported at all times.

2. For all types of shoring, support trench walls in pipe embedment zone throughout installation. Provide trench wall supports sufficiently tight to prevent washing trench wall soil out from behind trench wall support.

3. Leave sheeting driven into or below pipe embedment zone in place to preclude loss of support of foundation and embedment materials, unless otherwise directed by Project Manager. Leave rangers, walers, and braces in place as long as required to support sheeting, which has been cut off, and trench wall in vicinity of pipe zone.

4. Employ special methods for maintaining 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 pipe embedment zone, do not disturb pipe foundation and embedment materials by subsequent removal. Maximum thickness of

removable sheeting extending into embedment zone shall be equivalent of 1-inch-thick steel plate. As sheeting is removed, fill in voids left with grouting material.

G. Use of Trench Shields. When trench shield (trench box) is used as 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 trench sidewalls.

2. Move trench shields so that pipe, and backfill materials, after placement and compaction, are not damaged nor disturbed, nor degree of compaction reduced. Re-compact after shield is moved if soil is disturbed.

3. When required, place, spread, and compact pipe foundation and bedding materials beneath shield. For backfill above bedding, lift 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 safe manner.

5. Conform to applicable Government regulations.

H. Voids under paving area outside shield caused by Contractor's work will require removal of pavement, consolidation and replacement of pavement in accordance with Contract Documents. Repair damage resulting from failure to provide adequate supports.

I. Place sand or soil behind shoring or trench shield to prevent soil outside shoring from collapsing and causing voids under pavement. Immediately pack suitable material in outside voids following excavation to avoid caving of trench walls.

J. Coordinate excavation within 15 feet of pipeline with company's representative. Support pipeline with methods agreed to by pipeline company's representative. Use small, rubber-tired excavator, such as backhoe, to do exploratory excavation. Bucket that is used to dig in close proximity to pipelines shall not have teeth or shall have guard installed over teeth to approximate bucket without teeth. Excavate by hand within 1 foot of Pipeline Company's line. Do not use larger excavation equipment than normally used to dig trench in vicinity of pipeline until pipelines have been uncovered and fully exposed. Do not place large excavation and hauling equipment directly over pipelines unless approved by Pipeline Company's representative.

K. When, during excavation to uncover pipeline company's pipelines, screwed collar or an oxy-acetylene weld is exposed, immediately notify Project Manager. Provide supports for collar or welds. Discuss with Pipeline Company's representative and determine methods of supporting collar or weld during excavation and later backfilling operations. When collar is exposed, request

Pipeline Company to provide welder in a timely manner to weld ends of collar prior to backfilling of excavation.

L. Excavation and shoring requirements for proposed work or utility installation adjacent to or across a LDWL:

1. Identify LDWL area in field and barricade off from construction activities. Allow no construction related activities including, but not limited to, loading of dump trucks and material staging or storage, on top of LDWL.

2. Employ a groundwater control system when performing excavation activities within ten feet of LDWL to:

   a. Effectively reduce hydrostatic pressure affecting excavations,

   b. Develop substantially dry and stable subgrade for subsequent construction operations,

   c. Prevent loss of fines, seepage, boils, quick condition or softening of foundation strata, and

   d. Maintain stability of sides and bottom of excavations.

3. When edge of proposed trench or shoring is within a distance equal to one diameter of LDWL from outside of wall of LDWL, valve or appurtenance:

   a. Maintain minimum of four (4) feet horizontal clearance and minimum of two (2) feet vertical clearance between proposed utility and LDWL.

   b. Auger Construction

      i. Maintain minimum of four (4) feet horizontal clearance between proposed utility and LDWL.
      ii. Dry auger method required when auger hole is 12-inches and larger in diameter.

   c. Open Cut Construction and Auger pits
      i. Perform hand excavation when within four (4) feet of LDWL.
      ii. Employ hydraulic or pneumatic shoring system. Do not use vibratory or impact driven shoring or piling.
      iii. Expose no more than 30-feet of trench prior to backfilling.
      iv. A maximum of one (1) foot of vertical trench shall be un-braced at a time to maintain constant pressure on face of excavated soil.

v. Upon removal of shoring system, inject flowable fill into void space left behind by shoring system. Comply with Standard Specification 02322 - Flowable Fill.

d. When edge of utility excavation is greater than one diameter of LDWL from outside wall of LDWL, use a shielding system as required by Project Manager and proposed utility standards and practices.

3.06 HANDLING EXCAVATED MATERIALS

A. Use only excavated materials, which are suitable as defined in this Section and conforming to Section 02320 - Utility Backfill Materials. Place material suitable for backfilling in stockpiles at distance from trench to prevent slides or cave-ins.

B. When required, provide additional backfill material conforming to requirements of Section 02320 - Utility Backfill Materials.

C. Do not place stockpiles of excess excavated materials on streets and adjacent properties. Protect backfill material to be used on site. Maintain site conditions in accordance with Section 01504 - Temporary Facilities and Controls. Excavate trench so that pipe is centered in trench. Do not obstruct sight distance for vehicles utilizing roadway or detours with stockpiled materials.

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. When wet soil is encountered on trench bottom and dewatering system is not required, over excavate an additional 6 inches with approval by Project Manager. Place non-woven geotextile fabric and then compact 12 inches of crushed stone in one lift on top of fabric. Compact crushed stone with four passes of vibratory-type compaction equipment.

C. Perform over excavation, when directed by Project Manager, in accordance with Paragraph 3.07B above. Removal of unstable or unsuitable material may be required if approved by Project Manager;

1. Even though Contractor has not determined material to be unsuitable, or

2. If unstable trench bottom is encountered and an adequate ground water control system is installed and operating according to Section 01578 - Control of Ground Water and Surface Water.

D. 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. Remove loose, sloughing, caving, or otherwise unsuitable soil from bottoms and sidewalls of trenches immediately prior to placement of embedment materials.

B. Place embedment including bedding, haunching, and initial backfill as shown on Drawings.

C. For pipe installation, manually spread embedment materials around pipe to provide uniform bearing and side support when compacted. Protect flexible pipe from damage during placing of pipe zone bedding material. Perform placement and compaction directly against undisturbed soils in trench sidewalls, or against sheeting which is to remain in place.

D. Do not place trench shields or shoring within height of embedment zone unless means to maintain density of compacted embedment material are used. If moveable supports are used in embedment zone, lift supports incrementally to allow placement and compaction of material against undisturbed soil.

E. Place geotextile to prevent particle migration from 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 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 pipe with sand bags or other suitable means.

H. Place electrical conduit, if used, directly on foundation without bedding.

I. Shovel in-place and compact embedment material using pneumatic tampers in restricted areas, and vibratory-plate compactors or engine-powered jumping jacks in unrestricted areas. Compact each lift before proceeding with placement of next lift. Water tamping is not allowed.

J. For water lines construction embedment, use bank run sand, concrete sand, gem sand, pea gravel, or crushed limestone as specified in Section 02320 - Utility Backfill Material. Adhere to the following subparagraph numbers 1 and 2.

1. Class I, II and III Embedment Materials:

    a. Maximum 6 inches compacted lift thickness.

    b. Compact to achieve 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 Project Manager.

2. Cement Stabilized Sand (where required for special installations):

a. Maximum 6 inches compacted thickness.

b. Compact to achieve 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.

K. For Sanitary Sewers adhere to subparagraph number 1 and 2. For Storm Sewers provide cement stabilized sand per paragraph 2. This provision does not apply to Storm Sewers constructed of HDPE pipe installed under pavement.

1. 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 pipe to meet deflection test criteria.

c. Moisture content as determined by Contractor for effective compaction without softening soil of trench bottom, foundation or trench walls.

2. Class II Embedment and Cement Stabilized Sand.

a. Maximum 6-inches compacted thickness.

b. Compaction by methods determined by Contractor to achieve minimum of 95 percent of 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 dry side of optimum as determined according to ASTM D 558 but sufficient for effective hydration.

L. For Storm Sewers constructed of HDPE pipe and installed under pavement provide flowable fill pipe embedment as specified in Section 02322 Flowable Fill.

M.. Place trench dams in Class I embedment 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 minimum length of trench open as necessary for construction.

B. For water lines, under pavement and to within one foot back of curb, use backfill materials described below:

1. For water lines 20 inches in diameter and smaller, use bank run sand or select backfill materials up to pavement base or subgrade.

2. For water lines 24 inches in diameter and larger, backfill with suitable on-site material (random backfill) up to 12 inches below pavement base or subgrade. Place minimum of 12 inches of select backfill below pavement base or subgrade.

C. For sewer pipes (Storm and Sanitary), use backfill materials described by trench limits. For "trench zone backfill" under pavement and to within one foot back of curb, use cement stabilized sand for pipes of nominal sizes 36 inches in diameter and smaller to level 12 inches below the pavement. For sewer pipes 42 inches in diameter and larger, under pavement or natural ground, in satisfactory soil conditions, backfill from 12 inches above top of pipe to 12 inches below pavement with suitable on-site material or select backfill. For sewer pipes 42 inches in diameter and larger, under pavement or natural ground, in unsatisfactory soil conditions, backfill from 12 inches above top of pipe to 12 inches below pavement with suitable on-site material or select backfill. Use select backfill for rigid pavements or flexible base material for asphalt pavements for 12- inch backfill directly under pavement. For backfill materials reference Section 02320 - Utility Backfill Materials. This provision does not apply where a Storm Sewer is constructed of HDPE pipe.

D. For Storm Sewers constructed of HDPE pipe and installed under pavement provide flowable fill as specified in Section 02322 Flowable Fill. For Storm Sewers constructed of HDPE pipe and not installed under pavement provide cement stabilized sand.

E. Where damage to completed pipe installation work is likely to result from withdrawal of sheeting, leave sheeting in place. Cut off sheeting 1.5 feet or more above crown of pipe. Remove trench supports within 5 feet from ground surface.

F. Unless otherwise shown on Drawings. Use one of the following trench zone backfills under pavement and to within one foot of edge of pavement. Place trench zone backfill in lifts and compact. Fully compact each lift before placement of next lift.

1. Class I, II, or III or combination thereof:

a. Place in maximum 12-inch thick loose layers.

b. Compact by vibratory equipment to minimum of 95 percent of maximum dry density determined according to ASTM D 698.

c. Moisture content within zero percent to 5 percent above optimum determined according to ASTM D 698, unless otherwise approved by Project Manager.

2. Cement-Stabilized Sand:

a. Maximum lift thickness determined by Contractor to achieve uniform placement and required compaction, but do not exceed 12 inches.

b. Compact by vibratory equipment to minimum of 95 percent of maximum dry density determined according to ASTM D 558.

c. Moisture content on dry side of optimum determined according to ASTM D 558 but sufficient for cement hydration.

3. Class IVA and IVB (Clay Soils):

a. Place in maximum 8-inch thick loose lifts.

b. Compaction by vibratory Sheepfoot roller to minimum of 95 percent of maximum dry density determined according to ASTM D 698.

c. Moisture content within zero percent to 5 percent above optimum determined according to ASTM D 698, unless approved by Project Manager.

G. Unless otherwise shown on Drawings, for trench excavations not under pavement, random backfill of suitable material may be used in trench zone. This provision does not apply to HDPE storm sewers.

1. Fat clays (CH) may be used as trench zone backfill outside paved areas at Contractor's option. When required density is not achieved, at any additional cost to City, rework, dry out, use lime stabilization or other approved methods to achieve compaction requirements, or use 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 minimum of 90 percent of 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. Below paved areas or where shown on Drawings, encapsulate manhole with cement stabilized sand; minimum of 2 foot below base, minimum 2 foot around walls, up to pavement subgrade or natural ground. Compact in accordance with Paragraph 3.09.F.2 of this Section

B. In unpaved areas, use select fill for backfill. Existing material that qualifies as select material may be used, unless indicated otherwise on Drawings. Deposit backfill in uniform layers and compact each layer as specified. Maintain backfill material at no less than 2 percent below nor more than 5 percent above optimum moisture content, unless otherwise approved by Project Manager. Place fill material in uniform 8-inch maximum loose layers. Compact fill to at least 95 percent of maximum Standard Proctor Density according to ASTM D 698.

C. For LDWL projects, encapsulate manhole with cement stabilized sand; minimum of 1 foot below base, minimum of 2 feet around walls, up to within 12 inches of pavement subgrade or natural ground. For manholes over water line, extend encapsulation to bottom of trench. Compact in accordance with Paragraph 3.09 F.2 of this Section.

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 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 noticeable change in material gradation or plasticity, or when requested by Project Manager.

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. Perform additional moisture-density relationship tests once a month or whenever there is 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 following frequencies and conditions.

1. For open cut construction projects and auger pits: Unless otherwise approved by Project Manager, successful compaction to be measured by one test per 40 linear feet measured along pipe for compacted embedment and two tests per 40 linear feet measured along pipe for compacted trench zone backfill material. Length of auger pits to be measured to arrive at 40 linear feet.

2. A minimum of three density tests for each full shift of Work.

3. Density tests will be distributed among 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 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 acceptance criteria. Placement will be rejected unless both verification tests show acceptable results.

7. Recompacted placement will be retested at same frequency as first test series, including verification tests.

8. Identify elevation of test with respect to natural ground or pavement.

F. Recondition, re-compact, 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 02318

EXTRA UNIT PRICE WORK FOR EXCAVATION AND BACKFILL

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Measurement and payment applicable to extra unit price work items for excavation and backfill made necessary by unusual or unforeseen circumstances encountered during utility installations.

B. Extra unit price work for excavation and backfill is paid only when authorized in advance by Project Manager.

1.02 MEASUREMENT AND PAYMENT

A. UNIT PRICES

1. Excavation Around Obstructions: Payment for excavation around obstructions is on cubic yard basis, measured in place, without deduction for volume occupied by portions of pipes, ducts, or other structures left in place across trenches excavated under this item.

2. Extra Hand Excavation: Payment for extra hand excavation is on cubic yard basis, measured in place.

3. Extra Machine Excavation: Payment for extra machine excavation is on cubic yard basis, measured in place.

4. Extra Placement of Backfill Material: Payment for extra placement of backfill material is on cubic yard basis, measured in place, for material installed as part of Work. At discretion of Project Manager, measurement of cubic yards may be calculated from volume of Extra Hand Excavation or Extra Machine Excavation for which replacement is made, minus volume of any Extra Placement of Granular Backfill authorized in conjunction with Work.

5. Extra Placement of Granular Backfill: Payment for extra placement of granular backfill material is on cubic yard basis, measured in place.

6. Extra Select Backfill: Payment for extra select backfill is on cubic yard basis, measured in place for a theoretical minimum trench width. The project Manager may authorize extra select backfill when soil from the excavation work does not include adequate quantities for placement of suitable on-site material (random backfill).

7. Refer to Section 01270 – Measurement and payment for unit price procedures.

1.03 DEFINITIONS

A. Excavation Around Obstructions: Excavation necessitated by obstruction of pipes (other than service connections 3 inches in diameter or less), ducts, or other structures, not shown on Drawings, and of an unusual or unforeseen nature which interfere with installation of utility piping by normal methods of excavation or auguring.

B. Extra Hand Excavation: Excavation by manual labor made necessary by unusual or unforeseen circumstances at locations approved in advance by Project Manager.

C. Extra Machine Excavation: Excavation by machine at or near project site to perform related work not included in original project scope but added for convenience of City, as approved in advance by Project Manager.

D. Extra Replacement of Backfill Material: Handling, backfill, and compaction of excavated material authorized under extra work bid items for Extra Hand Excavation or Extra Machine Excavation. Placement and compaction shall conform to requirements specified for excavation and backfill in Sections 02316 – Excavation and Backfill for Structures and 02317 – Excavation and Backfill for Utilities.

E. Extra Placement of Granular Backfill: Hauling, placing, and compacting granular backfill materials as approved by Project Manager in conjunction with Extra Replacement of Backfill Material. Materials placed under this item shall conform to requirements for Bank Run Sand, Cement Stabilized Sand, Concrete Sand, Gem Sand, Crushed Stone, or Crushed Concrete specified for backfill material in Sections 02316 – Excavation and Backfill for Structures and 02317 – Excavation and Backfill for Utilities..

F. Extra Select Backfill: Unsuitable material removed from the project and select backfill material hauled to the project, or conditioning unsuitable material on the site to make it select backfill. Provide select backfill material specified in Section 02320 – Utility Backfill Materials.

PART 2 PRODUCTS Not Used

PART 3 EXECUTION Not Used

END OF SECTION

Section 02320

UTILITY BACKFILL MATERIALS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Material Classifications.

B. Utility Backfill Materials:

1. Concrete sand
2. Gem sand
3. Pea gravel
4. Crushed stone
5. Crushed concrete
6. Bank run sand
7. Select backfill
8. Random backfill
9. Cement stabilized sand

C. Material Handling and Quality Control Requirements.

1.02 MEASUREMENT AND PAYMENT

A. Unit Prices.

1. No payment will be made for backfill material. Include payment in unit price for applicable utility installation.
2. Payment for backfill material, when included as separate pay item or when directed by Project Manager, is on cubic yard basis for material placed and compacted within theoretical trench width limits and thickness of material according to Drawings, or as directed by Project Manager.
3. Payment for backfill of authorized over-excavation is in accordance with Section 02318 - Extra Unit Price Work for Excavation and Backfill.

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 DEFINITIONS

A. Unsuitable Material:

1. Materials 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 gradation, plasticity, or moisture content.

3. Materials containing large clods, aggregates, or stones greater than 4 inches in any dimension; debris, vegetation, or waste; or any other deleterious materials.

4. Materials contaminated with hydrocarbons or other chemical contaminants.

B. Suitable Material:

1. Materials meeting specification requirements.

2. Unsuitable materials meeting specification requirements for suitable soils after treatment with lime or cement.

C. 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 structure foundation base. Foundation backfill materials may include concrete fill and seal slabs.

D. Foundation Base: Crushed stone aggregate with filter fabric as required, cement stabilized sand, or concrete seal slab. Foundation base provides smooth, level working surface for construction of concrete foundation.

E. Backfill Material: Classified soil material meeting specified quality requirements for designated application as embedment or trench zone backfill.

F. Embedment Material: Soil material placed under controlled conditions within embedment zone extending vertically upward from top of foundation to an elevation 12 inches above top of pipe, and including pipe bedding, haunching and initial backfill.

G. Trench Zone Backfill: Classified soil material meeting specified quality requirements and placed under controlled conditions in trench zone from top of embedment zone to base course in paved areas or to surface grading material in unpaved areas.

H. Foundation: Either suitable soil of trench bottom or material placed as backfill of over-excavation for removal and replacement of unsuitable or otherwise unstable soils.

I. Source: Source selected by Contractor for supply of embedment or trench zone backfill material. Selected source may be project excavation, off-site borrow pits, commercial borrow pits, or sand and aggregate production or manufacturing plants.

J. Refer to Section 02317 - Excavation and Backfill for Utilities for other definitions regarding utility installation by trench construction.

1.04 REFERENCES

A. ASTM C 33 - Standard Specification for Concrete Aggregate.

B. ASTM C 40 - Standard Test Method for Organic Impurities in Fine Aggregates for Concrete.

C. ASTM C 123 - Standard Test Method for Lightweight Particles in Aggregate.

D. ASTM C 131 - Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in Los Angeles Machine.

E. ASTM C 136 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.

F. ASTM C 142 - Standard Test Method for Clay Lumps and Friable Particles in Aggregates.

G. ASTM D 1140 - Standard Test Method for Amount of Material in Soils Finer Than No. 200 Sieve.

H. ASTM D 2487 - Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System).

I. ASTM D 4318 - Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

J. ASTM D 4643 - Standard Test Method for Determination of Water (Moisture) Content of Soil by Microwave Oven Method.

K. TxDOT Tex-110-E - Determining Particle Size Analysis of Soils.

L. TxDOT Tex-460-A - Material Finer Than 75 Φm (No.200) Sieve In Mineral Aggregates (Decantation Test for Concrete Aggregates).

1.05 SUBMITTALS

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

B. Submit description of source, material classification and product description, production method, and application of backfill materials.

C. Submit test results for samples of off-site backfill materials. Comply with Paragraph 2.03, Material Testing.

D. Before stockpiling materials, submit copy of approval from landowner for stockpiling backfill material on private property.

E. Provide delivery ticket which includes source location for each delivery of material that is obtained from off-site sources or is being paid as specific bid item.

1.06 TESTS

A. Perform tests of sources for backfill material in accordance with Paragraph 2.03B.

B. Verification tests of backfill materials may be performed by City in accordance with Section 01454 - Testing Laboratory Services and in accordance with Paragraph 3.03.

PART 2 P R O D U C T S

2.01 MATERIAL CLASSIFICATIONS

A. Classify materials for backfill for purpose of quality control in accordance with Unified Soil Classification Symbols as defined in ASTM D 2487. Material use and application is defined in utility installation specifications and Drawings either by class, as described in Paragraph 2.01B, or by product descriptions, as given in Paragraph 2.02.

B. Class Designations Based on Laboratory Testing:

1. Class I: Well-graded gravels and sands, gravel-sand mixtures, crushed well-graded rock, little or no fines (GW, SW):

   a. Plasticity index: non-plastic.

   b. Gradation: D_{60}/D_{10} - greater than 4 percent; amount passing No. 200 sieve - less than or equal to 5 percent.

2. Class II: Poorly graded gravels and sands, silty gravels and sands, little to moderate fines (GM, GP, SP, SM):

a. Plasticity index: non-plastic to 4.

b. Gradations:
   1) Gradation (GP, SP): amount passing No. 200 sieve - less than 5 percent.
   2) Gradation (GM, SM): amount passing No. 200 sieve - between 12 percent and 50 percent.
   3) Borderline gradations with dual classifications (e.g., SP-SM): amount passing No. 200 sieve - between 5 percent and 12 percent.

3. Class III: Clayey gravels and sands, poorly graded mixtures of gravel, sand, silt, and clay (GC, SC, and dual classifications, e.g., SP-SC):

   a. Plasticity index: greater than 7.

   b. Gradation: amount passing No. 200 sieve - between 12 percent and 50 percent.

4. Class IVA: Lean clays (CL).

   a. Plasticity Indexes:
      1) Plasticity index: greater than 7, and above A line.
      2) Borderline plasticity with dual classifications (CL-ML): PI between 4 and 7.

   b. Liquid limit: less than 50.

   c. Gradation: amount passing No. 200 sieve - greater than 50 percent.

   d. Inorganic.

5. Class IVB: Fat clays (CH)

   a. Plasticity index: above A line.

   b. Liquid limit: 50 or greater.

   c. Gradation: amount passing No. 200 sieve - greater than 50 percent.

   d. Inorganic.

6. Use soils with dual class designation according to ASTM D 2487, and which are not defined above, according to more restrictive class.

2.02 PRODUCT DESCRIPTIONS

A. Soils classified as silt (ML) silty clay (CL-ML with PI of 4 to 7), elastic silt (MH), organic clay and organic silt (OL, OH), and organic matter (PT) are not acceptable as backfill materials. These soils may be used for site grading and restoration in unimproved areas as approved by Project Manager. Soils in Class IVB, fat clay (CH) may be used as backfill materials where allowed by applicable backfill installation specification. Refer to Section 02316 - Excavation and Backfill for Structures and Section 02317 - Excavation and Backfill for Utilities.

B. Provide backfill material that is free of stones greater than 6 inches, free of roots, waste, debris, trash, organic material, unstable material, non-soil matter, hydrocarbon or other contamination, conforming to following limits for deleterious materials:

1. Clay lumps: Less than 0.5 percent for Class I, and less than 2.0 percent for Class II, when tested in accordance with ASTM C 142.

2. Lightweight pieces: Less than 5 percent when tested in accordance with ASTM C 123.

3. Organic impurities: No color darker than standard color when tested in accordance with ASTM C 40.

C. Manufactured materials, such as crushed concrete, may be substituted for natural soil or rock products where indicated in product specification, and approved by Project Manager, provided that physical property criteria are determined to be satisfactory by testing.

D. Bank Run Sand: Durable bank run sand classified as SP, SW, or SM by Unified Soil Classification System (ASTM D 2487) meeting following requirements:

1. Less than 15 percent passing number 200 sieve when tested in accordance with ASTM D 1140. Amount of clay lumps or balls may not exceed 2 percent.

2. Material passing number 40 sieve shall meet the following requirements when tested in accordance with ASTM D 4318: Plasticity index: not exceeding 7.

E. Concrete Sand: Natural sand, manufactured sand, or combination of natural and manufactured sand conforming to requirements of ASTM C 33 and graded within following limits when tested in accordance with ASTM C 136:

Sieve	Percent Passing
3/8"	100
No. 4	95 to 100
No. 8	80 to 100
No. 16	50 to 85
No. 30	25 to 60
No. 50	10 to 30

No. 100	2 to 10

F. Gem Sand: Sand conforming to requirements of ASTM C 33 for course aggregates specified for number 8 size and graded within the following limits when tested in accordance with ASTM C 136:

Sieve	Percent Passing
3/8"	95 to 100
No. 4	60 to 80
No. 8	15 to 40

G. Pea Gravel: Durable particles composed of small, smooth, rounded stones or pebbles and graded within the following limits when tested in accordance with ASTM C 136:

Sieve	Percent Passing
1/2"	100
3/8"	85 to 100
No. 4	10 to 30
No. 8	0 to 10
No. 16	0 to 5

H. Crushed Aggregates: Crushed aggregates consist of durable particles obtained from an approved source and meeting the following requirements:

1. Materials of one product delivered for same construction activity from single source, unless otherwise approved by Project Manager.

2. Non-plastic fines.

3. Los Angeles abrasion test wear not exceeding 45 percent when tested in accordance with ASTM C 131.

4. Crushed aggregate shall have minimum of 90 percent of particles retained on No. 4 sieve with 2 or more crushed faces as determined by Tex-460-A, Part I.

5. Crushed stone: Produced from oversize plant processed stone or gravel, sized by crushing to predominantly angular particles from naturally occurring single source. Uncrushed gravel is not acceptable materials for embedment where crushed stone is shown on applicable utility embedment drawing details.

6. Crushed Concrete: Crushed concrete is an acceptable substitute for crushed stone as utility backfill. Gradation and quality control test requirements are same as crushed stone. Provide crushed concrete produced from normal weight concrete of uniform quality; containing particles of aggregate and cement material, free from other substances such as asphalt, reinforcing steel fragments, soil, waste gypsum (calcium sulfate), or debris.

7. Gradations, as determined in accordance with Tex-110-E.

Sieve	Percent Passing by Weight for Pipe Embedment by Ranges of Nominal Pipes Sizes		
	>15"	15" - 8"	<8"
1"	95 - 100	100	-
3/4"	60 - 90	90 - 100	100
1/2"	25 - 60	-	90 - 100
3/8"	-	20 - 55	40 - 70
No. 4	0 - 5	0 - 10	0 - 15
No. 8	-	0 - 5	0 - 5

I. Select Backfill: Class III clayey gravel or sand or Class IV lean clay with plasticity index between 7 and 20 or clayey soils treated with lime in accordance with Section 02951 - Pavement Repair and Restoration to meet plasticity criteria.

J. Random Backfill: Any suitable soil or mixture of soils within Classes I, II, III and IV; or fat clay (CH) v allowed by applicable backfill installation specification. Refer to Section 02316 - Excavation and Back for Structures and Section 02317 - Excavation and Backfill for Utilities.

K. Cement Stabilized Sand: Conform to requirements of Section 02321 - Cement Stabilized Sand.

L. Concrete Backfill: Conform to Class B concrete as specified in Section 03315 - Concrete for Utility Construction.

M. Flexible Base Course Material: Conform to requirements of applicable portions of Section 02711 - Hot Mix Asphaltic Base Course, Section 02712 - Cement Stabilized Base Course, and Section 02713 - Recycled Crushed Concrete Base Course.

2.03 MATERIAL TESTING

A. Source Qualification. Perform testing to obtain tests by suppliers for selection of material sources and products not from the project site. Test samples of processed materials from

current production representing material to be delivered. Use tests to verify that materials meet specification requirements. Repeat qualification test procedures each time source characteristics change or there is planned change in source location or supplier. Include the following qualification tests, as applicable:

1. Gradation. Report complete sieve analyses regardless of specified control sieves from largest particle through No. 200 sieve.

2. Plasticity of material passing No. 40 sieve

3. Los Angeles abrasion wear of material retained on No. 4 sieve

4. Clay lumps

5. Lightweight pieces

6. Organic impurities

B. Production Testing. Provide reports to Project Manager from an independent testing laboratory that backfill materials to be placed in Work meet applicable specification requirements.

C. Assist Project Manager in obtaining material samples for verification testing at source or at production plant.

PART 3 EXECUTION

3.01 SOURCES

A. Use of existing material in trench excavations is acceptable, provided applicable specification requirements are satisfied.

B. Identify off-site sources for backfill materials at least 14 days ahead of intended use so that Project Manager may obtain samples for verification testing.

C. Materials may be subjected to inspection or additional verification testing after delivery. Materials which do not meet requirements of specifications will be rejected. Do not use material which, after approval, has become unsuitable for use due to segregation, mixing with other materials, or by contamination. Once material is approved by Project Manager, expense for sampling and testing required to change to different material will be credited to City through change order.

D. Bank run sand, select backfill, and random backfill, if available in project excavation, may be obtained by selective excavation and acceptance testing. Obtain additional quantities of these materials and other materials required to complete work from off-site sources.

E. City does not represent or guarantee that any soil found in excavation work will be suitable and acceptable as backfill material.

3.02 MATERIAL HANDLING

A. When backfill material is obtained from either commercial or non-commercial borrow pit, open pit to expose vertical faces of various strata for identification and selection of approved material to be used. Excavate selected material by vertical cuts extending through exposed strata to achieve uniformity in product.

B. Establish temporary stockpile locations for practical material handling, control, and verification testing by Project Manager in advance of final placement. Obtain approval from landowner for storage of backfill material on adjacent private property.

C. When stockpiling backfill material near project site, use appropriate covers to eliminate blowing of materials into adjacent areas and prevent runoff containing sediments from entering drainage system.

D. Place stockpiles in layers to avoid segregation of processed materials. Load material by making successive vertical cuts through entire depth of stockpile.

3.03 FIELD QUALITY CONTROL

A. Quality Control

1. The Project Manager may sample and test backfill at:

   a. Sources including borrow pits, production plants and Contractor's designated off-site stockpiles.

   b. On-site stockpiles.

   c. Materials placed in Work.

2. The Project Manager may re-sample material at any stage of work or location if changes in characteristics are apparent.

B. Production Verification Testing: City's testing laboratory will provide verification testing on backfill materials, as directed by Project Manager. Samples may be taken at source or at production plant, as applicable.

END OF SECTION

Section 02321

CEMENT STABILIZED SAND

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Cement stabilized sand.

1.02 MEASUREMENT AND PAYMENT

A. Unit Prices.

1. No separate payment will be made for work performed under this Section. Include cost of such work in Contract unit prices for items listed in bid form requiring cement stabilized sand.

2. Refer to Paragraph 3.04 for material credit.

3. Refer to Section 01270 - Measurement and Payment for unit price procedures.

B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.03 REFERENCES

A. 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 42 - Standard Test Methods for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.

D. ASTM C 94 - Standard Specification for Ready-Mixed Concrete.

E. ASTM C 123 - Standard Test Method for Lightweight Particles in Aggregate.

F. ASTM C 142 - Standard Test Method for Clay Lumps and Friable Particles in Aggregates.

G. ASTM C 150 - Specification for Portland Cement.

H. ASTM D 558 - Standard Test Method for Moisture-Density Relations of Soil Cement-Mixtures.

I. ASTM D 1632 - Standard Practice for Making and Curing Soil-Cement Compression and Flexure Test Specimens in the Laboratory

J. ASTM D 1633 - Standard Test Method for Compressive Strength of Molded Soil-Cement Cylinders.

K. ASTM D 2487 - Standard Test Method for Classification of Soils for Engineering Purposes (Unified Soil Classification System).

L. ASTM D2922 - Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)

M. ASTM D 3665 - Standard Practice for Random Sampling of Construction Materials.

N. ASTM D 4318 - Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

1.04 SUBMITTALS

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

B. Submit proposed target cement content and production data for sand-cement mixture in accordance with requirements of Paragraph 2.03, Materials Qualifications.

1.05 DESIGN REQUIREMENTS

A. Use sand-cement mixture producing minimum unconfined compressive strength of 100 pounds per square inch (psi) in 48 hours.

1. Design will be based on strength specimens molded in accordance with ASTM D 558 at moisture content within 3 percent of optimum and within 4 hours of batching.

2. Determine minimum cement content from production data and statistical history. Provide no less than 1.1 sacks of cement per ton of dry sand.

PART 2 P R O D U C T S

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, or requirements for bank run sand of Section 02320 - Utility Backfill Materials, and the following requirements:

1. Classified as SW, SP, SW-SM, SP-SM, or SM by Unified 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 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 pugmill-type mixer.

B. Stamp batch ticket at plant with time of loading. Reject material not placed and compacted within 4 hours after mixing.

2.03 MATERIAL QUALIFICATION

A. Determine target cement content of material as follows:

1. Obtain samples of sand-cement mixtures at production facility representing range of cement content consisting of at least three points.

2. Complete molding of samples within 4 hours after 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 raw sand for following properties at point of entry into 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 data obtained in format similar to that provided in sample data form attached to this Section.

D. The target content may be adjusted when statistical history so indicates. For determination of minimum product performance use formula:

f'_c% 1/2 standard deviation

PART 3 EXECUTION

3.01 PLACING

A. Place sand-cement mixture in maximum 12-inch-thick loose lifts and compact to 95 percent of maximum density as determined in accordance with ASTM D 558, unless otherwise specified. Refer to related specifications for thickness of lifts in other applications. Target moisture content during compaction is $\pm$3 percent of optimum. Perform and complete compaction of sand-cement mixture within 4 hours after addition of water to mix at plant.

B. Do not place or compact sand-cement mixture in standing or free water.

C. Where potable water lines cross wastewater line, embed wastewater line with cement stabilized sand in accordance with Texas Administrative Code §290.44(e)(4)(B):

1. Provide minimum of 10% cement per cubic yard of cement stabilized sand mixture, based on loose dry weight volume. Use at least 2.5 bags of cement per cubic yard of mixture (2 sacks per ton of dry sand).

2. Unless otherwise shown on Drawings, embed wastewater main or lateral minimum of six inches above and below.

3. Use brown coloring in cement stabilized sand for wastewater main or lateral bedding for identification of pressure rated wastewater mains during future construction.

3.02 FIELD QUALITY CONTROL

A. Testing will be performed under provisions of Section 01454 - Testing Laboratory Services.

B. One sample of cement stabilized sand shall be obtained for each 150 tons of material placed per day with no less than one sample per day of production. Random samples of delivered cement stabililized sand shall be taken in the field at point of delivery in accordance with ASTM 3665. Obtain three individual samples of approximately 12 to 15 lb each from the first, middle, and last third of the truck and composite them into one sample for test purpose.

C. Prepare and mold four specimens (for each sample obtained) in accordance with ASTM D 558, Method A, without adjusting moisture content. Samples will be molded at approximately same time material is being used, but no later than 4 hours after water is added to mix.

D. After molding, specimens will be removed from molds and cured in accordance with ASTM D 1632.

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 average of strengths of two specimens molded from same sample of material and tested at same age. Average daily strength will be average of strengths of all specimens molded during one day's production and tested at same age.

G. Precision and Bias: Test results shall meet 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. Indication of 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
16. Supplier mixture identification
17. Specimen diameter and height, in.
18. Specimen cross-sectional area, sq. in.

3.03 ACCEPTANCE

A. Strength level of material will be considered satisfactory if:

1. The average 48-hour strength is greater than 100 psi with no individual strength test below 70 psi.

2. All 7-day individual strength tests (average of two specimens) are greater than or equal to 100 psi.

B. Material will be considered deficient when 7-day individual strength test (average of two specimens) is less than 100 psi but greater than 70 psi. See Paragraph 3.04 Adjustment for Deficient Strength.

C. The material will be considered unacceptable and subject to removal and replacement at Contractor=s expense when individual strength test (average of two specimens) has 7-day strength less than 70 psi.

D. When moving average of three daily 48-hour averages falls below 100 psi, discontinue shipment to project until plant is capable of producing material, which exceeds 100 psi at 48 hours. Five 48-hour strength tests shall be made in this determination with no individual strength tests less than 100 psi.

E. Testing laboratory shall notify Contractor, Project Manager, and material supplier by facsimile of tests indicating results falling below specified strength requirements within 24 hours.

F. If any strength test of laboratory cured specimens falls below the specified strength, Contractor may, at his own expense, request test of cores drilled from the area in question in accordance with ASTM C42. In such cases, three (3) cores shall be taken for each strength test that falls below the values given in 3.03.A.

G. Cement stabilized sand in an area represented by core tests shall be considered satisfactory if the average of three (3) cores is equal to at least 100 psi and if no single core is less that 70 psi. Additional testing of cores extracted from locations represented by erratic core strength results will be permitted.

3.04 ADJUSTMENT FOR DEFICIENT STRENGTH

A. When mixture produces 7-day compressive strength greater than or equal to 100 psi, then material will be considered satisfactory and bid price will be paid in full.

B. When mixture produces 7-day compressive strength less than 100 psi and greater than or equal to 70 psi, material shall be accepted contingent on credit in payment. Compute credit by the following formula:

$$\text{Credit per Cubic Yard} = \frac{\$30.00 \times 2\ (100\ \text{psi} - \text{Actual psi})}{100}$$

C. When mixture produces 7-day compressive strength less than 70 pounds per square inch, then remove and replace cement-sand mixture and paving and other necessary work at no cost to City.

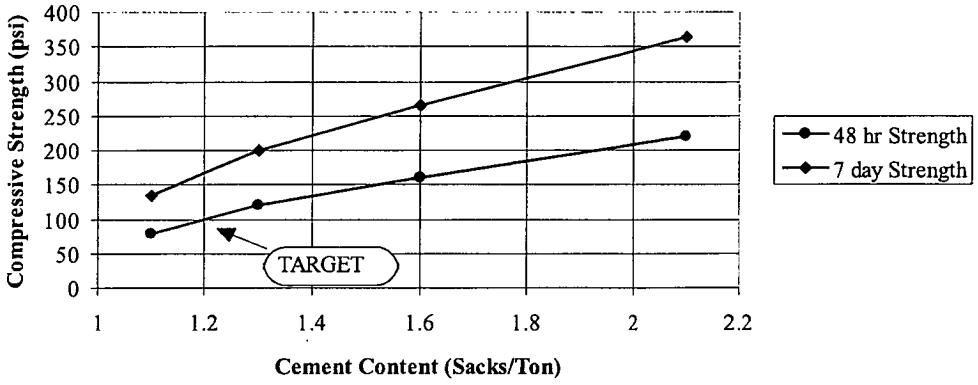
Supplier: City Stabilized Sand	**Plant No:** 1 - Main Street	**Date of Tests:** January 1, 1997

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	COH 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 Houston
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



END OF SECTION

Section 02336

LIME STABILIZED SUBGRADE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Foundation course of lime stabilized subgrade material.

1. Application of lime slurry to subgrade.

2. Mixing, compaction, and curing of lime slurry, water, and subgrade into a stabilized foundation.

1.02 MEASUREMENT AND PAYMENT

A. Unit Prices.

1. Measurement and payment for lime stabilized subgrade is on a square yard basis compacted in place to proper density. Separate measurement will be made for each required thickness of subgrade course.

   a. Limits of measurement shall match actual pavement replaced, but no greater than maximum pavement replacement limits shown on Drawings. Limits for measurement will be extended to include installed lime stabilized subgrade material that extends 2 foot beyond outside edge of pavement to be replaced, except where proposed pavement section shares common longitudinal or transverse edge with existing pavement section. No payment will be made for lime stabilized subgrade in areas beyond these limits.

   b. Limits of measurement and payment shall match pavement replacement limits shown on Drawings, except as noted in Paragraph 1.02.A.1.a, or as approved by Project Manager.

2. Measurement and payment for lime is by ton of 2000 pounds dry weight basis. Calculate weight of dry solids for lime slurry based on percentage by dry weight solids.

3. Refer to Section 01270 - Measurement and Payment for unit price procedures.

B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for Work in this Section is included in total Stipulated Price.

1.03 DEFINITION

B. Moist Cure: Curing soil and lime to obtain optimum hydration.

C. 1000-Foot Roadway Section: 1000 feet per lane width or approximately 500 square yards of compacted subgrade for other than full-lane-width roadway sections.

1.04 REFERENCES

A. ASTM D 698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3 (600 kN-m/m^3).

B. ASTM D 2922 - Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).

C. ASTM D 4318 - Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

D. TxDOT Tex-101-E (Part III) - Preparation of Soil and Flexible Base Material for Testing.

E. TxDOT Tex-140-E - Measuring Thickness of Pavement Layer.

F. TxDOT Tex-600-J - Sampling and Testing Hydrated Lime, Quicklime, and Commercial Lime Slurry.

1.05 SUBMITTALS

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

B. Submit certification that hydrated lime, quicklime, or commercial lime slurry complies with specifications.

C. Submit weight tickets, certified by supplier, with each bulk delivery of lime to work site.

1.06 DELIVERY, STORAGE AND HANDLING

A. Bagged lime shall bear manufacturer's name, product identification, and certified weight. Bags varying more than 5 percent of certified weight may be rejected; average weight of 50 random bags in each shipment shall not be less than certified weight.

B. Store lime in weatherproof enclosures. Protect lime from ground dampness.

PART 2 P R O D U C T S

2.01 WATER

A. Use clean, clear water, free from oil, acids, alkali, or vegetation.

2.02 LIME

A. Type A - Hydrated Lime: Dry material consisting essentially of calcium hydroxide or mixture of calcium hydroxide and an allowable percentage of calcium oxide as listed in chemical composition chart.

B. Type B - Commercial Lime Slurry: Liquid mixture consisting essentially of lime solids and water in slurry form. Water or liquid portion shall not contain dissolved material in sufficient quantity to be injurious or objectionable for purpose intended.

C. Type C - Quicklime: Dry material consisting essentially of calcium oxide. Furnish quicklime in either of the following grades:

1. Grade DS: Pebble quicklime of gradation suitable for use in preparation of slurry for wet placing.

2. Grade S: Finely-graded quicklime for use in preparation of slurry for wet placing. Donor use grade S quicklime for dry placing.

D. Conform to the following requirements:

CHEMICAL COMPOSITION	TYPE		
	A	B	C
Active lime content, % by weight $Ca(OH)_2$+CaO	90.0 min[1]	87.0 min[2]	-
Unhydrated lime content, % by weight CaO	5.0 max	-	87.0 min
Free water content, % by weight H_2O :	5.0 max	-	-
SIZING			
Wet Sieve, as % by weight residue retained:			
No. 6	0.2 max	0.2 max[2]	8.0 max[3]
No. 30	4.0 max	4.0 max[2]	-
Dry sieve, as % by weight residue retained:			
1-inch	-	-	0.0
1/2-inch	-	-	10.0 max

Notes:
1. Maximum 5.0% by weight CaO shall be allowed in determining total active lime content.
2. Maximum solids content of slurry.
3. Total active lime content, as CaO, in material retained on No. 6 sieve shall not exceed 2.0% by weight of original Type C lime.

E. Deliver lime slurry to job site as commercial lime, or prepare at job site by using hydrated lime or quicklime. Provide slurry free of liquids other than water and of consistency that can be handled and uniformly applied without difficulty.

F. Lime containing magnesium hydroxide is prohibited.

2.03 SOIL

A. Soil to receive lime treatment may include borrow or existing subgrade material, existing pavement structure, or combination of all three. Where existing pavement or base material is encountered, pulverized or scarify material so that 100 percent of sampled material passes 2-inch sieve.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify compacted subgrade will support imposed loads.

B. Verify subgrade lines and grades.

3.02 PREPARATION

A. Complete backfill of utilities prior to stabilization.

B. Cut material to bottom of subgrade using an approved cutting and pulverizing machine meeting following requirements:

1. Cutters accurately provide smooth surface over entire width of cut to plane of secondary grade.

2. Provide cut to depth as specified or shown in the Drawings.

C. Alternatively, scarify or excavate to bottom of stabilized subgrade. Remove material or windrow to expose secondary grade. Obtain uniform stability.

D. Correct wet or unstable material below secondary grade by scarifying, adding lime, and compacting as directed by Project Manager.

E. Pulverize existing material so that 100 percent passes a 1-3/4-inch sieve.

3.03 LIME SLURRY APPLICATION

A. Apply slurry with distributor truck equipped with an agitator to keep lime and water in consistent mixture. Make successive passes over measured section of roadway to attain proper moisture and lime content. Limit spreading to an area where preliminary mixing operations can be completed on same working day.

B. Minimum lime content shall be 5 percent of dry unit weight of subgrade as determined by ASTM D 698

3.04 PRELIMINARY MIXING

A. Use approved single-pass or multiple-pass rotary speed mixers to mix soil, lime, and water to required depth. Obtain homogeneous friable mixture free of clods and lumps.

B. Shape mixed subgrade to final lines and grades.

C. Eliminate following operations and final mixing if pulverization requirements of Paragraph 3.05C can be met during preliminary mixing:

1. Seal subgrade as precaution against heavy rainfall by rolling lightly with light pneumatic rollers.

2. Cure soil lime material for 24 to 72 hours or as required to obtain optimum hydration. Keep subgrade moist during cure.

3.05 FINAL MIXING

A. Use approved single-pass or multiple-pass rotary speed mixers to uniformly mix cured soil and lime to required depth.

B. Add water to bring moisture content of soil mixture to optimum or above.

C. Mix and pulverize until all material passes 13/4-inch sieve; minimum of 85 percent, excluding non-slacking fractions, passes 3/4-inch sieve; and minimum of 60 percent excluding non-slacking fractions passes No. 4 sieve. Test according to TxDOT Tex-101-E, Part III using dry method.

D. Shape mixed subgrade to final lines and grades.

E. Do not expose hydrated lime to open air for 6 hours or more during interval between application and mixing. Avoid excessive hydrated lime loss due to washing or blowing.

3.06 COMPACTION

A. Aerate or sprinkle to attain optimum moisture content to 3 percent above optimum, as determined by ASTM D 698 on material sample from roadway after final mix with lime.

B. Start compaction immediately after final mixing.

C. Spread and compact in two or more equal layers where total compacted thickness is greater than equipment manufacturer's recommended range of mixing and compaction.

D. Compact with approved heavy pneumatic or vibrating rollers, or combination of tamping rollers and light pneumatic rollers. Begin compaction at bottom and continue until entire depth is uniformly compacted.

E. Do not allow stabilized subgrade to mix with underlying material. Correct irregularities or weak spots immediately by replacing material and recompacting.

F. Compact subgrade to minimum density of 95 percent of maximum dry density, according to ASTM D 698, at moisture content of optimum to 3 percent above optimum, unless otherwise indicated on Drawings:

G. Seal with approved light pneumatic tired rollers. Prevent surface hair line cracking. Rework and recompact at areas where hairline cracking develops.

3.07 CURING

A. Moist cure for minimum of 3 days before placing base or surface course, or opening to traffic. Subgrade may be opened to traffic after 2 days when adequate strength has been attained to prevent damage. Restrict traffic to light pneumatic rollers or vehicles weighing less than 10 tons.

B. Keep subgrade surface damp by sprinkling. Roll with light pneumatic roller to keep surface knit together.

C. Place base or surface within 14 days after final mixing and compaction. Restart compaction and moisture content of base material when time is exceeded.

3.08 TOLERANCES

A. Completed surface: smooth and conforming to typical section and established lines and grades.

B. Top of compacted surface: Plus or minus 1/4 inch in cross section or in 16-foot length.

C. Depth of lime stabilization shall be plus or minus one inch of specified depth for each 1000-foot roadway section.

3.09 FIELD QUALITY CONTROL

A. Testing will be performed under provisions of Section 01454 - Testing Laboratory Services.

B. Test soils, lime, and mixtures as follows:

1. Tests and analysis of soil materials will be performed in accordance with ASTM D 4318, using the wet preparation method.

2. Sampling and testing of lime slurry shall be in accordance with TxDOT Tex-600-J, except using a lime slurry cup.

3. Sample mixtures of hydrated lime or quicklime in slurry form will be tested to establish compliance with specifications.

4. Moisture-density relationship will be established on material sampled from roadway, after stabilization with lime and final mixing, in accordance with ASTM 698, Moist preparation Method.

C. In-place depth will be evaluated for each 1000-foot roadway section and determined in accordance with TxDOT Tex-140-E in hand excavated holes. For each 1000-foot section, 3 phenolphthalein tests will be performed. Average stabilization depth for 1000-foot section will be based on average depth for three tests.

D. Perform compaction testing in accordance with ASTM D 2922. Three tests will be performed for each 1000-foot roadway section.

E. Pulverization analysis will be performed as required by Paragraph 3.05C on material sampled during mixing of each production area. Three tests will be performed per 1000-foot roadway section or a minimum of once daily.

3.10 REWORK OF FAILED SECTIONS

A. Rework sections that do not meet specified thickness.

B. Perform the following steps when more than 72 hours have lapsed since completion of compaction.

1. Moist cure for minimum of 3 days after compaction to required density.

2. Add lime at rate of 25 percent of specified rate at no additional cost to City.

3. Moisture density test of reworked material must be completed by laboratory before field compaction testing can be completed.

3.11 PROTECTION

A. Maintain stabilized subgrade to lines and grades and in good condition until placement of base or surface course. Protect asphalt membrane from being picked up by traffic.

B. Repair defects immediately by replacing material to full depth.

END OF SECTION

Section 02465

DRILLED SHAFT FOUNDATIONS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Construction of foundations consisting of reinforced concrete drilled shafts.

1.02 MEASUREMENT AND PAYMENT

A. Unit Prices.

1. No separate payment will be made for drilled shaft foundations under this Section. Include cost in lump sum payment for structure requiring drilled shaft foundations.

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

B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for Work in this Section is included in total Stipulated Price.

1.03 SUBMITTALS

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

B. Submit work plan for each structure with complete written description which identifies details of proposed method of construction and sequence of operations for construction relative to drilled shaft activities. Descriptions, with supporting illustrations, shall be sufficiently detailed to demonstrate to Project Manager that procedures meet requirements of Specifications and Drawings.

C. Submit project record documents under provisions of Section 01785 - Project Record Documents. Record locations of drilled shafts, as installed referenced to survey benchmarks. Include location of utilities encountered or rerouted. Give horizontal dimensions, elevations, inverts and gradients.

1.04 REFERENCE STANDARDS

A. ACI 336.1 - Standard Specification for Construction of Drilled Piers

B. TxDOT Standard Specification Item 416 - Drilled Shaft Foundations

PART 2 PRODUCTS

2.01 EQUIPMENT

A. Perform excavation with equipment suitable for achieving requirements of this Specification.

2.02 MATERIAL

A. For cast-in-place concrete, use Class A concrete. Refer to Section 03310 - Structural Concrete.

B. For reinforcing steel, refer to Section 03211 - Reinforcing Steel

PART 3 EXECUTION

3.01 PREPARATION

A. Conduct an inspection to determine condition and locations of existing structures and other permanent installations, prior to commencing work.

3.02 EXCAVATION

A. Perform excavation required for drilled cylindrical shafts, at locations shown on Drawings through whatever materials encountered, to dimensions and elevations shown or required by site conditions. When satisfactory material is not encountered at plan depth, bottom of shaft will be adjusted or foundation altered, as determined by Project Manager, to satisfactorily comply with design requirements.

B. Do not make shaft excavations within 3 shaft diameters (edge to edge) of shafts which have been concreted within previous 24 hours.

C. Inspect drilled shaft excavations for verticality and side sloughing. Verticality is specified at one inch in 10 feet of shaft length. Check to full depth of dry auguring prior to introducing drilling mud. Straighten or add suitable reinforcing steel to shafts not meeting specified tolerance.

D. Slurry is to contain 4 to 8 percent by weight of bentonite additive and satisfy slurry specifications set forth in ACI 336.1, Section 2.3.5.2e. These requirements are more stringent than TxDOT Standard Specification Item 416.3.1. Stricter slurry specifications are required to assure suspension of detritus from drilling operations, and to ensure adequate cleaning of slurry prior to concreting. Cleaning of slurry is important to prevent deposition of detritus on reinforcement cages and ensure that inclusions of detritus will not be formed within concrete mass.

E. At final bearing elevation, clean bottom of each shaft and remove seepage water for examination by Project Manager before reinforcing steel and concrete is placed. Suitable access and lighting for proper inspection of completed excavation is to be provided. Reinforcing steel and concrete is to be placed in drilled shaft without delay after approval of excavation by Project Manager.

3.03 DRILLED SHAFT CONSTRUCTION

A. Drilled shaft construction and installation is to follow TxDOT Standard Specification Item 416 (with exceptions noted below) and ACI 336.1.

B. Before placing concrete, clean out shaft bottom with drilling bucket in order to remove sediments which may not be displaced by concrete. Clean shaft bottom with "clean-out" bucket until rotation on bottom without crowd (i.e., penetration under force) produces little spoil. Probing after cleaning out is essential to verify condition of base of shaft.

C. Concrete is to conform to requirements of ACI 336.1 Section 2.3.5.5.

D. Concrete is to be placed continuously in shaft to construction joint indicated on Drawings or as directed in TxDOT Standard Specification Item 416.3.3. Concrete is to be placed through suitable tube or tremie to prevent segregation of materials. Tremie pipe diameter is to be at least 8 times as large as largest concrete aggregate size.

E. Computation of final concrete volume for each shaft is to be made. Core and check the integrity of shafts taking an unreasonably high or low volume of concrete.

F. If caving soil conditions or excessive groundwater is encountered, use of temporary casing is permitted to prevent caving of material around shaft and to control seepage of groundwater into excavation.

G. Casing material is to be metal of ample strength to withstand handling stresses, pressure of concrete and of surrounding earth or backfill materials and is to be water-tight. Casing shall be smooth, clean and free of accumulations of hardened concrete. Outside diameter of casing is not to be less than specified diameter of drilled shaft.

H. Elapsed time is not to exceed one hour from beginning of concrete placement in cased portion of shaft, until extraction of casing is begun.

I. Withdraw temporary casings as shaft is filled with concrete, or immediately following concreting operation. Bottom of casing is to always remain at least one foot below level of concrete during placement to overcome hydrostatic pressure. Smoothly extract casing with vibratory hammer. Casing extraction is to be at slow, uniform rate with pull in line with vertical axis of shaft. Leave no casing in place.

J. If upward movement of concrete or reinforcing steel occurs inside casing at beginning of pulling operation or at anytime during pulling, stop pulling immediately and leave casing in place.

K. If casing must be left in place, Project Manager is to be informed to determine shaft capacity calculations.

3.04 FIELD QUALITY CONTROL

A. Testing will be performed under provisions of Section 01454 - Testing Laboratory Services.

3.05 DISPOSAL OF EXCESS MATERIAL

A. Dispose of excess materials in accordance with requirements of Section 01504 - Temporary Facilities and Control or Section 01576 - Waste Material Disposal.

END OF SECTION

Section 02502

STEEL PIPE AND FITTINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Steel pipe and fittings for water lines for aerial crossings, aboveground piping, and encasement sleeves. Do not bury steel pipe, unless it is large diameter water line.

B. Specifications identify requirements for small-diameter less than or equal to 20 inches.

1.02 MEASUREMENT AND PAYMENT

A. Unit Prices.

1. No payment will be made for steel pipe and fittings under this Section. Refer to Section 02511 - Water Lines for measurement and payment.

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

B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.03 REFERENCES

A. AASHTO - Standard Specifications for Highway Bridges.

B. ASME B 16.1 - Cast-Iron Pipe Flanges and Flanged Fittings.

C. ASTM A 36 - Standard Specification for Carbon Structural Steel.

D. ASTM A 53 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.

E. ASTM A 105 - Standard Specification for Carbon Steel Pipe Forgings for Piping Applications

F. ASTM A 106 - Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service.

G. ASTM A 135 - Standard Specification for Electric-Resistance-Welded Steel Pipe.

H. ASTM A 139 - Standard Specification for Electric-Fusion (ARC) - Welded Steel Pipe (NPS 4 and Over).

I. ASTM A 1011 - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.

J. ASTM D 4541 - Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers

K. AWWA C 200 - Standard for Steel Water Pipe 6 in. and Larger.

L. AWWA C 206 - Standard for Field Welding of Steel Water Pipe.

M. AWWA C 207 - Standard for Steel Pipe Flanges for Waterworks Service - Sizes 4 in. through 144 in.

N. AWWA C 210 - Standard for Liquid Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines.

P. AWWA M 11 – Steel Pipe – A Guide for Design and Installation.

O. SSPC Good Painting Practice, Volume 1.

P. SSPC SP 1 - Surface Preparation Specification No. 1 Solvent Cleaning.

Q. SSPC SP 5 - Joint Surface Preparation Standard White Blast Cleaning.

R. SSPC SP 6 - Surface Preparation Specification No. 6 Commercial Blast Cleaning.

S. SSPC SP 10 - Surface Preparation Specification No. 10 Near-White Blast Cleaning.

T. SSPC VIS 1 - Visual Standard for Abrasive Blast Cleaned Steel.

1.04 SUBMITTALS

A. Conform to requirements of Section 01330 - Submittal Procedures. For aerial crossings and above ground piping, include lay schedule of new pipe and fittings indicating alignment and grade, laying dimensions, lining and coating systems, proposed welding procedures, fabrication, fitting, flange, and special details. Show station numbers for pipe and fittings corresponding to Drawings.

B. Submit manufacturer's certifications that pipe and fittings are new and unused.

C. Submit manufacturer's certifications that pipe and fittings have been hydrostatically tested at factory in accordance with AWWA C 200.

D. Submit manufacturer's affidavits that coatings and linings comply with applicable requirements of this Section and:

1. Polyurethane coatings were applied in strict accordance with manufacturer's recommendation and allowed to cure at temperature 5 degrees above dew point.

2. Linings were applied and allowed to cure at temperature above 32 F.

E. Submit certification from NACE Certified Coatings Inspector, having Level III certification for coatings and linings, that steel pipe furnished on project was properly inspected and defective coatings detected were properly repaired.

1.05 QUALITY CONTROL

A. Prior to start of work, provide proof of certification of qualification for welders employed for type of work, procedures and positions involved. Provide welder qualifications in accordance with AWWA C 206.

B. Shop-applied coatings and linings; provide services of an independent coating and lining inspection service or testing laboratory with qualified coating inspectors. Perform inspection by NACE trained inspectors under supervision of NACE Level III Certified Coatings Inspector verifying compliance with same requirements specified in Paragraph 3.02.

C. Coatings: Measure temperature and dew point of ambient air before applying coatings. Inspect physical dimensions and overall condition of coatings. Inspect for visible surface defects, thickness, and adhesion of coating to surface and between layers.

D. Final Inspection:

1. Before shipment, inspect each finished pipe, fitting, special and accessory for markings, metal thickness, coating thickness, lining thickness (if shop applied), joint dimensions, and roundness.

2. Inspect for coating placement and defects. Test exterior coating for holidays.

a. Inspect linings for thickness, pitting, scarring, and adhesion.

E. Ensure workmen engaged in manufacturing are qualified and experienced in performance of their specific duties.

PART 2 P R O D U C T S

2.01 STEEL PIPE

A. Manufacture pipe with nominal diameter 20 inches and less but more than 2 inches to conform to ASTM A106 or A 53 Grade B, standard weight.

B. Provide steel pipe and encasement sleeves designed and manufactured in conformance with AWWA C 200 and AWWA M 11 except as modified herein. Steel to be minimum of ASTM A 36, ASTM A 1011 Grade 36, ASTM A 53 Grade B, ASTM A 135 Grade B, or ASTM A 139 Grade B.

C. Minimum Allowable Steel-Wall Thickness:

CARRIER PIPE			
Nom. Pipe Size (In.)	Min. Wall		Approx. Wt. Per L. F. Uncoated (Lb.)
	O.D. (In.)	Thick. (In.)	
4	4.50	0.250	11.35
6	6.625	0.280	18.97
8	8.625	0.322	28.55
10	10.75	0.365	40.48
12	12.75	0.375	49.56
16	16.00	0.375	62.58
20	20.00	0.375	78.60

Notes Carrier Pipe:

1. Review pipe and fitting design for conditions exceeding those specified herein.

2. Provide pipe with wall thickness of no less than listed in table above.

MINIMUM DIAMETER CASING PIPE (ENCASEMENT SLEEVES)			
Corresp. Casing Pipe Size (In.)	Min. Wall		Approx. Wt. Per L. F. Uncoated (Lb.)
	O.D. (In.)	Thick. (In.)	
8	8.625	0.219	19.64
10	10.75	0.219	24.60
12	12.75	0.219	29.28
16	16.00	0.219	36.86
18	18.00	0.25	47.39
20	20.00	0.250	52.73
24	24.00	0.250	63.41

Notes for Casing Pipe:

1. Provide casing pipe with wall thickness of no less than listed in table above.

2. Casing pipe: AWWA C 200 new uncoated welded steel.

3. Verify casing diameter required with dimensions of casing spacer.

D. Provide pipe sections in lengths of no less than 16 feet except as required for special sections, and no greater than 40 feet.

E. Provide short sections of steel pipe no less than 4 feet in length unless indicated on Drawings or specifically permitted by Project Manager.

F. Fittings: Factory forged for sizes 4 inches through 20 inches; long radius bends; beveled ends for field butt welding; wall thickness equal to or greater than pipe to which fitting is to be welded unless otherwise shown on Drawings.

G. Joints:

1. Standard field joint for steel pipe and encasement sleeve: AWWA C 206. Single-welded, butt joint.

2. Electrically isolate flanged joints between steel and cast iron by using flange isolation fittings as specified in paragraph 2.03 of Specification Section 15460 – Joint Bonding and Electrical Isolation. Use epoxy coated nuts and bolts to assemble the fittings.

3. Elbows to be standard weight seamless elbows per ASTM A106, Grade A or B.

4. Flanges for pipe 20 inches in diameter and smaller shall be ANSI 150 lb. flat face, slip on or weld neck flanges, meeting ASTM A105 requirements. Where flanges are to join to valves with raised face flanges, use ANSI 150 lb. raised flange.

5. Provide same coating for exposed portions of nuts and bolts as flanges which they secure.

H. Fabricate flanges with over-size bolt holes, with flanges drilled in pairs, to accommodate insulating sleeves.

2.02 INTERNAL LINING SYSTEMS FOR STEEL PIPE, ALL INSTALLATIONS

A. Supply steel pipe with epoxy lining, capable of conveying water at temperatures not greater than 140 degrees F. Provide linings conforming to American National Standards Institute/National Sanitation Foundation (ANSI/NFS) Standard 61 and certification to be from organization accredited by ANSI. Unless otherwise noted, coat exposed (wetted) steel parts of flanges, blind flanges, bolts, access manhole covers, etc., with epoxy lining, as specified.

B. Epoxy Lining AWWA C 210, White, or approved equal for shop and field joint applied, except as modified in this Section. Provide material from same manufacturer. For Pipe larger than 2 inches in diameter protect interior surface with liquid two-part chemically cured epoxy primer specified for interior surfaces.

Surface Preparation 2.0 to 3.0 mils surface profile	SSPC-5 (64) White Blast Clean
Prime Coat 4.0 to 6.0 mils DFT	NSF Certified Epoxy - Buff, or approved equal
Intermediate Coat 4.0 to 6.0 mils DFT	NSF Certified Epoxy - Buff, or approved equal
Finish Coat 4.0 to 6.0 mils DFT	NSF Certified Epoxy - White, or approved equal

1. Total allowable dry film thickness for system:

   a. Minimum: 12.0 mils.

   b. Maximum: 18.0 mils.

   c. Minimum field adhesion: 700 psi.

2. Dry film thicknesses for approved alternate products in accordance with product manufacturer's recommendations.

3. Lining system may consist of three or more coats of same approved alternate epoxy lining without use of separate primer.

2.03 EXTERNAL COATING SYSTEM FOR STEEL PIPE INSTALLED ABOVEGROUND AND IN VAULTS (EXPOSED)

A. Provide 3-coat-epoxy/polyurethane coating system as designated below. Provide material from same manufacturer.

Surface Preparation 2.0 to 3.0 mils surface profile	SSPC SP 10 Near White Blast Clean
Prime Coat 4.0 to 6.0 mils DFT	Inhibitive Epoxy Primer, or approved equal
Intermediate Coat 4.0 to 6.0 mils DFT	Chemical Resistant Epoxy, or approved equal
Finish Coat 1.5 to 2.5 mils DFT	Polyurethane, or approved equal Blue Fed Std. No. 15102 color as approved by Project Manager

B. Total Allowable Dry Film Thickness (DFT) for System:

1. Minimum: 9.5 mils.

2. Maximum: 12.5 mils.

C. Clean bare pipe free from mud, mill lacquer, oil, grease, or other contaminant. Inspect and clean surfaces according to SSPC-SP-1 to remove oil, grease, and loosely adhering deposits prior to blast cleaning. Remove visible oil and grease spots by solvent wiping. Use only approved safety solvents which do not leave residue. Use preheating to remove oil, grease, mill scale, water, and ice provided pipe is preheated in uniform manner to avoid distortion.

D. Remove surface imperfections such as slivers, scabs, burrs, weld spatter, and gouges, presence of metallic defects may be cause for rejection of pipe.

PART 3 EXECUTION

3.01 PIPING INSTALLATION

A. Conform to applicable provisions of Section 02511 - Water lines, except as modified in this Section.

B. Comply with the following:

1. Bedding and Backfilling: Conform to requirements of Section 02317 - Excavation and Backfill for Utilities.

2. For pipes with coating: Do not roll or drag pipe on ground, move pipe in such a manner as not to damage pipe or coating. Carefully inspect pipe for abrasions and repair damaged coating before pipe is installed.

C. Static Electricity:

1. Properly ground steel pipeline during construction as necessary to prevent build-up of static electricity.

2. Electrically test where required after installation is complete.

3.02 EXTERNAL COATING SYSTEM FOR STEEL PIPE INSTALLED ABOVE GROUND AND IN VAULTS (EXPOSED) AND EPOXY INTERNAL LINING SYSTEM.

A. Safety: Paints, coatings, and linings specified in this Section are hazardous materials. Vapors may be toxic or explosive. Protective equipment, approved by appropriate regulatory agency, is mandatory for personnel involved in painting, coating, and lining operations.

B. Workmanship:

1. Application: By qualified and experienced workers who are knowledgeable in surface preparation and application of high-performance industrial coatings.

2. Paint Application Procedures: SSPC Good Painting Practices, Volume 1.

C. Surface Preparation:

1. Prepare surfaces for painting by using abrasive blasting.

2. Schedule cleaning and painting so that detrimental amounts of dust or other contaminants do not fall on wet, newly-painted surfaces. Protect surfaces not intended to be painted from effects of cleaning and painting operations.

3. Prior to blasting, clean surfaces to be coated or lined of grease, oil and dirt by steaming or detergent cleaning in accordance with SSPC SP 1.

4. Metal and Weld Preparation: Remove surface defects such as gouges, pits, welding and torch-cut slag, welding flux and spatter by grinding to 1/4-inch minimum radius.

5. Abrasive Material:

   a. Blast only as much steel as can be coated same day of blasting.

   b. Use sharp, angular, properly graded abrasive capable of producing depth of profile specified herein. Transport abrasive to job site in moisture-proof bags or airtight bulk containers. Copper slag abrasives are not acceptable.

   c. After abrasive blast cleaning, verify surface profile with replica tape such as Tes-Tex Coarse or Extra Coarse Press-O-Film Tape, or approved equal. Furnish tapes to Project Manager.

   d. Do not blast if metal surface may become wet before priming commences, or when metal surface is less than 5 degrees F above dew point.

6. Evaluate degree of cleanliness for surface preparation with use of SSPC Pictorial Surface Preparation Standards for Painting Steel Surfaces, SSPC-Vis 1.

7. Remove dust and abrasive residue from freshly blasted surfaces by brushing or blowing with clean, dry air. Test cleanliness by placing ¾-inch by-4 inch piece of clear Scotch type tape on blasted surface, then removing and placing tape on 3x5 white index card. Reclean areas exhibiting dust or residue.

D. Coating and Lining Application:

1. Environmental Conditions: Do not apply coatings or linings when metal temperature is less than 50 degrees F; when ambient temperature is less than 5 degrees F above dew point; when expected weather conditions are such that ambient temperature will drop below 40 degrees F within 6 hours after application; or when relative humidity is above 85 percent. Measure relative humidity and dew point by use of sling psychrometer in conjunction with U.S. Department of Commerce Weather Bureau Psychometric Tables. Provide dehumidifiers for field-applied coatings and linings to maintain proper humidity levels.

2. Application Procedures:

   a. Apply in accordance with manufacturer's recommendations and requirements of this Section. Provide finish free of runs, sags, curtains, pinholes, orange peel, fish eyes, excessive over spray, or delaminations.

   b. Thin materials only with manufacturers recommended thinners. Thin only amount required to adjust viscosity for temperature variations, proper atomization and flow-out. Mix material components using mechanical mixers.

c. Discard catalyzed materials remaining at end of day.

3. Thoroughly dry pipe before primer is applied. Apply primer immediately after cleaning surface. Apply succeeding coats before contamination of undersurface occurs.

4. Cure a minimum of 24 hours at 77 degrees F before successive coats are applied. During curing process, provide force air ventilation in volume sufficient to maintain solvent vapor levels below published threshold limit value. Apply successive coats within recoat threshold time as recommended by coating or lining manufacturer on printed technical data sheets or through written communications. Brush blast joints of pipe which have been shop primed and are to receive intermediate and finish coats in field prior to application of additional coats. After interior coatings are applied, provide forced air ventilation in sufficient volume and for sufficient length of time to ensure proper curing before filling pipe with water.

E. Testing of Coatings and Linings:

1. Inspect pipe for holidays and damage to coating:

   a. If test indicates no holidays and coating is damaged, remove damaged layers of coating and repair in accordance with coating manufacturer's recommendations.

2. Perform holiday test in accordance with NACE Standard Recommended Practice, RPO 188-90, Discontinuity (Holiday) Testing of Protective Coatings.

3. Begin testing of completed coating after coating has sufficiently cured, usually one to 5 days. Consult coating manufacturer for specific curing schedule.

4. Perform adhesion test on pipe in accordance with ASTM D 4541.

5. For coating thickness of 20 mils or less, test with wet sponge low-voltage holiday detector. For coating thickness in excess of 20 mils, test with high-voltage holiday detector. Perform electrical holiday test with 60-cycle current audio detector. Select test voltage as suggested in table below.

MINIMUM VOLTAGES FOR
HIGH VOLTAGE SPARK TESTING

Total Dry Film Thickness (mils)	Suggested Inspection (V)
20 to 40	3,000
41 to 55	4,000
56 to 80	6,000

3.03 JOINTS AND JOINTING

A. Welded Joints:

1. Conform to requirements of Section 02511 - Water Lines.

2. Field weld to be full penetration butt welded joints for steel pipe and encasement sleeves for entire circumference.

3. City will employ an independent certified testing laboratory to perform weld acceptance tests on welded joints. Testing Laboratory will test by X-ray methods for butt welds, for 100 percent of joint welds. Project Manager has final decision as to suitability of welds tested.

B. Flanged Joints: Conform to requirements of Section 02511 - Water Lines.

C. Joint Grouting and Testing: Conform to requirements of Section 02511 - Water Lines.

3.04 COATINGS AND LININGS INSPECTION RESPONSIBILITIES

A. Contractor is responsible for quality control of coatings and linings applications and testing and inspection stipulated in this Section. Project Manager is responsible for quality assurance and reserves the right to inspect or acquire services of an independent third-party inspector who is fully knowledgeable and qualified to inspect surface preparation and application of high-performance coatings at all phases of coatings and linings work, field- or shop-applied. Contractor is responsible for proper application and performance of coatings and linings whether or not Project Manager provides such inspection.

END OF SECTION

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Section 02511

WATER LINES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Installation of water lines.

B. Specifications identify requirements for both small diameter water lines and large diameter water lines. When specifications for large diameter water lines differ from those for small diameter water lines, large diameter specifications will govern for large diameter pipe.

1.02 MEASUREMENT AND PAYMENT

A. Unit Prices.

1. Payment for water lines installed by open-cut, trenchless construction with or without casing, aerial crossing, and pipe offset section or within limits of Potentially Petroleum Contaminated Area (PPCA) is on linear foot basis for each size of pipe installed. Separate pay items are used for each type of installation:

   a. Mains: Measure along axis of pipe and include fittings and valves.

   b. Branch Pipe: Measure from axis of water line to end of branch.

2. Payment for interconnection is on lump sum basis for each interconnection identified on Drawings. Payment will include tapping sleeve and valves piping, connections and other related work necessary for construction as shown on Drawings or specified herein.

3. Payment for removal of existing internal elliptical or dished head plug is on unit price 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 items incidental to operation.

4. Payment for plug and clamp is on a unit price basis for each size of pipe.

5. Payment for drainline connection with service manhole is on unit price basis for each drainline shown on drawings. Payment includes valve, access manhole and connection.

6. Payment for cylindrical corrosion barriers is on a unit price basis for each pipe fitting installed with one or more barriers.

7. When directed by Project Manager to install extra fittings as required to avoid unforeseen obstacles, payment will be based on the following:

   a. Each extra fitting requested by Project Manager and delivered to jobsite will be paid according to unit price for "Extra Fittings in Place."

   b. Payment will include and be full compensation for items necessary for installation and operation of water line.

8. Payment for pipe support structure, including pipe guards will be paid on a lump sum basis for each aerial crossings. Payment includes related work performed in accordance with related Sections.

9. No separate payment will be made for pavement removal and replacement of surface improvement necessary for augering, tunneling, or other trenchless methods of installation, unless shown on drawings.

10. Refer to Section 01270 - Measurement and Payment for unit price procedures.

B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.03 REFERENCES

A. ANSI A 21.11/AWWA C111 - Standard for Rubber-Gasket Joints for Ductile - Iron Pressure Pipe and Fittings.

B. ANSI/NSF Standard 61 - Drinking Water System -Health Components.

C. ASTM A 36 - Standard Specification for Carbon Structural Steel

D. ASTM A 536 - Standard Specification for Ductile Iron Castings

E. ASTM A 126 - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.

F. ASTM B 21 - Standard Specification for Naval Brass Rod, Bar, and Shapes.

G. ASTM B 98 - Standard Specification for Copper-Silicon Alloy Rod, Bar, and Shapes.

H. ASTM B 301 - Standard Specification for Free-Cutting Copper Rod and Bar.

I. ASTM B 584 - Standard Specification for Copper Alloy Sand Casting for General Application.

J. ASTM E 165 - Standard Test Method for Liquid Penetrant Examination

K. ASTM E 709 - Standard Guide for Magnetic Particle Examination

L. ASTM F 1674 - Standard Test Method for Joint Restraint Products for Use with PVC Pipe.

M. AWWA C 206 - Standard for Field Welding of Steel Water Pipe.

N. AWWA C 207 - Standard for Steel Pipe Flanges for Waterworks Service - Sizes 4 Inches through 144 Inches.

1.04 SUBMITTALS

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

B. Conform to submittal requirements of applicable Section for type of pipe used.

C. Photographs: Submit photographs conforming to requirements of Section 01321 - Construction Photographs prior to commencement of construction.

D. Submit Lone Star notification transmittal number prior to beginning excavation.

E. Submit, a minimum of 15 days before beginning pipe laying operations, layout drawing identifying proposed sections for disinfecting, hydrostatic testing and site restoration for entire project for review and approval. Layout drawing to identify sequence of sections for:

1. Disinfection according to the following criteria:

   a. 2,000 linear feet for small diameter pipelines (20-inches in diameters or smaller)
   b. 4,000 linear feet for large diameter pipelines (24-inches in diameters or larger)

2. Hydrostatic testing and transfer of services; to immediately follow sequence of disinfected section.

3. Site restoration; not to exceed limits specified; Sequence in order of disturbance.

F. For pipe with bell-and-spigot ends with rubber gasket, submit complete joint details with dimensions and tolerances and performance history indicating the proposed joint has performed satisfactorily under similar conditions.

PART 2 P R O D U C T S

2.01 PIPE MATERIALS

A. Install pipe materials which conform to following:

1. Section 02501 - Ductile Iron Pipe and Fittings.

2. Section 02502 - Steel Pipe and Fittings. Water line piping within plant site and aerial crossings to be welded joint steel pipe with flange or approved restraint joint connections, unless otherwise shown on Drawings.

3. Section 02506 - Polyvinyl Chloride Pipe.

4. Section 02507 - Prestressed Concrete Cylinder Pipe.

5. Section 02518 - Steel Pipe and Fittings for Large Diameter Water Lines.

6. Section 02613 - Bar-Wrapped Steel Cylinder 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.

D. Provide minimum of 3/8 inch inside joint recess between ends of pipe in straight pipe sections.

E. Pipe Manufacturer: Performance history shall be minimum 5 years of successful field installations with proposed pipe diameter and proposed type of pipe joint. In absence of 5-year performance history for proposed pipe diameter, the following items shall be required for review by Project Manager prior to approval:

a. Quality Assurance Program: Submit certified quality assurance program addressing all aspects of pipe manufacturing process, including coating and lining applications. Certified program shall be ISO 9001; 2000 or other equivalent industry standard nationally recognized program.

b. Hydrostatic Joint Test: Perform hydrostatic test of proposed joint at proposed pipe diameter in presence of Project Manager. Test duration shall be minimum 8 hours at 150 psi with no leakage, with pipe cylinder deflected at joint to 3% of nominal diameter, with maximum allowable joint engagement deflection.

c. Provide minimum four (4) weeks notice to Project Manager for hydrostatic joint test. Submit test procedures to Project Manager for approval.

Project Manager's decision as to acceptability of joint is final.

2.02 WELDED JOINT PROTECTION FITTING FOR SMALL DIAMETER STEEL PIPE

A. Cylindrical Corrosion Barrier: Provide approved cylindrical corrosion barrier.

B. O-rings: Conform to National Sanitary Foundation requirements.

2.03 RESTRAINED JOINTS

A. Ductile-Iron Pipe: See Section 02501 - Ductile Iron Pipe and Fittings.

B. PVC Pipe: See Section 02506 - Polyvinyl Chloride Pipe. Perform hydrostatic testing in accordance with ASTM F 1674.

C. Prestressed Concrete Cylinder Pipe, Bar-Wrapped Pipe and Steel Pipe: Welded joints (see Paragraph 3.06 D).

D. Restrained Joints where required on DIP and PVC pipe is allowed with the following requirement as an alternative to the pipe with an integral restrained joint systems:

1. Restraint devices: Manufacture of high strength ductile iron, ASTM A 536 up to 24 inches, and ASTM A 36 for sizes greater than 30 inches. Working pressure rating twice that of design test pressure.

2. Bolts and connecting hardware: High strength low alloy material in accordance with ANSI A21.11/AWWA C111.

E. Ductile Iron Pipe in auger holes must be provided with integral restrained joints at both the bell and the spigot.

2.04 COUPLINGS AND APPURTENANCES FOR LARGE DIAMETER WATERLINE

A. Flexible (Dresser-type) Couplings.

1. Install where shown on Drawings or where allowed by Project Manager 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; provide approved sleeve-type flexible couplings. Thickness of middle ring equal to or greater than thickness of pipe wall.

3. Provide approved flanged adapter couplings for steel pipe

4. Use Type 316 stainless steel bolts, nuts and washers where flexible couplings are installed underground. Coat entire coupling with 20-mil of approved coal tar coating.

B. Flap Valves: Provide approved flap valves 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:

4. Hinge Arms: ASTM B 584-CA865 high tensile bronze.

5. Hinge pins: ASTM B 98-CA655 silicon bronze.

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.

C. Lay pipe to lines and grades shown on Drawings.

D. Confirm that nine feet minimum separation from gravity sanitary sewers and manholes or separation of four feet minimum from force mains as specified in this Section in all directions unless special design is provided on Drawings.

E. Where above clearances cannot be attained, and special design has not been provided on Drawings, obtain direction from Project Manager before proceeding with construction.

F. Inform Project Manager if unmetered sprinkler or fire line connections exist which are not shown on Drawings. Make transfer only after approval by Project Manager.

G. For projects involving multiple subdivisions or locations, limit water line installation to maximum of two project site locations. Maximizing 2 pipe installation crews shall be permitted, unless otherwise approved by Project Manager.

H. City of Houston Utility Operations Division 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 (A.C.) pipe is encountered, follow safety practices outlined in American Water Works Association's publication, "Work Practices for A/C Pipe". Strictly adhere to "recommended practices" contained in this publication and make them "mandatory practices" for this Project.

J. For pipe diameters 36 inches and greater, clearly mark each section of pipe and fitting with unique designation on inside of pipe along with pressure class. Locate unique identifying mark minimum of five feet away from either end of each section of pipe. Provide one unique identifying mark in middle of each fitting. Place markings at consistent locations. Use permanent black paint and minimum letter height of 4 inches to mark designations.

K. Contractor is responsible for assuring chosen manufacturer fulfills requirements for extra fittings and, therefore, is responsible for costs due to downtime if requirements are not met.

L. Do not remove plugs or clamps during months of peak water demands; June, July and August, unless otherwise approved by Project Manager.

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 lines, handle pipe only by means of sling of canvas, leather, nylon, or similar material. Sling shall be 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. For cement mortar line and coated steel pipe, permit no visible cracks longer than 6 inches, measured within 15 degrees of line parallel to pipe longitudinal axis of finished pipe, except:

   a. In 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 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 and Section 02447 - Augering Pipe and Conduit.

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 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 Water tamping is not allowed.

E. Pipe Embedment: 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 Project Manager. 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. General Requirements:

1. Lay pipe in subgrade free of water.

2. Make adjustments of pipe to line and grade by scraping away subgrade or filling in with granular material.

3. Properly form bedding to fully support bell without wedging or blocking up bell.

4. Open Cut Construction: Keep pipe trenches free of water which might impair pipe laying operations. Grade trench to provide uniform support along bottom of pipe. Excavate for bell holes after bottom has been graded and in advance of placing pipe. Lay not more than 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.

B. Install pipe continuously and uninterrupted along each street on which work is to be performed. Obtain approval of Project Manager prior to skipping any portion of Work.

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.

D. Perform Critical Location as shown on Drawings. Refer to Section 02317 - Excavation and Backfill for Utilities for additional requirements at critical locations.

E. Laying Large Diameter Water Line

1. Lay not more than 50 feet of pipe in trench ahead of backfilling operations.

2. Dig trench proper width as shown. When trench width below top of pipe becomes 4 feet wider than specified, install higher class of pipe or improved bedding, as determined by Project Manager. No additional payment will be made for higher class of pipe or improved bedding.

3. 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 100 feet on record drawings.

4. Prevent damage to coating when placing backfill. Use backfill material free of large rocks or stones, or other material which could damage coatings.

5. Before assembling couplings, lightly coat pipe ends and outside of gaskets with cup grease or liquid vegetable soap to facilitate installation.

6. Prior to proceeding with critical tie-ins submit sequence of work based on findings from "critical location" effort.

F. Perform following additional procedures when working on plant sites.

1. Seventy-two hours prior to each plant shut down or connection, schedule coordination meeting with Project Manager and Water Production personnel. At this meeting, present proposed sequencing of Work and verification of readiness to complete Work as required and within time permitted. Do not proceed with Work until Project Manager agrees key personnel, equipment and materials are on hand to complete Work.

2. Prior to fully excavating around existing piping, excavate as minimal as possible to confirm type and condition of existing joints. Verify size, type, and condition of pipe prior to ordering materials or fully mobilizing for Work.

3. Do not proceed with connections to existing piping and identified critical stages of work unless approved by Project Manager and City's Utility Maintenance Division operator is present to observe.

4. Coordinate with Public Utilities Division (PUD) operators to obtain reduction in operating pressures prior to performing connections to existing piping.

5. Make connections to existing piping only when two valves are closed off between connection and source of water pressure. Do not make connection relying solely on one valve, unless otherwise approved by Project Manager.

6. Perform critical stages of Work identified on Drawings at night or during low water demand months as specified in Section 01110 - Summary of Work.

7. Excavation equipment used on plant sites to have smooth bucket; no teeth or side cutters.

8. Submit to Project Manager Lone Star Notification transmittal number prior to beginning excavation.

9. Before each "dig" with mechanical excavator, probe ground to determine potential obstructions. Repeat procedure until existing pipe is located or excavation reaches desired elevation. Perform excavations within one foot to existing piping by hand methods.

10. Provide adequate notice to pipe manufacture's representative when connecting or modifying existing prestressed or pretension concrete cylinder pipe.

11. Provide field surveyed (horizontal and vertical elevations) "as-builts" of new construction and existing underground utilities encountered. Submit in accordance with Section 01330 - Submittal Procedures.

12. Prior to performing plant work to be done on weekend, provide list of sites and contact person with phone numbers to Project Manager by noon on Thursday of week. Contact person must be accessible during weekend, have Houston Metro Area phone number, and be authorized to make emergency decisions.

13. No night work or plant shut down will be scheduled to begin two working days before or after designated City Holidays.

G. For tie-ins to existing water lines, provide necessary material on hand to facilitate connection prior to shutting down existing water line. Provide City a minimum of two weeks notice prior to shutting down existing water line.

3.06 JOINTS AND JOINTING

A. Rubber Gasketed Bell-and-Spigot Joints for Concrete Cylinder Pipe, Bar Wrapped 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 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 as shown on Drawings.

   a. Include buoyancy conditions for soil unit weight when computing thrust restraint calculations.

   b. Do not include passive resistance of soil in thrust restraint calculations.

6. Except for PVC pipe, provide means to prevent full engagement of spigot into bell as shown on Drawings. Means may consist of wedges or other types of stops as approved by Project Manager.

7. Use feeler gauge to verify water-tightness of each pipe joint prior to application of joint grout. Perform feeler gauge test from interior of pipe, immediately after installation and after backfilling and compaction. Perform feeler gauge test in accordance with manufacturer's recommendations to determine if the joint is within tolerance. Provide

results to Project Manager. Notify Project Manager immediately when a joint is found to be out of tolerance or fails feeler gauge test, and submit repair plan for approval by Project Manager.

B. Flanged Joints where required on Concrete Cylinder Pipe, Bar Wrapped Pipe, Ductile Iron Pipe, or Steel Pipe:

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 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. Maintain at all times approximately same distance between two flanges at points around flanges. Tighten bolts alternately (180° apart) until all are evenly tight. Draw bolts tight to ensure proper seating of gaskets. Provide Densco petroleum based tape or approved equal for all exposed portions of nuts, bolts and pipe.

4. Full length bolt isolating sleeves and washers shall be used with flanged connections. Furnish kits in accordance with City's "Approved Products List."

5. For in-line flange joints 30 inches in diameter and greater and at butterfly valve flanges, provide Pyrox G-10 with nitrite seal, conforming to ANSI A 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 nitrite seal gasket conforming to ANSI A 21.11 mechanical joint gaskets.

C. Welded Joints (Concrete Cylinder Pipe, Bar Wrapped Pipe, Steel Pipe):

1. Prior to starting work, provide certification of qualification for welders employed on 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 ½ 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, take care 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 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 Lines:

    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 ½ degrees.

    d. For large diameter water lines, employ an independent certified testing laboratory, approved by Project Manager, to perform weld acceptance tests on welded joints. Include cost of such testing and associated work to accommodate

testing in contract unit price bid for water line. Furnish copies of test reports to Project Manager for review. Project Manager has final decision as to suitability of welds tested.

1) Weld acceptance criteria:

a) Conduct in accordance with ASTM E165- Standard Test Method for Liquid Penetrant Examination and ASTM E709 Standard Guide for Magnetic Particle Examination. Use X-ray methods for butt welds, for 100 percent of joint welds.

b) Examine welded surfaces for the following defects:

i) Cracking.

ii) Lack of fusion/penetration.

iii) Slag which exceeds one-third (t) where (t) equals material thickness.

iv) Porosity/Relevant rounded indications greater than 3/16 inch; rounded indication is one of circular or elliptical shape with length equal to or less than three times its width.

v) Relevant linear indications in which length of linear indication exceeds three times its width.

vi) Four or more relevant 1/16-inch rounded indications in line separated by 1/16 inch or less edge to edge.

14. After pipe is joined and prior to start of welding procedure, make spigot and bell essentially concentric by jacking, shimming or tacking to obtain clearance tolerance around periphery of joint except for deflected joints.

15. Furnish each welder employed steel stencil for marking welds, so work of each welder can be identified. Mark pipe with assigned stencil adjacent to weld. When welder leaves job, stencil must be voided and not duplicated. Welder making defective welds must discontinue work and leave project site. Welder may return to project site only after recertification.

16. Provide cylindrical corrosion barriers for epoxy lined steel pipe 24-inch diameter and smaller, unless minimum wall thickness is 0.5 inches or greater.

a. In addition to welding requirements contained here in Paragraph 3.06, conform to protection fitting manufacturer's installation recommendations.

b. Provide services of technical representative of manufacturer available on site at beginning of pipe laying operations. Representative to train welders and advise regarding installation and general construction methods. Welders must have 12 months prior experience installing protection fittings.

c. All steel pipe is to have cutback 3/4 inch to no greater than 1 inch of internal diameter coating from weld bevel.

d. Furnish steel fittings with cylindrical corrosion barriers with shop welded extensions to end of fittings. Extension length to measure no less than diameter of pipe. Shop apply lining in accordance with AWWA C 210 or AWWA C 213.

e. All steel pipe receiving field adjustments are to be cold cut using standard practices and equipment. No cutting using torch is to be allowed.

D. Harnessed Joints (Concrete Cylinder Pipe, Bar Wrapped Pipe):

1. Use of snap-ring type restrained joints on pipe is limited to 20-inch through 48-inch diameters.

2. Position snap-ring joint bolt on top (12 o'clock portion). Provide minimum 1/2-inch joint recess. Use joint "diapers" 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 bend greater than 5 degrees.

5. Install harness type joints including snap rings at straight sections of pipe.

E. Restrained Joints

1. For existing water lines and water lines less than 16 inches in diameter, restrain pipe joints with concrete thrust blocks.

2. 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 for large diameter lines and ductile iron pipe for small diameter lines. 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 in State of Texas for review by Project Manager. Make adjustments in thrust restraint lengths at no additional cost to City.

3. Passive resistance of soil will not be permitted in calculation of thrust restraint.

4. For 16-inch lines and larger 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 restraint joints for a minimum length of 16 feet on each side of beveled joints.

5. Installation.

   a. Install restrained joints mechanism in accordance with manufacturer's recommendations.

   b. Examine and clean mechanism; remove dirt, debris and other foreign material.

   c. Apply gasket and joint NSF 61 FDA food grade approved lubricant.

   d. Verify gasket is evenly seated.

   e. Do not over stab pipe into mechanism.

6. Prevent any lateral movement of thrust restraints throughout pressure testing and operation.

7. 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.

F. Joint Grout (Concrete Cylinder Pipe, Bar Wrapped Pipe, Steel Pipe):

1. Mix cement grout mixture 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. Place 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: 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 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 structurally protective material. Do not remove band from joint. Proceed with placement of additional bedding and backfill material.

7. Interior Joints for Pipe 24 inches and Smaller: 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 swab approved by Project Manager 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 joint bands are protected by zinc metallizing or other approved protective coatings.

9. Remove and replace improperly cured or otherwise defective grout.

10. Strike off grout on interior joints and make smooth with inside diameter of pipe.

11. When installed in tunnel or encasement pipe and clearance within casing does not permit outside grout to be placed in normal manner, apply approved flexible sealer, such as Flex Protex 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.

12. Interior Joints for Water Lines 30 inches and Larger: Clean joint space, wet joint surfaces, fill with stiff grout and trowel smooth and flush with inside surfaces of pipe using steel trowel so that surface is smooth. Accomplish grouting at end of each work day. Obtain written acceptance from Project Manager of inside joints before proceeding with next day's pipe laying operation. During inspection, insure no delamination of joint mortar has occurred by striking joint mortar lining with rubber mallet. Remove and replace delaminated mortar lining.

13. Work which requires heavy equipment to be over water line must be completed before mortar is applied to interior joints.

14. Do not apply grout to joints that are out of tolerance until acceptable repairs are made.

G. Large Diameter Water Main Joint Testing: In addition to testing individual joints with feeler gauge approximately 1/2 inch wide and 0.015-inch thick, use other joint testing procedure approved or recommended by pipe manufacturer which will help ensure watertight installation prior to backfilling. Perform tests at no additional cost to City.

H. Make curves and bends by deflecting joints or other method as recommended by manufacturer and approved by Project Manager. Submit details of other methods of providing curves and bends which exceed manufacturer's recommended deflection prior to installation.

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 Project Manager at 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 curve, join pipe in straight alignment and then deflect to curved alignment.

I. Closures Sections and Approved Field Modifications to Steel, Concrete Cylinder Pipe, Bar Wrapped Pipe and Fittings:

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 pipe diameters 36 inches and greater, perform field welds on interior and exterior of pipe.

4. For large diameter water lines, provide minimum overlap of 4 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 including test stations at connections to existing water system or at locations to isolate one type of cathodic system from another type, between water line, access manhole piping and other major openings in water line, 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 or as shown on Drawings. No additional bonding required where joints are welded for thrust restraint. Repair coatings as specified by appropriate AWWA standard, as recommended by manufacturer, and as approved by Project Manager.

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 line 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 begins 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 POLYETHYLENE WRAP FOR DUCTILE IRON PIPE

A. Double wrap pipe and appurtenances (except fire hydrants and fusion bond or polyurethane coated fittings) with 8-mil polyethylene film.

B. Conform to requirements of Section 02528 - Polyethylene Wrap.

3.10 CLEANUP AND RESTORATION

A. Provide cleanup and restoration crews to work closely behind pipe laying crews, and where necessary, during disinfection and hydrostatic testing, service transfers, abandonment of old water lines, backfill and surface restoration.

B. Unless otherwise approved by Project Manager, comply with the following;

1. Once water line is installed to limits approved in layout submitted, immediately begin preparatory work for disinfection effort.

2. No later than three days after completing disinfection preparatory work, submit to City appropriate request for disinfection.

3. If City fails to perform initial disinfection of lines in accordance with Section 2514 - Disinfection of Water Lines, within seven days from submission of appropriate request, and if approved by Project Manager, pipe laying operations may continue beyond approved limits until the City responds.

4. Immediately after transfer of services, begin abandonment of old water lines and site restoration.

5. Do not exceed a total of 50% of total project linear feet of disturbed right-of-way and easement until site is restored in accordance with Section 01740 - Site Restoration.

6. Exceeding any of the above footage limitations shall be considered a material breach of the Contract and subject to termination in accordance with the General Conditions.

C. For large diameter water lines, do not install more than 2,000 linear feet of water line, without previous 2,000 linear feet being restored in accordance with Section 01740 - Site Restoration. Schedule paving crews so repaving work will not lag behind pipe laying work by more than 1,000 linear feet. Failure to comply with this requirement shall be considered a material breach of the Contract and subject to termination in accordance with the General Conditions.

3.11 CLEANING PIPING SYSTEMS

A. Remove construction debris or foreign material and thoroughly broom clean and flush piping systems. Provide temporary connections, equipment and labor for cleaning. City must inspect water line for cleanliness prior to filling.

3.12 DISINFECTION OF WATER LINES

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

3.13 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:

Size of Pipe	Charge per Linear Foot
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 Contract is Stipulated Price Contract, payment for work in

this Section is included in total Stipulated Price.

1.03 REFERENCES

A. AWWA C 651 - Standard for Disinfecting Water Mains.

PART 2 P R O D U C T S - Not Used

PART 3 E X E C U T I O N

3.01 CONDUCTING DISINFECTION

A. Promptly disinfect water lines constructed before 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 Project Manager.

3.02 PREPARATION

A. Provide temporary blind flanges, cast-iron sleeves, plugs, necessary service taps, copper service leads, risers and jumpers of sizes, location and materials, and other items needed to facilitate disinfection of new water lines 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. Use fire hydrants as blow-offs to flush newly constructed water lines 8 inch diameters and above. Where fire hydrants are not available on water lines, install temporary blow-off valves as approved by Project Manager and remove promptly upon successful completion of disinfection and testing.

C. Slowly fill each section of pipe with water in manner approved by Project Manager. 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. Backfill excavations immediately after installation of risers or blow-offs.

E. Install blow-off valves at end of water line to facilitate flushing of dead-end water lines. 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 Project Manager 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, charge will be levied against Contractor for each trip made by City personnel.

B. Notify and coordinate with Project Manager minimum of 72 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 chemical compound is used for sterilizing agent, place in pipes as directed by Project Manager.

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. When 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

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Section 02515

HYDROSTATIC TESTING OF PIPELINES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Field hydrostatic testing of newly installed water pipelines.

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 Contract is Stipulated Price Contract, payment for work in this Section is included in 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, when 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, obtain a transient meter from the City Deposit is required for transient meter.

D. Test pipelines with maximum lengths between valves, or plugs, according to the following criteria.

1. 2,000 linear feet for small diameter pipelines (20-inches in diameters or smaller)

2. 4,000 linear feet for large diameter pipelines (24-inches in diameters or larger)

E. Conduct hydrostatic tests in presence of Project Manager.

3.02 TEST PROCEDURES

A. Furnish, install, and operate connections, pump, meter and gages necessary for hydrostatic testing.

B. Allow pipeline to sit 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 minimum test pressure of 125 psi. For large diameter water lines, expel air and apply minimum test pressure of 150 psi.

D. Begin test by 9:00 a.m. unless otherwise approved by Project Manager. Maintain test pressure for 8 hours. When large quantity of water is required to maintain pressure during test, discontinue testing 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 WATERLINES

A. During hydrostatic tests, no leakage will be allowed for sections of water lines consisting of welded joints.

B. Maximum allowable leakage for water lines with rubber gasketed joints: 3.19 gallons per inch nominal diameter per mile of pipe per 24 hours while testing.

C. For meter run installation, when work cannot be isolated and line fails pressure test, visual inspection of work by Project Manager for leakage during pressure test may be used to fulfill requirements of this section.

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 cracked or defective pipes, fittings, and valves discovered during pressure test and replace with new items.

B. Project Manager 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. 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

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Section 02518

STEEL PIPE AND FITTINGS FOR LARGE DIAMETER WATER LINES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Large diameter (24 inches and greater) steel pipe and fittings for water lines and pumping facilities.

1.02 MEASUREMENT AND PAYMENT

A. Unit Prices.

1. No payment will be made for steel pipe and fittings under this Section. Include cost in unit price for water lines, pumping facilities, and encasement sleeves.

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

B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.03 REFERENCES

A. AASHTO - Standard Specifications for Highway Bridges.

B. AREMA - Manual for Railway Engineering, Volume II, Chapter 15.

C. ASTM A 36 - Standard Specification for Structural Steel.

D. ASTM A 53 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.

E. ASTM A 135 - Standard Specification for Electric-Resistance-Welded Steel Pipe.

F. ASTM A 139 - Standard Specification for Electric-Fusion (ARC) - Welded Steel Pipe (NPS 4 and Over).

G. ASTM A 570 - Standard Specification for Steel, Sheet and Strip, Carbon, Hot-Rolled, Structural Quality.

H. ASTM A1011 - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength

I. ASTM A1018 - Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Hot-Rolled, Carbon, Commercial, Drawing, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength

J. ASTM C 33 - Standard Specification for Concrete Aggregates.

K. ASTM C 35 - Standard Specification for Inorganic Aggregates for Use in Gypsum Plaster.

L. ASTM C 150 - Standard Specification for Portland Cement.

M. ASTM C 494 - Standard Specification for Chemical Admixtures for Concrete.

N. ASTM C 595 - Standard Specification for Blended Hydraulic Cements.

O. ASTM C 881 - Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete.

P. ASTM C 1107 - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).

Q. ASTM D 512 - Standard Test Methods for Chloride Ion in Water.

R. ASTM D 1293 - Standard Test Methods for pH of Water.

S. ASTM D 3363 - Standard Test Method for Film Hardness by Pencil Test.

T. ASTM D 4541 - Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Tests.

U. ASTM D 4752 - Standard Test Method for Measuring MEK Resistance of Ethyl Silicate (Inorganic) Zinc-Rich Primers by Solvent Rub.

V. AWWA C 200 - Steel Water Pipe 6 in. and Larger.

W. AWWA C 205 - Cement-Mortar Protective Lining and Coating for Steel Water Pipe.

X. AWWA C 206 - Standard for Field Welding of Steel Water Pipe.

Y. AWWA C 207 - Standard for Steel Pipe Flanges for Waterworks Service - Sizes 4 in. through 144 in.

Z. AWWA C 208 - Dimensions for Fabricated Steel Water Pipe Fittings; Addendum C 208A.

AA. AWWA C 209 - Cold-Applied Tape Coatings for the Exterior of Special Sections, Connections and Fittings for Steel Water Pipelines.

BB. AWWA C 210 - Liquid Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines.

CC. AWWA C 214 - Tape Coating Systems for the Exterior of Steel Water Pipelines.

BB. AWWA C216 - Heat-Shrinkable Cross-Linked Polyoefin Coatings for the Exterior of Special Sections, Connections, and Fittings for Steel Water Pipelines

CC AWWA C 602 - Cement-Mortar Lining of Water Pipelines - 4 In. (100 mm) and Larger - In Place.

DD. AWWA M 11 - Steel Pipe-A Guide for Design and Installation.

EE. SSPC Good Painting Practice, Volume 1.

FF. SSPC SP 1 - Surface Preparation Specification No. 1 Solvent Cleaning.

GG. SSPC SP 5 - Joint Surface Preparation Standard White Blast Cleaning.

HH. SSPC SP 6 - Surface Preparation Specification No. 6 Commercial Blast Cleaning.

II. SSPC SP 10 - Surface Preparation Specification No. 10 Near-White Blast Cleaning.

JJ. SSPC VIS 1 - Visual Standard for Abrasive Blast Cleaned Steel.

1.04 SUBMITTALS

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

B. Submit shop drawings signed and sealed by Professional Engineer registered in State of Texas showing following:

1. Manufacturer's pipe design calculations.

2. Provide lay schedule of pictorial nature indicating alignment and grade, laying dimensions, welding procedures, fabrication, fitting, flange, and special details, with plan view of each pipe segment sketched, detailing pipe invert elevations, horizontal bends, welded joints, and other critical features. Indicate station numbers for pipe and fittings corresponding to Drawings. Do not start production of pipe and fittings prior to review and approval by Project Manager. Provide final approved lay schedule on CD-ROM in Adobe portable document format (*.PDF).

3. Include hot tapping procedure.

4. Submit certification from manufacturer that design was performed for project in accordance with requirements of this section. Certification to be signed and sealed by professional Engineer registered in State of Texas.

C. Submit manufacturer's certifications that pipe has been hydrostatically tested at factory in accordance with AWWA C 200.

D. Submit certification from NACE Certified Coatings Inspector, under supervision of inspector having Level III certification for coatings and linings, that steel pipe furnished on project was properly inspected and defective coatings detected properly repaired.

E. Submit inspection procedures to be used by manufacturer and for quality control and assurance for materials and welding. Submit at least 30 days prior to repair work, procedures that describe in details shop and field work to be preformed. Repair defects such as substandard welds, excessive radial offsets (misalignment), pitting, gouges, cracks, etc.

F. Submit following for nonshrink grout for special applications:

1. Manufacturer's technical literature including specifications for mixing, placing, and curing grout.

2. Results of tests performed by certified independent testing laboratory showing conformance to ASTM C 1107, Nonshrink Grout and requirements of this specification.

3. Certification product is suitable for use in contact with potable water.

G. Submit proof of certification for welders. Indicate certified procedures and position each welder is qualified to perform. Ensure welder and welding operator have been certified in accordance with AWWA C206.

H. Within 45 calendar days after manufacturing of all pipe, submit affidavit of compliance that materials and work furnished comply with applicable requirements of referenced standards and these specifications. Make available copy of physical and chemical testing reports.

I. Within 45 days of manufacturing of all pipe, submit manufacturer's affidavits that coatings and linings comply with applicable requirements of this Section and:

1. Polyurethane coatings were applied in accordance with manufacturer's recommendation and allowed to cure at temperature 5 degrees above dew point.

2. Mortar coatings and linings were applied and allowed to cure at temperature above 32 degrees F.

3. Test Results

a. Compressive strength (7 and 28 day) test results for mortar coating.

b. Hydrostatic testing, magnetic particle and x-ray weld test reports as required

J. Prior to start of field-applied cement mortar lining operation, submit comprehensive plan which identifies and describes as minimum:

1. Equipment used for batching, weighing, mixing transporting and placing mortar.

2. Qualifications and specific experience of machine operators.

3. Source and type of cement, pozzolan, sand and admixtures used and certifications from suppliers that materials meet specifications.

4. Mix proportions to be used and slump limits (max. and min.).

5. A quality control plan which identifies quality control material tests and documented inspections necessary to ensure compliance with specified requirements.

K. Submit certification showing calibration within last 12 months for equipment such as scales, measuring devices, and calibration tools used in manufacture of pipe. Each device used in manufacture of pipe is required to have tag recording date of last calibration. Devices are subject to inspection by Project Manager.

1.05 QUALITY CONTROL

A. Manufacturer to provide permanent quality control department and laboratory facility capable of performing inspections and testing as required by specifications. Material testing, inspection procedures, and manufacturing process are subject to inspection by Project Manager. Perform manufacturer's tests and inspections required by referenced standards and these specifications, including the following. Correct nonconforming conditions.

1. Steel Plate and Coils: Review mill certifications for conformance to requirements of specifications; perform physical and chemical testing of each heat of steel for conformance to applicable ASTM standards.

2. Pipe:

a. Inspect thickness, circumference, roundness, strength and size of seam welds (spiral or longitudinal), and squareness of pipe ends to verify compliance with AWWA C200.

b. Inspect physical dimensions and overall conditions of all joints for compliance with AWWA C200, approved submittals, and Specifications.

c. Hydrostatically test finished pipe section to 75 percent of specified minimum yield strength of steel being used with zero leakage.

d. For wall thickness greater than 1/2-inch perform Charpy V-Notch (CVN) Test in accordance with AWWA C200.

3. Linings:

a. Inspect unlined pipe for overall condition of inside barrel. Maintain inside barrel free of corrosive products, oil, grease, dirt, chemical, and deleterious material.

b. Inspect lined pipe for physical dimensions and overall condition of lining, visible surface defects, thickness of lining, and adhesion to steel surface.

c. Review certifications by manufacturers of lining components for conformance to AWWA standards and these Specifications.

4. Coatings: Measure temperature and dew point of ambient air before applying coatings. Inspect physical dimensions and overall condition of coatings. Inspect for visible surface defects, thickness, and adhesion of coating to surface and between layers.

5. Final Inspection:

a. Before shipment, inspect finished pipe, fittings, specials and accessories for markings, metal, coating thickness, lining thickness (if shop applied), joint dimensions, and roundness.

b. Inspect for coating placement and defects. Test exterior coating for holidays.

c. Inspect linings for thickness, pitting, scarring, and adhesion.

B. Shop-applied coatings and linings; provide services of independent coating and lining inspection service or testing laboratory with qualified coating inspectors. Perform inspection by NACE trained inspectors under supervision of NACE Level III Certified Coatings Inspector.

C. Ensure workmen engaged in manufacturing are qualified and experienced in performance of their specific duties.

D. Cast four standard test cylinders each day for each 50-cubic yards of mortar coating or portion thereof for each coating and lining placed in a day. Perform compressive strength test at 28 days. No cylinder test result will be less than 80 percent of specified strength.

E. Dented steel cylinders will result in rejection of pipe.

F. Make available copy of physical and chemical testing reports for steel cylinders and provide reports at request of Project Manager.

G. Check physical dimensions of pipe and fittings. Physical dimensions to include at least pipe lengths, pipe I.D., pipe O.D. and bend angles.

H. Test special sections via non-destructive testing methods in accordance with AWWA C200. Acceptable weld test methods include magnetic particle, liquid penetrant, ultrasonic, and radiographic.

1.06 INSPECTION

A. Project Manager may witness manufacture and fabrication of pipe and appurtenances. Independent testing laboratory under contract to Project Manager may perform tests at direction of Project Manager to verify compliance with these specifications. Provide assistance to accomplish such testing, including equipment and personnel, at no additional cost to City.

PART 2 PRODUCTS

2.01 STEEL PIPE

A. Furnish pipe by same manufacturer.

B. Furnish pipe smaller than 24 inch in accordance with Section 02502 - Steel Pipe and Fittings.

C. Fabricate and supply miscellaneous steel pipe and fittings with nominal diameter of 24 inches and larger in accordance with AWWA C200, C207, C208 and AWWA M11 except as modified herein. Steel to be minimum of ASTM A 36, ASTM A 570 Grade 36, ASTM A 53 Grade B, ASTM A 135 Grade B, ASTM A 139 Grade B, ASTM A 1011 Grade 36, or ASTM A 1018 Grade 36.

D. Provide pipe sections in lengths no greater than 40 feet and no less than 10 feet except as required for special fittings or closure sections.

E. Provide shop-coated and shop-lined steel pipe with minimum of one coat of shop-applied primer approved for use in potable water transmission on all exposed steel surfaces. Primer for tape-coated steel pipe to be used for field-applied coatings shall have no less than 5 percent solids. Provide primer compatible with coating system and in accordance with coating manufacturer's recommendations.

F. Provide closure sections and short sections of steel pipe not less than 4 feet in length unless indicated on Drawings or specifically permitted by Project Manager.

G. Square flanges with pipe with bolt holes straddling both horizontal and vertical axis. Provide 1/2 -inch gap between pipe ends to be coupled with sleeve coupling unless otherwise indicated on Drawings

1. Provide standard ring or hub type flanges, conforming to AWWA C207, Class D.

2. Apply Densco petroleum-based tape or approved equal to exposed portions of nuts and bolts.

H. Pipe Design Conditions:

1. Design: Design pipe and fittings to withstand most critical simultaneous application of external loads and internal pressures. Base design on minimum of AASHTO HS-20 loading, AREMA E-80 loads and depths of bury as indicated on Drawings. Design pipes with Marston's earth loads for transition width trench for all heights of cover.

2. Groundwater Level: Design for most critical ground water level condition,

3. Working pressure = 100 psi.

4. Hydrostatic field test pressure = 150 psi.

5. Maximum pressure due to surge = 150 psi.

6. Minimum pressure due to surge = -10 psi.

7. Modulus of elasticity (E) = 30,000,000 psi.

8. Maximum deflection from specified diameter: Two percent for mortar coating; three percent for flexible coatings and three percent for mortar lining.

9. Design stress due to working pressure to be no greater than 50 percent of minimum yield, and stress not to exceed 16,500 psi for mortar coated pipe.

10. Design stress due to maximum hydraulic surge pressure to be no greater than 75 percent of minimum yield, and stress not to exceed 24,750 psi for mortar coated pipe, or 31,500 psi for flexible coated pipe.

11. Modulus of soil reaction (EN) < 1500 psi. If EN > 1000 psi, do not use silty sand (SM) for embedment.

12. Unit weight of fill (w) > 120 pcf.

13. Deflection lag factor (D1) = 1.2.

14. Bedding constant (K) = 0.1.

15. Fully saturated soil conditions: hw = h = depth of cover above top of pipe.

16. Do not allow diameter (D) over thickness (t) ratio to be greater than 230.

17. Provide minimum inside clear diameter for tunnel liners or casing in accordance with Section 02425LD- Tunnel Excavation and Primary Liner.

18. Exclude structural benefits associated with primary liner in design of pipe in tunnel installations.

    a. Design pipe and joints to carry loads including overburden and lateral earth pressures, subsurface soil and water loads, grouting, other conditions of service, thrust of jacks, and stresses anticipated during handling and construction loads during installation of pipe.

    b. Do not use internal removable stiffeners for pipe in tunnel, unless approved by Project Manager.

    c. External welded steel stiffeners will be permitted in design calculations for steel pipe, provided wall thickness is minimum of 1/2 inch. Minimum clearances specified between exterior pipe wall and tunnel liner applies to distance between outside diameter of external welded stiffener and tunnel liner.

19. Nominal Allowable Steel-wall Thickness for Water Lines: Provide in accordance with following table for HS-20 live loads and depths of cover of up to 16 feet. Net internal diameter (including inside linings) to be no less than net inside diameter listed. Contractor to review design for conditions more extreme than those indicated by this specification and design accordingly. If, in opinion of Project Manager, proposed pipe wall thicknesses appear inadequate for indicated loading conditions, submittal of design calculations will be required for review. Pipe wall not to be less than that defined in following table.

Net Inside Diameter (Inches)	**Minimum Wall Thickness (Inches)**	
	Flexible Coating	**Mortar Coating**
96	0.484	0.464
90	0.454	0.430
84	0.423	0.395
78	0.393	0.359
72	0.362	0.320

66	0.333	0.295
60	0.301	0.268
54	0.271	0.250
48	0.235	0.215
42	0.207	0.189
36	0.178	0.163
30	0.149	0.136
24	0.149	0.136

I. Fittings for Water Lines: Fabricate in accordance with AWWA M11, Section 13.3-13.7, and AWWA C208.

1. Wall Thickness: Equal to or greater than pipe to which fitting is to be welded.

2. Elbows: 2-piece for 0 degrees to 22-1/2 degrees; 3-piece for 23 degrees to 45 degrees; 4-piece for 46 degrees to 67-1/2 degrees; and 5-piece for 68 degrees to 90 degrees, unless otherwise shown on Drawings.

3. Outlets: Reinforced in accordance with AWWA M11, Sections 13.3-13.7, AWWA C200, and AWWA C208. Provide interior lining and exterior coating in accordance with paragraphs on coating and lining and matching pipe to access inlets, service outlets, test inlets, and air-vacuum valve and other outlets, including riser pipes.

4. Radius: Minimum radius of two and one-half times pipe diameter.

5. Butt Straps for Closure Piece: Minimum 12-inch-wide split butt strap; minimum plate thickness equal to thinnest member being joined; fabricated from material equal in chemical and physical properties to thinnest member being joined. Provide minimum lap of 4 inches between member being joined and edge of butt strap, welded on both inside and outside, unless otherwise approved by Project Manager. Provide minimum 6-inch welded outlet for inspecting each closure section, unless access manway is within 40 feet of closure section.

6. Joints are to be double-welded and butt or lap joints as shown on drawings. Use flanged joints at valves.

7. Provide double-welded lap field joints or full penetration butt-welded joints for tee fitting supported on pier foundation, aboveground piping and field welds for risers including vertical portion of crossover piping.

J. Joints:

1. Standard field joint for steel pipe: AWWA C206. Rubber gasket Carnegie shape joint or rolled-groove rubber gasket and O-ring joint, 66-inch maximum diameter. Joints may be lap-welded slip type in accordance with AWWA C206, except where flanged joints or butt strap joints are required.

2. Provide double-welded butt joints at aerial crossings and where noted on Drawings.

3. Pipe Manufacturer: Minimum of 5 years of successful service with proposed field joint or submit results from joint tests determined by Project Manager. Tests which may be required include tensile strength or yield tests of base material and spiral welded sections (API 5L), flattening tests, chemical analysis, impact and hardness tests. Project Manager's decision as to acceptability of joint is final.

4. Capable of withstanding jacking forces.

5. Design restrained joints for test pressure or maximum surge pressure as specified, whichever is greater. Only minimum restrained joint lengths for prestressed concrete cylinder pipe are shown on Drawings.

6. Provide full circumferential welds at joints required to be welded.

7. Use wire and flux from same manufacturer throughout entire project.

8. Rubber Gasketed Bell-and-Spigot Joints.

   a. Bells: Formed by either expansion of pipe end, or by segmental expander which stretches steel past its elastic limit, or by attaching sized weld-on bell rings. Weld-on bell rings shall comply with AWWA M11 and AWWA C200, attached with full-thickness fillet welds, and welded inside and out (double welded). Minimum thickness of completed bell ring is equal to thickness of pipe wall in barrel of pipe between joint ends.

   b. Spigots: Sized prior to rolling gasket groove. For Carnegie joints, attach with full thickness fillet welds, welded inside and out (double welded). Minimum thickness of joint ring shall be equal to or greater than thickness of pipe wall in barrel of pipe between joint ends..

   c. Joints shall be interchangeable and match up during installation, even if used out of sequence.

   d. Provide bells and spigots with dimensions and tolerances in accordance with AWWA C 200, as modified herein. Difference in circumference between ID of bell and OD of spigot shall be between 0.00 inch to 0.10 inch as measured with

steel circumference tape. Measurement shall be taken at point of full joint engagement, and pipe cylinder shall be within allowable deflection. Clearance between bell and spigots shall be such that, when joint is assembled, water-tightness will be obtained under operating conditions.

e. Furnish joint suitable for safe working pressure equal to class of pipe. Joint shall operate satisfactorily with pull-out, tangent of which is not to exceed 0.75 inch/D, where D is outside diameter of pipe in inches or with pull-out of 3/4 inch.

f. Joints shall be self-centered and gasket shall be restrained or confined to annular space in such a manner than movement of pipe or hydrostatic pressure cannot displace it. Compression of gasket when joint is completed shall provide watertight joints under operating conditions when properly installed. Compression of gasket shall not be dependent upon water pressure in pipe and will provide watertight joints under operating conditions when properly installed. Compression of gasket shall not be dependent upon water pressure I pipe.

K. Manufacturer must maintain on site or in plant enough fittings to satisfy the following requirements:

Line Diameter	Required Bends*
20 and 24 inches	Four 45 degree bends per 5,000 LF of water line
> 24 inches	Four 22.5 degree bends per 10,000 LF of water line
*Based on total length of contract (minimum of four). Any combination of bends may be substituted at manufacturer's option (i.e. two 22.5 degree bends are equivalent to one 45 degree bend) and will be counted as one fitting.	

L. Manufacturer must be capable of delivering bends to job site within 12 hours of notification. Use fittings at direction of Project Manager where unforeseen obstacles are encountered during construction. These fittings are in addition to fittings called out on Drawings and must be available at all times. Use same product throughout entire project.

M. Hydrostatic Test of Pipe:

1. AWWA C200, Section 5.2, at point of manufacture. Hold test for minimum 2 minutes and conduct thorough inspection of pipe. Repair or reject pipe revealing leaks or cracks.

2. Calibrate pressure gauges within one year prior to testing as specified in Section 1.04 L.

N. Provide forged steel threaded outlets of approved design where required for use in passing hose or lead wires into pipe. Tap plugs with standard pipe threads and weld to pipe in approved manner and use solid forged steel plugs for closure.

O. Flanges:

1. Fabricate flanges with oversize bolt holes, with flanges drilled in pairs, to accommodate insulating sleeves.

2. Test, coat, line and ship each shop-assembled insulated flange assembly to field as fitting. Use no less than two snug-fitting alignment pins to assist in aligning flanges during assembly. Do not remove pins until bolts have been installed in all remaining holes and have been drawn up tight. After insulating joints have been assembled, subject each assembly (fitting) to shop hydrostatic test pressure of 150 psi and electrically test to ensure that insulated sections are effective. After assembly has been tested, coat insulating joint and adjacent steel pipe as specified for below-ground installation. Line assembly as specified for interior surfaces and in accordance with details shown on Drawings.

P. Dished Head Plugs: Design dished head plugs (test plugs) to withstand field hydrostatic test pressure from either side of plug. Design stress due to hydrostatic pressure to be no greater than 50 percent of minimum yield. Pipe on opposite side of hydrostatic test may or may not contain water. Manufacturer of the steel pipe to hydrostatically test plug at factory.

Q. Make curves and bends by deflecting joints, or by using beveled joints, or by combination of two methods, unless otherwise indicated on Drawings or permitted by Project Manager. Do not exceed deflection angle at joint as recommended by pipe manufacturer. Make penetration of spigot into bell at all points of circumference at least equal to minimum required penetration shown on Drawings. Beveled pipe sections used in curved alignment to be of standard length except when shorter sections are required to limit radius of curvature, in which case all sections throughout curve are to be of equal length. Do not allow bevel to exceed 5 degrees.

2.02. INTERNAL LINING SYSTEMS FOR STEEL PIPE, ALL INSTALLATIONS

A. Supply steel pipe with either epoxy lining or cement-mortar lining, capable of conveying water at temperatures not greater than 140 degrees F. Provide linings conforming to American National Standards Institute/National Sanitation Foundation (ANSI/NFS) Standard 61, and certification to be from organization accredited by ANSI. Unless otherwise noted, coat all exposed (wetted) steel parts of flanges, blind flanges, bolts, access manhole covers, with epoxy lining, as specified. Epoxy lining shall be used for steel pipe in aerial crossing.

B. Epoxy Lining:

1. AWWA C210, color White, or approved equal for shop and field joint applied, except as modified in this Section. Provide materials from same manufacturer.

a. Protect interior surface with approved liquid two-part chemically cured epoxy primer specified for interior surfaces.

Surface Preparation	SSPC-SP5 White Blast Clean 2.0 to 3.0 mils surface profile.
Prime Coat 4.0 to 6.0 mils DFT	NSF Certified Epoxy - Buff, or approved equal
Intermediate Coat 4.0 to 6.0 mils DFT	NSF Certified Epoxy - Buff, or approved equal
Finish Coat 4.0 to 6.0 mils DFT	NSF Certified Epoxy - White, or approved equal

2. Total allowable dry film thickness for system:

   a. Minimum: 12.0 mils.

   b. Maximum: 18.0 mils.

3. Provide dry film thicknesses for approved alternate products in accordance with product's manufacturer recommendations.

4. Lining system may consist of three or more coats of same approved alternate epoxy lining without use of separate primer.

5. Perform adhesion test on pipe 48 inches in diameter and larger in accordance with ASTM D 4541. Minimum field adhesion: 700 psi. Perform test on pipe for project at frequency of one for every 1000 square feet of epoxy lining. Perform cure test in accordance with ASTM D 4752 (solvent rub test) and ASTM D 3363 (pencil hardness) for each section of pipe. Repair tested areas with approved procedures.

C. Shop-applied Cement-mortar Lining:

1. AWWA C205; except as specified herein: 1/2-inch minimum thickness for pipe diameters 42 inches and larger; 3/8-inch minimum thickness for pipe diameters 36 inches and smaller. Cut back lining from joint ends no more than 2 inches to facilitate joining and welding of pipe.

2. Apply cement-mortar lining to inside of pipe by centrifugally spinning. For special sections (shape of which precludes application by spinning method) accomplish by mechanical placement or pneumatic placement and finish to produce smooth, dense surface comparable to centrifugally spinning.

3. Use galvanized wire mesh when shop-applied mortar is not applied by machine. Do not extend wire mesh across welded portion of mitered fittings. Crimp mesh to provide integral "chair" so wire does not fully rest against steel cylinder.

4. Make repairs of cement-mortar lining for widths exceeding 6 inches by bonding to steel and adjacent faces of lining with bonding agent conforming to ASTM C 881, Type II.

5. Restrict usage of sprinkler heads during moist curing to prevent over spraying onto lining. No alternative curing methods are allowed as described in Section 4.4.7.4 of AWWA C205.

6. Satisfy Project Manager that above requirements can be accomplished by manufacturer prior to shipment of pipe.

D. Field-applied Cement-mortar Lining (for pipe $\geq$ 48 inches in diameter): Provide field-applied internal cement-mortar linings in accordance with AWWA C602, latest edition, except as modified in this Section.

1. Lining: Applied in one-course application of cement-mortar by machine that centrifugally places mortar against wall of pipe and mechanically trowel lining to smooth finish.

2. Steel pipe, fittings, receives cement-mortar lining.

3. Cement-mortar for lining.

   a. Cement-mortar: Dense, smooth, and of uniform quality and consistency to assure efficient machine operation and uniform cement-mortar lining on pipe wall.

   b. Water-cement ratio: Kept as low as possible; consistent with proper plasticity for application, allowing slight variations dependent upon temperature, length of haul for mortar, and moisture condition in pipe.

   c. Mortar: Mixture of one part cement with not less than one or more than 1-1/2 parts of dry screened sand, by volume. After determining mixture, control materials to within plus or minus 2-1/2 percent by weight throughout entire work.

   d. Comply with following materials for cement-mortar:

      1) Provide Type II low-alkali Portland cement conforming to ASTM C 150, or Type IP (MS) Portland-Pozzolan cement conforming to ASTM C 595, unless otherwise specified. Conform to low alkali requirements of Table IA of ASTM C 150. Type IP (MS) cement to

contain no more than 20 percent Pozzolan, to be inter-ground with clinker.

2) Use suitable facilities approved by Project Manager when available for handling and weighing bulk cement. Otherwise, deliver cement in original unopened sacks that have been filled by manufacturer. Plainly mark sacks with manufacturer's name or brand, cement type lot number and weight. Discard unused cement. Use unopened bags of cement for each new batch.

3) Material storage: Store cement to permit ready access for inspection and sampling. Protect cement and sand against contamination or moisture. Do not use and remove from site cement delivered with evidence of contamination or otherwise unsuitable. Store admixtures in accordance with manufacturer's directions.

4) Use Portland cement of same brand and type unless otherwise approved by Project Manager.

5) Pozzolanic material: AWWA C602, Paragraph 2.2.

6) Sand: AWWA C205, Section 2.3, except gradation of sand to yield fineness modulus of approximately 1.7; having no material coarser than that passing No. 16 sieve. Submit certification for compliance of sand with these specifications at least 10 calendar days before start of lining placement.

7) Water: Clean; free of deleterious amounts of acids, alkalis or organic materials; total dissolved solids less than 1000 mg/l; ASTM D 512 chloride ions less than 100 mg/l for slurry and mortar cure; ASTM D 1293 pH greater than 6.5.

2.03 EXTERNAL COATING SYSTEM FOR STEEL PIPE INSTALLED ABOVEGROUND AND IN VAULTS (EXPOSED)

A. Provide approved 3-coat epoxy/polyurethane coating system as designated below. Provide materials from same manufacturer.

Surface Preparation	SSPC SP 10 Near White Blast Clean 2.0 to 3.0 mils surface profile
Prime Coat 4.0 to 4.0 mils DFT	Inhibitive Epoxy Primer, or approved equal

Surface Preparation	SSPC SP 10 Near White Blast Clean 2.0 to 3.0 mils surface profile
Intermediate Coat 4.0 to 6.0 mils DFT	Chemical Resistant Epoxy, or approved equal
Finish Coat 1.5 to 2.5 mils DFT	Polyurethane, or approved equal Blue Fed. Std. No. 15102 color as approved by Project Manager

B. Total Allowable Dry Film Thickness for System:

1. Minimum: 9.5 mils.

2. Maximum: 12.5 mils.

C. Perform adhesion test on pipe in accordance with ASTM D 4541. Minimum field adhesion: 1,000 psi. Perform test on pipe for project at frequency of one for every 1,000 square feet of polyurethane coating. Perform cure test in accordance with ASTM D 4752 (solvent rub test) and ASTM D 3363 (pencil hardness) for each section of pipe. Repair tested areas with approved procedures.

2.04 EXTERNAL COATING SYSTEMS FOR BURIED STEEL PIPE

A. Supply pipe with one of the following coatings specified.

1. Tape Coating: Provide approved tape for external tape coating. Apply in accordance with AWWA C214 and requirements of this section; 80-mil.

a. Components: Primer, one 20-mil layer of inner-layer tape for corrosion protection and two 30-mil layers of outer-layer tape for mechanical protection.

b. Where sleeve type or victaulic couplings are required, bond coupling to adjacent pipes with bonding cables as shown on Drawings.

c. Use approved filler putty type insulating putty to fill in gap and create smooth sloped transition between top of reinforcing plate and pipe, before tape coating is applied.

d. Primer: Compatible with tape coating, supplied by coating-system manufacturer.

e. Provide pipe with shop coatings cut back approximately 4 to 4-1/2 inches from joint ends to facilitate joining and welding of pipe. Taper successive tape layers by 1-inch staggers to facilitate field wrapping and welding of joints.

f. Inner and outer tape width: 12 or 18 inches.

g. Do not expose tape coating to direct sunlight for more than 60 days.

2. Cement-mortar Coating: AWWA C205; shop-applied, cement-mortar coating except as modified in this Section; 1-inch minimum thickness; cut back coating from joint ends no more than 2 inches to facilitate joining and welding of pipe.

3. Polyurethane Coating: See Section 02527 - Polyurethane Coatings on Steel or Ductile Iron Pipe for requirements for use of polyurethane coating system. Refer to Paragraph 2.03 C of this Section for field testing requirements. Provide inspections by NACE trained inspectors under supervision of NACE Certified Coatings Inspector having Level III Certification.

B. Heat Shrink Joint Sleeves for Tape and Polyethane Coating: Aqua-shield, or approved equal. For repairs to heat shrink joint sleeves, use Aqua-shield Repair Kit or approved equal. Pipe manufacturer to hold back coatings at joints as per shrink sleeve manufacturer's recommendations.

2.05 EXTERNAL COATING SYSTEM FOR STEEL PIPE IN TUNNEL, CASING

A. Provide exterior coating system of pipe in tunnel, without annular grout, as specified in Cement Mortar Coating for Buried Steel Pipe, or provide minimum 80 mils of polyurethane coating in accordance with Specification Section 02527 - Polyurethane Coatings for Steel or Ductile Iron Pipe.

B. For water lines in tunnel where annular grout will be used, shop prime external surfaces of steel pipe with 4.0 to 6.0 mils DFT of approved Inhibited Epoxy Primer unless pipe has cement-mortar coating.

1. Surface Preparation: SSPC-SP 10(64); Near White Blast Clean 2.0 to 3.0 mils surface profile.

2. Prime Coat: Approved Inhibitive Epoxy Primer 4.0 to 6.0 mils DFT.

3. Use coating procedures and dry film thicknesses for approved alternate product in accordance with product manufacturer's recommendations.

2.06 GROUT FOR JOINTS AND SPECIAL APPLICATIONS

A. Cement Grout Mixture: One part cement to two parts of fine, sharp clean sand. Mix interior joint mortar with as little water as possible until very stiff but workable. Mix exterior joint mortar with water until it has consistency of thick cream. Mix cement grout to specific gravity of 19 lb/gallon or greater as measured by grout/slurry balance. Use balance manufactured grout/slurry by Baroid or approved equal. Perform test in presence of and at request of Project Manager. Add additional cement grout or water to mixed cement grout to bring mix to proper moisture content or specific gravity. Discard cement grout that has been mixed more than 20 minutes and is not at proper specific gravity or moisture content.

1. Portland Cement: ASTM C 150, Type II. Provide one type of cement for entire project.

2. Sand:

   a. Interior joints: ASTM C 35 fine graded plaster sand.

   b. Exterior joints: ASTM C 33; natural sand with 100 percent passing No. 16 sieve.

3. Water: Potable water with total dissolved solids less than 1000 mg/l; ASTM D 512 chloride ions less than 100 mg/l for slurry and mortar cure; ASTM D 1293 pH greater than 6.5. Use potable water with 250 ppm limit on chlorides and sulfates.

B. Provide approved Nonshrink Grout for Special Applications, Patches and Repairs.

1. Conform to requirements of ASTM C 1107, Nonshrink Grout.

2. Pre-blended factory-packaged material manufactured under rigid quality control, suitable for use in joints of prestressed concrete cylinder pipe.

3. Contain non-metallic natural aggregate and be nonstaining and noncorrosive.

4. Meeting NSF 61 Standard suitable for use in contact with potable water supply.

5. Exterior: Highly flowable to fill joint wrapper without leaving voids or trapped air. Interior capable of being placed with plastic consistency.

6. Compressive strength: ASTM C 1107 2500 psi minimum 7-day unconfined; 5000 psi minimum 28-day unconfined.

7. Non-bleeding and non-segregating at fluid consistency.

8. Contain no chlorides or additives which may contribute to corrosion of steel pipe.

9. Free of gas-producing, gas-releasing agents.

10. Resist attack by oil or water.

11. Mix, place, and cure in accordance with manufacturer's instructions and recommendations. Upon 72 hours' notice, provide services of qualified representative of nonshrink grout manufacturer to aid in assuring proper use of product under job conditions. Representative to be on site when product is first used.

12. Mix cement grout to specific gravity of 17.7 lb/gallon or greater as measured by grout/slurry balance. Use balance manufactured grout/slurry by Baroid or approved equal. Perform test in presence of and at request of Project Manager. Add additional cement grout to mixed cement grout or water to bring mix to proper moisture content or specific gravity. Discard cement grout that has been mixed more than 20 minutes and is not at proper specific gravity or moisture content.

13. Compressive strength: ASTM C 1107 2500 psi minimum 7-day unconfined; 5000 psi minimum 28-day unconfined.

C. Finished surface of lining and interior joint to be comparable to surface rubbed with No. 16 Carborundum stone. Rub joint mortar sufficiently to bring paste to surface, to remove depressions and projections, and to produce smooth, dense surface. Add cement to form surface paste as necessary. Leave interior with clean, neat and uniform-appearing finish.

D. Joint Wrapper: Minimum width of 9 inches for 33-inch diameter and smaller; minimum width of 12 inches for diameters greater than 33-inch hemmed at edge to allow threading with minimum 5/8-inch-wide steel strap. Provide minimum 6-inch-wide Ethafoam strip sized, positioned, and sewn such that two circumferential edges of Ethafoam are 1-1/2 inches from outer edge of wrapper.

2.07 COLD-APPLIED TAPE COATING

A. Shop-applied Tape Wrap Coating

1. Use primer furnished by tape manufacturer.

2. Wrap, specials and fittings that cannot be machine wrapped due to configuration with primer layer and two layers of prefabricated tape each 35 mils thick.

3. Overlap machine applied tape with hand applied tape by minimum of two inches and bind to it.

4. Apply approved 30 mil filler tape parallel to spiral weld seams if weld height measures greater than or equal to 1/8 inch.

B. Surface Preparation

1. Clean bare pipe from mud, mill lacquer, oil, grease, or other contaminants. Inspect and clean surfaces according to SSPC-SP-1 to remove oil, grease, and loosely adhering deposits prior to blast cleaning. Remove visible oil and grease spots by solvent wiping. Use approved safety solvents which do not leave residue. Preheating to remove oil, grease, mill scale, water, and ice may be used provided pipe is preheated in uniform manner to avoid distortion.

2. Remove surface imperfections such as slivers, scabs, burrs, weld spatter, and gouges by hand filling or grinding to prevent excessive number of holidays. Presence of metallic defects may be cause for rejection of pipe.

2.08 EXTERNAL TAPE COATING SHOP APPLICATION

A. Separate tape dispensing equipment far enough apart to visually inspect continuous steps.

B. Make cutbacks straight and for total thickness of coating.

C. State of dryness of primer prior to application of weld filler and inner layer of tape to be in accordance with written recommendation of manufacturer.

D. Apply weld filler tape over primer and extend minimum of one inch on each side of weld seam. Filler tape may contact rollers as long as release liner is in place and adhesion requirements are met. Remove release liner before applying inner layer tape.

E. Spirally apply inner layer of tape in direction of helix weld. Overlap each spiral of tape1 inch or greater with next successive spiral of tape applied.

F. Overlap end of new roll on top of previous roll minimum of 6 inches.

G. Tape-roll body temperature to be greater than 70 degrees F; pipe surface temperature to be greater than 60 degrees F.

H. Spirally apply outer layer tapes in direction of helix weld and use overlap width and application tensions as recommended by manufacturer.

2.09 INSPECTION AND TESTING OF COATINGS

A. Perform electrical inspection on inner layer of tape before intermediate layer of tape is applied.

B. If holidays are detected, repair holidays immediately before applying outer layer of tape. Clear holiday area of material and reprime if necessary. Recoat area with inner wrap tape. Overlap inner wrap tape onto surrounding inner wrap coating by at least 2 inches. Perform electrical retest at repaired area after repairing holiday, and before outer wrap is continued.

C. Shrink Wrap: Perform electrical inspection on shrink wrap to check for holidays. Perform peel tests over heat affected zone. Minimum acceptable result: 15 lbs-ft/in.

PART 3 EXECUTION

3.01 PIPING INSTALLATION

A. Conform to applicable provisions of Section 02511 - Water Lines, except as modified in this Section.

B. Comply with following:

1. Make available services of manufacturer's representative when deemed necessary by Project Manager. Representative to advise in aspects of installation, including but not limited to handling and storing, cleaning and inspecting, coating and lining repair, and general construction methods as applicable to pipe.

2. Install stulls prior to placement of pipe, bends, and fittings to prevent deflection during installation. Provide stulls consisting of timber struts with end blocks shaped to fit curvature of interior surface of pipe or other appropriate configuration and material. Firmly edge and secure stulls to blocks so that they will remain intact position during handling and installation. Provide stulls adequate to resist loads encountered without structural failure to stull members or damage to pipe. Where applicable, place stulls at such lengths so as to elongate vertical diameter of pipe as required to suit trench conditions encountered.

3. Handling and Storage: Install padded struts or stulls prior to shipping, horizontally and vertically at 10-foot intervals, or as proposed by manufacturer and approved by Project Manager. Spiders: Installed in joint ends of fittings. Stulls to remain in place, horizontally and vertically positioned under following conditions:

   a. During storage and shipping.

   b. Until welding is complete.

4. Reject and remove immediately from site pipe that arrives at site with defects in lining, including sand pockets, voids, and oversanded areas.

5. Store pipe at job site with securely fastened plastic endcaps to maintain moist pipe interior. Promptly replace damaged endcaps to avoid shrinkage or cracking of cement-mortar lining.

6. Immediately replace damaged plastic end caps. Do not leave uncapped for more than 4 hours.

7. Bedding and Backfilling:

a. Conform to requirements of Section 02317 - Excavation and Backfill for Utilities.

b. Align pipe at proper grade prior to joint connection and do not shift after jointing operation has been completed.

c. Take necessary precautions during bedding and backfilling operations to prevent deformation or deflection of cylindrical shape of pipe by more than allowable pipe deflection. Do not move trench support system (trench safety system) once bedding material is compacted.

d. Excavate outside specified trench section for bell holes, and for spaces sufficient to permit removal of slings. Provide bell holes at proper locations for unrestricted access to joint. Form bell holes large enough to facilitate joint wrapping and to permit visual examination of process. Enlargement of bell holes as required or directed by Project Manager. Subsequent backfilling thereof will not be considered as authorized additional excavation and backfill. Backfill bell holes and spaces to satisfaction of Project Manager.

e. Blocking may be removed 24 hours after placing backfill to top of pavement or natural ground level.

8. Pipe Deflection: After backfill is complete, test pipe for excessive deflection by measuring actual inside vertical diameter. For maximum deflection allowable, see Section 2.01.

   a. Deflection may be measured by Project Manager at location along pipe. Arithmetical averages of deflection are not acceptable.

   b. If deflection exceeds that specified, do one of the following:

      1) Remove backfill and side support. Reround the pipe and properly replace compacted backfill and side support. Review cement mortar lining to assure that no harmful damage has occurred.

      2) Remove entire portion of deflected pipe section and install new pipe as directed by Project Manager at no additional cost to City.

9. Move pipe in such manner not to damage pipe or coating. Do not roll pipe nor drag on ground. Inspect and repair coating abrasions before pipe is lowered into trench.

10. Use of dogs, clips, lugs, or equivalent devices welded to steel pipe for purpose of forcing it into position will not be permitted unless approved by Project Manager. Remove foreign matter and protective material from surfaces that are to be in contact at joints. Leave surfaces of joint areas thoroughly clean for metal-to-metal contact of field joints.

C. Static Electricity:

1. Properly ground steel pipeline during construction as necessary to prevent build-up of static electricity.

2. Electrically test where required after installation of pipeline is complete.

D. Deviation of installed pipe in one pipe section from line and grade shown on approved shop drawing layout will not exceed 2 inches from grade and 3 inches from line. No deviation from line and grade at contact interfaces are allowed.

E. Use adequate surveying methods, procedures and employ competent surveying personnel to ensure pipe sections are laid to line and grade and within stipulated tolerances. Measure and record, in form approved by Project Manager and submit copy of data to Project Manager at end of that day. Survey data to include unique pipe number, deflection angle at pipe joint and whether beveled ends were used, invert elevation at pipe joint, deviation of joint from project line, deviation of joint from project grade, inside pipe joint lap measured at top, bottom, and at springline (each side).

F. Any time that laying of additional pipe is stopped for more than eight hours; plug ends of installed pipe and take proper precautions against flotation of pipe segments.

3.02 EXTERNAL COATING SYSTEM FOR STEEL PIPE INSTALLED ABOVE GROUND AND IN VAULTS (EXPOSED) AND EPOXY INTERNAL LINING SYSTEM

A. Safety: Paints, coatings, and linings specified in this Section are hazardous materials. Vapors may be toxic or explosive. Protective equipment, approved by appropriate regulatory agency, is mandatory for personnel involved in painting, coating, and lining operations.

B. Workmanship:

1. Application: By qualified and experienced workers who are knowledgeable in surface preparation and application of high-performance industrial coatings.

2. Paint Application Procedures: SSPC Good Painting Practices, Volume 1.

C. Surface Preparation:

1. Use abrasive blasting to prepare surfaces.

2. Schedule cleaning and painting so that detrimental amounts of dust or other contaminants do not fall on wet, newly-painted surfaces. Protect surfaces not intended to be painted from effects of cleaning and painting operations.

3. Prior to blasting, clean surfaces to be coated or lined of grease, oil and dirt by steaming or detergent cleaning in accordance with SSPC SP 1.

4. Metal and Weld Preparation: Remove surface defects such as gouges, pits, welding and torch-cut slag, welding flux and spatter by grinding to 1/4-inch minimum radius.

5. Abrasive Material:

   a. Blast only as much steel as can be coated within same day of blasting.

   b. Use sharp, angular, properly graded abrasive capable of producing depth of profile specified herein. Transport abrasive to jobsite in moisture-proof bags or airtight bulk containers. Copper slag abrasives are not acceptable.

   c. After abrasive blast cleaning, verify surface profile with replica tape such as Tes-Tex Coarse or Extra Coarse Press-O-Film Tape, or approved equal. Furnish tapes to Project Manager.

   d. Do not blast if metal surface may become wet before priming commences, or when metal surface is less than 5 degrees F above dew point.

6. Evaluate degree of cleanliness for surface preparation with use of SSPC Pictorial Surface Preparation Standards for Painting Steel Surfaces, SSPC-Vis 1.

7. Remove dust and abrasive residue from freshly blasted surfaces by brushing or blowing with clean, dry air. Test cleanliness by placing 3/4-inch by 4-inch piece of clear Scotch-type tape on blasted surface, then removing and placing tape on 3x5 white index card. Reclean areas exhibiting dust or residue.

D. Coating and Lining Application:

1. Environmental Conditions: Do not apply when metal temperature is less than 50 degrees F; when ambient temperature is less than 5 degrees F above dew point; when expected weather conditions are such that ambient temperature will drop below 40 degrees F within 6 hours after application; or when relative humidity is above 85 percent. Measure relative humidity and dew point by use of sling psychrometer in conjunction with U.S. Department of Commerce Weather Bureau Psychometric Tables. Provide dehumidifiers for field-applied coatings and linings to maintain proper humidity levels.

2. Application Procedures:

   a. Apply in accordance with manufacturer's recommendations and requirements of this Section. Provide finish free of runs, sags, curtains, pinholes, orange peel, fish eyes, excessive over spray, or delaminations.

b. Thin materials only with manufacturer's recommended thinners. Thin only amount required to adjust viscosity for temperature variations, proper atomization and flow-out. Mix material components using mechanical mixers.

c. Discard catalyzed materials remaining at end of day.

3. Thoroughly dry pipe before primer is applied. Apply primer immediately after cleaning surface. Apply succeeding coats before contamination of undersurface occurs.

4. Cure minimum of 24 hours at 77 degrees F before successive coats are applied. During curing process, provide force air ventilation in volume sufficient to maintain solvent vapor levels below published threshold limit value. Apply successive coats within recoat threshold time as recommended by coating or lining manufacturer on printed technical data sheets or through written communications. Brush blast joints of pipe which have been shop primed and are to receive intermediate and finish coats in field prior to application of additional coats. After interior coats are applied, provide forced-air ventilation in sufficient volume and for sufficient length of time to ensure proper curing before filling pipe with water.

3.03 EXTERNAL COATING SYSTEM FOR BURIED STEEL PIPE

A. Tape Coating System:

1. Joint Protection

a. Heat Shrink Sleeve: In accordance with AWWA C216. Provide Aqua-Shield, or approved equal. Apply manufacturer-approved insulating putty at bell step-offs. For welded joints, apply heat-resistant protective sleeve, such as Aqua-Shield AQW-WAB or approved equal, prior to internal welding. Surface preparation: Clean exposed metal with solvent, wire brush, and blast clean in accordance with AWWA C216 and manufacturer's specifications. Apply sleeve in accordance with manufacturer's specifications. Visually inspect sleeve to verify adhesive flows beyond edge, and there are no cracks or holes. Repair as necessary in accordance with AWWA C216 and manufacturer's recommendations. Shrink sleeve manufacturer's technical representative shall be available on site at beginning of pipe laying operations, and advise Contractor and Project Manager regarding installation, repairs, and general construction methods.

b. Heat-Resistant Tape Coating System: In accordance with AWWA C209. Polyken or approved equal. Apply manufacturer-approved insulating putty at bell step-offs. Surface Preparation: Clean exposed metal with solvent, wire brush and blast clean in accordance with AWWA C209 and manufacturer's specifications. Follow with primer, and then tape coating in accordance with manufacturer's specifications. Visually inspect finished coating for damages,

flaws, holidays or mislaps. Repair as necessary in accordance with AWWA C209 and manufacturer's recommendations. Tape manufacturer's technical representative shall be available on site at beginning of pipe laying operations, and advise Contractor and Project Manager regarding installation, repairs and general construction methods.

2. Field Application: AWWA C209 around joint cutbacks except as modified:

   a. Field-welded joints: Clean shop-primed ends of weld splatter, damaged primer, and rust to achieve required surface preparation prior to field repair of coatings.

   b. Extend joint cleaning 4 inches onto existing coating. Completely remove damaged and loose end-coatings.

   c. Prior to placing pipe in trench, remove shop-applied primer by abrasive blasting, solvent or other method as approved by Project Manager. Avoid damage to adjacent existing coatings.

   d. Clean surfaces to achieve surface preparation at least equivalent to SSPC SP 6 in accordance with AWWA C209. Provide solvent that is environmentally safe and compatible with coating system primer.

   e. Apply insulating putty onto bell step-off as shown on Drawings. Remove release liner during application.

   f. Apply primer immediately prior to application of first layer of tape to achieve maximum bond. Apply tape while primer is still "tacky" with 3-inch minimum overlap over shop-applied coating.

3. Joint Tape

   a. Extend inner wrap minimum of 2 inches onto existing coating on each side of joint. Extend outer wrap minimum of 4 inches onto existing coating each side of joint. Stagger end laps minimum of 6 inches. Overlap adjacent tape wraps at least 1 inch, and overlap seam of outer wrap. Do not allow to be coincident with overlap seam of inner wrap. Wash with Xylol area that will be overlapped.

   b. Apply approved joint wrap tape to uncontaminated primer at proper roll body temperature. If necessary, store joint wrap material in heated box up to point of application.

   c. Apply joint wrap material to pipe in either spiral or cigarette fashion dependent upon specification. Begin wrapping process 2 to 4 inches onto mill-applied pipe wrap and proceed wrinkle-free up over bell and across joint to spigot side pipe wrap.

d. Apply joint wrap under machine tension of 5 to 10 pounds per inch width. Joint wrap width should narrow (neck down) as material is applied tightly around pipe.

e. Apply first 1/3 and last 1/3 turn of joint material around pipe with less tension to prevent wrap crawlback. Overlap of joint wrap material and system's total thickness as specified in this specification section.

f. End joint wrap process such that its final edge is directed downwards when pipe is placed in ditch to prevent backfill from pulling exposed joint wrap edge.

4. Do not expose tape coatings or heat-shrinkable joint sleeves to harmful ultraviolet light for more than 90 days. Discard (remove) and replace outer layer of tape coating when exposure exceeds 90 days. In case of factory-applied coatings, remove pipe from site for removal and reapplication of outer layer of tape coatings.

5. At option of Project Manager, coating system and application may be tested and inspected at plant site in accordance with AWWA C214.

B. Test for holidays:

1. Inspect pipe for holidays and damage to coating.

a. If test indicates no holidays and outer wrap is torn, remove damaged layers of outer wrap by carefully cutting with sharp razor-type knife. Wash with Xylol area to be patched and at least 4 inches of undamaged tape where hand-applied tape wrap will overlap. AWWA C209 cold-applied tape compatible with tape-wrapping system applied for each layer of outer-wrap tape that has been removed.

b. If test indicates holiday, remove outer layers and expose inner wrap. Prime exposed area and overlaps with light coat of primer. Firmly press into place patch of two 35-mil inner wrap tape extending 4 inches from affected area in all directions. Second patch to overlap first patch by 2 inches. Perform holiday test of patch to verify satisfactory installation. Wash exposed outer wrap tape with Xylol and prime.

c. For severe outer wrap tape tears or damage, and holiday is not detected, remove outer wrap to boundaries of damaged area, taking care not to damage inner wrap coating. Before replacing outer wrap, apply holiday detector to exposed area to determine that no damage has been made to primary coating. After verification that no holidays exist in underlying tape, clean damaged area and use patch of 35-mil outer wrap tape. Apply as specified herein for repair of areas where bare pipe is exposed.

2. Do not allow bubbles in tape coating system regardless of holiday test results, cut out bubbles and patch as described above as directed by Project Manager.

3. Perform test procedure in accordance with NACE Standard RP-02-74. Perform electrical holiday test with 60-cycle current audio detector. Use test voltage below:

Total Coating Thickness (Mils)	Test Voltage (Volts)
20	6,000
30/35	7,500
50	9,000
70	11,500
80	12,000

C. Remove areas having physical damage and recoat. After repairing area, apply holiday detector as stated above to verify area is adequately repaired.

D. Cement mortar coating. AWWA C 205; 1-inch minimum thickness; Cut back from joint ends no more than 2 inches to facilitate joining and welding of pipe.

E. Polyurethane Coating. Comply with requirements of Paragraph 3.02.

3.04 JOINTS AND JOINTING

A. Rubber Gasketed Bell-and-Spigot Joints.

1. Use O-ring gasket with sufficient volume to approximately fill area of groove and gasket material in accordance with AWWA C200. Check each splice in gasket by stretching gasket to at least twice original length of gasket. Visually check stretched splice by rotating 360 degrees. Reject splices showing visible separation or cracks.

2. Equalize rubber gasket cross section after rubber gasket is placed in spigot groove of pipe by inserting tool or bar such as large screwdriver under rubber gasket and moving it around periphery of pipe spigot. Lubricate gaskets with nontoxic water-soluble lubricant before pipe units are joined. Fit pipes together in manner to avoid twisting or otherwise displacing or damaging rubber gasket. Check gaskets after pipe sections are joined with feeler gauge to ensure that no displacement of gasket has occurred at point around circumference after joining. If displacement has occurred, remove pipe section and remake joint as if for new pipe. Remove old gasket and replace before remaking joint.

B. Welded Joints:

1. Conform to requirements of Section 02511 - Water Lines.

2. Field weld to be double-welded lap field joints or full penetration butt welded joints for steel pipe and encasement sleeves for entire circumference.

3. Employ independent certified testing laboratory, approved by Project Manager, 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 Project Manager for review. Test by magnetic particle test method for lap welds and fillet welds or by X-ray methods for butt welds, for 100 percent of all joint welds. Project Manager has final decision as to suitability of welds tested.

C. Flanged Joints: Conform to requirements of Section 02511 - Water Lines.

D. Joint Grouting and Testing: Conform to requirements of Section 02511 - Water Lines.

E. Do not allow steel plugs for threaded outlets to project beyond inner surface of pipe shell and seal weld by at least two passes. Apply weld around outside of plug after it has been inserted in final position. Coat outlets and plugs inside and outside as required at field joints on pipe.

3.05 FIELD-APPLIED CEMENT-MORTAR LINING

A. Entrances Into Pipeline:

1. Establish means to permit entry and exit of labor, materials and equipment necessary for progress of work, as approved by Project Manager.

2. Provide dikes and channeling for diversion of flood and drainage waters away from these openings in pipeline. Use temporary airtight covers over openings to provide proper curing conditions in completed sections of lined pipe. Where operation of equipment requires that end of pipe be left open, install temporary bulkhead inside pipe to eliminate direct draft through pipe over completed sections.

3. Brace closure sections of pipeline left out to facilitate field lining above ground to conform as nearly as possible to shape of pipe in ground and then place cement-mortar lining by machine or hand trowel to same thickness as in adjoining machine-lined sections. Bulkhead sections immediately after being lined to maintain proper curing conditions for period of not less than 48 hours before sections are installed in pipeline. Install these sections of steel pipe.

4. Coat exterior surface of buttstraps and uncoated exterior surface area of steel pipe within excavations in accordance specifications. Place cement-mortar lining inside areas of joints in accordance with specifications.

B. Mixing of Cement-mortar: Mix ingredients for cement-mortar for not less than 1-1/2 and not more than 6 minutes; use mortar promptly after mixing for lining pipe. Do not use mortar that has attained its initial for lining. Do not retemper mortar. Add water to mix last.

C. Placing Cement-mortar Lining:

1. Complete joint work, backfill and welding before cement-mortar lining begins. After cement-mortar lining has cured hydrostatic testing of pipe can begin.

2. Provide provisions necessary for Project Manager to conduct inspections of work in safe and thorough manner during and after initial application of mortar and after necessary repairs made. Include, as minimum, space on application machine, and adequate lighting to inspect gross surface areas

3. Comply with ASTM C 494 and with manufacturer's recommendations when using chemical admixtures, bonding agents, accelerators, and other additives.

4. Remove dirt, debris, oil, grease and loose mill scale and rust from interior surfaces of pipe, and scrape or brush surface with stiff bristle brush and/or water blast as may be necessary, and approved by Project Manager, to ensure clean surfaces for successful application of cement-mortar lining. Interior surfaces to be approved by Project Manager prior to placing lining.

5. Provide cement-mortar lining uniform in thickness along entire length of pipe. Provide cement-mortar no less than 1/2 inch over all surfaces with tolerance of plus 1/8 inch, and no allowance for minus tolerance.

6. Mechanically control travel of machine and rates of discharge of mortar to produce uniform thickness of lining without segregation around perimeter and along length of pipe.

7. Check finished surface by placing 12-inch straightedge parallel to axis of pipe along surface of straight section of lining. At no point will space between lined surface and straightedge be greater than 1/16 inch.

8. Provide smooth finished surface, within tolerances specified. Repair or replace surface irregularities including corrugations, ripples, or pits in any direction, to satisfaction of Project Manager. Remove defective lining material, including, sand pockets, voids, oversanded areas, blisters, delaminations, or unbounded areas, cracked areas, irregular surfaces, and unsatisfactory thin spots. Remove to pipe wall and area repaired to full thickness of mortar lining.

9. Repair cracks 1/16 inch and larger to satisfaction of Project Manager.

10. Place cement-mortar lining by machine having following features:

    a. An applicator head which can be centered within pipe and which will centrifugally project mortar against wall of pipe at high velocity producing dense, uniformly distributed mortar on wall of pipe.

b. Equipped with mechanically driven, rotating steel trowels that immediately follow applicator, providing smooth, hard surface without spiral shoulders. Compensate for torque so that machine will sit true in pipe and trowel faces will not vary in angle with mortar face during complete 360-degree cycle. Clean trowels at frequent intervals to prevent accumulated mortar from obtaining initial set resulting in sanded or unglazed finish. Continuously operate trowels during application of cement-mortar and forward progress of lining machine.

c. Design applicator so that nothing will come in contact with troweled surface until it has attained final set, and so that forward progress of machine and mechanical placing of mortar can be controlled to assure uniform thickness of lining.

11. Cement-mortar Lining: Adhere to steel at all points; provide consistent thickness except that lining of bell end of pipe where lining is to be thicker in order to fill depression and make smooth surface.

12. Immediately prior to application of cement-mortar lining, sweep and clean off slime, dirt, loose rust, loose mill scale, and other foreign materials. Free interior surface of pipe after cleaning of accumulated water on pipe wall or at joints.

13. After receiving its finish troweling, do not roughen lining by rebound material or by mortar direct from machine.

14. Temporarily close outlets in pipeline with easily removable stoppers to prevent spun mortar from being thrown into such openings. After lining is applied, remove stoppers from outlets and repair lining damaged by removal of stoppers. Point outlet openings up to provide smooth flow.

D. Hand Finishing:

1. Repair defective areas in machine-applied lining and unlined joints by hand patching to yield lining equal to that required for machine-applied troweled lining.

2. Provide nonshrink grout for patching or lining joints as specified in this Section.

3. Clean defective areas of loose foreign material and moisten with water just prior to application of hand-applied mortar.

4. Use steel finishing trowels for hand application of cement-mortar.

5. Complete hand finishing required in given pipe section not later than day following machine application of mortar lining to that particular pipe section, whether normal working day or otherwise. Slow down or stop machine application of mortar lining to allow time for hand patching.

E. Curing of Lining: Begin curing operations immediately after completing any portion of mortar lining. Close pipe by airtight bulkheads, and maintain moist atmosphere in completed section of pipe to keep lining damp and to prevent evaporation of entrained water from mortar lining. Humidify air introduced into pipe for ventilating or curing purposes and maintain moist atmosphere inside pipe until Project Manager accepts Work.

3.06 INSPECTION (EXCEPT MORTAR COATED PIPE)

A. Include cost of inspection described in Paragraph 3.08, Inspection, in contract unit price for water line. Furnish copies of certified inspection reports to Project Manager for review.

B. Holiday Test and Adhesion Test: Provide services of independent coating and lining inspection service or testing laboratory with qualified coating inspectors. Provide inspections by NACE trained inspectors under supervision of NACE Certified Coatings Inspector having Level III Certification.

3.07 COATINGS AND LININGS INSPECTION RESPONSIBILITIES

A. Contractor is responsible for quality control of coatings and linings applications and testing and inspection stipulated in this Section. Project Manager is responsible for quality assurance and reserves right to inspect or acquire services of independent third-party inspector who is fully knowledgeable and qualified to inspect surface preparation and application of high-performance coatings at phases of coatings and linings, field or shop applied. Contractor is responsible for proper application and performance of coatings and linings whether or not Project Manager provides such inspection.

B. Cement Mortar Lining and Joint Finish: Finished surface of lining and joint to be comparable to surface rubbed with No. 16 Carborundum stone. Rub joint mortar sufficiently to bring paste to surface, to remove depressions and projections, and to produce smooth, dense surface. Add cement to form surface paste as necessary. Leave interior with clean, neat and uniform-appearing finish.

3.08 FIELD REPAIR PROCEDURES AND SPECIAL FITTINGS APPLICATION FOR CEMENT MORTAR LINING

A. Areas less than or equal to 6 inches in diameter: Patch honeycomb and minor defects in concrete surfaces with nonshrink grout. Repair defects by cutting out unsatisfactory material and replacing with nonshrink grout, securely bonded to existing concrete. Finish to make junctures between patches and existing concrete as inconspicuous as possible. After each patch has stiffened sufficiently to allow for greatest portion of shrinkage, strike off grout flush with surrounding surface.

B. Areas greater than 6 inches in diameter:

1. Remove defective lining down to bare steel by chipping, making sure care is taken to prevent further lining damage. Ends of lining where defective lining is removed are to be left square and uniform not feathered.

2. Clean bare steel with wire brush to remove loose or other foreign matter.

3. Remove existing wire reinforcement and replace. Overlap new reinforcement to existing reinforcement by 1/2 inch. Secure reinforcement, against wall of pipe, at frequent intervals, by tack welding to pipe.

4. Prepare cement mortar mixture. Mixture to compose of Portland Type II cement, sand, and water. Proportions of sand to cement not to exceed 3 parts sand to 1 part cement, by weight. Use only enough water to obtain proper placement characteristics. Set up time before mixture is to be discarded is to be no longer than 1/2 hour. Nonshrink grout may also be used. Do not use combination of cement mortar and nonshrink grout within same repair.

5. Apply WELD-CRETE, or approved equal, concrete bonding agent to bare steel and interface of existing lining. After bonding agent is applied to steel and lining new mix must be applied within 10 minutes.

6. Apply cement mortar to repair area 1/2 inch thick then hand trowel to achieve smooth dense finish, making sure wire is not left exposed. To ensure proper thickness while placing new mortar, check thickness with 1/2 inch long wire gauge.

7. Curing: Place plastic sheeting over repair area, use tape to adhere plastic to area surrounding repair area. Let cure for 4 days then remove plastic sheeting.

END OF SECTION

SECTION 02519
DISINFECTION OF POTABLE WATER FACILITIES

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, tools, equipment and related items required to disinfect all potable water facilities installed or modified in this Contract. Dechlorination will be required in order to reduce chlorine concentration to less than four parts per million if chlorine solution used for disinfection is to be discharged to waterways or water courses known to support fish or wildlife. Refer to Section 26.040 of The Texas Water Code, Control of Certain Waste Dischargers by Rule.

B. The potable water facilities include:

1. Piping which is designated to carry either Potable Water, Plant Potable Water, Finished Water, Filtered Water, Distribution Water, Backwash Water, Protected Water, Raw Water, or Return Flow Water.

2. Chemical Bulk Storage Tanks inclusive of all chemical piping, equipment, valves, etc. used in the water treatment process.

1.02 MEASUREMENT AND PAYMENT

A. No separate payment will be made for work provided under this section. Include the cost for this work in the lump sum Base Bid Item.

1.03 REFERENCE STANDARDS

A. American Water Works Association (AWWA)

1. AWWA C651-14 – Disinfecting Water Mains

2. AWWA C652-11 – Disinfection of Water Storage Facilities

3. AWWA C653-13 – Disinfection of Water Treatment Plants

1.04 SUBMITTALS

A. Prior to starting disinfection work, furnish to Engineer a detailed outline of proposed sequence of work, manners of filling and flushing units, source and quality of water to be used, and disposal of wastewater.

B. Submit material data sheets on all disinfectants and neutralization chemicals to be used.

1.05 QUALITY ASSURANCE

A. Bacteriological Sampling and Testing:

1. Bacteriological sampling and water quality testing of disinfected potable water facilities shall be conducted by Drinking Water Operations, Public Utilities Division of the City of Houston Public Works Department.

2. Results to be acceptable to City Houston.

3. Potable water facilities shall be verified free of coliform bacteria contamination. Work to be in accordance with AWWA standards as applicable.

4. Methods of bacteriological analysis are as specified in the Standard Methods for Examination of Water and Wastewater, (Sections 9221, 9222, 9223) by the American Public Health Association, latest edition.

PART 2 PRODUCTS

2.01 CHLORINE

A. Liquid chlorine shall meet the requirements of AWWA B301.

B. Calcium hypochloride shall meet the requirements of AWWA B300.

2.02 WATER

A. Water for the first potable water facility washdown, disinfection, fill and testing of piping to meet the TCEQ Standards for potable water will be provided by the Plant Facility.

B. The Contractor may be required to pay for water required for refill or retesting due to failures in workmanship caused by the Contractor discovered during initial testing.

2.03 CHLORINE NEUTRALIZING CHEMICALS

A. Chlorine neutralizing chemicals (e.g., sulfur dioxide, sodium bisulfite, sodium sulfite, etc.), if required for residual reduction of heavy chlorinated water, are to be of grade and analysis approved by the City.

PART 3 EXECUTION

3.01 CLEAN-UP

A. Remove all construction equipment, scaffolding, planks, tools, rags, paint containers, or other materials not part of the potable water facilities.

B. Clean potable water facilities of dirt, blast products, and debris by sweeping, scrubbing, vacuuming or equally effective measures.

C. Hose down potable water facilities interior (walls, roof, and floor) with potable water to remove remaining foreign materials.

D. Collect and properly dispose of all accumulated rinse water and associated solids.

3.02 INSTALLATION OF SENSITIVE EQUIPMENT

A. Complete the installation of cathodic protection devices, instrumentation, and other equipment not installed prior to initial clean-up operations.

B. Conduct installation in a clean and neat manner that will minimize introduction of dirt and debris.

C. Post clean interior surfaces as required.

3.03 DISINFECTION OF PLANT PIPING

A. General:

1. Furnish pump, pipe connections, and necessary apparatus, gauges and meters.

2. Furnish necessary labor, assistance and chlorination agent for disinfection.

3. During installation, the interior of all pipe, fittings and other accessories shall be kept as free as possible from dirt and foreign matter at all times. If, in the opinion of the City Engineer, the pipe contains dirt or foreign matter that could not be removed during the flushing operation, the interior of the pipe will be broom brushed cleaned, hose washdowned, and swabbed with a bactericidal solution. When pipe laying is not in progress, the open ends of it shall be sealed with watertight plugs. If water has accumulated in the trench, the seal shall remain in place until the trench-water has been removed to such an extent that it will not enter the pipe.

4. After completion of hydrostatic pressure tests and prior to disinfection, the pipeline shall be flushed as thoroughly as possible, with the water pressure and outlets available. If feasible, flushing rate should develop a velocity in the pipeline of at least 2.5 fps. If a velocity of 2.5 fps cannot be obtained, the requirements of Paragraph 3.03 A.3 above shall be rigidly enforced. The minimum quantity of water used for flushing shall be in excess of the storage capacity of the pipeline to insure that clean water has traversed the entire length of line.

5. After flushing has been completed to the point that apparent dirt and foreign matter have been removed from the pipeline, either liquid chlorine or calcium hypochlorite solution shall be injected into the pipeline as provided in AWWA C651.

B. Contamination Control:

1. Prevent admission of contaminated water to previously disinfected units.

2. If contaminated water is admitted to previously disinfected units, disinfect these units at no additional cost to City.

C. Disinfect:

In accordance with applicable section of AWWA C651, Disinfecting Water Mains and as follows:

1. Chlorine dose, 100 mg/l minimum for a period of not less than three hours.

2. At the discretion of the City, retain chlorine water in system until completion of hydrostatic tests. Minimum retention period to be 24 hours.

3. Following chlorination, flush treated water from piping until replacement water has chlorine content not more than 0.1 mg/l in excess of residual in water from supply line, and in any event not more than 0.2 mg/l total.

4. If initial treatment results in an unsatisfactory bacterial test, repeat disinfection procedures at no additional cost to the City until satisfactory results are obtained.

3.04 DISINFECTION OF WATER STORAGE FACILITIES AND TREATMENT PLANT STRUCTURES

A. All potable water storage facilities located downstream of the filters shall be disinfected in accordance with AWWA C652, Chlorination Method No. 1. This includes Chemical Bulk Storage Systems that feed chemical to the filters or downstream of the filters.

B. All other potable water facilities shall be disinfected per AWWA C652, Chlorination Method No. 2.

C. Water Sampling:

1. Water samples are to be taken from the tank by the City for bacteriological and quality analyses suggested parameters considered for testing include disinfectant residual, total coliform bacteria, turbidity, pH, alkalinity, odor, and specific conductance.

2. The Contractor shall notify the Engineer when the tank is ready to be sampled.

3. All sampling to be done during normal business working hours.

D. Additional Testing Requirements:

1. Repeat disinfection procedure, if necessary, at Contractor's expense until acceptable water samples are obtained.

2. Contractor responsible for disposing of chlorinated water.

3. Responsibility to include the obtaining of any necessary permits and all required neutralizing chemicals.

4. After the bacteriological criteria have been satisfied, the water in the potable water facility must have a chlorine residual of less than 2.0 ppm before the potable water facility is placed in service.

5. A Partial Certificate of Substantial Completion will be issued for each potable water facility. The Contractor shall complete all requirements for bacteriological testing, fill the tank for use by the City, restore site, and complete all other ancillary construction to obtain the Certificate of Substantial Completion. The Contractor shall complete all incorrect or incomplete items cited with each Partial Certificate of Substantial Completion within 30 days.

6. Record of Compliance
   a. The report of bacteriological test results certifying that the water discharged from the treatment facility is free of total coliform bacteria shall serve as the record of compliance.

3.05 WATER DISCHARGE

A. Contractor will not be permitted to discharge water used for disinfection purposes to any waterway if the water contains more than 4 ppm of chlorine. Dechlorination by methods acceptable to the City must be used if the Contractor proposes discharge to waterways.

END OF SECTION

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Section 02521

GATE VALVES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Gate valves.

1.02 MEASUREMENT AND PAYMENT

A. Unit Prices.

1. No separate payment will be made for gate valves 20 inches in diameter and smaller under this Section. Include payment in unit price for water lines.

2. Payment for gate valves 24 inches to 36 inches in diameter is on a unit price basis. Unit price includes cost of required box for gate valves.

3. Payment for 2-inch blow-off valve with box is on a unit price basis for each installation.

4. Refer to Section 01270 - Measurement and Payment for unit price procedures.

B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.03 REFERENCES

A. ASTM A 307 - Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile.

B. ASTM B 62 - Standard Specification for Composition Bronze or Ounce Metal Casting.

C. ASTM D 429 - Standard Test Methods for Rubber Property-Adhesion to Rigid Substrates.

D. ASTM B 763 - Standard Specification for Copper Alloy Sand Casting for Valve Application.

E. AWWA C 500 - Standard for Metal-Seated Gate Valves for Water Supply Service.

F. AWWA C 509 - Standard for Resilient-Seated Gate Valves for Water Supply Service.

G. AWWA C 515- Standard for Reduced Wall, Resilient- Seated Gate Valves for Water Supply Service.

H. AWWA C 550 - Standard for Protective Epoxy Interior Coatings for Valves and Hydrants.

1.04 SUBMITTALS

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

B. Submit manufacturer's product data for proposed valves for approval.

C. Provide detailed drawings of gearing mechanism for 20-inch and larger gate valves.

1.05 QUALITY CONTROL

A. Submit manufacturer's affidavit that gate valves are manufactured in the United States and conform to stated requirements of AWWA C 500, AWWA C 509, AWWA C 515, and this Section, and that they have been satisfactorily tested in the United States in accordance with AWWA C 500, AWWA C 509, and AWWA C 515.

PART 2 P R O D U C T S

2.01 MATERIALS

A. Gate Valves: AWWA C 500, AWWA C 509, AWWA C 515 and additional requirements of this Section. Direct bury valves and those in subsurface vaults open clockwise; aboveground and plant valves open counterclockwise.

B. If type of valve is not indicated on Drawings, use gate valves as line valves for sizes 20-inches and smaller. When type of valve is indicated, no substitute is allowed.

C. Gate Valves 1-1/2 inches in Diameter and Smaller: 125 psig; bronze; rising-stem; single-wedge; disc type; screwed ends

D. Coatings for Gate Valves 2 inches and larger: AWWA C 550 non-toxic, imparts no taste to water, functions as physical, chemical, and electrical barrier between base metal and surroundings, minimum 8-mil-thick, fusion-bonded epoxy. Prior to assembly of valve, apply protective coating to interior and exterior surfaces of body.

E. Gate Valves 2 inches in diameter: Iron body, double disc or resilient-seated, non-rising stem, 150-pound test, 2-inch square nut operating clockwise to open.

F. Gate Valves 3 inches to 12 inches in diameter: Non-directional, standard-wall resilient seated (AWWA C 509), parallel seat double disc (AWWA C 500), or reduced-wall resilient seated gate valves (AWWA C 515), 200 psig pressure rating, bronze mounting, push-on bell ends with rubber joint rings, and nut-operated unless otherwise specified. Provide approved standard-wall resilient seated valves. Provide approved reduced-wall resilient seated valves.

Provide approved double disc valves. Comply with following requirements unless otherwise specified in Drawings:

1. Design: Fully encapsulated rubber wedge or rubber seat ring mechanically attached with minimum 304 stainless-steel fasteners or screws; threaded connection isolated from water by compressed rubber around opening.

2. Body: Cast or ductile iron, flange bonnet and stuffing box together with ASTM A 307 Grade B bolts. Manufacturer's initials, pressure rating, and year manufactured shall be cast in body.

3. Bronze: Valve components in waterway to contain not more than 15 percent zinc and not more than 2 percent aluminum.

4. Stems: ASTM B 763 bronze, alloy number-995 minimum yield strength of 40,000 psi; minimum elongation in 2-inches of 12 percent, non-rising.

5. O-rings: For AWWA C 500, Section 3.12.2. For AWWA C 509, Sections 2.2.6 and 4.8.2. For AWWA C 515, Section 4.2.2.5.

6. Stem Seals Consist of three O-rings, two above and one below thrust collar with anti-friction washer located above thrust collar for operating torque.

7. Stem Nut: Independent or integrally cast of ASTM B 62 bronze.

8. Resilient Wedge: Molded, synthetic rubber, vulcanized and bonded to cast or ductile iron wedge or attached with 304 stainless steel screws tested to meet or exceed ASTM D 429 Method B; seat against epoxy-coated surface in valve body.

9. Bolts: AWWA C 500 Section 3.4, AWWA C 509 Section 4.4 or AWWA C 515 Section 4.4.4; stainless steel; cadmium plated, or zinc coated.

G. Gate valves 14 inch and larger in Diameter: AWWA C 500; parallel seat double disc gate valves; push-on bell ends with rubber rings and nut-operated unless otherwise specified. Provide approved double disc valves with 150 psig pressure rating. Comply with following requirements unless otherwise specified on Drawings:

1. Body: Cast iron or ductile iron; flange together bonnet and stuffing box with ASTM A 307 Grade B bolts. Cast following into valve body manufacturer's initials, pressure rating, and year manufactured. When horizontally mounted, equip valves greater in diameter than 12 inches with rollers, tracks, and scrapers.

2. O rings: For AWWA C 500, Section 3.12.2. For AWWA C 515, Section 4.2.2.5.

3. Stems: ASTM B 763 bronze, alloy number-995 minimum yield strength of 40,000 psi; minimum elongation in 2-inches of 12 percent, non-rising.

4. Stem Nut: Machined from ASTM B 62 bronze rod with integral forged thrust collar machined to size; non-rising.

5. Stem Seals: Consist of three O-rings, two above and one below thrust collar with anti-friction washer located above thrust collar for operating torque.

6. Bolts: AWWA C 500 Section 3.4 or AWWA C 515 Section 4.4.4; stainless steel; cadmium plated, or zinc coated.

7. Discs: Cast iron with bronze disc rings securely penned into machined dovetailed grooves.

8. Wedging Device: Solid bronze or cast-iron, bronze-mounted wedges. Thin plates or shapes integrally cast into cast-iron surfaces are acceptable. Other moving surfaces integral to wedging action shall be bronze monel or nickel alloy-to-iron.

9. Provide bypass for double-disc valves (AWWA C500).

10. Bronze Mounting: Built as integral unit mounted over, or supported on, cast-iron base and of sufficient dimensions to be structurally sound and adequate for imposed forces.

11. Gear Cases: Cast iron; furnished on 18-inch and larger valves and of extended type with steel side plates, lubricated, gear case enclosed with oil seal or O-rings at shaft openings.

12. Stuffing Boxes: Located on top of bonnet and outside gear case.

H. Gate valves 14 inches to 48 inches: Provide AWWA C 515; reduced-wall, resilient seated gate valves with 250 psig pressure rating. Furnish with spur or bevel gearing.

1. Mount valves horizontally if proper ground clearance cannot be achieved by normal vertical installation. For horizontally mounted gate valves, provide bevel operation gear mounted vertically for above ground operation.

2. Use valve body, bonnet, wedge, and operator nut constructed of ductile iron. Fully encapsulate exterior of ductile iron wedge with rubber.
3. Ensure wedge is symmetrical and seals equally well with flow in either direction.

4. Provide ductile iron operator nut with four flats at stem connection to apply even input torque to the stem.

5. Bolts: AWWA C515, Section 4.4.4, Stainless Steel; cadmium plated or zinc coated.

6. Provide high strength bronze stem and nut.

7. O-rings: AWWA C515, Section 4.2.2.5, pressure O-rings as gaskets.

8. Provide stem sealed by three O-rings. Top two O-rings are to be replaceable with valve fully open at full rated working pressure.

9. Provide thrust washers to the thrust collar for easy valve operation.

I. Gate Valves Extension Stem: When shown on Drawings, provide non-rising, extension stem having coupling sufficient to attach securely to operating nut of valve. Upper end of extension stem shall terminate in square wrench nut no deeper than 4 feet from finished grade or as shown on Drawings. Support extension stem with an arm attached to wall of manhole or structure that loosely holds extension stem and allows rotation in the axial direction only.

J. Gate Valves in Factory Mutual (Fire Service) Type Meter Installations: Conform to provisions of this specification; outside screw and yoke valves; carry label of Underwriters' Laboratories, Inc.; flanged, Class 125; clockwise to close.

K. Gate Valves for Tapping Steel Pipe: Provide double disc gate valve. Resilient wedge gate valve shall only be installed in a vertical position.

L. Provide flanged joints when valve is connected to steel or PCCP.

M. Key valve stem into the operator nut.

N. Do not exceed 600 ft-lbs of torque on operator nut on gate valve.

PART 3 EXECUTION

3.01 INSTALLATION

A. Earthwork. Conform to applicable provisions of Section 02317 - Excavation and Backfilling for Utilities.

B. Operation. Do not use valves for throttling without prior approval of manufacturer.

3.02 SETTING VALVES AND VALVE BOXES

A. Remove foreign matter from within valves prior to installation. Inspect valves in open and closed positions to verify that parts are in satisfactory working condition.

B. Install valves and valve boxes where shown on Drawings. Set valves plumb and as detailed. Center valve boxes on valves. Carefully tamp earth around each valve box for minimum radius of 4 feet, or to undisturbed trench face when less than 4 feet. Install valves completely closed when placed in water line.

C. For pipe section of each riser, use only 6 inch, ductile iron Class 51, or DR18 PVC pipe cut to proper length. Riser must be installed to allow complete access for operation of valve. Assemble and brace box in vertical position as indicated on Drawings.

3.03 DISINFECTION AND TESTING

A. Assist Project Manager with disinfection of valves and appurtenances as required by Section 02514 - Disinfection of Water Lines and test as required by Section 02515 - Hydrostatic Testing of Pipelines.

B. Double-Disc Gate Valves: Apply hydrostatic test pressure equal to twice rated working pressure of valve between discs. Valve shall show no leakage through metal, flanged joints, or stem seals. Test at rated working pressure, applied between discs. Valve shall show no leakage through metal, flanged joints, or stem seals. Do not exceed leakage rate of 1 oz/hr/inch of nominal valve size.

C. Solid-Wedge Gate Valves: Apply hydrostatic pressure equal to twice rated working pressure of valve with both ends bulkheaded and gate open. Valve shall show no leakage through metal, flanged joints, or stem seals. Test at rated working pressure, applied through bulkheads alternately to each side of closed gate with opposite side open for inspection. Valve shall show no leakage through metal, flanged joints, or stem-seals. Do not exceed leakage rate of 1 oz/hr/inch of nominal valve size.

D. Repair or replace valves which exceed leakage rate.

3.04 PAINTING OF VALVES

A. Paint valves in vaults, stations, and above ground with approved paint.

END OF SECTION

Section 02522

BUTTERFLY VALVES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Butterfly valves.

1.02 MEASUREMENT AND PAYMENT

A. Unit Prices.

1. Payment for butterfly valves 20 inches and smaller is on unit price basis for each. Payment include box (when required), actuator and appurtenances necessary for complete installation of the valve.

2. Payment for butterfly valves 24 inches and larger is on a unit price basis. Payment includes manhole, actuator and appurtenances necessary for complete installation of the valve.

3. Refer to Section 01270 - Measurement and Payment for unit price procedures.

B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.03 REFERENCES

A. ASME B 16.1 - Cast Iron Pipe Flanges and Flanged Fittings.

B. ASTM A 126 - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.

C. AWWA C 504 - Standard for Rubber-Seated Butterfly Valves.

D. AWWA C 550 - Standard for Protective Interior Coatings for Valves and Hydrants.

1.04 SUBMITTALS

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

B. Submit manufacturer's product data for proposed valves and actuators for approval.

C. Submit manufacturer's affidavit for proposed valves and actuators certifying compliance with specifications.

D. Submit manufacturer's affidavit that butterfly valves were manufactured in the United States, and conform to applicable requirements of AWWA C 504 and that they have been satisfactorily tested in the United States in accordance with AWWA C 504 using test pressure of 150 psi in both directions. Submit Proof-of-Design and hydrostatic testing procedure in accordance with AWWA C 504.

E. Submit manufacturer's affidavit that coating for interior surfaces of valves conform to applicable requirements of AWWA C 550. Submit results of holiday test and thickness measurements of coatings.

F. Furnish, at time of delivery, affidavit of compliance, as specified in Section 6.3 of AWWA C 504 certifying compliance with applicable portion of AWWA C 504 and modification or supplements herein. Furnish certified drawings and material test records by manufacturer covering items included in Section 4.3 of AWWA C 504, for review. Furnish certified copies of test reports covering items in Sections 4.5.8.5.5, 4.5.8.5.8 and 5.2.1 through 5.2.4.3 of AWWA C 504 for review.

G. Submit data indicating maximum torque required to open valve, maximum torsional strength of shaft and torque output of actuator.

H. Provide submittal information on CD-ROM in Adobe portable document format (*.PDF).

I. Include number of turns to operate valves to fully open/closed.

1.05 QUALITY CONTROL

A. Perform valve leakage tests in both directions at 150 psi in factory and field. Hydrostatic field tests of 150 psi shall be made against dished head plug or similar arrangement.

B. For purposes of interpreting referenced AWWA tests, the following shall apply: Shutoff pressure is 150 psi; cycle consists of rotating disc from fully opened to fully closed position, for valves larger than 72 inches, proof of design shall require 1000 cycles and shall be performed on valve greater than 72 inches of like design and construction. When proof of design tests are performed on valve delivered to job site, replace disc, bushing, shaft and seals with new and unused items, and test and certify as described above.

C. Hydrostatic Testing by Manufacturer:

1. Hydrostatic testing to be witnessed by Project Manager prior to shipment of valves. Provide minimum 4 weeks notice to Project Manager to schedule witness testing. When possible, maximize number of valves to be tested during a plant visit, no more than two visits will be allowed per project to witness test valves, unless otherwise approved by

Project Manager. City will pay expenses for each visit up to total of two visits incurred by Project Manager to witness testing of each grouping of valve(s) per project. Expenses for subsequent or extended visits by Project Manager for defective valves, improper scheduling or valve failures are to be paid by Contractor. Witness of hydrostatic testing by Project Manager will only be in regards to compliance with this specification and will not constitute approval by Project Manager nor relieve Contractor of obligations to comply with contract documents.

2. Document serial number on valve at time of testing and reflect in certified test records furnished to Project Manager. Identification plate must be permanently affixed to valve and actuator prior to hydrostatic testing.

3. Hydrostatic testing to conform to AWWA C504 except as modified below:

   a. Install actuator prior to hydrostatic testing. Test actuator to verify actual number of turns match manufacturer's published number of turns. Verify valve stops are in correct positions.

   b. Fully open and close valve prior to performing shell test and prior to each leakage test.

   c. Perform shell test first.

   d. When tested with water, adequately dry seat and disc.

   e. When tested with air, fill top of valve with water to aid in viewing possible leakage.

   f. Pressure Gauges: Calibrated within past 12 months; 0-500 psi range in increments of 5 psi, present calibration certificates prior to hydrostatic testing.

   g. If seat adjustment is required during hydrostatic testing, perform valve leakage test again in both directions. Once seat adjustment is made, fully open and fully close valve three (3) times, and repeat leakage test.

4. Field Testing

   a. When valve arrives at the job site, Contractor is to operate valve fully open and closed twice in presence of Project Manager. Document number of turns to open and close each time.

   b. Install operator nut plum.

   c. After valve is installed, repeat the operation test and document number of turns in presence of Project Manager.

d. Manufacturer's representative must be present to witness the operation test. Verify valve operate fully open/closed twice at the appropriate number of turns.

PART 2 PRODUCTS

2.01 VALVES AND ACTUATORS

A. Butterfly Valves and Actuators: Provide approved butterfly valves and actuators. Conform to AWWA C 504, except as modified or supplemented herein. ,

B. If type of valve is not indicated on Drawings, use butterfly valves for line valve sizes 24-inch and larger. When type of valve is specified on Drawings, no substitute will be allowed, unless otherwise approved by Project Manager.

C. Butterfly valves shall be short-body, flanged design and installed at locations as shown on Drawings.

D. Direct-bury valves and valves in subsurface vaults shall open clockwise. Above-ground and plant valves shall open counterclockwise.

E. Provide flanged joints when valve is connected to steel or PCCP.

F. Butterfly Valves and Actuators (Additional Requirements for Large Diameter Water Lines):

1. Provide valves from approved manufacturer [(1)]. Provide all valves for single project, from same manufacturer.
[(1)] as modified for seat replacement in field for City of Houston

2. Valves larger than 72-inches in diameter design: allowable stresses at rated pressure not to exceed one-third of yield strength or one-fifth of ultimate strength of material used.

3. Provide manual actuators for single project, from same manufacturer.

4. Shaft connecting actuator to valve body must be fully enclosed. Bonnet and extension to be fully enclosed and watertight.

2.02 VALVE CONSTRUCTION

A. Valves: AWWA C 504, Class 150B. Body: Cast iron, ASTM A 126, Class B. Flanges: ASME B 16.1, Class 125 lb.

B. Discs for Butterfly Valves: Either cast iron or ductile iron. Valves greater than 54" in diameter must utilize flow through disc or low-profile disc.

C. Seats: Buna-N or neoprene, and may be applied to disc or body. Seats shall be mechanically secured and may not rely solely on adhesive properties of epoxy or similar bonding agent to attach seat to body. Seats on disc shall be mechanically retained by stainless steel (18-8) retaining ring held in place by stainless steel (18-8) cap screws that pass through rubber seat for added retention. When seat is on disc, seat shall be retained in position by shoulders located on both disc and stainless-steel retaining ring. Mating surfaces for seats: Type 304 or 316, stainless steel and secured to disc by mechanical means. Sprayed-on or plated mating surfaces will not be allowed. Seat must be replaceable in field for valves greater than 30 inches in diameter. Valves with segmented retaining rings will not be accepted.

D. Coat interior wetted ferrous surfaces of valve, including disc, with epoxy suitable for potable water conditions. Epoxy, surface preparation, and epoxy application: In accordance with AWWA C 550 and coating manufacturer's recommendations. Provide three coats of two-component, high-build epoxy with minimum dry film thickness of 12 mils. Provide approved epoxy coating. Coatings shall be holiday tested and measured for thickness.

E. Valve shaft and keys: 24 inches in diameter and greater valves require a minimum of two (2) taper pins used for attaching valve shaft to valve disc, use of torque plug for purposes of attaching valve shaft to valve disc is not permitted: Type 304 stainless steel for treated (potable) water applications, Type 316 stainless steel for raw water applications. Shaft Bearings: Stainless steel, bronze, nylon, or Teflon (supported by fiberglass mat or backing material with proven record of preventing Teflon flow under load) in accordance with AWWA C 504. Sinter stainless steel bearing material. Design valve shaft to withstand 3 times amount of torque necessary to open valve.

F. Packing: Self adjusting and wear compensating, full or split ring V-type, and replaceable without removing actuator assembly.

G. Retaining Hardware for Seats: Type 304 or 316 stainless steel. Nuts and screws used with clamps and discs for rubber seats shall be held securely with locktight, or other approved method, to prevent loosening by vibration or cavitational effects.

H. Valve disc shall seat in position at 90 degrees to pipe axis and shall rotate 90 degrees between full-open and tight-closed position. Install valves with valve shafts horizontal and convex side of disc facing anticipated direction of flow, except where shown otherwise on Drawings.

I. For valves utilizing retaining rings, tighten bolts to a uniform torque. Measure torque prior to testing valve.

2.03 VALVE ACTUATOR CONSTRUCTION

A. Provide actuators for valves with size based on line velocity of 12 feet per second and uni-directional service, and, unless otherwise shown on Drawings, equip with geared manual actuators. Provide fully enclosed and traveling-nut type, rack-and-pinion type, or worm-gear type for valves 24 inches and smaller. Provide worm-gear type for valves 30 inches and larger.

B. Provide actuator designed for installation with valve shaft horizontal unless otherwise indicated on Drawings.

C. Provide bonnet extensions, as required, between valve body and actuator. Space between actuator housing and valve body shall be completely enclosed so that no moving parts are exposed to soil or elements.

D. Provide oil-tight and watertight actuator housings for valves, specifically designed for buried service or submerged service when located in valve vaults, and factory packed with suitable grease.

E. Install valve position indicator on each actuator housing located above ground or in valve vaults. Valves shall be equipped with 2-inch actuator nut only.

F. Indicate direction of opening of valve on exposed visible part of assembly and cast direction of open on 2 inch nut on top of valve operator extension. Paint 2 inch actuator nut and extension shaft black when counter clockwise open and red when clockwise to open.

G. Design worm-gear or traveling-nut actuators to be self-locking and designed to transmit twice the required actuator torque without damage to faces of gear teeth or contact faces of screw or nut.

H. The valve stops shall be capable of withstanding a 450 ft lb. torque against the stop without damage to either the stop or the gear teeth.

2.04 VALVE BOXES

A. Provide Standard Type "A" valve boxes conforming to requirements of Section 02085 - Valve Boxes, Meter Boxes, and Meter Vaults.

2.05 VALVE SERVICE MANHOLES

A. For valves 24 inches and larger, provide manholes to dimensions shown on Drawings conforming to requirements of Section 02082 - Precast Concrete Manholes.

PART 3 EXECUTION

3.01 EARTHWORK

A. Conform to applicable provisions of Section 02317 - Excavation and Backfill for Utilities.

3.02 SETTING VALVES AND VALVE BOXES

A. Prior to Hydrostatic testing of water line and valve:

1. Test valve by opening and closing valve at a minimum of two times to verify valve seats properly.

2. Verify number of turns from fully open to fully closed position is same as identified in manufacturer's submittal.

3. Adjust valve as required if number of turns do not match.

4. Remove foreign matter from within valves.

B. Install valves where shown on Drawings or as located by Project Manager. Use valve boxes for valves 20 inches and smaller. Set valves plumb and as detailed. Center valve boxes on valves. Carefully tamp earth around each valve box for minimum radius of 4 feet, or to undisturbed trench face when less than 4 feet.

C. Avoid disturbing or overstressing valve body when installing valves. Perform field adjustment of valves under pressure to ensure shutoff occurs in number of rotations as described in valves operation and maintenance manual.

D. Attach two four (4) foot lengths of pipe to each side of valve prior to installation in line.

E. Submit certification that large diameter valve was installed, adjusted, and exercised in accordance with manufacturer's instructions. Manufacturer's certification shall state that all performance characteristics of large diameter valves, as installed, have been met. Adjustments made to valve, for any reason, must be made by manufacturer's representative.

3.03 DISINFECTION AND TESTING

A. Assist City with disinfection of valves and appurtenances as required by Section 02514 - Disinfection of Water Lines and test as required by Section 02515 - Hydrostatic Testing of Pipelines. Do not use valves for throttling without prior approval of manufacturer.

3.04 COATING OF PIPING

A. Coat valves located in vaults, stations, and above ground using approved paint. Coating shall be 6-12 mils thick, but no more than 12 mils. Apply coating in accordance with manufacturer's recommendations.

END OF SECTION

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Section 02527

POLYURETHANE COATINGS ON STEEL OR DUCTILE IRON PIPE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Two-component polyurethane coating system for use as external coating for steel or ductile iron pipe.

1.02 MEASUREMENT AND PAYMENT

A. Unit Prices.

1. No separate payment will be made for work performed under this Section. Include cost of polyurethane coatings in contract unit prices for steel pipe or ductile iron pipe.

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

B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.03 REFERENCES

A. AWWA C 210 - Standard for Liquid Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines.

B. ASTM D 522 - Standard Test Method for Mandrel Bend Test of Attached Organic Coatings.

C. SSPC-PA 2 - Measurement of Dry Paint Thickness with Magnetic Gauges.

D. SSPC-PA Guide 3 - A Guide to Safety in Paint Application.

E. SSPC-PS Guide 17.00 - Guide for Selecting Urethane Painting Systems.

F. SSPC-PS10 - Near-White Blast Cleaning.

1.04 SAFETY

A. Secure, from manufacturer, Material Safety Data Sheet (MSDS) for polyurethane coatings and repair materials listed in this Section.

B. Safety requirements stated in this specification and in related sections apply in addition to applicable federal, state and local rules and regulations. Comply with instructions of coating manufacturer and requirements of insurance underwriters.

C. Follow handling and application practices of SSPC-PA Guide 3; SSPC-PS Guide 17.00; Coating Manufacturer's Material Safety Data Sheet.

1.05 SUBMITTALS

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

B. Submit coating manufacturer's catalog sheets and technical information for approval, prior to delivery of pipe.

C. Obtain from coating manufacturer and submit coating "affidavit of compliance" to requirements of this Section stating that coatings were applied in factory and in accordance with manufacturer's minimum requirements.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Use standard containers to prevent gelling, thickening deleteriously or forming of gas in closed containers within period of one year from date of manufacture.

B. Label each container of separately packaged component clearly and durably to indicate date of manufacture, manufacturer's batch number, quantity, color, component identification and designated name or formula specification, number of coatings together with special instructions. Do not use coating components older than one year.

C. Deliver coating materials to pipe manufacturer in sealed containers showing designated name, batch number, color, date of manufacture and name of coating manufacturer.

D. Store material onsite in enclosures, out of direct sunlight in warm, ventilated and dry area.

E. Prevent puncture, inappropriate opening or other action which may lead to product contamination.

PART 2 PRODUCTS

2.01 COATING MATERIAL

A. CORROPIPE II PW - TOUCHUP (two-component) or approved equal; mix in accordance with coating manufacturer's recommendations.

1. For areas less than or equal to 6 inches in diameter, brush apply.

2. For areas greater than 6 inches in diameter, spray apply.

B. Coating System: Use Type V system which is 2-package polyisocyanate, polyol-cured urethane coating, mixed in 1:1 ratio at time of application. Components shall be balanced viscosities in their liquid state and not require agitation during use.

C. Exterior Coating Material: CORROPIPE II-TX and Joint Coating Material CORROPIPE II-PW, manufactured by Madison Chemical Industries, Inc.

D. Internal Coating Material: Joint Coating Material CORROPIPE II-PW, manufactured by Madison Chemical Industries, Inc

E. Cured Coating Properties:

1. Conversion to Solids by Volume: 97 percent plus or minus 3 percent.

2. Temperature Resistance: Minus 40 degrees F and plus 130 degrees F.

3. Minimum Adhesion: 500 psi, when applied without primer to ductile iron pipe which has been blasted to comply with SSPC-SP 10.

4. Cure Time: For handling in 1 minute at 120 degrees F, and full cure within 7 days at 70 degrees F.

5. Maximum Specific Gravities: Polyisocyanate resin, 1.20. Polyol resin, 1.15.

6. Minimum Impact Resistance: 80 inch-pounds using 1-inch diameter steel ball where coating is applied at 30 mils to ductile iron pipe surface which has been blasted to SSPC No. 10 finish.

7. Minimum Tensile Strength: 2,000 psi.

8. Hardness: 55 plus or minus 5 Shore D at 70 degrees F.

9. Flexibility Resistance: ASTM D 522 using 1-inch mandrel. Allow coating to cure for 7 days. Perform testing on test coupons held for 15 minutes at temperature extremes specified in this Paragraph.

2.02 REPAIR AND TOUCHUP MATERIAL

A. CORROPIPE II PW (Two-component, brush applied, or approved equal). Mix in accordance with coating manufacturer's recommendations.

PART 3 EXECUTION

3.01 SURFACE PREPARATION

A. Remove deposits of oil, grease or other organic contaminates before blast cleaning by using solvent wash as specified in SSPC-PA Guide 3. Clean and dry surfaces making them completely dry, free of moisture, dust, grit, oil, grease or other deleterious substances prior to application of coating.

B. Exterior and Interior Surfaces: SSPC-SP10, near-white metal blast cleaning. Blast with clean, hard, sharp cutting abrasives with no steel or cast iron shot in mix.

C. Ductile Iron Pipe: Prior to start of production blasting, prepare specimens for white metal blast and near-white metal blast using equipment and abrasives proposed for work. During preparation of specimens, Change blasting intensity and abrasive as necessary to provide degree of cleaning required by SSPC-SP10, except that color of blasted substrate is not expected to match color of blasted steel. After examination and concurrence by Project Manager, production blasting may begin. Monitor and control production blasting so that production pipe surfaces match surface of approved blasting specimens.

3.02 THICKNESS

A. External Coatings: Minimum DFT of 25 mils (0.025 inch).

B. Internal Coatings: Minimum DFT of 35 mils.

C. Thickness Determinations: Use Type 1 magnetic thickness gauge as described in SSPC-PA2 specification. Individual readings below 90 percent of specified minimum are not acceptable. Average individual spot readings (consisting of three point measurements within 3 inches of each other) less than 95 percent of minimum are not acceptable. Average of all spot readings less than minimum thickness specified are not acceptable.

3.03 FACTORY APPLICATION OF POLYURETHANE COATING

A. Equipment: Two-component, 1:1 mix ratio, heated airless spray unit.

B. Temperature: Minimum 5 degrees F above dew point temperature. Temperature of surface shall not be less than 60 degrees F during application.

C. Humidity: Heating of pipe surfaces may be required to meet requirements of Paragraph 2.01E, Cured Coating Properties, when relative humidity exceeds 80 percent.

D. Do not thin or mix resins; use as received. Store resins at temperature above 55 degrees F at all times.

E. Application: Conform to coating manufacturer's recommendations. Apply directly to substrate to achieve specified thickness. Multiple-pass, one-coat application process is permitted provided maximum allowable recoat time specified by coating manufacturer is not exceeded.

F. Recoat only when coating has cured less than maximum time specified by coating manufacturer. When coating has cured for more than recoat time, brush-blast or thoroughly sand coating surface. Blow-off cleaning using clean, dry, high pressure compressed air.

G. Cure at ambient temperature above 0 degrees F. Do not handle pipe until coating has been allowed to cure as follows:

Ambient Temperature	Minimum Full Cure Time
Over 70 degrees F	7 days
50 to 70 degrees F	9 days
0 to 50 degrees F	12 days

3.04 JOINTS

A. Apply coating to unlined pipe surfaces including inside of bell socket and outside of spigot.

B. Coating thickness on sealing areas of spigot end of pipe exterior: Minimum 8 mils (0.008 inch), maximum of 10 mils (0.010 inch). Maximum 10 mils may be exceeded in spigot end provided maximum spigot diameter as specified by pipe manufacturer is not exceeded.

3.05 INSPECTION

A. Project Manager may inspect coatings at coating applicator's facilities.

B. Secure approval of surface preparation by coating manufacturer's representative prior to coating application.

C. Holiday Inspection: Conform to AWWA C 210, Section 5.3.3.1. Follow coating manufacturer's recommendation. Conduct inspection any time after coating has reached initial cure. Repair in accordance with Paragraph 3.07, Repair and Field Touchup.

3.06 PIPE INSTALLATION

A. When required by Project Manager, provide services of manufacturer's representative for period of not less than 2 weeks at beginning of actual pipe laying operations to advise Contractor regarding installation including but not limited to handling and storing, cleaning and inspecting, coatings repairs, and general construction methods as to how they may affect pipe coatings.

B. Use nylon straps, padded lifts and padded storage skids. Field cuts should be kept to minimum. Repair damage to coating due to handling or construction practices. See Section 02501 - Ductile - Iron Pipe and Fittings and Section 02502 - Steel Pipe and Fittings for additional requirements.

C. Just before each section of pipe is to be placed into trench, conduct visual and holiday inspection. Repair defects in coating system before pipe is installed.

3.07 REPAIR AND FIELD TOUCHUP

A. Apply repair and touchup materials in conformance with factory application of polyurethane coating requirements specified in this Section, excluding equipment requirements.

B. Repair Procedure - Holidays:

1. Remove traces of oil, grease, dust, dirt, and other deleterious materials

2. Roughen area to be patched by sanding with rough grade sandpaper (40 grit).

3. Apply one coat of repair material described above. Work repair material into scratched surface by brushing.

C. Repair Procedure - Field Cuts or Large Damage:

1. Remove burrs from field cut ends or handling damage and smooth out edge of polyurethane coating.

2. Remove traces of oil, grease, dust, dirt, and other deleterious materials

3. Roughen area to be patched with rough grade sandpaper (40 grit). Feather edges and include overlap of 1 inch to 2 inches of roughened polyurethane in area to be patched.

4. Apply thick coat of repair material described above. Work repair material into scratched surface by brushing. Feather edges of repair material into prepared surface. Cover at least 1 inch of roughened area surrounding damage, or adjacent to field cut.

D. Repair Procedure - Thermite Brazed Connection Bonds:

1. Remove polyurethane coating with power wire brush from area on metal surface which is to receive thermite brazed connection.

2. Grind metal surface to shiny metal with power grinder and coarse grit grinding wheel.

3. Apply thermite-brazed connection using equipment, charge and procedure recommended by manufacturer of thermite equipment.

4. After welded surface has cooled to temperature below 130 degrees F, apply protective coating repair material to weld, exposed pipe surface and damaged areas of polyurethane coating.

5. Do not cover or backfill freshly repaired areas of coating at thermite-brazed connection until repair material has completely cured. Allow material to cure in conformance with manufacturer's recommendations.

END OF SECTION

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Section 02533

ACCEPTANCE TESTING FOR SANITARY SEWERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Acceptance testing of sanitary sewers including:

1. Visual inspection of sewer pipes
2. Mandrel testing for flexible sewer pipes.
3. Leakage testing of sewer pipes.
4. Leakage testing of manholes.
5. Smoke testing of point repairs.
6. Television and Video Inspection.

B. All tests listed in this Section are not necessarily required on this Project. Required tests are named in other Sections which refer to this Section for testing criteria and procedures.

1.02 MEASUREMENT AND PAYMENT

A. Unit Prices.

1. No payment will be made for acceptance testing under this Section. Include payment in unit price for work requiring acceptance testing.
2. Refer to Section 01270 - Measurement and Payment for unit price procedures.

B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.03 REFERENCES

A. ASTM C 828 - Standard Test Method for Low Pressure Air Test of Vitrified Clay Pipe Lines.

B. ASTM C 924 - Standard Practice for Testing Concrete Pipe Sewer Lines by Low-Pressure Air Test Method.

C. ASTM D 3034 - Standard Specification for Type PSM Polyethylene (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.

D. ASTM F 794 - Specification for Poly (Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter.

E. ASTM F 1417 - Standard Test Method for Installation Acceptance of Plastic Gravity Sewer Lines Using Low Pressure Air.

F. ASTM C 1244 Standard Test Method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test Prior to Backfill.

1.04 PERFORMANCE REQUIREMENTS

A. Gravity flow sanitary sewers are required to have straight alignment and uniform grade between manholes.

B. Flexible pipe, including "semi-rigid" pipe, is required to show no more than 5 percent deflection. Test pipe no sooner than 30 days after backfilling of line segment but prior to final acceptance using standard mandrel to verify that installed pipe is within specified deflection tolerances.

C. Must meet Texas Commission on Environmental Quality (TCEQ) Testing Requirements Chapter-217-57.

1.05 SUBMITTALS

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

B. Test Plan: Before testing begins and in adequate time to obtain approval through submittal process, prepare and submit test plan for approval by Project Manager. Include testing procedures, methods, equipment, and tentative schedule. Obtain advance written approval for deviations from Drawings and Specifications.

C. Test Reports: Submit test reports for each test on each segment of sanitary sewer.

1.06 GRAVITY SANITARY SEWER QUALITY ASSURANCE

A. Repair, correct, and retest manholes or sections of pipe which fail to meet specified requirements when tested.

B. Provide testing reports and video tape of television inspection as directed by Project Manager.

C. Upon completion of tape reviews by Project Manager, Contractor will be notified regarding final acceptance of sewer segment.

1.07 SEQUENCING AND SCHEDULING

A. Perform testing as work progresses. Schedule testing so that no more than 1000 linear feet of installed sewer remains untested at one time.

B. Coordinate testing schedules with Project Manager. Perform testing under observation of Project Manager.

PART 2 P R O D U C T S

2.01 DEFLECTION MANDREL

A. Mandrel Sizing. Rigid mandrel shall have outside diameter (O.D.) equal to 95 percent of inside diameter (I.D.) of pipe. Inside diameter of pipe, for purpose of determining outside diameter of mandrel, shall be average outside diameter minus two minimum wall thicknesses for O.D. controlled pipe and average inside diameter for I.D. controlled pipe, dimensions shall be per appropriate standard. Statistical or other "tolerance packages" shall not be considered in mandrel sizing.

B. Mandrel Design. Rigid mandrel shall be constructed of metal or rigid plastic material that can withstand 200 psi without being deformed. Mandrel shall have nine or more "runners" or "legs" as long as total number of legs is odd number. Barrel section of mandrel shall have length of at least 75 percent of inside diameter of pipe. Rigid mandrel shall not have adjustable or collapsible legs which would allow reduction in mandrel diameter during testing. Provide and use proving ring for modifying each size mandrel.

C. Proving Ring. Furnish "proving ring" with each mandrel. Fabricate ring of 1/2-inch-thick, 3-inch-wide bar steel to diameter 0.02 inches larger than approved mandrel diameter.

D. Mandrel Dimensions (5 percent allowance). Average inside diameter and minimum mandrel diameter are specified in Table 02533-5, Pipe vs. Mandrel Diameter, at end of this Section. Mandrels for higher strength, thicker wall pipe or other pipe not listed in table may be used when approved by Project Manager.

2.02 EXFILTRATION TEST

A. Water Meter: Obtain transient water meter from City for use when water for testing will be taken from City system. Conform to City requirements for water meter use.

B. Test Equipment:

1. Pipe plugs.

2. Pipe risers where manhole cone is less than 2 feet above highest point in pipe or service lead.

2.03 INFILTRATION TEST

A. Test Equipment:

1. Calibrated 90 degree V-notch weir.

2. Pipe plugs.

2.04 LOW PRESSURE AIR TEST

A. Minimum Requirement for Equipment:

1. Control panel

2. Low-pressure air supply connected to control panel.

3. Pneumatic plugs: Acceptable size for diameter of pipe to be tested; capable of withstanding internal test pressure without leaking or requiring external bracing.

4. Air hoses from control panel to:

a. Air supply.

b. Pneumatic plugs.

c. Sealed line for pressuring.

d. Sealed line for monitoring internal pressure.

B. Testing Pneumatic Plugs: Place pneumatic plug in each end of length of pipe on ground. Pressurize plugs to 25 psig; then pressurize sealed pipe to 5 psig. Plugs are acceptable when they remain in place against test pressure without external aids.

2.05 GROUND WATER DETERMINATION

A. Equipment: Pipe probe or small diameter casing for ground water elevation determination.

2.06 SMOKE TESTING

A. Equipment:

1. Pneumatic plugs.

2. Smoke generator as supplied by Superior Signal Company, or approved equal.

3. Blowers producing 2500 scfm minimum.

PART 3 EXECUTION

3.01 PREPARATION

A. Provide labor, equipment, tools, test plugs, risers, air compressor, air hose, pressure meters, pipe probe, calibrated weirs, or any other device necessary for proper testing and inspection.

B. Determine selection of test methods and pressures for gravity sanitary sewers based on ground water elevation. Determine ground water elevation using equipment and procedures conforming to Section 01578 - Control of Ground Water and Surface Water.

3.02 VISUAL INSPECTION OF GRAVITY SANITARY SEWERS

A. Check pipe alignment visually by flashing light between structures. Verify if alignment is true and no pipes are misplaced. In case of misalignment or damaged pipe, remove and re-lay or replace pipe segment.

3.03 MANDREL TESTING FOR GRAVITY SANITARY SEWERS

A. Perform deflection testing on flexible and semi-rigid pipe to confirm pipe has no more than 5 percent deflection. Mandrel testing shall conform to ASTM D 3034. Perform testing no sooner than 30 days after backfilling of line segment, but prior to final acceptance testing of line segment.

B. Pull approved mandrel by hand through sewer sections. Replace any section of sewer not passing mandrel. Mandrel testing is not required for stubs.

C. Retest repaired or replaced sewer sections.

3.04 LEAKAGE TESTING FOR GRAVITY COLLECTION SYSTEM PIPES

A. For a collection system pipe that will transport wastewater by gravity flow, test gravity sanitary sewer pipes for leakage by either exfiltration or infiltration methods, as appropriate, or with low pressure air testing.

B. Compensating for Ground Water Pressure:

1. Where ground water exists, install pipe nipple at same time sewer line is placed. Use 1/2-inch capped pipe nipple approximately 10 inches long. Make installation through manhole wall on top of sewer line where line enters manhole.

2. Immediately before performing line acceptance test, remove cap, clear pipe nipple with air pressure, and connect clear plastic tube to nipple. Support tube vertically and allow water to rise in tube. After water stops rising, measure height in feet of water over invert of pipe. Divide this height by 2.3 feet/psi to determine ground water pressure to be used in line testing.

C. Exfiltration test:

1. Determine ground water elevation.

2. Plug sewer in downstream manhole.

3. Plug incoming pipes in upstream manhole.

4. Install riser pipe in outgoing pipe of upstream manhole when highest point in service lead (house service) is less than 2 feet below bottom of manhole cone.

5. Fill sewer pipe and manhole or pipe riser, when used, with water to point 2-1/2 feet above highest point in sewer pipe, house lead, or ground water table, whichever is highest.

6. Allow water to stabilize for one to two hours. Take water level reading to determine drop of water surface, in inches, over one-hour period, and calculate water loss (1 inch of water in 4 feet diameter manhole equals 8.22 gallons) or measure quantity of water required to keep water at same level. Loss shall not exceed that calculated from allowable leakage according to Table 02533-1 at end of this Section.

D. Infiltration test: Ground water elevation must be not less than 2.0 feet above highest point of sewer pipe or service lead (house service).

1. Determine ground water elevation.

2. Plug incoming pipes in upstream manhole.

3. Insert calibrated 90 degree V-notch weir in pipe on downstream manhole.

4. Allow water to rise and flow over weir until it stabilizes.

E. Low Air Pressure Test: When using this test conform to ASTM C 828, ASTM C 924, or ASTM F 1417, as applicable, with holding time not less than that listed in Table 02533-2.

1. Low Pressure Air testing for sections of pipe shall be limited to lines less than 36-inch average inside diameter. Refer to charts 02533-2 and 02533-3.

2. Lines 36-inch average inside diameter and larger shall be tested at each joint. Minimum time allowable for pressure to drop from 3.5 pounds per square inch gauge to 2.5 pounds per square inch during joint test shall be 10 seconds, regardless of pipe size.

F. Retest: Repair and retest any section of pipe which fails to meet requirements.

3.05 TEST CRITERIA TABLES

A. Exfiltration and Infiltration Water Tests: Refer to Table 02533-1, Water Test Allowable Leakage, at end of this Section.

B. Low Pressure Air Test:

1. Times in Table 02533-2, Time Allowed for Pressure Loss from 3.5 psig to 2.5 psig, at end of this Section, are based on equation from Texas Commission on Environmental Quality (TCEQ) Design Criteria 217.57

			$T = 0.0850(D)(K)/(Q)$
where:	T	=	time for pressure to drop 1.0 pounds per square inch gauge in seconds
	K	=	0.000419 DL, but not less than 1.0
	D	=	average inside diameter in inches
	L	=	length of line of same pipe size in feet
	Q	=	rate of loss, 0.0015 ft^3/min./sq. ft. internal surface

2. Since K value of less than 1.0 shall not be used, there are minimum testing times for each pipe diameter as given in Table 02533-3, Minimum Testing Times for Low Pressure Air Test.

Notes:
1. when two sizes of pipe are involved, compute time by ratio of lengths involved.
2. Lines with 27-inch average inside diameter and larger may be air tested at each joint.
3. Lines with average inside diameter greater than 36 inches must be air tested for leakage at each joint.
4. If joint test is used, perform visual inspection of joint immediately after testing.
5. For joint test, pipe is to be pressurized to 3.5 psi greater than pressure exerted by groundwater above pipe. Once pressure has stabilized, minimum times allowable for pressure to drop from 3.5 pounds per square inch gauge to 2.5 pounds per square inch gauge shall be 10 seconds.

3.06 LEAKAGE TESTING FOR MANHOLES

A. After completion of manhole construction, wall sealing, or rehabilitation, but prior to backfilling, test manholes for water tightness using hydrostatic or vacuum testing procedures.

B. Plug influent and effluent lines, including service lines, with suitably-sized pneumatic or mechanical plugs. Ensure plugs are properly rated for pressures required for test; follow manufacturer's safety and installation recommendations. Place plugs minimum of 6 inches outside of manhole walls. Brace inverts to prevent lines from being dislodged when lines entering manhole have not been backfilled.

C. Vacuum testing:

1. Install vacuum tester head assembly at top access point of manhole and adjust for proper seal on straight top section of manhole structure. Following manufacturer's instructions and safety precautions, inflate sealing element to recommended maximum inflation pressure; do not over-inflate.

2. Evacuate manhole with vacuum pump to 10 inches mercury (Hg), disconnect pump, and monitor vacuum for time period specified in Table 02533-4, Vacuum Test Time Table.

3. A manhole passes the test if after 2.0 minutes and with all valves closed, the vacuum is at least 9.0 inches of mercury (Hg).

D. Perform hydrostatic exfiltration testing as follows:

1. Seal wastewater lines coming into manhole with internal pipe plug. Then fill manhole with water and maintain it full for at least one hour.
2. The maximum leakage for hydrostatic testing shall be 0.025 gallons per foot diameter per foot of manhole depth per hour.

3. If water loss exceeds amount tabulated above, locate leaks, complete repairs necessary to seal manhole and repeat test procedure until satisfactory results are obtained.

3.07 SMOKE TEST PROCEDURES FOR POINT REPAIRS

A. Application: Perform smoke test to:

1. Locate points of line failure for point repair.

2. Determine when point repairs are properly made.

3. Determine when service connections have been reconnected to rehabilitated sewer.

4. Check integrity of connections to newly replaced service taps to liners and to existing private service connections.

B. Limitations: Do not backfill service taps until completion of this test. Test only those taps in single manhole section at one time. Keep number of open excavations to minimum.

C. Preparation: Prior to smoke testing, give written notices to area residents no fewer than 2 days, nor more than 7 days, prior to proposed testing. Also give notice to City of Houston Police and Fire Departments 24 hours prior to actual smoke testing.

D. Isolate Section: Isolate manhole section to be tested from adjacent manhole sections to keep smoke localized. Temporarily seal annular space at manhole for sliplined sections.

E. Smoke Introduction:

1. Operate equipment according to manufacturer's recommendation and as approved by Project Manager.

2. Conduct test by forcing smoke from smoke generators through sanitary sewer main and service connections. Operate smoke generators for minimum of 5 minutes.

3. Introduce smoke into upstream and downstream manhole as appropriate. Monitor tap/connection for smoke leaks. Note sources of leaks.

F. Repair and Retest: Repair and replace taps or connections noted as leaking and then retest. Taps and connections may be left exposed in only one manhole section at time. When repair or replacement, testing or retesting, and backfilling of excavation is not completed within one work day, properly barricade and cover each excavation as approved by Project Manager.

G. Service Connections: On houses where smoke does not issue from plumbing vent stacks to confirm reconnection of sewer service to newly installed liner pipe, perform dye test to confirm reconnection. Introduce dye into service line through plumbing fixture inside structure or sewer cleanout immediately outside structure and flush with water. Observe flow at service reconnection or downstream manhole. Detection of dye confirms reconnection.

3.08 TELEVISION AND VIDEO INSPECTION PROCEDURE

A. Refer to Document 02588- Cleaning and Television Inspection

Table 02533-1
WATER TEST ALLOWABLE LEAKAGE

DIAMETER OF RISER OR STACK IN INCHES	VOLUME PER INCH OF DEPTH		ALLOWANCE LEAKAGE*	
	INCH	GALLONS	PIPE SIZE IN INCHES	GALLONS/MINUTE PER 100 FT.
1	0.7854	.0034	6	0.0039
2	3.1416	.0136	8	0.0053
2.5	4.9087	.0212	13	0.0066
3	7.0686	.0306	12	0.0079
4	12.5664	.0306	15	0.0099
5	19.6350	.0544	18	0.0118
6	28.2743	.1224	21	0.0138
8	50.2655	.2176	24	0.0158
			27	0.0177
			30	0.0197
			36	0.0237
			42	0.0276
For other diameters, multiply square of diameters by value for 1" diameter.			Equivalent to 50 gallons per inch of inside diameter per mile per 24 hours.	

* Allowable leakage rate must not exceed 10 gallons per inch of inside diameter per mile per 24 hours, when sewer is identified as located within 25-year flood plain.

Table 02533-2
ACCEPTANCE TESTING FOR
SANITARY SEWERS

TIME ALLOWED FOR PRESSURE LOSS FROM 3.5 PSIG TO 2.5 PSIG

Pipe Diam. (in)	Min. Time (min: sec)	Length for Min. Time (ft)	Time for Longer Length (sec)	Specification Time for Length (L) Shown (min:sec)										
				100 ft	150 ft	200 ft	250 ft	300 ft	350 ft	400 ft	450 ft	500 ft	550 ft	600 ft
6	5:40	398	0.8548	5:40	5:40	5:40	5:40	5:40	5:40	5:42	6:25	7:07	7:50	8:33
8	7:33	298	1.5196	7:33	7:33	7:33	7:33	7:36	8:52	10:08	11:24	12:40	13:56	15:12
10	9:27	239	2.3743	9:27	9:27	9:27	9:54	11:52	13:51	15:50	17:48	19:47	21:46	23:45
12	11:20	199	3.4190	11:20	11:20	11:20	14:15	17:06	19:57	22:48	25:39	28:30	31:20	34:11
15	14:10	159	5.3423	14:10	14:10	17:48	22:16	26:43	31:10	35:37	40:04	44:31	48:58	53:25
18	17:00	133	7.6928	17:00	19:14	25:39	32:03	38:28	44:52	51:17	57:42	64:06	70:31	76:56
21	19:50	114	10.4708	19:50	26:11	34:54	43:38	52:21	61:05	69:48	78:32	87:15	95:59	104:42
24	22:40	99	13.6762	22:48	34:11	45:35	56:59	68:23	79:47	91;10	102:34	113:58	125:22	136:46
27	25:30	88	17.3089	28:51	43:16	57:42	72:07	86:33	100:58	115:24	129:49	144:14	158:40	173:05
30	28:20	80	21.3690	35:37	53:25	71:14	89:02	106:51	124:39	142:28	160:16	178:05	195:53	213:41
33	31:10	72	25.8565	43:06	64:38	86:11	107:44	129:17	150:50	172:23	193:55	215:28	237:01	258:34

Table 02533-3
MINIMUM TESTING TIMES FOR LOW
PRESSURE AIR TEST

PIPE DIAMETER *(INCHES)*	**MINIMUM TIME** *(SECONDS)*	**LENGTH FOR MINIMUM TIME** *(FEET)*	**TIME FOR LONGER LENGTH** *(SECONDS/FT*
6	340	398	0.855
8	454	298	1.520
10	567	239	2.374
12	680	199	3.419
15	850	159	5.342
18	1020	133	7.693
21	1190	114	10.471
24	1360	100	13.676
27	1530	88	17.309
30	1700	80	21.369
33	1870	72	25.856

Table 02533-4
VACUUM TEST TIME TABLE

DEPTH IN FEET	**TIME IN SECONDS BY PIPE DIAMETER**		
	48"	60"	72"
4	10	13	16
8	20	26	32
12	30	39	48
16	40	52	64
20	50	65	80
24	60	78	96
*	5.0	6.5	8.0

*Add T times for each additional 2-foot depth.
(The values listed above have been extrapolated from ASTM C 1244

Table 02533-5
PIPE VS. MANDREL DIAMETER

Material and Wall Construction	Nominal Size (Inches)	Average I.D. (Inches)	Minimum Mandrel Diameter (Inches)
PVC-Solid (SDR 26)	6	6	5.764
5.476			
	8	7.715	7.329
	10	9.646	9.162
PVC-Solid (SDR 35)	12	12	11.737
11.150			
	15	14.374	13.655
	18	17.629	16.748
	21	20.783	19.744
	24	23.381	22.120
	27	26.351	25.033
PVC-Truss		8	7.750
7.363			
	10	9.750	9.263
	12	11.790	11.201
	15	14.770	14.032
PVC-Profile (ASTM F 794)	12	11.740	11.153
	15	14.370	13.652
	18	17.650	16.768
	21	20.750	19.713
	24	23.500	22.325
	27	26.500	25.175
	30	29.500	28.025
	36	35.500	33.725
	42	41.500	39.425
	48	47.500	45.125
HDPE-Profile	18	18.000	17.100
	21	21.000	19.950
	24	24.000	22.800
	27	27.000	25.650
	30	30.000	28.500
	36	36.000	34.200
	42	42.000	39.900
	48	48.000	45.600
	54	54.000	51.300
	60	60.000	57.000
Fiberglass		12	12.85
11.822			
(Class SN 46)	18	18.66	17.727

20	20.68	19.646
24	24.72	23.484
30	30.68	29.146
36	36.74	34.903
42	42.70	40.565
48	48.76	46.322
54	54.82	52.079
60	60.38	57.361

END OF SECTION

Section 02611

REINFORCED CONCRETE PIPE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Reinforced concrete pipe for sanitary sewers and storm sewers.

1.02 MEASUREMENT AND PAYMENT

A. Unit Prices.

1. No separate payment will be made for reinforced concrete pipe under this Section. Include cost in unit price Work as specified in following Sections:

   a. Section 02426 - Sewer Line in Tunnels.

   b. Section 02531 - Gravity Sanitary Sewers.

   c. Section 02631 - Storm Sewers.

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

B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for Work in this section is included in total Stipulated Price.

1.03 REFERENCES

A. ASTM C 76 - Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.

B. ASTM C 443 - Standard Specification for Joints for Circular Concrete Sewer and Culvert Pipe Using Rubber Gaskets.

C. ASTM C 497 - Standard Test Method for Concrete Pipe, Manhole Sections, or Tile.

D. ASTM C 506 - Standard Specification for Reinforced Concrete Arch Culvert, Storm Drain and Sewer Pipe

E. ASTM C 655 - Standard Specification for Reinforced Concrete D-load Culvert, Storm Drain and Sewer Pipe.

F. ASTM C 877 - Standard Specification for External Sealing Bands for Noncircular Concrete Sewer, Storm Drain, and Culvert Pipe.

1.04 SUBMITTALS

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

B. Submit complete product data for pipe, fittings and gaskets for approval. Indicate conformance to appropriate reference standards.

C. Submit manufacturer's certificate that concrete pipes meet applicable standards.

D. For jacking pipe, submit drawings and data describing grouting port design and closure procedures when required by Section 02431 - Tunnel Grout, including liner repair, as applicable.

PART 2 P R O D U C T S

2.01 REINFORCED CONCRETE PIPE

A. Conform circular reinforced concrete pipe to requirements of ASTM C 76, for Class III wall "B" thickness. Conform to rubber gasket joints for sanitary sewers and storm sewers and tongue and groove for roadside ditch culverts to ASTM C 443.

B. Conform reinforced concrete arch pipe to requirements of ASTM C 506 for Class A-III. Joints shall conform to ASTM C 877.

C. Reinforced concrete elliptical pipe, either vertical or horizontal, shall conform to requirements of ASTM C 507 for Class VE-III for vertical or Class HE-III for horizontal. Use rubber gasket joints conforming to ASTM C 877.

D. Conform reinforced concrete D-load pipe requirements of ASTM C 655.

2.02 GASKETS

A. When no contaminant is identified, furnish rubber gasket conforming to ASTM C 443 for circular reinforced concrete pipe and rubber gasket conforming to ASTM C 877 for reinforced concrete elliptical pipe.

B. Use the following gasket materials for pipes to be installed in potentially contaminated areas, especially where free product is found near elevation of proposed sewer:

CONTAMINANT	GASKET MATERIAL REQUIRED
Petroleum (diesel, gasoline)	Nitrile Rubber
Other Contaminants	As recommended by pipe manufacturer, Engineer of the Record and approved by City Engineer prior to installation

2.03 LINERS FOR SANITARY SEWER PIPE

A. Reinforced concrete pipe for sanitary sewers shall be PVC lined and conform to Section 02427 - Plastic Liner for Large Diameter Concrete Sewers and Structures.

B. Reinforced concrete pipes to be installed in potentially contaminated areas shall have liners recommended by manufacturer as resistant to contaminants identified in Phase II Environmental Site Assessment Report.

2.04 SOURCE QUALITY CONTROL

A. Representatives of City Engineer will inspect manufacturer's plant and casting operations as deemed necessary.

PART 3 E X E C U T I O N

3.01 INSTALLATION

A. Conform to requirements of following Sections, as applicable:

1. Section 02448 - Pipe and Casing Augering for Sewers.
2. Section 02531 - Gravity Sanitary Sewers.
3. Section 02631 - Storm Sewers.
4. Section 02441 - Micro-tunneling and Pipe-Jacked Tunnels.

B. Install reinforced concrete pipe in accordance with manufacturer's recommendations.

END OF SECTION

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Section 02631

STORM SEWERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. New storm sewers and appurtenances, modifications to existing storm sewer system and installation of roadside ditch culverts.

1.02 MEASUREMENT AND PAYMENT

A. Unit Prices.

1. Payment for storm sewers, including elliptical or box storm sewer, installed by open-cut, augered with or without casing, or tunneling is on linear foot basis. Measurement for storm sewers and roadside ditch culverts will be taken along center line of pipe from center line to center line of manholes or from end to end of culverts. Measurement for storm sewer will be taken along center line of storm sewer from inside wall of storm sewer junction box when installed in conjunction with storm sewer junction box. Payment will be made for each linear foot installed complete in place, including connections to existing manholes and inlets.

2. Payment for storm sewer leads, including elliptical leads, is on a linear foot basis.

3. Payment for corrugated metal pipe storm sewer outfall, including timber bents, is on a linear foot basis.

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 SUBMITTALS

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

B. Submit manufacturer's literature for product specifications and installation instructions.

C. Submit proposed methods, equipment, materials, and sequence of operations for sewer construction. Plan operations to minimize disruption of utilities to occupied facilities or adjacent property.

1.04 QUALITY ASSURANCE

A. The Condition for acceptance shall be watertight storm sewer that is watertight both in pipe-to-pipe joints and in pipe-to-manhole connections.

B. Provide manufacturer's certification to Specifications.

1.05 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Comply with manufacturer's recommendations.

B. Handle pipe, fittings, and accessories carefully with approved handling devices. Do not drop or roll pipe off trucks or trailers. Do not use Materials cracked, gouged, chipped, dented, or otherwise damaged shall not be use materials for installation.

C. Store pipe and fittings on heavy timbers or platforms to avoid contact with ground.

D. Unload pipe, fittings, and appurtenances as close as practical to location of installation to avoid unnecessary handling.

E. Keep interiors of pipe and fittings free of dirt and foreign matter.

F. Store PVC pipe out of direct sunlight.

PART 2 PRODUCTS

2.01 PIPE

A. Provide piping materials for storm sewers shall be of sizes and types specified unless otherwise indicated on Drawings.

B. In diameters where material alternatives are available, provide pipe from single manufacturer for each pipe diameter, unless otherwise approved by Project Manager or otherwise shown on Drawings.

C. Existing pipe that has been removed during construction cannot be reused.

2.02 PIPE MATERIAL SCHEDULE

A. Storm Sewer Pipe: Use pipe materials that conforming to requirements specified in one or more of the following Sections as shown on the Drawings.

1. Section 02506 - Polyvinyl Chloride Pipe. Not allowed in the following applications:

a. Potentially Petroleum Contaminated Areas (PPCA).

b. Augering/ jacking

2. Section 02505 - High Density Polyethylene (HDPE) Solid and Profile Wall Pipe. For use only where Storm Sewers are associated with Local Streets, where Local Street is definded by City of Houston Code of Ordinances 42-122.

3. Section 02611 - Reinforced Concrete Pipe.

4. Section 02641 - Monolithic Reinforced Concrete Sewers.

5. Section 02612 - Precast Reinforced Concrete Box Sewers.

6. Section 02642 - Corrugated Metal Pipe use only where Corrugated Metal Pipe is shown on Drawings.

B. Driveway Culvert Pipe for Streets with Open Ditches: Use pipe materials conforming to requirements specified in one or more of the following Sections as shown on the Drawings.

1. Section 02505 - High Density Polyethylene (HDPE) Solid and Profile Wall Pipe Use for Residential Culverts only. Use Concrete Pipe for long run culverts.

2. Section 02611 - Reinforced Concrete Pipe.

3. Section 02641 - Monolithic Reinforced Concrete Sewers.

4. Section 02612 - Precast Reinforced Concrete Box Sewers.

C. Provide pipe meeting minimum class, dimension ratio, or other criteria indicated.

D. Pipe materials other than those listed above shall not be used for storm sewers.

2.03 BEDDING, BACKFILL, AND TOPSOIL MATERIAL

A. Bedding and Backfill Material: Conform to requirements of Sections 02317 - Excavation and Backfill for Utilities, Section 02320 - Utility Backfill Material, and Section 2321 – Cement Stabilized Sand, and 02322 – Flowable Fill.

B. Topsoil: Conform to requirements of Section 02911 - Topsoil.

PART 3 EXECUTION

3.01 PREPARATION

A. Prepare traffic control plans and set up street detours and barricades in preparation for excavation when construction will affects traffic. Conform to requirements of Section 01555 Traffic Control and Regulation.

B. Provide barricades, flashing warning lights, and signs for excavations. Conform to requirements of Section 01555 - Traffic Control and Regulation. Maintain barricades and warning lights for streets and intersections while Work is in progress or where traffic is affected by Work.

C. Immediately notify agency or company owning utility lines which are damaged, broken, or disturbed. Obtain approval from Project Manager and agency for repairs or relocations, either temporary or permanent.

D. Remove old pavements and structures, including sidewalks and driveways in accordance with requirements of Section 02221 - Removing Existing Pavements and Structures.

E. Install and operate dewatering and surface water control measures in accordance with Section 01578 - Control of Ground Water and Surface Water.

3.02 EXCAVATION

A. Earthwork. Conform to requirements of Section 02317 - Excavation and Backfill for Utilities. Use bedding as indicated on Drawings.

B. Line and Grade. Establish required uniform line and grade trench from benchmarks identified by Project Manager. Maintain this control for minimum of 100 feet behind and ahead of pipe-laying operation. Use laser beam equipment to establish and maintain proper line and grade of Work. Or use appropriately sized grade boards which are substantially supported.

C. Trench Excavation. Excavate pipe trenches to level as indicated on Standard Details. Backfill excavation with specified bedding material to level of lower one-third of pipe barrel. Tamp and compact backfill to provide bedding at indicated grade. Form bedding foundation to minimum depth of one-eighth of pipe diameter, but not less than 12 inches.

3.03 PIPE INSTALLATION

A. Install in accordance with pipe manufacturer's recommendations and as specified in this section.

B. Install pipe only after excavation is completed, bottom of trench is shaped, bedding material is installed, and trench has been approved by Project Manager.

C. Install pipe to line and grade indicated on Drawings. Place pipe so that it has continuous bearing of barrel on bedding material with no voids, and is laid in trench so interior surfaces of pipe follows grades and alignments indicated.

D. Install pipe with bells of pipe facing upstream of anticipated flow.

E. Form concentric joint with each section of adjoining pipe to prevent offsets.

F. Place and drive home newly laid sections with a sling or come-a-long winches to eliminate damage to sections. Unless otherwise approved by Project Manager, provide end protection to prevent damage while using back hoes or similar powered equipment to drive home newly laid sections.

G. Keep interior of pipe clean as installation progresses.

H Keep excavations free of water during construction and until final inspection.

I. When work is not in progress, cover exposed ends of pipes with pipe plug specifically designed to prevent foreign material from entering pipe.

J. For PVC Pipe:

1. Provide a minimum cover as per City Standard detail from top of pavement to top of pipe, but no less than 2 feet.

2. Accomplish transitions to different material of pipe in a manhole or inlet box. No adapter, coupling for dissimilar pipe, or saddle connections allowed.

3. Provide pipe sections in standard lengths with minimum length of 13 feet. Pipe may be field modified to shorten length no less than 4 feet, unless otherwise approved by Project Manager. Field modify pipe per manufacturer's recommendations.

4. No beveling at joint allowed. Cut to be perpendicular to longitudinal axis.

5. Provide gasketed bell and spigot joints installed per manufacturer's recommendations. Gasketed pipe joints; clean and free of debris, show no leakage after installation.

3.04 PIPE INSTALLATION OTHER THAN OPEN CUT

A. Conform to requirements of Section 02448 - Pipe and Casing Augering for Sewers where required.

B. Conform to requirements of Section 02441 - Microtunneling and Pipe-Jacking Tunnels where required.

C. Not allowed for plastic sewer pipe.

3.05 INSTALLATION OF APPURTENANCES

A. Construct manholes to conform to requirements of Sections 02081 - Cast-in-place Concrete Manholes, Section 02082 - Precast Concrete Manholes, and Section 2087 - Brick Manholes for

Storm Sewers. Install frames, grate rings, and covers to conform to requirements of Section 02084 - Frames, Grates, Rings, and Covers.

B. Install PVC pipe culverts with approved end treatments. Approved end treatments include concrete headwalls, wingwalls and collars. Refer to City Standards detail for end treatment requirements.

C. Install HDPE pipe culverts with approved end treatments. Approved end treatments include concrete headwalls, wingwalls and collars. Refer to City Standards detail for end treatment requirements.

D. Install inlets, headwalls, and wingwalls to conform to requirements of Section 02632 - Cast-in-place Inlets, Headwalls, and Wingwalls and Section 02633 - Precast Concrete Inlets, Headwalls, and Wingwalls.

E. Rehabilitate existing manholes to conform to requirements of Section 02555 – Manhole Rehabilitation. Adjust manhole covers and inlets to grade conforming to requirements of Section 02086 - Adjusting Manholes, Inlets, and Valve Boxes to Grade.

F. Dimension for Type C and Type E manholes shall be as shown on Drawings.

3.06 INSPECTION AND TESTING

A. Perform post installation television inspection in accordance with Section 02531 – Gravity Sanitary Sewers. Hand held cameras may be used in storm sewers in lieu of requirements of Paragraph 3.09 of Section 02531 – Gravity Sanitary Sewers. Clearly stencil distance markings on each joint of pipe to indicate distance from starting manhole when using hand held cameras.

3.07 BACKFILL AND SITE CLEANUP

A. Backfill trench after pipe installation is inspected and approved by Project Manager.

B. Backfill and compact soil in accordance with Section 02317 - Excavation and Backfill for Utilities.

C. Repair and replace removed or damaged pavement and sidewalks as specified in Section 02951 - Pavement Repair and Restoration.

D. In unpaved areas, grade surface as uniform slope to natural grade as indicated on Drawings. Provide minimum of 4 inches of topsoil and seed according to requirements of Section 02921 Hydromulch Seeding, or Section 02922 - Sodding, as required.

END OF SECTION

Section 02633

PRECAST CONCRETE INLETS, HEADWALLS, AND WINGWALLS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Precast concrete inlets for storm or sanitary sewers, including cast iron frame and plate or grate.

B. Precast concrete headwalls and wingwalls for storm sewers.

C. Precast junction box with lid or grate top.

1.02 MEASUREMENT AND PAYMENT

A. Unit Prices.

1. Payment for inlets is on unit price basis for each inlet installed.

2. Payment for headwalls and wingwalls is on unit price basis for each headwall and wingwall installed.

3. Payment for junction box with lid or grate top is on unit price basis for each junction box installed.

4. Payment for inlets, headwalls, wingwalls, and junction boxes includes connection of lines and furnishing and installing frames, grates, rings, and covers.

5. Refer to Section 01270 - Measurement and Payment for unit price procedures.

B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.03 REFERENCES

A. ASTM C 76 - Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.

1.04 SUBMITTALS

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

B. Submit shop drawings for approval of design and construction details for precast concrete inlets, junction box headwalls, and wingwalls. Precast units differing from standard designs shown on Drawings will be rejected unless shop drawing submittals are approved. Clearly show proposed substitution is equal or superior in every aspect to standard designs.

C. Submit manufacturers' data and details for frames, grates, rings, and covers.

1.05 STORAGE AND SHIPMENT

A. Store precast units on level blocking. Do not place loads until design strength is reached. Shipment of acceptable units may be made when 28-day strength requirements have been met.

PART 2 P R O D U C T S

2.01 MATERIALS

A. Concrete: Provide concrete for precast machine-made units meeting requirements of ASTM C 76 regarding reinforced concrete, cement, aggregate, mixture, and concrete test. Minimum 28-day compressive strength shall be 4000 psi.

B. Reinforcing Steel: Place reinforcing steel to conform to details shown on Drawings and as follows:

1. Provide positive means for holding steel cages in place throughout production of concrete units. Maximum variation in reinforcement position is plus or minus 10 percent of wall thickness or plus or minus 1/2 inch, whichever is less. Regardless of variation, maintain minimum cover of concrete over reinforcement as shown on Drawings.

2. Welding of reinforcing steel is not permitted unless noted on Drawings.

C. Mortar and Hydraulic Cement: Conform to requirements of Section 04261 - Mortar.

D. Miscellaneous Metal: Cast-iron frames and plates conforming to requirements of Section 02084 - Frames, Grates, Rings, and Covers.

2.02 SOURCE QUALITY CONTROL

A. Tolerances: Allowable casting tolerances for concrete units are plus or minus 1/4 inch from dimensions shown on Drawings. Concrete thickness in excess of that required will not

constitute cause for rejection provided that excess thickness does not interfere with proper jointing operations.

B. Precast Unit Identification: Mark date of manufacture and name or trademark of manufacturer clearly on inside of inlet, headwall, or wingwall.

C. Rejection: Precast units rejected for non-conformity with these specifications and for following reasons:

1. Fractures or cracks passing through shell, except for single end crack that does not exceed depth of joint.

2. Surface defects indicating honeycombed or open texture.

3. Damaged or misshaped ends, where damage would prevent making satisfactory joint.

D. Replacement: Immediately remove rejected units from Work site and replace with acceptable units.

E. Repairs: Occasional imperfections resulting from manufacture or accidental damage may be repaired if, in opinion of Project Manager, repaired units conform to requirements of these specifications.

PART EXECUTION

3.01 EXAMINATION

A. Verify lines and grades are correct.

B. Verify compacted subgrade will support loads imposed by inlets.

3.02 INSTALLATION

A. Install units complete in place to dimensions, lines, and grades as shown on Drawings.

B. Excavate in accordance with requirements of Section 02317 - Excavation and Backfill for Utilities.

C. Bed precast concrete units on foundations of firm, stable material shaped to conform to shape of unit bases.

D. Provide adequate means to lift and place concrete units.

3.03 FINISHES

A. Use hydraulic cement to seal joints, fill lifting holes and as otherwise required.

B. When box section of inlet has been completed, shape floor of inlet with mortar to conform to Drawing details.

C. Adjust cast iron inlet plate frames to line, grade, and slope shown on Drawings. Grout frame in place with mortar.

3.04 INLET WATERTIGHTNESS

A. Verify that inlets are free of leaks. Repair leaks in approved manner.

3.05 CONNECTIONS

A. Connect storm sewer leads to inlets as shown on Drawings. Seal connections inside and outside with hydraulic cement. Make connections watertight.

3.06 BACKFILL

A. Backfill area of excavation surrounding each completed inlet, headwall, or wingwall according to requirements of Section 02317 - Excavation and Backfill for Utilities.

END OF SECTION

Section 02751

CONCRETE PAVING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Portland cement concrete paving.

1.02 MEASUREMENT AND PAYMENT

A. Unit Prices.

1. Payment for concrete paving is on square yard basis. Separate pay items are used for each different required thickness of pavement.

2. Payment for concrete paving, high early strength, is on square yard basis.

3. Payment for pavement repair or pavement replacement for utility projects is on a square yard basis and includes base materials in accordance with Section 02951.

4. Refer to Section 01270 - Measurement and Payment for unit price procedures.

5. Refer to Paragraph 3.15, Unit Price Adjustment.

B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for Work in this Section is included in total Stipulated Price.

1.03 REFERENCES

A. ASTM A82 - Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.

B. ASTM A185 - Standard Specifications for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement.

C. ASTM A497 – Standard Specification for Steel Welded Wire Reinforcement, Deformed, for Concrete.

D. ASTM A615 - Standard Specification for Deformed and Plain Billet - Steel Bars for Concrete Reinforcement.

E. ASTM C 31 - Standard Practice for Making and Curing Concrete Test Specimens in the Field.

F. ASTM C 33 - Standard Specifications for Concrete Aggregates.

G. ASTM C 39 - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.

H. ASTM C 40 - Standard Test Method for Organic Impurities in Fine Aggregates for Concrete.

I. ASTM C 42 - Standard Test Method of Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.

J. ASTM C 78 - Standard Test Method for Flexural Strength of Concrete (Using Simple Beam with Third Point Loading).

K. ASTM C 94 - Standard Specification for Ready-Mixed Concrete.

L. ASTM C 131 - Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.

M. ASTM C 136 - Standard Method for Sieve Analysis of Fine and Coarse Aggregates.

N. ASTM C 138 - Standard Test Method for Unit Weight, Yield, and Air Content (Gravimetric) of Concrete.

O. ASTM C 143 - Standard Test Method for Slump of Hydraulic Cement Concrete.

P. ASTM C 150 - Standard Specification for Portland Cement.

Q. ASTM C 174 - Standard Test Method for Measuring Thickness of Concrete Elements Using Drilled Concrete Cores.

R. ASTM C 231 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.

S. ASTM C 260 - Standard Specification for Air-Entraining Admixtures for Concrete.

T. ASTM C 494 - Standard Specification for Chemical Admixtures for Concrete.

U. ASTM C 618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for use as a Mineral Admixture in Portland Cement Concrete.

V. TxDOT Tex-203-F - Sand Equivalent Test.

W TxDOT Tex-406-A - Material Finer than 75 Φm (No. 200) Sieve In Mineral Aggregates (Decantation Test for Cement Aggregates).

1.04 SUBMITTALS

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

B. Submit proposed mix design and test data for each type and strength of concrete in Work. Include proportions and actual flexural strength obtained from design mixes at required test ages.

C. Submit for approval manufacturer's description and characteristics for mixing equipment, and for traveling form paver, when proposed for use.

D. Submit manufacturer's certificates giving properties of reinforcing steel. Include certificate of compliance with ASTM A 82. Provide specimens for testing when required by Project Manager.

1.05 HANDLING AND STORAGE

A. Do not mix different classes of aggregate without written permission of Project Manager.

B. Class of aggregate being used may be changed before or during Work with written permission of Project Manager. Comply new class with specifications.

C. Reject segregated aggregate. Before using aggregate whose particles are separated by size, mix them uniformly to grading requirements.

D. Reject aggregates mixed with dirt, weeds, or foreign matter.

E. Do not dump or store aggregate in roadbed.

PART 2 P R O D U C T S

2.01 MATERIALS

A. Portland Cement:

1. Sample and test cement to verify compliance with Standards of ASTM C 150, Type I or Type III.

2. Bulk cement which meets referenced standards may be used when method of handling is approved by Project Manager. When using bulk cement, provide satisfactory weighing devices.

3. Fly ash which meets standards of ASTM C 618 may be used as mineral fill when method of handling is approved by Project Manager.

B. Water: Conform to requirements for water in ASTM C 94.

C. Coarse Aggregate: Crushed stone, gravel, or combination thereof, which is clean, hard, and durable, conforms to requirements of ASTM C 33, and has abrasion loss not more than 45 percent by weight when subjected to Los Angeles Abrasion Test (ASTM C 131).

1. Maximum percentage by weight of deleterious substances shall not exceed following values:

Item	Percent by Weight of Total Sample Maximum
Clay lumps and friable particles	3.0
Material finer than 75-μm (No. 200) sieve:	
Concrete subject to abrasion	3.0*
All Other concrete	5.0*
Coal and lignite:	
Where surface appearance of concrete is of importance	0.5
All other concrete	1.0

* In case of manufactured sand, when material finer than 75-μm (No. 200) sieve consists of dust of fracture, essentially free from clay or shale, these limits may be increased to 5 and 7 percent, respectively.

2. Conform coarse aggregate (size 1 1/2 inch to No. 4 sieve) to requirements of ASTM C 33. Use gradation within following limits when graded in accordance with ASTM C 136:

Sieve Designation (Square Openings)	Percentage by Weight
Retained on 1 3/4" sieve	0
Retained on 1 1/2"sieve	0 to 5
Retained on 3/4" sieve	30 to 65
Retained on 3/8" sieve	70 to 90
Retained on No. 4 sieve	95 to 100
Loss by Decantation Test *Method Tex-406-A	1.0 maximum

* In case of aggregates made primarily from crushing of stone, when material finer than 200 sieve is dust of fracture essentially free from clay or shale as established by Part III of TxDOT Tex-406-A, percent may be increased to 1.5.

D. Fine Aggregate: Sand, manufactured sand, or combination thereof, composed of clean, hard, durable, uncoated grains, free from loams or other injurious foreign matter. Conform fine aggregate for concrete to requirements of ASTM C 33. Use gradation within following limits when graded in accordance with ASTM C 136:

Sieve Designation (Square Openings)	Percentage by Weight

Retained on 3/8" sieve	0
Retained on No. 4 sieve	0 to 5
Retained on No. 8 sieve	0 to 20
Retained on No. 16 sieve	15 to 50
Retained on No. 30 sieve	35 to 75
Retained on No. 50 sieve	65 to 90
Retained on No. 100 sieve	90 to 100
Retained on No. 200 sieve	97 to 100

1. When subjected to color test for organic impurities (ASTM C 40), fine aggregate shall not show color darker than standard color. Fine aggregate shall be subjected to Sand Equivalent Test (Tex-203-F). Sand equivalent value shall not be less than 80, unless higher value is shown on Drawings.

E. Mineral Filler: Type "C" or Type "F" fly ash of acceptable quality and meeting requirements of ASTM C 618 may be used as mineral admixture in concrete mixture. When fly ash mineral filler is used, store and inspect in accordance with ASTM C 618. Do not use fly ash in amounts to exceed 25 percent by weight of cementatious material in mix design. Cement content may be reduced when strength requirements can be met. Note: When fly ash is used, term "cement" is defined as cement plus fly ash.

F. Air Entraining Agent: Furnish air entraining agent conforming to requirements of ASTM C 260.

G. Water Reducer: Water reducing admixture conforming to requirements of ASTM C 494 may be used when required to improve workability of concrete. Amount and type of admixture is subject to approval by Project Manager.

H. Reinforcing Steel:

1. Provide new billet steel manufactured by open hearth process and conforming to ASTM A 615, Grade 60. Store steel to protect it from mechanical injury and rust. At time of placement, steel shall be free from dirt, scale, rust, paint, oil, or other injurious materials.

2. Cold bend reinforcing steel to shapes shown. Once steel has been bent, it may not be rebent.

3. Provide wire fabric conforming to ASTM A 82. Use fabric in which longitudinal and transverse wires have been electrically welded at points of intersection. Welds shall have sufficient strength not to be broken during handling or placing. Conform welding and fabrication of fabric sheets to ASTM A 185.

2.02 EQUIPMENT

A. Conform Equipment to requirements of ASTM C94.

2.03 MIXING

A. Flexural strength shall be as specified using test specimens prepared in accordance with ASTM C 31 and tested in accordance with ASTM C78 (using simple beam with third-point loading). Compressive strength shall be as specified using test specimens prepared in accordance with ASTM C 31 and tested in accordance with ASTM C 39. Determine and measure batch quantity of each ingredient, including water for batch designs and all concrete produced for Work. Mix shall conform to these specifications and other requirements indicated on Drawings.

B. Mix design to produce concrete which will have flexural strength of 500 psi at 7 days and 600 psi at 28 days. Minimum compressive strength shall be 3000 pounds per square inches for 7 days and 3500 pounds per square inches at 28 days when tested in accordance with ASTM C39. Slump of concrete shall be at least 2 inches but no more than 5 inches, when tested in accordance with ASTM C143.

1. Concrete pavement, including curb, curb and gutter, and saw-tooth curb, shall contain at least 5 1/2 sacks (94 pounds per sack) of cement per cubic yard, with not more than 6.5 gallons of water, net, per sack of cement (water-cement ratio maximum 0.57). Determine cement content in accordance with ASTM C 138. Addition of mineral filler may be used to improve workability or plasticity of concrete to limits specified.

2. Coarse dry aggregate shall not exceed 85 percent of loose volume of concrete.

3. Add air-entraining admixture to ensure uniform distribution of agent throughout batch. Base air content of freshly mixed air-entrained concrete upon trial mixes with materials to be used in Work, adjusted to produce concrete of required plasticity and workability. Percentage of air entrainment in mix shall be 4 1/2 percent plus or minus 1 1/2 percent. Determine air content by testing in accordance with ASTM C 231.

4. Use retardant when temperature exceeds 90 degrees F. Proportion as recommended by manufacturer. Use same brand as used for air-entraining agent. Add and batch material using same methods as used for air-entraining agent.

C. Use high early strength concrete pavement to limits shown on Drawings. Design to meet following:

1. Concrete Mix: Flexural strength greater than or equal to 500 psi at 72 hours.

2. Cement: Minimum of 7 sacks of cement per cubic yard of concrete.

3. Water-Cement Ratio maximum of 0.45. Slump of concrete shall a maximum of 5 inches, when tested in accordance with ASTM C 143.

4. Other requirements for proportioning, mixing, execution, testing, etc., shall be in accordance with this Section 02751 - Concrete Paving.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify compacted base is ready to support imposed loads and meets compaction requirements.

B. Verify lines and grades are correct.

3.02 PREPARATION

A. Properly prepare, shape and compact each section of subgrade before placing forms, reinforcing steel or concrete. After forms have been set to proper grade and alignment, use subgrade planer to shape subgrade to its final cross section. Check contour of subgrade with template.

B. Remove subgrade that will not support loaded form. Replace and compact subgrade to required density.

3.03 EQUIPMENT

A. Alternate equipment and methods, other than those required by this Section, may be used provided equal or better results will be obtained. Maintain equipment for preparing subgrade and for finishing and compacting concrete in good working order.

B. Subgrade Planer and Template:

1. Use subgrade planer with adjustable cutting blades to trim subgrade to exact section shown on Drawings. Select planer mounted on visible rollers which ride on forms. Planer frame must have sufficient weight so that it will remain on form, and have strength and rigidity that, under tests made by changing support from wheels to center, planer will not develop deflection of more than 1/8 inch. Tractors used to pull planer shall not produce ruts or indentations in subgrade. When slip form method of paving is used, operate subgrade planer on prepared track grade or have it controlled by electronic sensor system operated from string line to establish horizontal alignment and elevation of subbase.

2. Provide template for checking contour of subgrade. Template shall be long enough to rest upon side forms and have strength and rigidity that, when supported at center, maximum deflection shall not exceed 1/8 inch. Fit template with accurately adjustable rods projecting downward at 1 foot intervals. Adjust these rods to gauge cross sections of slab bottom when template is resting on side forms.

C. Machine Finisher: Provide power-driven, transverse finishing machine designed and operated to strike off and consolidate concrete. Machine shall have two screeds accurately adjusted to crown of pavement and with frame equipped to ride on forms. Use finishing machine with rubber tires when it operates on concrete pavement.

D. Hand Finishing:

1. Provide mechanical strike and tamping template 2 feet longer than width of pavement to be finished. Shape template to pavement section.

2. Provide two bridges to ride on forms and span pavement for finishing expansion and dummy joints. Provide floats and necessary edging and finishing tools.

E. Burlap Drag or transverse broom for Finishing Slab: Furnish four plies of 10 ounce burlap material fastened to bridge to form continuous strip of burlap full width of pavement. Maintain contact 3 foot width of burlap material with pavement surface. Keep burlap drags clean and free of encrusted mortar.

F. Vibrators: Furnish mechanically-operated, synchronized vibrators mounted on tamping bar which rides on forms and hand-manipulated mechanical vibrators. Furnish vibrators with frequency of vibration to provide maximum consolidation of concrete without segregation.

G. Traveling Form Paver: Approved traveling form paver may be used in lieu of construction methods employing forms, consolidating, finishing and floating equipment. Meet requirements of this specification for subgrade, pavement tolerances, pavement depth, alignments, consolidation, finishing and workmanship. When traveling form paver does not provide concrete paving that meets compaction, finish, and tolerance requirements of this Specification, immediately discontinue its use and use conventional methods.

1. Equip traveling paver with longitudinal transangular finishing float adjustable to crown and grade. Use float long enough to extend across pavement to side forms or edge of slab.

2. Ensure that continuous deposit of concrete can be made at paver to minimize starting and stopping. Use conventional means of paving locations inaccessible to traveling paver, or having horizontal or vertical curvature that traveling paver cannot negotiate.

3. Where Drawings require tie bars for adjacent paving, securely tie and support bars to prevent displacement. Tie bars may be installed with approved mechanical bar inserter mounted on traveling-form paver. Replace pavement in which tie bars assume final position other than that shown on Drawings.

3.04 FORMS

A. Side Forms: Use metal forms of approved shape and section. Preferred depth of form is equal to required edge thickness of pavement. Forms with depths greater or less than

required edge thickness of pavement will be permitted, provided difference between form depth and edge thickness when not greater than 1 inch, and further provided that forms of depth less than pavement edge are brought to required edge thickness by securely attaching wood or metal strips to bottom of form, or by grouting under form. Bottom flange of form shall be same size as thickness of pavement. Aluminum forms are not allowed. Forms shall be approved by Project Manager. Length of form sections shall be not less than 10 feet and each section shall provide for staking in position with not less than 3 pins. Flexible or curved forms of wood or metal of proper radius shall be used for curves of 200 foot radius or less. Forms shall have ample strength and shall be provided with adequate devices for secure setting so that when in-place they will withstand, without visible springing or settlement, impact and vibration of finishing machine. In no case shall base width be less than 8 inches for form 8 inches or more in height. Forms shall be free from warp, bends or kinks and shall be sufficiently true to provide straight edge on concrete. Top of each form section, when tested with straight edge, shall conform to requirements specified for surface of completed pavement. Provide sufficient forms for satisfactory placement of concrete. For short radius curves, forms less than 10 feet in length or curved forms may be used. For curb returns at street intersections and driveways, wood forms of good grade and quality may be used.

B. Form Setting:

1. Rest forms directly on subgrade. Do not shim with pebbles or dirt. Accurately set forms to required grade and alignment and, during entire operation of placing, compacting and finishing of concrete, do not deviate from this grade and alignment more than 1/8 inch in 10 feet of length. Do not remove forms for at least 8 hours after completion of finishing operations. Provide supply of forms that will be adequate for orderly and continuous placing of concrete. Set forms and check grade for at least 300 feet ahead of mixer or as approved by Project Manager.

2. Adjacent slabs may be used instead of forms, provided that concrete is well protected from possible damage by finishing equipment. Do not use adjacent slabs for forms until concrete has aged at least 7 days.

3.05 REINFORCING STEEL AND JOINT ASSEMBLIES

A. Place reinforcing steel and joint assemblies and position securely as indicated on Drawings. Wire reinforcing bars securely together at intersections and splices. Bars and coatings shall be free of rust, dirt or other foreign matter when concrete is placed. Secure reinforcing steel to chairs.

B. Position pavement joint assemblies at required locations and elevations, and rigidly secure in position. Install dowel bars in joint assemblies, each parallel to pavement surface and to center line of pavement, as shown.

C. Cut header boards, joint filler, and other material used for forming joints to receive each dowel bar.

D. Secure in required position to prevent displacement during placing and finishing of concrete.

E. Drill dowels into existing pavement, secure with epoxy, and provide paving headers as required to provide rigid pavement sections.

F. Use sufficient number of chairs for steel reinforcement bars to maintain position of bars within allowable tolerances. Place reinforcement as shown on Drawings. In plane of steel parallel to nearest surface of concrete, bars shall not vary from plan placement by more than 1/12 of spacing between bars. In plane of steel perpendicular to nearest surface of concrete, bars shall not vary from plan placement by more than 1/4 inch.

3.06 FIBROUS REINFORCING

A. Do not use fibrous reinforcing to replace structural, load-bearing, or moment-reinforcing steel.

3.07 PLACEMENT

A. Place concrete when air temperature taken in shade and away from artificial heat is above 35 degrees F and rising. Do not place concrete when temperature is below 40 degrees F and falling.

B. Place concrete within 90 minutes after initial water had been added. Remove and dispose of concrete not placed within this period.

C. Concrete slump during placement shall be 1 to 5 inches, except when using traveling-form paver, slump shall be maximum of 2 inches.

D. Deposit concrete continuously in successive batches. Distribute concrete in manner that will require as little rehandling as possible. Where hand spreading is necessary, distribute concrete with shovels or by other approved methods. Use only concrete rakes in handling concrete. At placement interruption of more than 30 minutes, place transverse construction joint at stopping point. Remove and replace sections less than 10 feet long.

E. Take special care in placing and spading concrete against forms and at longitudinal and transverse joints to prevent honeycombing. Voids in edge of finished pavement will be cause for rejection.

3.08 COMPACTION

A. Consolidate concrete using mechanical vibrators as specified herein. Extend vibratory unit across pavement, not quite touching side forms. Space individual vibrators at close enough intervals to vibrate and consolidate entire width of pavement uniformly. Mount mechanical vibrators to avoid contact with forms, reinforcement, transverse or longitudinal joints.

B. Furnish enough hand-manipulated mechanical vibrators for proper consolidation of concrete along forms, at joints and in areas not covered by mechanically controlled vibrators.

3.09 FINISHING

A. Finish concrete pavement with power-driven transverse finishing machines or by hand finishing methods.

1. Hand finish with mechanical strike and tamping template in same width as pavement to be finished. Shape template to pavement section shown on Drawings. Move strike template forward in direction of placement, maintaining slight excess of material in front of cutting edge. Make minimum of two trips over each area. Screed pavement surface to required section. Work screed with combined transverse and longitudinal motion in direction work is progressing. Maintain screed in contact with forms. Use longitudinal float to level surface.

B. On narrow strips and transitions, finish concrete pavement by hand. Thoroughly work concrete around reinforcement and embedded fixtures. Strike off concrete with strike-off screed. Move strike-off screed forward with combined transverse and longitudinal motion in direction work is progressing, maintaining screed in contact with forms, and maintaining slight excess of materials in front of cutting edge. Tamp concrete with tamping template. Use longitudinal float to level surface.

C. After completion of straightedge operation, make first pass of burlap drag or transverse broom as soon as construction operations permit and before water sheen has disappeared from surface. Follow with as many passes as required to produce desired texture depth. Permit no unnecessary delays between passes. Keep drag wet, clean and free from encrusted mortar during use.

3.10 JOINTS AND JOINT SEALING

A. Conform to requirements of Section 02752 - Concrete Pavement Joints.

3.11 CONCRETE CURING

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

3.12 TOLERANCES

A. Test entire surface before initial set and correct irregularities or undulations. Bring surface within requirements of following test and then finish. Place 10 foot straightedge parallel to center of roadway to bridge depressions and touch high spots. Do not permit ordinates measured from face of straight edge to surface of pavement to exceed 1/16 inch per foot from nearest point of contact. Maximum ordinate with 10 foot straightedge shall not exceed 1/8 inch. Grind spots in excess of required tolerances to meet surface test requirements. Restore texture by grooving concrete to meet surface finishing specifications.

3.13 FIELD QUALITY CONTROL

A. Perform testing under provisions of Section 01454 - Testing Laboratory Services.

B. Compressive Strength Test Specimens: Make four test specimens for compressive strength test in accordance with ASTM C 31 for each 150 cubic yards or less of pavement that is placed in one day. Test two specimens at 7 days or at number of hours as directed by the Project Manager for high early strength concrete. Test remaining two specimens at 28 days. Test specimens in accordance with ASTM C 39. Minimum compressive strength shall be 3000 pounds per square inch for first two specimens and 3500 pounds per square inch at 28 days.

C. When compressive test indicates failure, make yield test in accordance with ASTM C 138 for cement content per cubic yard of concrete. When cement content is found to be less than that specified per cubic yard, increase batch weights until amount of cement per cubic yard of concrete conforms to requirements.

D. Minimum of one 4 inch core will be taken at random locations per 375 feet per 12 feet lane or 500 square yards of pavement to measure in-place depth. Measure depth in accordance with ASTM C 174. Each core may be tested for 28 day compressive strength according to methods of ASTM C 42. 28 day compressive strength of each core tested shall be a minimum of 3000 pounds per square inch.

E. Request, at option, three additional cores in vicinity of cores indicating nonconforming in-place depths at no cost to City. In-place depth at these locations shall be average depth of four cores.

F. Fill cores and density test sections with new concrete paving or non shrink grout.

3.14 NONCONFORMING PAVEMENT

A. Remove and replace areas of pavement found deficient in thickness by more than 10 percent, or that fail compressive strength tests, with concrete of thickness shown on Drawings.

B. When measurement of any core is less than specified thickness by more than 10 percent, actual thickness of pavement in this area will be determined by taking additional cores at 10 foot intervals parallel to centerline in each direction from deficient core until, in each direction, core is taken which is not deficient by more than 10 percent. Exploratory cores for

deficient thickness will not be used in averages for adjusted unit price. Exploratory cores are to be used only to determine length of pavement in unit that is to be removed and replaced. Replace nonconforming pavement sections at no additional cost to City.

3.15 UNIT PRICE ADJUSTMENT

A. Unit price adjustments shall be made for in-place depth determined by cores as follows:

1. Adjusted Unit Price shall be ratio of average thickness as determined by cores to thickness bid upon, times unit price.

2. Apply adjustment to lower limit of 90 percent and upper limit of 100 percent of unit price.

3. Average depth below 90 percent but greater than 80 percent may be accepted by Project Manager at adjusted Unit Price of:

   a. Unit Price Bid - [2 x (1-ratio) x Unit Price Bid]

   b. Ratio equals average core thickness divided by thickness bid upon

   c. 0.9 ratio pays 80 percent of unit price and 0.8 ratio pays 60 percent of unit price.

4. Average depth below 80 percent will be rejected by Project Manager.

3.16 PAVEMENT MARKINGS

A. Restore pavement markings to match those existing in accordance with City of Houston standard specifications and details and Project Manager's requirements.

3.17 PROTECTION

A. Barricade pavement section to prevent use until concrete has attained minimum design strength. Cure barricade pavement section for minimum 72 hours before use. Do not open pavement to traffic until concrete is at least 10 days old. Pavement may be open to traffic earlier provided Contractor pays for testing and additional specimen once 7 day specified strength is obtained. Pavement may be opened when high early strength concrete is used meeting specified 72 hour strength.

B. High early strength concrete may be used to provide access at driveways, street intersections, esplanades and other locations approved by Project Manager.

C. On those sections of pavement to be opened to traffic, seal joints, clean pavement, and place earth against pavement edges before permitting use by traffic. Opening of pavement to traffic shall not relieve responsibility for Work.

D. Maintain concrete paving in good condition until completion of Work.

E. Repair defects by replacing concrete to full depth.

END OF SECTION

Section 02752

CONCRETE PAVEMENT JOINTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Joints for concrete paving; concrete sidewalks, concrete driveways, curbs, and curb and gutters.

B. Saw-cutting existing concrete or asphalt pavements for new joints.

1.02 MEASUREMENT AND PAYMENT

A. Unit Prices.

1. Payment for street pavement expansion joints, with or without load transfer, is on linear foot basis.

2. Payment for horizontal dowels is on a unit price basis for each horizontal dowel.

3. No separate payment will be made for formed or sawed street pavement contraction joints and longitudinal weakened plane joints. Include payment in unit price for Concrete Paving.

4. No separate payment will be made for joints for Curb, Curb and Gutter, Saw-tooth Curb, Concrete Sidewalks, and Concrete Driveways. Include payment in unit price for Curb and Gutter, Concrete Sidewalks, and Concrete Driveways.

5. Payment will be made for Preformed Expansion Joints on a linear foot basis only when field conditions require that sidewalk be moved adjacent to existing concrete structure (i.e., street, back of curb, etc.).

6. Refer to Section 01270 - Measurement and Payment for unit price procedures.

B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.03 REFERENCES

A. ASTM A 615 - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.

B. ASTM D 994 - Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type).

C. ASTM D 1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).

D. ASTM D 3405 - Standard Specification for Joint Sealants, Hot-Applied, for Concrete and Asphalt Pavements.

E. TxDOT Tex-525-C - Tests for Asphalt and Concrete Joint Sealers

1.04 SUBMITTALS

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

B. Submit product data for joint sealing compound and proposed sealing equipment for approval.

C. Submit samples of dowel cup, metal supports, and deformed metal strip for approval. Submit manufacturer's recommendation for placing sealant(s).

PART 2 P R O D U C T S

2.01 BOARD EXPANSION JOINT MATERIAL

A. Filler board of selected stock. Use wood of density and type as follows:

1. Clear, all-heart cypress weighing no more than 40 pounds per cubic foot, after being oven dried to constant weight.

2. Clear, all-heart redwood weighing no more than 30 pounds per cubic foot, after being oven dried to constant weight.

2.02 PREFORMED EXPANSION JOINT MATERIAL

A. Bituminous fiber and bituminous mastic composition material conforming to ASTM D 994 and ASTM D 1751.

2.03 JOINT SEALING COMPOUND

A. Conform joint sealants to one of sealant classes described in this section.

B. Conform hot-poured rubber-asphalt compound to ASTM D 3405.

C. Two-component Synthetic Polymer.

1. Curing is to be by polymerization and not by evaporation of solvent or fluxing of harder particles.

2. Cure sufficiently at average temperature of 25 ∀ 1 C (77 ∀ 2 F) so as not to pick up under wheels of traffic in maximum three hours.

3. Performance requirements, when tested in accordance with TxDOT Tex-525-C, shall meet above curing times and requirements as follows:

Cold-Extruded and Cold-Pourable (Self-Leveling) Specifications	
Property	**Requirement**
Penetration, 25 C (77 F) 150 g Cone, 5 s, 0.1 mm (in.), maximum	130
Bond and Extension 50%, -29 C (-20 F), 3 cycles: X Dry Concrete Block X Steel blocks (Primed, if recommended by manufacturer) *Steel blocks shall be used when armor joints are specified	 Pass Pass
Flow at 70 C (158 F)	None
Water content % by mass, maximum	5.0
Resilience: X Original sample, % min. (cured) X Oven-aged at 70 C (158 F), % min.	 50 50
Cold-extruded material only - Cold Flow (10 minutes)	None

After bond and extension test, there shall be no evidence of cracking, separation or other opening that is over 3 millimeters (1/8 inch) deep in sealer or between sealer and test blocks.

4. Provide cold-extruded type for vertical or sloping joints.

5. Provide self-leveling type for horizontal joints.

D. Self-Leveling, Low Modulus Silicone or Polyurethane Sealant for Asphaltic Concrete and Portland Cement Concrete Joints. This shall be a single component self-leveling silicone or polyurethane material that is compatible with both asphalt and concrete pavements. The sealer shall not require a primer for bond; a backer rod shall be required which is compatible with the sealant; no reaction shall occur between rod and sealant.

When tested in accordance with TxDOT Tex-525-C, self-leveling sealant shall meet following requirements:

Self-Leveling, Low Modulus Silicone or Polyurethane Sealant	
Property	**Requirements**
Tack Free Time, 25 ∀ 1 C (77 ∀ 2 F), minutes	120 maximum
Nonvolatile content, % by mass	93 minimum
Tensile Strength and 24 Hour Extension Test: X Initial, 10-day cure, 25 ∀ 1 C (77 ∀ 2 F), kPa (psi) X After Water Immersion, kPa (psi) X After Heat Aging, kPa (psi) X After Cycling, -29 C (-20 F), 50%, 3 cycles, kPa (psi) X 24 Hour Extension	 X 21 to 69 (3 to 10) X 21 to 69 (3 to 10) X 21 to 69 (3 to 10) X 21 to 69 (3 to 10) X Pass (All Specimens) After 24 hours, there shall be no evidence of cracking, separation or other opening that is over 3 mm (1/8 in.) deep at any point in the sealer or between the sealer and test blocks.

2.04 LOAD TRANSMISSION DEVICES

A. Smooth, steel dowel bars conforming to ASTM A 615, Grade 60. When indicated on Drawings, encase one end of dowel bar in approved cap having inside diameter 1/16 inch greater than diameter of dowel bar.

B. Deformed steel tie bars conforming to ASTM A 615, Grade 60.

2.05 SUPPORTS FOR REINFORCING STEEL AND JOINT ASSEMBLY

A. Employ supports of approved shape and size that will secure reinforcing steel and joint assembly in correct position during placing and finishing of concrete. Space supports as directed by Project Manager.

PART 3 EXECUTION

3.01 PLACEMENT

A. When new Work is adjacent to existing concrete, place joints at same location as existing joints in adjacent pavement.

B. If limit of removal of existing concrete or asphalt pavement does not fall on existing joint, saw cut existing pavement minimum of 2 inches deep to provide straight, smooth joint surface without chipping, spalling or cracks.

3.02 CONSTRUCTION JOINTS

A. Place transverse construction joint wherever concrete placement must be stopped for more than 30 minutes. Place longitudinal construction joints at interior edges of pavement lanes using No. 6 deformed tie bars, 30 inches long and spaced 18 inches on centers.

3.03 EXPANSION JOINTS

A. Place 3/4 inch expansion joints at radius points of curb returns for cross street intersections, or as located in adjacent pavement but no further than 80 feet apart. Use no boards shorter than 6 feet. When pavement is 24 feet or narrower, use not more than 2 lengths of board. Secure pieces to form straight joint. Shape board filler accurately to cross section of concrete slab. Use load transmission devices of type and size shown on Drawings unless otherwise specified or shown as "No Load Transfer Device." Seal with joint sealing compound.

3.04 CONTRACTION JOINTS

A. Place contraction joints at same locations as in adjacent pavement or at spaces indicated on Drawings. Place smoothed, painted and oiled dowels accurately and normal to joint. Seal groove with joint sealing compound.

3.05 LONGITUDINAL WEAKENED PLANE JOINTS

A. Place longitudinal weakened plane joints at spaces indicated on Drawings. If more than 15 feet in width is poured, longitudinal joint must be saw cut. Seal groove with joint sealing compound.

3.06 SAWED JOINTS

A. Use sawed joints as alternate to contraction and weakened plane joints. Use circular cutter capable of cutting straight line groove minimum of 1/4 inch wide. Maintain depth of one quarter of pavement thickness. Commence sawing as soon as concrete has hardened sufficiently to permit cutting without chipping, spalling or tearing and prior to initiation of cracks. Once sawing has commenced, continue until completed. Make saw cut with one pass. Complete sawing within 24 hours of concrete placement. Saw joints at required spacing consecutively in sequence of concrete placement.

B. Concrete Saw: Provide sawing equipment adequate in power to complete sawing to required dimensions and within required time. Maintain ample supply of saw blades at work site during sawing operations. Maintain sawing equipment on job during concrete placement.

3.07 JOINTS FOR CURB, CURB AND GUTTER

A. Place 3/4 inch preformed expansion joints through curb and gutters at locations of expansion and contraction joints in pavement, at end of radius returns at street intersections and driveways, and at curb inlets. Maximum spacing shall be 120-foot centers.

3.08 JOINTS FOR CONCRETE SIDEWALKS

A. Provide 3/4 inch expansion joints conforming to ASTM A 1751 along and across sidewalk at back of curbs, at intersections with driveways, steps, and walls; and across walk at intervals not to exceed 36 feet. Provide expansion joint material conforming to ASTM D 994 for small radius curves and around fire hydrants and utility poles. Extend expansion joint material full depth of slab.

3.9 JOINTS FOR CONCRETE DRIVEWAYS

A. Provide 3/4-inch expansion joints conforming to ASTM D 1751 across driveway in line with street face of sidewalks, at existing concrete driveways, and along intersections with sidewalks and other structures. Extend expansion joint material full depth of slab.

3.10 JOINT SEALING

A. Seal joints only when surface and joints are dry, ambient temperature is above 50 degrees F and less than 85 degrees F and weather is not foggy or rainy.

B. Use joint sealing equipment in like new working condition throughout joint sealing operation, and be approved by Project Manager. Use concrete grooving machine or power-operated wire brush and other equipment such as plow, brooms, brushes, blowers or hydro or abrasive cleaning as required to produce satisfactory joints.

C. Clean joints of loose scale, dirt, dust and curing compound. The term joint includes wide joint spaces, expansion joints, dummy groove joints or cracks, either preformed or natural. Remove loose material from concrete surfaces adjacent to joints.

D. Fill joints neatly with joint sealer to depth shown. Pour sufficient joint sealer into joints so that, upon completion, surface of sealer within joint will be 1/4 inch above level of adjacent surface or at elevation as directed.

3.11 PROTECTION

A. Maintain joints in good condition until completion of Work.

B. Replace damaged joints material with new material as required by this Section.

END OF SECTION

Section 02753

CONCRETE PAVEMENT CURING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Curing of Portland cement concrete paving.

1.02 MEASUREMENT AND PAYMENT

A. Unit Prices.

1. No separate payment will be made for concrete curing under this Section. Include payment in unit price for Concrete Paving, Concrete Sidewalks, Concrete Driveways, Curbs, and Curb and Gutters.

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

B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.03 REFERENCES

A. ASTM C 156 - Standard Test Method for Water Retention by Concrete Curing Materials.

B. ASTM C 171 - Standard Specifications for Sheet Materials for Curing Concrete.

C. ASTM C 309 - Standard Specifications for Liquid Membrane-Forming Compounds for Curing Concrete.

1.04 SUBMITTALS

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

B. Submit manufacturer's product data for cover materials and liquid membrane-forming compounds.

PART 2 PRODUCTS

2.01 COVER MATERIALS FOR CURING

A. Conform curing materials to one of the following:

1. Polyethylene Film: Opaque pigmented white film conforming to requirements of ASTM C 171.

2. Waterproofed Paper: Paper conforming to requirements of ASTM C 171.

3. Cotton Mats: Single layer of cotton filler completely enclosed in cover of cotton cloth. Mats shall contain not less than 3/4 of a pound of uniformly distributed cotton filler per square yard of mat. Cotton cloth used for covering materials shall weigh not less than 6 ounces per square yard. Stitch mats so that mat will contact surface of pavement at all points when saturated with water.

2.02 LIQUID MEMBRANE-FORMING COMPOUNDS

A. Conform liquid membrane-forming compounds to ASTM C 309. Membrane shall restrict loss of water to not more than 0.55 kg/m^2 in 72 hours using test method ASTM C 156.

PART 3 E X E C U T I O N

3.01 CURING REQUIREMENT

A. Cure concrete pavement by protecting against loss of moisture for period of not less than 72 hours immediately upon completion of finishing operations. Do not use membrane curing for concrete pavement to be overlaid by asphalt concrete.

B. Failure to provide sufficient cover material shall be cause for immediate suspension of concreting operations.

3.02 POLYETHYLENE FILM CURING

A. Immediately after finishing surface, and after concrete has taken its initial set, apply water in form of fine spray. Cover surface with polyethylene film so film will remain in direct contact with surface during specified curing period.

B. Cover entire surface and both edges of pavement slab. Overlap joints in film sheets minimum of 12 inches. Immediately repair tears or holes occurring during curing period by placing acceptable moisture-proof patches or replacing.

3.03 WATERPROOFED PAPER CURING

A. Immediately after finishing surface, and after concrete has taken its initial set, apply water in form of fine spray. Cover surface with waterproofed paper so paper will remain in direct contact with surface during specified curing period.

B. Prepare waterproofed paper to form blankets of sufficient width to cover entire surface and both edges of pavement slab, and not be more than 60 feet in length. Overlap joints in blankets caused by joining paper sheets not less than 5 inches and securely seal with asphalt cement having melting point of approximately 180 degrees F. Place blankets to secure overlap of at least 12 inches. Immediately repair tears or holes appearing in paper during curing period by cementing patches over defects.

3.04 COTTON MAT CURING

A. Immediately after finishing surface, and after concrete has taken its initial set, completely cover surface with cotton mats, thoroughly saturated before application, maintaining contact with surface of pavement equally at all points.

B. Keep mats on pavement for specified curing period. Keep mats saturated so that, when lightly compressed, water will drip freely from them. Keep banked earth or cotton mat covering edges saturated.

3.05 LIQUID MEMBRANE-FORMING COMPOUNDS

A. Immediately after free surface moisture, and after concrete has dispersed, apply liquid membrane-forming compound in accordance with manufacturer's instructions.

B. Moisten concrete by water fogging prior to application of membrane when surface has become dry.

C. Seal concrete surface with single coat at rate of coverage recommended by manufacturer and directed by Project Manager, but not less than one gallon per 200 square feet of surface area.

3.06 TESTING MEMBRANE

A. Treated areas will be visually inspected for areas of lighter color of dry concrete as compared to dump concrete. Test suspected areas by placing few drops of water on surface. Membrane passes test when water stands in rounded beads or small pools which can be blown along surface of concrete without wetting surface.

B. Reapply membrane compound immediately at no cost to City when membrane fails above test.

END OF SECTION

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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 foot basis, including excavation.

2. No payment will be made for work in areas where driveway has been removed or replaced for Contractor's convenience.

3. Refer to Section 01270 - Measurement and Payment for unit price procedures.

B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for Work in this Section is included in total Stipulated Price.

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 reinforcing steel 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, Section 02337 - Lime/Fly-Ash Stabilized Subgrade, or Section 02338 - Portland Cement Stabilized Subgrade.

PART 3 EXECUTION

3.01 PREPARATION

A. Prepare subgrade in accordance with applicable portions of Section 02336 - Lime Stabilized Subgrade, Section 02337 - Lime/Fly-Ash Stabilized Subgrade, and Section 02338 - Portland Cement 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 02768
PIPELINE LINE STOPPING

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals required to insert a line stop and/or hot tap) as specified herein. The components of the line stopping system shall be designed for the maximum operating pressure of the pump station or pipelines where the line stop is to be installed.

B. The line stop shall be installed to temporarily plug the existing pipeline for installation of temporary bypass systems, and removal of hydropneumatic existing surge tank.

C. The line stop shall be accomplished utilizing a specialized plugging system. The system shall consist of a line stop fitting, to be permanently attached to the pipeline; a temporary plug for stopping flow; and the line stopping equipment.

D. All temporary valves piping, couplings, excavation, dewatering, concrete placement, and other necessary work required for successful plugging of the pipeline, shall be performed by the Contractor and included in any proposal to complete the work.

E. Contractor/Line Stop Specialist shall verify the pipe O.D. and pipe wall thickness for each pipeline location that receives a line stop. Only non-destructive techniques shall be utilized.

1.02 MEASUREMENT AND PAYMENT

A. No separate payment will be made for work performed under this Section. Include the cost for this work in the lump sum Base Bid Item.

B. Extra Unit Price for 42" Line Stop on HSPS Suction Header: Under Section 00410, Part B, C. Extra Unit Price Table, the Contractor is required to provide a unit price to install line stop to isolate a line to perform the work. This item shall cover all labor, materials, equipment and incidentals that are incurred by the Contractor to install and complete in place, additional line stops to perform work on the 42-inch pump suction butterfly valves. Final quantities for unit price bid items will be determined in accordance with the General Conditions and Section 01270-Measurement and Payment. Extra unit price work is paid only when authorized in advance by the Construction Manager.

C. Extra Unit Price for 30" Line Stop on HSPS Discharger Header: Under Section 00410, Part B, C. Extra Unit Price Table,, the Contractor is required to provide a unit price to install line stop to isolate a line to perform the work. This item shall cover labor, materials, equipment and incidentals that are incurred by the Contractor to install and complete in place, additional line stops to perform work on the 30-inch pump discharge butterfly valves. Final quantities for unit price bid items will be determined in accordance with the General Conditions and Section 01270-Measurement and Payment. Extra unit price work is paid only when authorized in advance by the Construction Manager.

1.03 RELATED WORK

A. Steel Pipe and Fittings is included in Section 02318.

B. Disinfection of Water Main is included in Section 02514

C. Valves are included in Section 15100.

D. Concrete work is included in Division 03.

1.04 SUBMITTALS

A. Copies of all materials required to establish compliance with the Specifications shall be submitted in accordance with the provisions of Section 01330. Submittals shall include at least the following:

1. Installation plan including complete step by step descriptions of the methods to install the line-stop fitting and related equipment, and detailed procedures for inserting the line stop through the line-stop head. This includes engineering calculations signed by a registered Professional Engineer in the State of Texas for design of the support system to install the line stop and piping stress analysis.

2. Complete drawings showing the location of the existing pipelines; coupled with existing pipe dimensions and wall thickness, and the proposed installation location of the line stop, including the proposed method of supporting the existing pipeline at that location.

3. Complete detail drawings of the line stopping equipment showing equipment and fitting positioning and overall dimensions and weights.

4. Complete detail drawings and description of materials of the proposed line stop fitting, including completion plug and blind flange.

5. Complete detailed drawings signed and sealed by a registered Professional Engineer in the State of Texas for additional pipe support required for performing work and installation of the line stop equipment.

6. Statement or literature indicating the design pressure rating of the line stop fitting, valves, and line stop equipment.

1.05 REFERENCE STANDARDS

A. American Society for Testing and Materials (ASTM)

1. ASTM A139 - Standard Specification for Electric-Fusion (ARC) Welded Steel Pipe

2. ASTM A283 – Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates

3. ASTM A570 - Standard Specification for Steel, Sheet and Strip, Carbon Hot Rolled, Structural Quality.

4. ASTM A572 - Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel

5. ASTM C150 - Standard Specification for Portland cement

6. ASTM A36 - Standard Specification for Carbon Structural Steel

7. ASTM A53 - Standard Specification for Pipe, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

8. ASTM A1011- Standard Specification for Steel, Sheet and Strip, Hot Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability

9. ASTM A1018 - Standard Specification for Steel, Sheet and Strip, Heavy Thickness Coils, Hot Rolled, Carbon, Structural, High-Strength Low-Alloy, Columbium, Vanadium, and High-Strength Low-Alloy with Improved Formability.

B. American Water Works Association (AWWA)

1. AWWA C200 - Steel Water Pipe - 6 in (150mm) and Larger

2. AWWA C205 - Cement Mortar Protective Lining and Coating for Steel Water Pipe 4 in and Larger - Shop Applied.

3. AWWA C206 - Field Welding of Steel Water Pipe.

4. AWWA C207 - Steel Pipe Flanges for Waterworks Service Sizes 4 in Through 144 in (100mm Through 3600mm).

5. AWWA C208 - Dimensions for Fabricated Steel Water Pipe Fittings.

6. AWWA C600 - Installation of Ductile-Iron Water Mains and Their Appurtenances.

7. AWWA C606 - Grooved and Shouldered Joints.

8. AWWA C651 - Disinfection of Water Mains.

9. AWWA M11 - Steel Pipe - A Guide for Design and Installation.

C. American National Standards Institute (ANSI)

1. ANSI B1.1 - Unified Inch Screw Threads (UN and UNR Thread Form).

2. ANSI B16.1 - Cast Iron Pipe Flanges and Flanged Fittings Classes 25, 125 and 250.

3. ANSI B18.2 - Square and Hex Bolts and Screws Inch Series Including Hex Cap Screws and Lag Screws.

1.06 QUALIFICATIONS

A. The Contractor shall employ a specialty subcontractor (Line Stop Specialist) to perform the line stop work. The Line Stop Specialist shall have demonstrated experience with line stopping work on buried and exposed pipelines in sizes as could be encountered in performing work on this project. Subcontractors meeting the experience requirements include:

1. Mickie Service Company, (713) 682-7454 (Telephone), 6901 Rator, Houston, TX 77055

2. T.D.Williamson, Inc., US Houston Service Center 832-448-7200 x208 (Telephone) 4220 World Houston Parkway, Suite 100, Houston, TX 77032

3. Team Industrial Services, Inc., (713) 378-8600 (Telephone), 8115 Red Bluff Road, Pasadena, TX 77507

1.07 WARRANTY

A. Provide warranty under provisions of Section 01770 – Closeout Procedures.

PART 2 PRODUCTS

2.01 GENERAL

A. The Contractor and Line Stop Specialist shall determine the type and size of the of the line stop tapping device, ANSI flange rating of the line stop tap valve, header line size, header wall thickness based on the process fluid, operating pressure, and operating temperature as indicated on the Drawings and specified in these specifications. See Table 1 attached to the end of this Section for existing pipeline information and estimated operation pressure.

B. Contractor shall identify if process fluid creates a hazard or non hazardous condition (classified area) and plan work accordingly.

C. Contractor/Line Stop Specialist shall obtain all necessary dimensional information for working clearances to install the line stop.

2.02 LINE STOP FITTINGS FOR CARBON STEEL PIPE

A. As a general rule of thumb, a full encirclement saddle, with a flanged nozzle weld attachment, should be installed any time one of the following conditions exist:

1. For horizontal tapping where a twisting moment could be imposed on the header pipe.

2. Where hot tapping is required at or near the mid span point between the pipe supports.

3. When the branch outlet size is equal to or greater than half the size of the header pipe.

4. For line stopping of underground pipe where proper inspection may be difficult to achieve.

5. Whenever excessive loads may be imposed due to the proximity of loads to valve and pumping equipment.

6. Where the intersection may be subjected to excessive thermal or pressure cycles.

7. Whenever an anchor or cold spring is used in the branch line close to the line stop location.

8. For lines where spring supports are called for near the line stop point.

9. In cases where the header is constructed of thin walled material.

10. Whenever required by the Construction Manager or Engineer.

11. Any time it is requested by the Line Stop Specialist where the work must carry a warranty.

B. For all other conditions, the initial attachment can be made using a weld-o-let.

C. The thickness and width of a branch reinforcement pad shall be determined by the Line Stop Specialist in accordance with Part 1.04. Minimum pad thickness shall equal that of header pipe.

D. Contractor/Line Stop Specialist shall design reinforcement pad to minimize any local stresses and provide for as low a stress intensification factor as far as practical.

E. The Contractor/Line Stop specialist shall pressure test the line stop full encirclement saddle with a blind flange equipped with a pressure testing port/connection. This hydrostatic test shall be equal to the pressure of the header pipe. Extreme care should be taken not to exceed line pressure capability to prevent buckling of the line.

2.03 LINE STOP TAP VALVES

A. Full Port gate or ball valves shall be used for all line stop operations.

B. Contractor/ Line Stop specialist shall coordinate selection of line stop tap valves to be compatible with the proposed method of hot tapping of the pipe.

C. Valves used for hot tapping shall be pre-tested for bubble tight shut-off in both directions.

D. Line stop valves shall be manufactured with materials and trim acceptable for the proposed service and capable of operating at the pressure and temperature conditions of the header pipe. Materials used shall be common to the water and wastewater industry and compatible with the proposed process service as listed on the Drawings.

E. Materials in contact with potable water shall be NSF-61 listed.

2.04 COATINGS AND LININGS

A. All coatings in contact with water shall be NSF-61 certified for use with potable water.

B. Refer to Section 02518 for additional detail on interior lining and exterior coating requirements.

C. Exterior coatings; aboveground, will also be in compliance with Section 09901 requirements.

PART 3 EXECUTION

3.01 INSTALLATION

A. The following narrative shall be used as a guide in preparation of the Contractor/Line Stop Specialist installation plan described in paragraph 1.04.A above. The Contractor shall be responsible for developing and submitting a detailed plan of all equipments and methods in accordance with this section and Section 01330. The line stop operation shall proceed approximately as follows:

B. Perform an initial field inspection of the pipe to receive the line stop under the supervision of the Construction Manager to determine the location of the line stop and determine the exact pipe dimensions (outside diameter, ovality, and pipe wall thickness) prior to shop fabrication of the line stop fitting. Contractor shall provide all non destructive devices to verify dimensions.

C. The Contractor and Line Stop Specialist in conjunction with input from the Construction Manager and Owner shall prepare a procedure of emergency shut-down and evacuation of a work area should something catastrophically fail during the line stop procedure.

D. Following fabrication, install the line stop fitting on the pipeline. Conduct a leakage test using the 1-in diameter outlet connection of the nozzle section of the line stop fitting. The leakage test shall be carried out using water at a pressure in excess of the operating pressures as shown on the Drawings and/or to be determined by the Engineer, depending upon the location, for ½-hour. The Construction Manager shall witness the pressure test.

E. After a successful leakage test, Contractor/Line Stop Specialist shall install engineered additional pipe support as required to suit installation of line stop. Refer to Part 1.04 A (5) for additional information.

F. Install the valve and tapping machine. The tapping machine cutting components (shell cutter and pilot drill) shall be designed to provide a clean cut at the pipe wall, and retain the cut coupon for removal. Upon approval from the Construction Manager, perform the tap and withdraw the cutter.

G. The line stop equipment shall consist of a folding or pivoting plugging head that contains an elastomer sealing element. The element shall be monolithically molded from a polyurethane compound suitable for potable water service (or service as indicated on the Drawings). The element shall be flat in a plane perpendicular to the flow in the pipeline when the plugging head is in the full open position. The plugging head shall have a sealing element to seal against the inside of the pipeline when in the full open position. The plugging head shall be advanced into and retracted from the main by means of a linear actuator. When retracted, the plugging head and carrier shall be contained in a housing, bolted pressure tight between the sandwich valve and the actuator.

H. Upon the re-installation or replacement of the valves and/or pumps, the line stop shall be removed, and air bled from the new piping through the 1-in corporation stop. The completion plugs shall be inserted into the line stop fitting nozzle, and the temporary sandwich valve removed. A permanent blind flange shall be placed on the outlet of the nozzle.

Table 1: Information on Existing Pipelines that Require Temporary Line Stopping and Bypass during Construction

Location	Minimum Qty. of Line Stoppers	Nominal Pipe Diameter (inch)	Type of Pipe	Max. Estimated Line Pressure (psig)	Pipe Service	Reason for Performing Line Stopping	Bypass Needed	Above or Below Grade	Pipe Location (Indoor/ Outdoor)	Notes
8" PW line at the Finished Water Flow meter station	2	8	Carbon Steel	85	Potable water	Isolate and bypass existing 8" PW line for removal of couplings	Yes	Above grade	Outdoor	
42" TW line on the pump station line to Surge Tank No.1.	1	42	Carbon Steel	85	Potable water	Isolate to remove existing hydropneumatic Surge Tank No.1	No	Above grade	Outdoor	
Phase I 48" filtered water upstream & downstream of UV reactors	2	48	Carbon Steel	40	Potable water	Isolate and bypass existing UV Building for removal of pipe couplings	Yes	Below grade	Outdoor	The bypass piping needs to have 1" sample tap and nozzles for chemical injections as shown on the Drawings
Phase I 30" filter backwash supply pipe	1	30	Carbon Steel	40	Filter Backwash water	Isolate and bypass existing UV Building for removal of pipe couplings	Yes	Below grade	Outdoor	The bypass piping needs to have temporary flow meter and modulating valves for filter backwash flow control and monitoring
Phase II 48" filtered water upstream & downstream of UV reactors	2	48	Carbon Steel	40	Potable water	Isolate and bypass existing UV Building for removal of pipe couplings	Yes	Below grade	Outdoor	The bypass piping needs to have 1" sample tap and nozzles for chemical injections as shown on the Drawings
Phase II 30" filter backwash supply pipe	1	30	Carbon Steel	40	Filter Backwash water	Isolate and bypass existing UV Building for removal of pipe couplings	Yes	Above grade	Outdoor	The bypass piping needs to have temporary flow meter and modulating valves for filter backwash flow control and monitoring

END OF SECTION

Section 02775

CONCRETE SIDEWALKS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Reinforced concrete sidewalks.

B. Wheelchair ramps.

C. Reinforced slope paving.

1.02 MEASUREMENT AND PAYMENT

A. Unit Prices.

1. Payment for concrete sidewalks is on square foot basis.

2. No payment will be made for work outside these limits or in areas where driveway has been removed or replaced for Contractor's convenience.

3. Payment for wheelchair ramps of each type specified is on square foot basis. Removal and replacement of existing sidewalk, curb or curb and gutter and saw-cutting is paid by unit cost for each item. Sodding will be paid one foot on each side of sidewalk unless otherwise noted. Staining of wheelchair ramps is included in cost of ramp.

4. Refer to Section 01270 - Measurement and Payment for unit price procedures.

B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.03 REFERENCES

A. ASTM C 31 - Standard Practice for Making and Curing Concrete Test Specimens in Field.

B. ASTM C 39 - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.

C. ASTM C 42 - Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.

D. ASTM C 138 - Standard Test Method for Unit Weight, Yield, and Air Content (Gravimetric) of Concrete.

E. ASTM C 143 - Standard Test Method for Slump of Hydraulic Cement Concrete.

F. ASTM C 172 - Standard Practice for Sampling Freshly Mixed Concrete.

G. ASTM D 698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3 (600 kN-m/m^3).

H. Texas Accessibility Standards of Architectural Barriers Act, Article 9102, Texas Civil Statues.

1.04 SUBMITTALS

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

B. Submit certified testing results and certificates of compliance.

PART 2 P R O D U C T S

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 of Section 02751 - Concrete Paving for reinforcing steel. Use No. 3 reinforcing bars.

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. Forms: Use straight, unwarped wood or metal forms with nominal depth equal to or greater than proposed sidewalk thickness. The use of 2 inch by 4 inch lumber as forms will not be allowed.

F. Sand Bed: Conform to material requirements for bank run sand of Section 02320 - Utility Backfill Materials.

G. Sodding: Conform to material requirements for sodding of Section 02922 - Sodding.

H. Coloring for wheelchair ramps: Conform to material requirements for colored concrete of Section 02761 - Colored Concrete for Medians and Sidewalks. Color shall be Brick Red or as shown on the drawings.

PART 3 EXECUTION

3.01 REPLACEMENT

A. Replace sidewalks and slope paving which are removed or damaged during construction with thickness and width equivalent to one removed or damaged, unless otherwise shown on Drawings. Finish surface (exposed aggregate, brick pavers, etc.) to match existing sidewalk.

B. Provide replaced and new sidewalks with wheelchair ramps when sidewalk intersects curb at street or driveway.

3.02 PREPARATION

A. Identify and protect utilities which are to remain.

B. Protect living trees, other plant growth, and features designated to remain.

C. Conduct clearing and grubbing operations in accordance with Section 02233 - Clearing and Grubbing.

D. Excavate subgrade 6 inches beyond outside lines of sidewalk. Shape to line, grade and cross section. For soils with plasticity index above 40 percent, stabilize soil with lime in accordance with Section 02336 – Lime-Stabilized Subgrade. Compact subgrade to minimum of 90 percent maximum dry density at optimum to 3 percent above optimum moisture content, as determined by ASTM D 698.

E. Immediately after subgrade is prepared, cover with compacted sand bed to depth as shown on Drawings. Lay concrete when sand is moist but not saturated.

3.03 PLACEMENT

A. Setting Forms: Straight, unwarped wood or metal forms with nominal depth equal to or greater than proposed sidewalk thickness. Use of 2 by 4's as forms will not be allowed. Securely stake forms to line and grade. Maintain position during concrete placement.

B. Reinforcement:

1. Install reinforcing bars.

2. Install reinforcing steel as shown on the drawings. Lay longitudinal bars in walk

continuously, except through expansion joints.

3. Use sufficient number of chairs to support reinforcement in manner to maintain reinforcement in center of slab vertically during placement.

4. Drill dowels into existing paving, sidewalk and driveways, secure with epoxy, and provide headers as required.

5. Use sufficient number of chairs for steel reinforcement bars to maintain position of bars within allowable tolerances. Place reinforcement as shown on Drawings. In plane of steel parallel to nearest surface of concrete, bars shall not vary from plan placement by more than 1/12 of spacing between bars. In plane of steel perpendicular to nearest surface of concrete, bars shall not vary from plan placement by more than 1/4 inch.

C. Expansion Joints: Install expansion joints with load transfer units in accordance with Section 02752 - Concrete Pavement Joints.

E. Place concrete in forms to specified depth and tamp thoroughly with "jitterbug" tamp, or other acceptable method. Bring mortar to surface.

F. Strike off to smooth finish with wood strike board. Finish smoothly with wood hand float. Brush across sidewalk lightly with fine-haired brush.

G. Apply coating to wheelchair ramp with contrasting color in accordance with Section 02761 - Colored Concrete for Medians and Sidewalks.

H. Unless otherwise indicated on Drawings, mark off sidewalk joints 1/8 inch deep, at spacing equal to width of walk. Use joint tool equal in width to edging tool.

I. Finish edges with tool having 1/4 inch radius.

J. After concrete has set sufficiently, refill space along sides of sidewalk to one-inch from top of walk with suitable material. Tamp until firm and solid, place sod as applicable. Dispose of excess material in accordance with Section 01576 - Waste Material Disposal. Repair driveways and parking lots damaged by sidewalk excavation in accordance with Section 02951 - Pavement Repair and Resurfacing.

3.04 CURING

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

3.05 FIELD QUALITY CONTROL

A. Testing will be performed under provisions of Section 01454 - Testing Laboratory Services.

B. Compressive Strength Test Specimens: Four test specimens for compressive strength test will be made in accordance with ASTM C 31 for each 30 cubic yards or less of sidewalk that is placed in one day. Two specimens will be tested at 7 days. Remaining two specimens will be tested at 28 days. Specimens will be tested in accordance with ASTM C 39. Minimum compressive strength: 2500 psi at 7 days and 3000 psi at 28 days.

C. Yield test for cement content per cubic yard of concrete will be made in accordance with ASTM C 138. When cement content is found to be less than that specified per cubic yard, reduce batch weights until amount of cement per cubic yard of concrete conforms to requirements.

D. If the Contractor places concrete without notifying the laboratory, the City will have the concrete tested by means of core test as specified in ASTM C 42. When concrete does not meet specification, cost of test will be deducted from payment.

E. Sampling of fresh concrete shall be in accordance with ASTM C 172.

F. Take slump tests when cylinders are made and when concrete slump appears excessive.

G. Concrete shall be acceptable when average of two 28 day compression tests is equal to or greater than minimum 28 day strength specified.

H. If either of two tests on field samples is less than average of two tests by more than 10 percent, that entire test shall be considered erratic and not indicative of concrete strength. Core samples will be required of in-place concrete in question.

I. If 28 day laboratory test indicates that concrete of low strength has been placed, test concrete in question by taking cores as directed by Project Manager. Take and test at least three representative cores as specified in ASTM C 42 and deduct cost from payment due.

3.06 NONCONFORMING CONCRETE

A. Remove and replace areas that fail compressive strength tests, with concrete of thickness shown on Drawings.

B. Replace nonconforming sections at no additional cost to City.

3.07 PROTECTION

A. Maintain newly place concrete in good condition until completion of Work.

B. Replace damaged areas.

END OF SECTION

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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 - Hydro-mulch Seeding or Section 02922 - Sodding.

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

B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

PART 2 PRODUCTS

2.01 TOPSOIL

A. Topsoil shall be fertile, friable, natural sandy loam surface soil obtained from excavation or borrow operations having 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 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 minimum depth of 4 inches and has similar characteristics to that found at placement site. Do not obtain topsoil from areas infected with growth of, or reproductive parts of nut grass or other noxious weeds.

PART 3 EXECUTION

3.01 EXAMINATION

A. Excavate topsoil for esplanades and areas to receive grass or landscaping from areas to be further excavated. Stockpile in area approved by Project Manager.

B. Stockpile topsoil to depth not exceeding 8 feet. Cover to protect from erosion.

3.02 TOPSOIL EXCAVATION

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

3.03 PLACEMENT

A. Place no topsoil until subgrade has been approved. For areas to be seeded or sodded, scarify or plow existing material to minimum depth of 4 inches, or as indicated on Drawings. Remove vegetation and foreign inorganic material. Place 4 inches of topsoil on loosened material and roll lightly with 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 depth and dimensions shown on 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.

E. Place topsoil to promote good drainage and compact with light roller. Water topsoil after placement until saturated for minimum depth 6 inches, fill in and recompact areas of settlement.

3.04 PROTECTION

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

END OF SECTION

Section 02921

HYDRO MULCH 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 hydro mulch seeding is on an acre basis, within limits of construction if shown on the drawings.

2. No payment will be made for hydro mulch seeding under this Section if limits of constructions are not shown on the drawings. Include payment in Section 01740 – Site Restoration.

3. Refer to Section 01270 - Measurement and Payment for unit price procedures.

B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.03 SUBMITTALS

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

B. Submit certification from supplier that each type of seed conforms to these specifications and requirements of Texas Seed Law. Certification shall accompany seed delivery.

C. Submit certificate stating that fertilizer complies with these specifications and requirements of 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 Federal Seed Act and Texas Seed Law. Seed shall be certified 90 percent pure and furnish 80 percent germination and meet 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 Unhulled Common Bermuda Grass 98/88	40 40	Jan 1 to Mar 31
Hulled Common Bermuda Grass 98/88	40	Apr 1 to Sep 30
Hulled Common Bermuda Grass 98/88 Unhulled Common Bermuda Grass 98/88 Annual Rye Grass (Gulf)	40 40 30	Oct 1 to Dec 31

C. Fertilizer: Dry and free flowing, inorganic, water soluble commercial fertilizer, which is uniform in composition. Deliver in unopened containers which bear manufacturers guaranteed analysis. Caked, damaged, or otherwise unsuitable fertilizer will not be accepted. Fertilizer shall contain minimum percentages of 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 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 same fiber content and size as for cellulose fibers from wood chips.

3. Dye mulch 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 rate of 500 pounds per acre.

C. Mulch: Apply uniformly at rate of 50 pounds per 1000 square feet.

D. Soil Stabilizer: Apply uniformly at rate of 40 pounds per acre.

E. Weed Control Agent: Apply at manufacturer's recommended rate prior to hydro mulching.

F. Sod: Lay single row of sod along perimeter where top soil and pavement intersect. Apply in conformance to Section 02922 - Sodding.

G. Suspend operations under conditions of drought, excessive moisture, high winds, or extreme or prolonged cold. Obtain Project Manager approval before resuming operations.

3.03 MAINTENANCE

A. Maintain grassed areas minimum of 90 days, or as required to establish an acceptable lawn. For areas seeded in fall, continue maintenance following spring until 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.

D. Reseed small, sparse grass areas. When sparse areas exceed 20 percent of planted area, reseed by hydro mulch.

E. Mow grass when height reaches 3 1/2 inches or greater on average before final acceptance. Mow to height of 2 1/2 inches.

END OF SECTION

Section 02922

SODDING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Restoration of existing lawn areas disturbed by construction shall be by installation of new sod.

B. Planting of sod within areas designated on Drawings for purpose of surface stabilization, channel stabilization or vegetation buffer strips.

C. Sod is defined as blocks, squares, strips of turfgrass, and adhering soil used for vegetative planting. To be placed edge to edge for complete coverage.

D. Lawn is defined as ground covered with fine textured grass kept neatly mowed.

1.02 MEASUREMENT AND PAYMENT

A. Unit Prices.

1. Payment for sodding is on square yard basis.

2. For utility construction, no separate payment will be made for sodding. Include payment in section 01740 under site restoration.

3. Refer to Section 01270 - Measurement and Payment for unit price procedures.

B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.03 SUBMITTALS

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

1.04 QUALITY ASSURANCE

A. Sod only when weather and soil conditions are deemed by Project Manager to be suitable for proper placement.

B Water and fertilize new sod.

C. Guarantee sod to be growing 30 days after substantial completion.

D. Maintenance Period:

1. Begin maintenance immediately after each section of grass sod is installed and continue for 30 day period from date of substantial completion.

2. Resod unacceptable areas.

3. Water, fertilize, control disease and insect pests, mow, edge, replace unacceptable materials, and perform other procedures consistent with good horticultural practice to ensure normal, vigorous and healthy growth. Install disease control within guidelines set forth by Structural Pest Control Board of the State of Texas.

E. Notify Project Manager 10 days before end of maintenance period for inspection.

PART 2 PRODUCTS

2.01 SOD

A. Species: Bermuda (Cynodon Dactylon), Buffalo (Buchloe Dactyloides), or St. Augustine (Stenotaphrum Secundatum) Gulf Coast variety to match existing sod.

B. Contents: 95 percent permanent grass suitable to climate in which it is to be placed; not more than 5 percent weeds and undesirable grasses; good texture, free from obnoxious grasses, roots, stones and foreign materials.

C. Size: 12 inch wide strips, uniformly 2 inches thick with clean-cut edges.

D. Sod is to be supplied and maintained in healthy condition as evidenced by grass being normal green color.

2.02 FERTILIZER

A. Available nutrient percentage by weight: 12 percent nitrogen, 4 percent phosphoric acid, and 8 percent potash; or 15 percent nitrogen, 5 percent phosphoric acid, and 10 percent potash.

2.03 WEED AND INSECT TREATMENT

A. Provide acceptable treatment to protect sod from weed and insect infestation. Submit treatment method to Project Manager for approval. Install insect and disease control within guidelines set forth by Structural Pest Control Board of the State of Texas.

2.04 WATER

A. Potable, available on-site through Contractor's water trucks. Contractor may use City of Houston hydrants when water use is measured through Contractor's meter. Do not use private resident's water.

2.05 BANK SAND

A. Free of clay lumps, roots, grass, salt or other foreign material.

PART 3 EXECUTION

3.01 PREPARATION

A. Verify that soil placement and compaction have been satisfactorily completed. Verify that soil is within allowable range of moisture content.

B. Top soil shall be free of weeds and foreign material immediately before sodding.

C. Do not start work until conditions are satisfactory. Do not start work during inclement or impending inclement weather.

D. Rake areas to be sodded smooth, free from unsightly variations, bumps, ridges or depressions.

E. Spread 2 inch layer of bank sand over areas to be sodded prior to planting of sod.

F. Apply fertilizer at rate of 25 pounds per 1000 square feet. Apply after raking soil surface and not more than 48 hours prior to laying sod. Mix thoroughly into upper 2 inches of soil. Lightly water to aid in dissipation of fertilizer.

3.02 APPLICATION

A. Full Sodding: Lay sod with closely fitted joints leaving no voids and with ends of sod strips staggered. Lay sod within 24 hours of harvesting.

B. On slopes 2:1 and steeper, lay sod perpendicular to slope and secure every row with wooden pegs at maximum 2 feet on center. Drive pegs flush with soil portion of sod.

C. Prior to placing sod, on slopes 3:1 or where indicated, place Hold/Gro or Roll Lite or equal over topsoil. Securely anchor in place with posts sunk firmly into ground at maximum 16 feet on center along pitch of slope and equal to width of wire mesh horizontally across slopes.

D. After sod is laid, irrigate thoroughly to secure 6-inch minimum penetration into soil below sod.

E. Tamp and roll sod with approved equipment to eliminate minor irregularities and to form close contact with soil bed immediately after planting and watering. Submit type of tamping and rolling equipment to be used to Project Manager for approval, prior to construction.

3.03 MAINTENANCE

A. Watering:

1. Water lawn areas once a day with minimum 1/2 inch water for first 3 weeks after area is sodded.

2. After 3 week period, water twice a week with 3/4 inch of water each time unless comparable amount has been provided by rain.

3. Make weekly inspections to determine moisture content of soil unless soil is in frozen condition.

4. Water in afternoon or at night to enable soil to absorb maximum amount of water with minimum evaporation.

B. Mowing:

1. Mow sod at intervals which will keep grass height from exceeding 3 1/2 inches.

2. Set mower blades at 2 1/2 inches.

3. Do not remove more than one-half of grass leaf surface.

4. Mow sodded areas requiring mowing within 1 month after installation with light-weight rotary type mower. Mow sod only when dry and not in saturated or soft condition.

5. Remove grass clippings during or immediately after mowing.

C. Fertilizer and Pest Control:

1. Evenly spread fertilizer composite at rate of 40 pounds per 5000 square feet or as recommended by manufacturer. Do not place fertilizer until 2 weeks after placement of sod.

2. Restore bare or thin areas by topdressing with mix of 50 percent sharp sand and 50 percent sphagnum peat moss.

3. Apply mixture 1/4 to 1/2 inch thick.

4. Treat areas of heavy weed and insect infestation as recommended by treatment manufacturer.

D. Restrict all traffic from sodded areas until sod is established or for minimum 10 days during growing season. Use wood lath and plastic tape to cordon sodded areas. Maintain tape and lath throughout for minimum 30 days during growing season.

3.04 CLEANUP

A. During course of planting, remove excess and waste materials; keep lawn areas clean and take precautions to avoid damage to existing structures, plants, grass, and streets.

B. Remove barriers, signs, and other Contractor material and equipment from project site at termination of establishment period.

C. Dispose of unused materials and rubbish in accordance with Section 01576 - Waste Material Disposal.

END OF SECTION

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Section 02951

PAVEMENT REPAIR AND RESTORATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Repairing and replacing streets, highways, and other pavements as required per street cut ordinance that have been cut, broken, or damaged due to utility excavation.

1.02 MEASUREMENT AND PAYMENT

A. Unit Prices.

1. Payment for pavement repair and replacement for utility projects is on a square yard basis and includes surface and base materials as required per street cut ordinance.

2. Measurement for utility projects: Match actual pavement replaced but no greater than maximum pavement replacement limits in accordance with the street cut ordinance or otherwise shown on drawings.

3. Refer to Section 01270 - Measurement and Payment for other 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.

PART 2 PRODUCTS

2.01 MATERIALS

A. Subgrade:

1. Provide backfill material as required by applicable excavation and fill sections (Sections 02315 through 02319) and Section 02330 - Embankment.

2. Provide material for stabilization as required by applicable portions of Section 02336 - Lime Stabilized Subgrade, Section 02337 - Lime/Fly-Ash Stabilized Subgrade, and Section 02338 - Portland Cement Stabilized Subgrade.

B. Base: Provide base material as required by applicable portions of Section 02711 - Hot Mix Asphaltic Base Course, Section 02712 - Cement Stabilized Base Course, and Section 02713 - Crushed Concrete Base Course.

C. Pavement: Provide paving materials as required by applicable portions of Section 02741 - Asphaltic Concrete Pavement, Section 02751- Concrete Paving, Section 02754 - Concrete Driveways, and Section 02771 - Curb, Curb and Gutter, and Headers, and Section 02775 - Concrete Sidewalks.

PART 3 EXECUTION

3.01 PREPARATION

A. Notify City prior to commencement of excavation in pavement for which an Excavation in Public Way permits has been obtained. Follow directions contained in the permit.

B. Conform to requirement of Section 02221 - Removing Existing Pavements and Structures, for removals.

C. Saw cut pavement 18 inches wider than width of trench needed to install utilities unless otherwise indicated on Drawings.

D. When removing pavement to existing deformed metal strip (i.e. dummy joint), saw cut pavement minimum 2 inches deep on opposite side of deformed metal strip. Place saw joint far enough behind deformed metal strip to obtain continuously straight joint. Remove damaged portion of deformed metal strip as required to provide proper joint. Saw cut and remove metal strip before placement of new concrete pavement.

E. Protect edges of existing pavement to remain from damage during removals, utility placement, backfill, and paving operations. For concrete pavement, protect undisturbed subgrade that is to remain to support replacement slab.

F. Dowel in existing pavement where no reinforcement is found or is broken due to construction activities. Unless otherwise directed by Project Manager, provide No. 6 bars 24 inches long, drilled and embedded 8 inches into center of existing slab with 'PO-ROC' epoxy grout or approved equal. Space dowels to match new pavement reinforcement spacing.

G. Provide transitional paving and earthwork as required to tie proposed pavement to existing pavement when unable to dowel new pavement into existing pavement.

3.02 INSTALLATION

A. Parking Areas, Service Drives, Driveways, and Sidewalks: Replace with material equal to or better than existing or as indicated on Drawings. Conform to applicable requirements of sections referenced in Paragraph 2.01, Materials.

B. Street Pavements and Curbs, Curbs and Gutters: Replace subgrade, base, and surface course with like materials or as indicated on Drawings and City of Houston Standard Detail 02951.01. Curbs and curbs and gutters shall match existing. Conform to requirements of sections referenced in Paragraph 2.01, Materials.

C. For concrete pavement, install size and length of reinforcing steel and pavement thickness indicated on Drawings and City of Houston Standard Detail 02751.01. Place types and spacing of joints to match existing or as indicated on Drawings.

D. Where existing pavement consists of concrete pavement with asphaltic surfacing, resurface with minimum 2 inch depth asphaltic pavement.

E. Repair state highway and county crossings in accordance with TxDOT permit or county requirements as appropriate and within 1 week after utility work is installed.

3.03 WASTE MATERIAL DISPOSAL

A. Dispose of waste material in accordance with requirements of Section 01576 - Waste Material Disposal.

3.04 PROTECTION

A. Maintain pavement in good condition until completion of Work.

B. Replace pavement damaged by Contractor's operations at no cost to City.

END OF SECTION

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Section 03100
CONCRETE FORMWORK

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals required and design, install and remove formwork for cast in place concrete as shown on the Drawings and as specified herein.

B. Secure to forms as required or set for embedment as required, all miscellaneous metal items, sleeves, reglets, anchor bolts, inserts and other items furnished under other Sections and required to be cast into concrete.

1.02 MEASUREMENT AND PAYMENT

A. No separate payment will be made for work performed under this Section. Include the cost for this work in the lump sum Base Bid Item in Section 00410.

1.03 RELATED WORK

A. Concrete Reinforcement is included in Section 03200.

B. Concrete Joints and Joint Accessories are included in Section 03250.

C. Cast in Place Concrete is included in Section 03300.

D. Grout is included in Section 03600.

E. Modifications to Existing Concrete are included in Section 03740.

1.04 SUBMITTALS

A. Submit, in accordance with Section 01330, shop drawings and product data showing materials of construction and details of installation for:

1. Form release agent

2. Form ties

3. Bond breakers

B. Samples

1. Demonstrate to the Engineer on a designated area of the concrete substructure exterior surface that the form release agent will not adversely affect concrete surfaces to be painted, coated or otherwise finished and will not affect the forming materials.

C. Test Reports

D. Certificates

1. Certify form release agent is suitable for use in contact with potable water after 30 days (non toxic and free of taste and odor).

1.05 REFERENCE STANDARDS

A. American Concrete Institute (ACI)

1. ACI 301 - Standard Specification for Structural Concrete

2. ACI 318 – Building Code Requirements for Structural Concrete

3. ACI 347 - Formwork for Concrete

B. American Plywood Association (APA)

1. Material grades and designations as specified

C. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.06 QUALITY ASSURANCE

A. If a form liner is required the manufacturer's representative shall be on site during the initial installation of the form liner to instruct the Contractor on the proper methods of application and use of the liner. He/She shall be available to answer any questions on the liner that the Engineer may have.

1.07 SYSTEM DESCRIPTION

A. General: Architectural Concrete is wall, slab, beam or column concrete which will have surfaces exposed to view in the finished work. It includes similar exposed surfaces in water containment structures from the top of walls to 2-ft below the normal water surface in open tanks and basins.

B. Structural design responsibility: All forms and shoring shall be designed at the Contractor's expense by a professional engineer registered in the State of Texas. Formwork shall be designed and erected in accordance with the requirements of ACI 301 and ACI 318 and as recommended in ACI 347 and shall comply with all applicable regulations and codes. The design shall consider any special requirements due to the use of plasticized and/or retarded set concrete.

PART 2 PRODUCTS

2.01 GENERAL

A. The usage of a manufacturer's name and model or catalog number is for the purpose of establishing the standard of quality and general configurations desired.

2.02 MATERIALS

A. Forms for cast in place concrete shall be made of wood, metal, or other approved material. Construct wood forms of sound lumber or plywood of suitable dimensions and free from knotholes and loose knots. Where used for exposed surfaces, dress and match boards. Sand plywood smooth and fit adjacent panels with tight joints. Metal forms may be used when approved by the Engineer and shall be of an appropriate type for the class of work involved. All forms shall be designed and constructed to provide a flat, uniform concrete surface requiring minimal finishing or repairs.

B. Wall Forms

1. Forms for all exposed exterior and interior concrete walls shall be new and unused "Plyform" exterior grade plywood panels manufactured in compliance with the APA and bearing the trademark of that group, or equal acceptable to the Engineer. Provide B grade or better veneer with High Density Overlay on all faces to be placed against concrete during forming. The class of material and grades of interior plies shall be of sufficient strength and stiffness to provide a flat, uniform concrete surface requiring minimal finishing and grinding.

2. All joints or gaps in forms shall be taped, gasketed, plugged, and/or caulked with an approved material so that the joint will remain watertight and will withstand placing pressures without bulging outward or creating surface patterns.

3. Forms for circular structures shall conform to the circular shape of the structure. Straight panels may be substituted for circular panels if the straight panels do not exceed 2-ft in width nor deflect more than 3-1/2 degrees per joint, nor conflict with specific notes on the Drawings.

C. Column Forms

1. Rectangular columns shall be formed as specified for wall forms. All corners shall have a 3/4-in chamfer unless otherwise noted on the Drawings.

2. Circular columns shall be formed with steel, fiberglass reinforced plastic, or seamless cardboard column forms. The forms shall be continuous for the height of the column between construction joints indicated on the Drawings unless otherwise approved by the Engineer.

D. Rustications shall be at the location and shall conform to the details shown on the Drawings. Moldings for chamfers and rustications shall be milled and planed smooth. Rustications and

corner strips shall be of a nonabsorbent material, compatible with the form surface and fully sealed on all sides to prohibit the loss of paste or water between the two surfaces.

E. Form Release Agent

1. Coat all forming surfaces in contact with concrete using an effective, non-staining, non residual, water based, bond breaking form coating unless otherwise noted.

F. Concrete surfaces which are to be painted shall be formed with hard plastic finished plywood or a similar material which does not require a form release agent unless the Contractor can substantiate to the satisfaction of the Engineer that the form release agent will not remain on the formed surface after it is stripped.

G. Form Ties

1. Form ties encased in concrete other than those specified in the following paragraphs shall be designed so that, after removal of the projecting part, no metal shall remain within 1-1/2-in of the face of the concrete. The part of the tie to be removed shall be provided with a removable cone at least 1-in diameter and 1-1/2-in deep. Form ties in concrete exposed to view shall be the cone washer type.

2. Flat bar ties for panel forms shall have plastic or rubber inserts having a minimum depth of 1-1/2-in and sufficient dimensions to permit proper patching of the tie hole.

3. Ties for liquid containment structures shall have an integral waterstop that is tightly welded to the tie.

4. Common wire shall not be used for form ties.

5. Alternate form ties consisting of tapered through bolts at least 1 in in diameter at smallest end or through bolts that utilize a removable tapered sleeve of the same minimum size may be used at the Contractor's option. Obtain Engineer's acceptance of system and spacing of ties prior to ordering or purchase of forming. Clean, fill and seal form tie hole with non shrink cement grout. The Contractor shall be responsible for watertightness of the form ties and any repairs needed.

PART 3 EXECUTION

3.01 GENERAL

A. Forms shall be used for all cast in place concrete including sides of footings. Forms shall be constructed and placed so that the resulting concrete will be of the shape, lines, dimensions and appearance indicated on the Drawings.

B. Forms for walls shall have removable panels at the bottom for cleaning, inspection and joint surface preparation. Forms for walls of considerable height shall have closable intermediate inspection ports. Tremies and hoppers for placing concrete shall be used to allow concrete

inspection, prevent segregation and prevent the accumulation of hardened concrete on the forms above the fresh concrete.

C. Molding, bevels, or other types of chamfer strips shall be placed to produce blockouts, rustications, or chamfers as shown on the Drawings or as specified herein. Chamfer strips shall be provided at horizontal and vertical projecting corners to produce a 3/4-in chamfer. Rectangular or trapezoidal moldings shall be placed in locations requiring sealants where specified or shown on the Drawings. Sizes of moldings shall conform to the sealants manufacturer's recommendations.

D. Forms shall be sufficiently rigid to withstand construction loads and vibration and to prevent displacement or sagging between supports. Construct forms so that the concrete will not be damaged by their removal. The Contractor shall be entirely responsible for the adequacy of the forming system.

E. Before form material is re used, all surfaces to be in contact with concrete shall be thoroughly cleaned, all damaged places repaired, all projecting nails withdrawn and all protrusions smoothed. Reuse of wooden forms for other than rough finish will be permitted only if a "like new" condition of the form is maintained.

F. Accessories which remain embedded in the concrete after formwork removal shall be approved by the Engineer. Permanent embedments shall have sufficient concrete cover or be of suitable materials for the exposure condition as approved by the Engineer.

3.02 FORM TOLERANCES

A. Forms shall be surfaced, designed and constructed in accordance with the recommendations of ACI 347 and shall meet the following additional requirements for the specified finishes.

B. Formed Surface Exposed to View: Edges of all form panels in contact with concrete shall be flush within 1/32-in and forms for plane surfaces shall be such that the concrete will be plane within 1/16-in in 4-ft. Forms shall be tight to prevent the passage of mortar, water and grout. The maximum deviation of the finish wall surface at any point shall not exceed 1/4-in from the intended surface as shown on the Drawings. Form panels shall be arranged symmetrically and in an orderly manner to minimize the number of seams.

C. Formed surfaces not exposed to view or buried shall meet requirements of Class "C" Surface in ACI 347.

D. Formed rough surfaces including mass concrete, pipe encasement, electrical duct encasement and other similar installations shall have no minimum requirements for surface smoothness and surface deflections. The overall dimensions of the concrete shall be plus or minus 1-in.

E. Formed concrete Surfaces to Receive Paint: Surface deflections shall be limited to 1/32-in at any point and the variation in wall deflection shall not exceed 1/16-in per 4-ft. The maximum deviation of the finish wall surface at any point shall not exceed 1/4-in from the intended surface as shown on the Drawings.

3.03 FORM PREPARATION

A. Wood forms in contact with the concrete shall be coated with an effective release agent prior to form installation.

B. Steel forms shall be thoroughly cleaned and mill scale and other ferrous deposits shall be sandblasted or otherwise removed from the contact surface for all forms, except those utilized for surfaces receiving a rough finish. All forms shall have the contact surfaces coated with a release agent.

C. Form liners to be installed for architectural concrete finish, if required, shall be in accordance to the manufacturer recommendations.

3.04 REMOVAL OF FORMS

A. The Contractor shall be responsible for all damage resulting from removal of forms. Forms and shoring for structural slabs or beams shall remain in place in accordance with ACI 301 and ACI 347. Form removal shall conform to the requirements specified in Section 03300.

3.05 INSPECTION

A. The Engineer shall be notified when the forms are complete and ready for inspection at least 6 hours prior to the proposed concrete placement.

B. Failure of the forms to comply with the requirements specified herein, or to produce concrete complying with requirements of this Section shall be grounds for rejection of that portion of the concrete work. Rejected work shall be repaired or replaced as directed by the Engineer at no additional cost to the Owner. Such repair or replacement shall be subject to the requirements of this Section and approval of the Engineer.

END OF SECTION

SECTION 03200
CONCRETE REINFORCEMENT

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals required and install all concrete reinforcement complete as shown on the Drawings and as specified herein.

1.02 MEASUREMENT AND PAYMENT

A. No separate payment will be made for work performed under this Section. Include the cost for this work in the lump sum Base Bid Item in Section 00410, Paragraph B.

B. Include price for Extra Unit Work as described herein in the Extra Unit Price Schedule.

1.03 RELATED WORK

A. Concrete Formwork is included in Section 03100.

B. Concrete Joints and Joint Accessories are included in Section 03250.

C. Cast in place Concrete is included in Section 03300.

D. Grout is included in Section 03600.

E. Modifications to Existing Concrete are included in Section 03740.

1.04 SUBMITTALS

A. Submit to the Engineer, in accordance with Section 01330, shop drawings and product data showing materials of construction and details of installation, including the following:

1. Reinforcing steel placing drawings. Placing drawings shall conform to the recommendations of ACI 315. Clearly identify the portion of the Work covered by each placing drawing. All bar splice locations and lap lengths shall be clearly shown. Clearly show the placement of all required additional reinforcement (around openings, at corners, etc.) as shown on the Drawings.

2. Bill of materials (bar list). Clearly show the placement of each bar listed in the bill of materials on the placing drawings.

3. Bar bending details. The bars shall be referenced to the same identification marks shown on the placing drawings. Include standard bending diagrams in the submittal, as applicable.

4. Identify the grade of reinforcing steel in the submittal. Clearly identify any bars that are of a different grade or that have special coatings.

B. Submit samples of each of the following items.

1. Two samples of each type of mechanical reinforcing steel connectors.

C. Submit Test Reports, in accordance with Section 01330, of each of the following items.

1. Certified copy of mill test on each steel proposed for use showing the physical properties of the steel and the chemical analysis.

2. Certified copy of test reports for each foreign manufactured steel proposed for use in the fabrication of reinforcement. The tests shall be specifically made for this project at the expense of the Contractor by a domestic independent testing laboratory certified to perform the tests. The testing shall be for conformity to the applicable ASTM standard.

3. Welder's certification. The certification shall be in accordance with AWS D1.4 when welding of reinforcement required.

1.05 REFERENCE STANDARDS

A. American Society for Testing and Materials (ASTM)

1. ASTM A82 - Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.

2. ASTM A184 - Standard Specification for Fabricated Deformed Steel Bar Mats for Concrete Reinforcement.

3. ASTM A185 - Standard Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement

4. ASTM A496 - Standard Specification for Steel Wire, Deformed, for Concrete Reinforcement

5. ASTM A497 - Standard Specification for Steel Welded Wire Fabric, Deformed, for Concrete Reinforcement

6. ASTM A615 - Standard Specification for Deformed and Plain Billet Steel Bars for Concrete Reinforcement

B. American Concrete Institute (ACI)

1. ACI 301 - Standard Specification for Structural Concrete

2. ACI 315 - Details and Detailing of Concrete Reinforcement

3. ACI 318 – Building Code Requirements for Structural Concrete

4. ACI SP 66 - ACI Detailing Manual

C. Concrete Reinforcing Steel Institute (CRSI)

1. Manual of Standard Practice

D. American Welding Society (AWS)

1. AWS D1.4 - Structural Welding Code - Reinforcing Steel

E. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.06 DELIVERY, HANDLING AND STORAGE

A. Reinforcing steel shall be substantially free from mill scale, rust, dirt, grease, or other foreign matter.

B. Reinforcing steel shall be shipped and stored with bars of the same size and shape fastened in bundles with durable tags, marked in a legible manner with waterproof markings showing the same "mark" designations as those shown on the submitted Placing Drawings.

C. Reinforcing steel shall be stored off the ground, protected from moisture and kept free from dirt, oil, or other injurious contaminants.

PART 2 PRODUCTS

2.01 MATERIALS

A. Materials shall be new, domestically fabricated and shall comply with the following material specifications.

B. Deformed Concrete Reinforcing Bars: ASTM A615, Grade 60 deformed bars.

C. Concrete Reinforcing Bars required on the Drawings to be Field Bent or Welded: ASTM A706.

D. Spiral Reinforcement

1. ASTM A615, Grade 60 for hot rolled plain or deformed bars.

2. ASTM A82 for cold drawn wire.

E. Welded Steel Wire Fabric: ASTM A185. Provide in flat sheets.

F. Welded Deformed Steel Wire Fabric: ASTM A497.

G. Welded Plain Bar Mats: ASTM A704 and ASTM A615 Grade 60 plain bars.

H. Fabricated Deformed Steel Bar Mats: ASTM A184 and ASTM A615 Grade 60 deformed bars.

I. The following alternate materials are allowed:

1. ASTM A615 Grade 60 may be used for ASTM A706 provided the following requirements are satisfied:
   a. The actual yield strength of the reinforcing steel based on mill tests shall not exceed the specified yield strength by more than 18,000 psi. Retests shall not exceed this value by more than an additional 3000 psi.
   b. The ratio of the actual ultimate tensile strength to the actual tensile yield strength of the reinforcement shall not be less than 1.25.
   c. The carbon equivalency (CE) of bars shall be 0.55 or less.

J. Reinforcing Steel Accessories

1. Plastic Protected Bar Supports: CRSI Bar Support Specifications, Class 1 - Maximum Protection.

2. Stainless Steel Protected Bar Supports: CRSI Bar Support Specifications, Class 2 - Moderate Protection.

3. Precast Concrete Block Bar Supports: CRSI Bar Support Specifications, Precast Blocks. Blocks shall have equal or greater strength than the surrounding concrete.

K. Tie Wire

1. Tie Wires for Reinforcement shall be 16 gauge or heavier, black annealed wire.

L. Mechanical reinforcing steel butt splices shall be positive connecting taper threaded type employing a hexagonal coupler such as Lenton rebar splices as manufactured by Erico Products Inc., Solon, OH or equal. They shall meet all ACI 318 Building Code requirements. Bar ends must be taper threaded with coupler manufacturer's bar threader to ensure proper taper and thread engagement. Bar couplers shall be torqued to manufacturer's recommended value.

1. Unless otherwise noted on the Drawings, mechanical tension splices shall be designed to produce a splice strength in tension or compression of not less than 125 percent of the ASTM specified minimum yield strength of the rebar.

2. Compression type mechanical splices shall provide concentric bearing from one bar to the other bar and shall be capable of developing the ultimate strength of the rebar in compression.

2.02 FABRICATION

A. Fabrication of reinforcement shall be in compliance with the CRSI Manual of Standard Practice and ACI 315.

B. Bars shall be cold bent. Bars shall not be straightened or rebent.

C. Bars shall be bent around a revolving collar having a diameter of not less than that recommended by the ACI 318.

D. Bar ends that are to be butt spliced, placed through limited diameter holes in metal, or threaded, shall have the applicable end(s) saw cut. Such ends shall terminate in flat surfaces within 1-1/2 degrees of a right angle to the axis of the bar.

E. Spirals

1. Provide a minimum of 1-1/2 finishing turns at the top and bottom.

2. Splices shall be tension lap splices at least 48 bar diameters, but not less than 12 in in length. Welded splices shall only be used where specifically approved by the Engineer.

3. Provide spacers as recommended by the CRSI.

PART 3 EXECUTION

3.01 INSTALLATION

A. Surface condition, bending, spacing and tolerances of placement of reinforcement shall comply with the CRSI Manual of Standard Practice and ACI 301. The Contractor shall be solely responsible for providing an adequate number of bars and maintaining the spacing and clearances shown on the Drawings.

B. Except as otherwise indicated on the Drawings, the minimum concrete cover of reinforcement shall be as follows:

1. Concrete cast against and permanently exposed to earth: 3-in

2. Concrete exposed to soil, water, sewage, sludge and/or weather: 2-in (including bottom cover of slabs over water or sewage)

3. Concrete not exposed to soil, water, sewage, sludge and/or weather:
   a. Slabs (top and bottom cover), walls, joists, shells and folded plate members - 1-in
   b. Beams and columns (principal reinforcement, ties, spirals and stirrups) - 1-1/2-in

C. Reinforcement which will be exposed for a considerable length of time after being placed shall be coated with a heavy coat of neat cement slurry.

D. No reinforcing steel bars shall be welded either during fabrication or erection unless specifically shown on the Drawings or specified herein, or unless prior written approval has been obtained from the Engineer. All bars that have been welded, including tack welds, without such approval shall be immediately removed from the work. When welding of reinforcement is approved or called for, it shall comply with AWS D1.4.

E. Reinforcing steel interfering with the location of other reinforcing steel, conduits or embedded items may be moved within the specified tolerances or one bar diameter, whichever is greater.

Greater displacement of bars to avoid interference shall only be made with the approval of the Engineer. Do not cut reinforcement to install inserts, conduits, mechanical openings or other items without the prior approval of the Engineer.

F. Securely support and tie reinforcing steel to prevent movement during concrete placement. Secure dowels in place before placing concrete.

G. Reinforcing steel bars shall not be field bent except where shown on the Drawings or specifically authorized in writing by the Engineer. If authorized, bars shall be cold bent around the standard diameter spool specified in the CRSI. Do not heat bars. Closely inspect the reinforcing steel for breaks. If the reinforcing steel is damaged, replace, Cadweld or otherwise repair as directed by the Engineer. Do not bend reinforcement after it is embedded in concrete unless specifically shown otherwise on the Drawings.

3.02 REINFORCEMENT AROUND OPENINGS

A. Unless specific additional reinforcement around openings is shown on the Drawings, provide additional reinforcing steel on each side of the opening equivalent to one half of the cross sectional area of the reinforcing steel interrupted by an opening. The bars shall have sufficient length to develop bond at each end beyond the opening or penetration.

3.03 SPLICING OF REINFORCEMENT

A. Lap splices shall be provided as shown on the Drawings. For lap splices not shown, request clarification from the Engineer. (In general, lap splices will be required to be Class B tension lap splices in accordance with ACI 318.

B. Splices in Circumferential Reinforcement in Circular Walls: Provide Class B tension lap splices and stagger as indicated.

C. Splicing of reinforcing steel in concrete elements noted to be "tension members" on the Drawings shall be avoided whenever possible. However, if required for constructability, splices in the reinforcement subject to direct tension shall be welded to develop, in tension, at least 125 percent of the specified yield strength of the bar. Splices in adjacent bars shall be offset the distance of a Class B splice.

D. Install wire fabric in as long lengths as practicable. Wire fabric from rolls shall be rolled flat and firmly held in place. Splices in welded wire fabric shall be lapped in accordance with the requirements of ACI 318 but not less than 12-in. The spliced fabrics shall be tied together with wire ties spaced not more than 24-in on center and laced with wire of the same diameter as the welded wire fabric. Do not position laps midway between supporting beams, or directly over beams of continuous structures. Offset splices in adjacent widths to prevent continuous splices.

E. Mechanical reinforcing steel splices shall be used only where shown on the Drawings. Splices in adjacent bars shall be offset by at least 30 bar diameters. Mechanical reinforcing splices are only to be used for special splice and dowel conditions approved by the Engineer.

F. After installation of mechanical splices coating damage shall be repaired in accordance with the applicable ASTM standard. All parts of mechanical connectors used on coated bars including steel splice sleeves, bolts and/or nuts shall be coated with the same material used for the repair of coating damage.

3.04 ACCESSORIES

A. Determine, provide and install accessories such as chairs, chair bars and the like in sufficient quantities and strength to adequately support the reinforcement and prevent its displacement during the erection of the reinforcement and the placement of concrete.

B. Use precast concrete blocks where the reinforcing steel is to be supported over soil.

C. Stainless steel bar supports or steel chairs with stainless steel tips shall be used where the chairs are set on forms for a concrete surface that will be exposed to weather, high humidity, or liquid (including bottom of slabs over liquid containing areas). Use of galvanized or plastic tipped metal chairs is permissible in all other locations unless otherwise noted on the Drawings or specified herein.

D. Alternate methods of supporting top steel in slabs, such as steel channels supported on the bottom steel or vertical reinforcing steel fastened to the bottom and top mats, may be used if approved by the Engineer.

3.05 INSPECTION

A. In no case shall any reinforcing steel be covered with concrete until the installation of the reinforcement, including the size, spacing and position of the reinforcement has been observed by the Engineer and the Engineer's release to proceed with the concreting has been obtained. The Engineer shall be given ample prior notice of the readiness of placed reinforcement for observation. The forms shall be kept open until the Engineer has finished his/her observations of the reinforcing steel.

END OF SECTION

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SECTION 03250
CONCRETE JOINTS AND JOINT ACCESSORIES

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals required and install accessories for concrete joints as shown on the Drawings and as specified herein.

1.02 MEASUREMENT AND PAYMENT

A. No separate payment will be made for work performed under this Section. Include the cost for this work in the lump sum Base Bid Item in Section 00410.

1.03 RELATED WORK

A. Concrete Formwork is included in Section 03100.

B. Concrete Reinforcement is included in Section 03200.

C. Cast-In-Place Concrete is included in Section 03300.

D. Concrete Finishes are included in Section 03350.

E. Grout is included in Section 03600.

F. Modifications to Existing Concrete are included in Section 03740.

G. Miscellaneous Metals are included in Section 05580.

1.04 SUBMITTALS

A. Submit, in accordance with Section 01330, shop drawings and product data. Submittals shall include the following:

1. Premolded joint fillers: Product data including catalogue cut, technical data, storage requirements, installation requirements, location of use and conformity to ASTM standards.

2. Bond breaker: Product data including catalogue cut, technical data, storage requirements, installation requirements, location of use and conformity to ASTM standards.

3. Compressible joint filler: Product data including catalogue cut, technical data, storage requirements, installation requirements, location of use and conformity to ASTM standards.

4. Bonding agents: Product data including catalogue cut, technical data, storage requirements, product life, application requirements and conformity to ASTM standards.

B. Certifications

1. Certify that all materials used within the joint system are compatible with each other.

2. Certify that materials used in the construction of joints are suitable for use in contact with potable water 30 days after installation.

1.05 REFERENCE STANDARDS

A. American Society for Testing and Materials (ASTM)

1. ASTM A675 - Standard Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality, Mechanical Properties.

2. ASTM C881 - Standard Specification for Epoxy Resin Base Bonding Systems for Concrete.

3. ASTM C1059 - Standard Specification for Latex Agents for Bonding Fresh to Hardened Concrete.

4. ASTM D1751 - Standard Specification for Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction. (Non-extruding and Resilient Bituminous Types).

5. ASTM D1752 - Standard Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.

B. Federal Specifications

1. FS SS-S-210A - Sealing Compound for Expansion Joints.

C. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply unless otherwise noted.

PART 2 PRODUCTS

2.01 GENERAL

A. The use of manufacturer's name and model or catalog number is for the purpose of establishing the standard of quality and general configuration desired.

B. All materials used together in a given joint (bond breakers, backer rods, joint fillers, sealants, etc) shall be compatible with one another. Coordinate selection of suppliers and products to ensure compatibility. Under no circumstances shall asphaltic or bituminous bond breakers or joint fillers be used in joints receiving sealant.

2.02 MATERIALS

A. Premolded Joint Filler

1. Premolded joint filler - structures. Self expanding cork, premolded joint filler shall conform to ASTM D1752, Type III. The thickness shall be 3/4 in unless shown otherwise on the Drawings.

2. Premolded joint filler - sidewalk and roadway concrete pavements or where fiber joint filler is specifically noted on the Drawings. The joint filler shall be asphalt impregnated fiber board conforming to ASTM D1751. Thickness shall be 3/4 in unless otherwise shown on the Drawings. Fiber joint filler shall be sealed with a joint sealant where recommended by the joint filler manufacturer.

B. Bond Breaker

1. Bond breaker tape shall be an adhesive backed glazed butyl or polyethylene tape which will satisfactorily adhere to the premolded joint filler or concrete surface as required. The tape shall be the same width as the joint unless otherwise noted.

2. Except where tape is specifically called for on the drawings, bond breaker for concrete shall be either bond breaker tape or a non-staining type bond prevention coating such as Williams Tilt up Compound by Williams Distributors Inc.; Silcoseal 2000F, by SCA Construction Supply Division, Superior Concrete Accessories or equal.

C. Bonding Agent

1. Epoxy bonding agent shall be a two component, solvent free, moisture insensitive, epoxy resin material conforming to ASTM C881, Type V. The bonding agent shall be Sikadur 32 Hi Mod by Sika Corporation of Lyndhurst, N.J.; Concresive Liquid (LPL) by Master Builders of Cleveland, OH or equal.

2. Latex bonding agent shall be a non reemulsifiable acrylic polymer latex conforming to ASTM C1059, Type II.

D. Compressible Joint Filler

1. The joint filler shall be a non extruded watertight strip material use to fill expansion joints between structures. The material shall be capable of being compressed at least 40 percent for 70 hours at 68 degrees F and subsequently recovering at least 20 percent of its original thickness in the first 1/2 hour after unloading. Compressible Joint filler shall be Evazote 380 E.S.P, by E Poxy Industries, Inc., Ravena, NY or equal.

PART 3 EXECUTION

3.01 INSTALLATION

A. Construction Joints

1. Make construction joints only at locations shown on the Drawings or as approved by the Engineer. Any additional or relocation of construction joints proposed by the Contractor, must be submitted to the Engineer for written approval.

2. Additional or relocated joints should be located where they least impair strength of the member. In general, locate joints within the middle third of spans of slabs, beams and girders. However, if a beam intersects a girder at the joint, offset the joint a distance equal to twice the width of the member being connected. Locate joints in walls and columns at the underside of floors, slabs, beams or girders and at tops of footings or floor slabs. Do not locate joints between beams, girders, column capitals, or drop panels and the slabs above them. Do not locate joints between brackets or haunches and walls or columns supporting them.

3. All joints shall be perpendicular to main reinforcement. Continue reinforcing steel through the joint as indicated on the Drawings. When joints in beams are allowed, provide a shear key and inclined dowels as approved by the Engineer.

4. Provide sealant grooves for joint sealant where indicated on the Drawings.

5. At all construction joints and at concrete joints designated on the Drawings to be "roughened", uniformly roughen the surface of the concrete to a full amplitude (distance between high and low points or side to side) of approximately 1/4 in to expose a fresh face. Thoroughly clean joint surfaces of loose or weakened materials by waterblasting and prepare for bonding. At least 2 hours before and again shortly before the new concrete is deposited, the joints and adjacent concrete surfaces to at least 12-in past the joint shall be saturated with water. After glistening water disappears, horizontal construction joints shall be given a thorough coating of neat cement slurry mixed to the consistency of very heavy paste. The surfaces shall receive a coating at least 1/8 in thick, well scrubbed in by means of stiff bristle brushes whenever possible. Horizontal wall joints with no access to the earlier concrete placement surface shall have the roughened surface thoroughly coated with a neat, cement slurry of pouring consistency. New concrete shall be deposited before the neat cement dries.

6. In lieu of the above method for bonding plastic concrete to hardened concrete, the following optional method may be used. Concrete must be allowed to set a minimum of 28 days. Use an epoxy bonding agent applied to roughened and cleaned surfaces of set concrete in strict accordance with manufacturer's recommendations.

7. Keyways shall not be used in construction joints unless specifically shown on the Drawings or approved by the Engineer.

END OF SECTION

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SECTION 03300
CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor and materials required and install cast in place concrete complete as shown on the Drawings and as specified herein.

B. Furnish all sampling and testing as required for qualification of proposed materials and establishment of design mixtures by a qualified testing laboratory acceptable to the Engineer and engaged by and at the expense of the Contractor.

1.02 MEASUREMENT AND PAYMENT

A. No separate payment will be made for work performed under this Section. Include the cost for this work in the lump sum Base Bid Item in Section 00410.

B. Include price for Extra Unit Work as described herein in the Extra Unit Price Schedule.

1.03 RELATED WORK

A. Concrete Formwork is included in Section 03100.

B. Concrete Reinforcement is included in Section 03200.

C. Concrete Joints and Joint Accessories are included in Section 03250.

D. Concrete Finishes are included in Section 03350.

E. Grout is included in Section 03600.

F. Modifications to Existing Concrete are included in Section 03740.

1.04 SUBMITTALS

A. Submit, in accordance with Section 01330, shop drawings and product data including the following:

1. Sources of cement, pozzolan, and aggregates.

2. Material Safety Data Sheets (MSDS) for all concrete components and admixtures.

3. Air entraining admixture. Product data including catalogue cut, technical data, storage requirements, product life, recommended dosage, temperature considerations, field testing methods and conformity to ASTM standards.

4. Water-reducing admixture. Product data including catalogue cut, technical data, storage requirements, product life, recommended dosage, temperature considerations and conformity to ASTM standards.

5. High-range water reducing admixture (plasticizer). Product data including catalogue cut, technical data, storage requirements, product life, recommended dosage, temperature considerations, retarding effect, slump range and conformity to ASTM standards. Identify proposed locations of use.

6. Concrete mix for each formulation of concrete proposed for use including constituent quantities per cubic yard, water-cementitious materials ratio, concrete slump, type and manufacturer of cement. Provide either a. or b. below for each mix proposed.
   a. Compression test results for proposed mixes. Include standard deviation data for each proposed concrete mix based on statistical records where applicable.
   b. Curve of water-cementitious materials ratio versus concrete cylinder strength for each formulation of concrete proposed based on laboratory tests. The cylinder strength shall be the average of the 28 day cylinder strength test results for each mix. Provide results of 7 and 14 day tests if available.

7. Sheet curing material. Product data including catalogue cut, technical data and conformity to ASTM standard.

8. Liquid curing compound. Product data including catalogue cut, technical data, storage requirements, product life, application rate and conformity to ASTM standards. Identify proposed locations of use.

B. Samples

1. Fine and coarse aggregates if requested by the Engineer.

C. Test Reports

1. Fine aggregates - Conformity with ASTM standards, including sieve analysis, physical properties, and deleterious substance.

2. Coarse aggregates - Conformity with ASTM standards, including sieve analysis, physical properties, and deleterious substances.

3. Cements - Conformity with ASTM standards, including chemical analysis and physical properties for each type.

4. Pozzolans - Conformity with ASTM standards, including chemical analysis and physical properties.

5. Proposed concrete mixes - compressive strength, slump, shrinkage, water-soluble chloride ion content, and air content.

D. Certifications

1. Certify admixtures used in the same concrete mix are compatible with each other and the aggregates.

2. Certify admixtures are suitable for use in contact with potable water after 30 days of concrete curing.

3. Certify curing compound is suitable for use in contact with potable water after 30 days (non toxic and free of taste or odor).

1.05 REFERENCE STANDARDS

A. American Society for Testing and Materials (ASTM)

1. ASTM C31 - Standard Practice for Making and Curing Concrete Test Specimens in the Field.

2. ASTM C33 - Standard Specification for Concrete Aggregates.

3. ASTM C39 - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.

4. ASTM C42 - Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.

5. ASTM C94 - Standard Specification for Ready Mixed Concrete.

6. ASTM C143 - Standard Test Method for Slump of Hydraulic Cement Concrete

7. ASTM C150 - Standard Specification for Portland Cement

8. ASTM C156 - Standard Test Method for Water Retention by Concrete Curing Materials

9. ASTM C171 - Standard Specification for Sheet Materials for Curing Concrete

10. ASTM C173 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.

11. ASTM C231 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.

12. ASTM C260 - Standard Specification for Air Entraining Admixtures for Concrete.

13. ASTM C309 - Standard Specification for Liquid Membrane Forming Compounds for Curing Concrete.

14. ASTM C494 - Standard Specification for Chemical Admixtures for Concrete.

15. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete.

16. ASTM C1017 - Standard Specification for Chemical Admixtures for use in Producing Flowing Concrete.

17. ASTM C1218 - Standard Test Method for Water-Soluble Chloride in Mortar and Concrete.

B. American Concrete Institute (ACI).

1. ACI 304R - Guide for Measuring, Mixing, Transporting and Placing Concrete.

2. ACI 305R - Hot Weather Concreting.

3. ACI 306.1 - Standard Specification for Cold Weather Concreting.

4. ACI 318 – Building Code Requirements for Structural Concrete.

C. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.06 QUALITY ASSURANCE

A. Reinforced concrete shall comply with ACI 318 and other stated requirements, codes and standards. The most stringent requirement of the codes, standards and this Section shall apply when conflicts exist.

B. Only one source of cement and aggregates shall be used on any one structure. Concrete shall be uniform in color and appearance.

C. Well in advance of placing concrete, discuss with the Engineer the sources of individual materials and batched concrete proposed for use. Discuss placement methods, waterstops and curing. Propose methods of hot and cold weather concreting as required. Prior to the placement of any concrete containing a high-range water-reducing admixture plasticizer, the Contractor, accompanied by the plasticizer manufacturer, shall discuss the properties and techniques of batching and placing plasticized concrete.

D. If, during the progress of the work, it is impossible to secure concrete of the required workability and strength with the materials being furnished, the Engineer may order such changes in proportions or materials, or both, as may be necessary to secure the desired properties. All changes so ordered shall be made at the Contractor's expense.

E. If, during the progress of the work, the materials from the sources originally accepted change in characteristics, the Contractor shall, at his/her expense, make new acceptance tests of aggregates and establish new design mixes.

F. Testing of the following materials shall be furnished by Contractor to verify conformity with this Specification Section and the stated ASTM Standards.

1. Fine aggregates for conformity with ASTM C33 - sieve analysis, physical properties, and deleterious substances.

2. Coarse aggregates for conformity with ASTM C33 - sieve analysis, physical properties, and deleterious substances.

3. Cements for conformity with ASTM C150 - chemical analysis and physical properties.

4. Pozzolans for conformity with ASTM C618 - chemical analysis and physical properties.

G. Field testing and inspection services will be provided by the Owner. The cost of such work, except as specifically stated otherwise, will be paid by the Owner. Testing of the following items will be by the Owner to verify conformity with this Section.

1. Concrete placements - compressive strength (cylinders), compressive strength (cores), slump, and air content.

2. Other materials that may require field testing.

H. All materials incorporated in the work shall conform to accepted samples.

1.07 DELIVERY, STORAGE AND HANDLING

A. Cement: Store in weathertight buildings, bins or silos to provide protection from dampness and contamination and to minimize warehouse set.

B. Aggregate: Arrange and use stockpiles to avoid excessive segregation or contamination with other materials or with other sizes of like aggregates. Build stockpiles in successive horizontal layers not exceeding 3-ft in thickness. Complete each layer before the next is started. Do not use frozen or partially frozen aggregate.

C. Sand: Arrange and use stockpiles to avoid contamination. Allow sand to drain to a uniform moisture content before using. Do not use frozen or partially frozen aggregates.

D. Admixtures: Store in closed containers to avoid contamination, evaporation or damage. Provide suitable agitating equipment to assure uniform dispersion of ingredients in admixture solutions which tend to separate. Protect liquid admixtures from freezing and other temperature changes which could adversely affect their characteristics.

E. Pozzolan: Store in weathertight buildings, bins or silos to provide protection from dampness and contamination.

F. Sheet Curing Materials: Store in weathertight buildings or off the ground and under cover.

G. Liquid Curing Compounds: Store in closed containers.

PART 2 PRODUCTS

2.01 GENERAL

A. The use of manufacturer's name and model or catalog number is for the purpose of establishing the standard of quality and general configuration desired.

B. Like items of materials shall be the end products of one manufacturer in order to provide standardization for appearance, maintenance and manufacturer's service.

2.02 MATERIALS

A. Materials shall comply with this Section and applicable State or local requirements.

B. Cement: Domestic portland cement complying with ASTM C150. Air entraining cements shall not be used. Cement brand shall be subject to approval by the Engineer and one brand shall be used throughout the Work. Cement type(s) shall be one of the following:

1. Class A, B, or D Concrete - Type I, or Type III

C. Fine Aggregate: Washed inert natural sand conforming to the requirements of ASTM C33.

D. Coarse Aggregate: Well graded crushed stone or washed gravel conforming to the requirements of ASTM C33. Size numbers for the concrete mixes shall be as shown in Table 1 herein. Grading requirements shall be as listed in ASTM C33 for the specified coarse aggregate size number. Limits of Deleterious Substances and Physical Property Requirements shall be as listed in ASTM C33 for severe weathering regions. Coarse aggregates known to be deleteriously reactive with alkalis in cement shall not be used.

E. Water: Potable water free from injurious amounts of oils, acids, alkalis, salts, organic matter, or other deleterious substances.

F. Admixtures: Admixtures shall be free of chlorides and alkalis (except for those attributable to water). Each admixture shall be compatible with all of the components in the concrete mix and shall be suitable when it is required to use more than one admixture in a concrete mix, the admixtures shall be from the same manufacturer. Admixtures shall be compatible with the concrete mix including other admixtures and shall be suitable for use in contact with potable water after 30 days of concrete curing.

1. Air-Entraining Admixture: The admixture shall comply with ASTM C260. Proportioning and mixing shall be in accordance with manufacturer's recommendations.

2. Water-Reducing Agent: The admixture shall comply with ASTM C494, Type A. Proportioning and mixing shall be in accordance with manufacturer's recommendations.

3. High Range Water-Reducer (Plasticizer): The admixture shall comply with ASTM C494, Type F and shall result in non segregating plasticized concrete with little bleeding and with the physical properties of low water/cement ratio concrete. The treated concrete shall be

capable of maintaining its plastic state in excess of 2 hours. Proportioning and mixing shall be in accordance with manufacturer's recommendations.

4. Admixtures causing retarded or accelerated setting of concrete shall not be used without written approval from the Engineer. When allowed, the admixtures shall be retarding or accelerating water reducing or high range water reducing admixtures.

G. Pozzolan (Fly Ash) Pozzolan shall be Class F fly ash complying with ASTM C618 except the Loss on Ignition (LOI) shall be limited to 3 percent maximum.

H. Sheet Curing Materials. Waterproof paper, polyethylene film or white burlap polyethylene sheeting all complying with ASTM C171.

I. Liquid Curing Compound. Liquid membrane forming curing compound shall comply with the requirements of ASTM C309, Type 1 D (clear or translucent with fugitive dye) and shall contain no wax, paraffin, or oil. Curing compounds shall have a minimum of 18 percent solids, be non-yellowing and have a unit moisture loss no greater than 0.039 gm/cm^2 at 72 hours as measured by ASTM C156.

2.03 MIXES

A. Development of mix designs and testing shall be by a qualified testing laboratory acceptable to the Engineer engaged by and at the expense of the Contractor.

B. Select proportions of ingredients to meet the design strength and materials limits specified in Table 1 and to produce concrete having proper placability, durability, strength, appearance and other required properties. Proportion ingredients to produce a homogenous mixture which will readily work into corners and angles of forms and around reinforcement without permitting materials to segregate or allowing excessive free water to collect on the surface.

C. The design mix shall be based on one of the following:

1. Standard deviation data of prior mixes with essentially the same proportions of the same constituents in accordance with ACI 318. Acceptance of mixes based on standard deviation shall be based on the modification factors for standard deviation tests contained in ACI 318.

2. Trial mixtures developed by the design mix shall be based on standard deviation data of prior mixes with essentially the same proportions of the same constituents or, if such data is not available, be developed by a testing laboratory, acceptable to the Engineer, engaged by and at the expense of the Contractor. The water content of the concrete mix, determined by laboratory testing, shall be based on a curve showing the relation between water cementitious ratio and 7 and 28 day compressive strengths of concrete made using the proposed materials. The curves shall be determined by four or more points, each representing an average value of at least three test specimens at each age. The curves shall have a range of values sufficient to yield the desired data, including the specified design strengths as modified below, without extrapolation. The water content of the concrete mixes to be used, as determined from the curve, shall correspond to strengths 16 percent

greater than the specified design strengths. The resulting mix shall not conflict with the limiting values for maximum water cementitious ratio and net minimum cementitious content as specified in Table 1.

D. Compression Tests: Provide testing of the proposed concrete mix or mixes to demonstrate compliance with the specified design strength requirements in conformity with the above paragraph.

E. Entrained air, as measured by ASTM C231, shall be as shown in Table 1.

1. If the air-entraining agent proposed for use in the mix requires testing methods other than ASTM C231 to accurately determine air content, make special note of this requirement in the admixture submittal.

F. Slump of the concrete as measured by ASTM C143, shall be as shown in Table 1. If a high-range water-reducer (plasticizer) is used, the slump indicated shall be that measured before plasticizer is added. Plasticized concrete shall have a slump ranging from 7 to 10-in.

G. Proportion admixtures according to the manufacturer's recommendations. Two or more admixtures specified may be used in the same mix provided that the admixtures in combination retain full efficiency and have no deleterious effect on the concrete or on the properties of each other.

H. Where fly ash is included in the mix, the fly ash content shall be no less than 15 percent nor more than 25 percent of the total cement plus pozzolan content, by weight.

I. Where Type III cement is approved for use, the concrete shall conform to Table 1 except that the design strength shall be attained at 7 days.

TABLE 1
CONCRETE MIX REQUIREMENTS

Class	Design Strength(1)	Coarse Aggregate(2)	Cementitious Content(3)			
A	2500	57	440 min.			
B	3000	57	480 min.			
D	4000	57	560 min.			
Class	W/C Ratio(4)	Fly Ash	AE Range(5)	WR(6)	HRWR(7)	Slump Range Inches
A	0.62 max.	--	4.5 to 7.5	Yes	No	1-4
B	0.54 max.	--	4.5 to 7.5	Yes	No	1-3
D	0.44 max.	--	4.5 to 7.5	Yes	No	3-5

NOTES:
(1) Minimum compressive strength in psi at 28 days
(2) Size Number in ASTM C33
(3) Cementitious content in lbs/cu yd.
(4) W/C is Water-Cementitious ratio by weight
(5) AE is percent air-entrainment
(6) WR is water-reducer admixture
(7) HRWR is high-range water-reducer admixture

PART 3 EXECUTION

3.01 GENERAL

A. It is the intent of this Section to require quality work including adequate forming, proper mixture and placement of concrete and curing so completed concrete surfaces will require no patching.

B. Position embedded anchor bolts using templates.

C. Unless otherwise shown or approved, conduits and pipes embedded within a slab, wall, or beam (other than those merely passing thru) shall satisfy the following:

1. Maximum outside dimension shall be no greater than one third the overall thickness of slab, wall, or beam.

2. Spacing shall be greater than or equal to three diameters or widths on center.

D. Ensure that all aluminum embedments are effectively coated or isolated to prevent aluminum-concrete reaction or electrolytic action between aluminum and steel."

3.02 MEASURING MATERIALS

A. Concrete shall be composed of portland cement, pozzolan, fine aggregate, coarse aggregate, water and admixtures as specified and shall be produced by a concrete mixing plant acceptable to the Engineer. All constituents, including admixtures, shall be batched at the plant.

B. Measure materials for batching concrete by weighing in conformity with and within the tolerances given in ASTM C94 except as otherwise specified. Scales shall have been certified by the local Sealer of Weights and Measures within 1 year of use.

C. Measure the amount of free water in fine aggregates within 0.3 percent with a moisture meter. Compensate for varying moisture contents of fine aggregates. Record the number of gallons of water as batched on printed batching tickets.

D. Admixtures shall be dispensed either manually using calibrated containers or measuring tanks, or by means of an automatic dispenser approved by the manufacturer of the specific admixture.

1. Charge air entraining and chemical admixtures into the mixer as a solution using an automatic dispenser or similar metering device.

2. Inject multiple admixtures separately during the batching sequence.

3.03 MIXING AND TRANSPORTING

A. Concrete shall be ready mixed concrete produced by equipment acceptable to the Engineer. No hand mixing will be permitted. Clean each transit mix truck drum and reverse drum rotation before the truck proceeds under the batching plant. Equip each transit mix truck with a

continuous, nonreversible, revolution counter showing the number of revolutions at mixing speeds.

B. Ready mix concrete shall be transported to the site in watertight agitator or mixer trucks loaded not in excess of their rated capacities as stated on the name plate.

C. Keep the water tank valve on each transit truck locked at all times. Any addition of water must be directed by the Engineer. Added water shall be incorporated by additional mixing of at least 35 revolutions. All added water shall be metered and the amount of water added shall be shown on each delivery ticket.

D. All central plant and rolling stock equipment and methods shall comply with ACI 318 and ASTM C94.

E. Select equipment of size and design to ensure continuous flow of concrete at the delivery end. Metal or metal lined non aluminum discharge chutes shall be used and shall have slopes not exceeding 1 vertical to 2 horizontal and not less than 1 vertical to 3 horizontal. Chutes more than 20-ft long and chutes not meeting slope requirements may be used if concrete is discharged into a hopper before distribution.

F. Retempering (mixing with or without additional cement, aggregate, or water) of concrete or mortar which has reached initial set will not be permitted.

G. Handle concrete from mixer to placement as quickly as practicable while providing concrete of required quality in the placement area. Dispatch trucks from the batching plant so they arrive at the work site just before the concrete is required, thus avoiding excessive mixing of concrete while waiting or delays in placing successive layers of concrete in the forms.

H. Furnish a delivery ticket for ready mixed concrete to the Engineer as each truck arrives. Each ticket shall provide a printed record of the weight of cement and each aggregate as batched individually. Use the type of indicator that returns for zero punch or returns to zero after a batch is discharged. Clearly indicate the weight of fine and coarse aggregate, cement and water in each batch, the quantity delivered, the time any water is added, and the numerical sequence of the delivery. Show the time of day batched and time of discharge from the truck. Indicate the number of revolutions of the truck mixer.

I. Temperature and Mixing Time Control

1. In cold weather, do not allow the as mixed temperature of the concrete and concrete temperatures at the time of placement in the forms to drop below 40 degrees F.

2. If water or aggregate has been heated, combine water with aggregate in the mixer before cement is added. Do not add cement to mixtures of water and aggregate when the temperature of the mixture is greater than 90 degrees F.

3. In hot weather, cool ingredients before mixing to maintain temperature of the concrete below the maximum placing temperature of 90 degrees F. If necessary, substitute well crushed ice for all or part of the mixing water.

4. The maximum time interval between the addition of mixing water and/or cement to the batch and the placing of concrete in the forms with concrete agitated shall not exceed the values shown in Table 2.

TABLE 2

MAXIMUM TIME TO DISCHARGE OF CONCRETE

Air or Concrete Temperature (whichever is higher)	Maximum Time
80 to 90 Degree F (27 to 32 Degree C)	45 minutes
70 to 79 Degree F (21 to 26 Degree C)	60 minutes
40 to 69 Degree F (5 to 20 Degree C)	90 minutes

If an approved high-range water-reducer (plasticizer) is used to produce plasticized concrete, the maximum time interval shall not exceed 90 minutes.

3.04 PLACING AND COMPACTING

A. Placing

1. Verify that all formwork completely encloses concrete to be placed and is securely braced prior to concrete placement. Remove ice, excess water, dirt and other foreign materials from forms and exposed concrete joints. Voids in sleeves, inserts, etc, shall be filled temporarily with readily removable material to prevent entry of concrete. Confirm that reinforcement and other embedded items are securely in place. Have a competent workman at the location of the placement who can assure that reinforcing steel and embedded items remain in designated locations while concrete is being placed. Sprinkle semi porous subgrades or forms to eliminate suction of water from the mix. Seal extremely porous subgrades in an approved manner.

2. Deposit concrete as near its final position as possible to avoid segregation due to rehandling or flowing. Place concrete continuously at a rate which ensures the concrete is being integrated with fresh plastic concrete. Do not deposit concrete which has partially hardened or has been contaminated by foreign materials or on concrete which has hardened sufficiently to cause formation of seams or planes of weakness within the section. If the section cannot be placed continuously, place construction joints as specified or as approved.

3. Pumping of concrete will be permitted. Use a mix design and aggregate sizes suitable for pumping and submit for approval.

4. Remove temporary spreaders from forms when the spreader is no longer useful. Temporary spreaders may remain embedded in concrete only when made of galvanized metal or concrete and if prior approval has been obtained.

5. Do not place concrete for supported elements until concrete previously placed in the supporting element (columns, slabs and/or walls) has reached adequate strength.

6. Where surface mortar is to form the base of a finish, especially surfaces designated to be painted, work coarse aggregate back from forms with a suitable tool to bring the full surface of the mortar against the form. Prevent the formation of excessive surface voids.

7. Slabs
   a. After suitable bulkheads, screeds and jointing materials have been positioned, the concrete shall be placed continuously between construction joints beginning at a bulkhead, edge form, or corner. Each batch shall be placed into the edge of the previously placed concrete to avoid stone pockets and segregation.
   b. Avoid delays in casting. If there is a delay in casting, the concrete placed after the delay shall be thoroughly spaded and consolidated at the edge of that previously placed to avoid cold joints. Concrete shall then be brought to correct level and struck off with a straightedge. Bullfloats or darbies shall be used to smooth the surface, leaving it free of humps or hollows.
   c. Where slabs are to be placed integrally with the walls below them, place the walls and compact as specified. Allow 1 hour to pass between placement of the wall and the overlying slab to permit consolidation of the wall concrete. Keep the top surface of the wall moist so as to prevent cold joints.

8. Formed Concrete
   a. Place concrete in forms using tremie tubes and taking care to prevent segregation. Bottom of tremie tubes shall preferably be in contact with the concrete already placed. Do not permit concrete to drop freely more than 4-ft. Place concrete for walls in 12 to 24-in lifts, keeping the surface horizontal. If plasticized concrete is used, the maximum lift thickness may be increased to 7-ft and the maximum free fall of concrete shall not exceed 15-ft.
   b. A minimum of 48 hours shall have elapsed between casting of adjacent wall sections at a vertical construction joint

B. Compacting

1. Consolidate concrete by vibration, puddling, spading, rodding or forking so that concrete is thoroughly worked around reinforcement, embedded items and openings and into corners of forms. Puddling, spading, etc, shall be continuously performed along with vibration of the placement to eliminate air or stone pockets which may cause honeycombing, pitting or planes of weakness.

2. All concrete shall be placed and compacted with mechanical vibrators. The number, type and size of the units shall be approved by the Engineer in advance of placing operations. No concrete shall be ordered until sufficient approved vibrators (including standby units in working order) are on the job.

3. A minimum frequency of 8000 rpm is required for mechanical vibrators. Insert vibrators and withdraw at points from 18 to 30-in apart. At each insertion, vibrate sufficiently to

consolidate concrete, generally from 5 to 15 seconds. Do not over vibrate so as to segregate. Keep a spare vibrator on the site during concrete placing operations.

4. Concrete Slabs: Concrete for slabs less than 8 in thick shall be consolidated with vibrating screeds; slabs 8 to 12 in thick shall be compacted with internal vibrators and (optionally) with vibrating screeds. Vibrators shall always be placed into concrete vertically and shall not be laid horizontally or laid over.

5. Walls and Columns: Internal vibrators (rather than form vibrators) shall be used unless otherwise approved by the Engineer. In general, for each vibrator needed to melt down the batch at the point of discharge, one or more additional vibrators must be used to densify, homogenize and perfect the surface. The vibrators shall be inserted vertically at regular intervals, through the fresh concrete and slightly into the previous lift, if any.

6. Amount of Vibration: Vibrators are to be used to consolidate properly placed concrete but shall not be used to move or transport concrete in the forms. Vibration shall continue until:
   a. Frequency returns to normal.
   b. Surface appears liquefied, flattened and glistening.
   c. Trapped air ceases to rise.
   d. Coarse aggregate has blended into surface, but has not disappeared.

3.05 CURING AND PROTECTION

A. Protect all concrete work against injury from the elements and defacements of any nature during construction operations.

B. Curing Methods

1. Curing Methods for Concrete Surfaces: Cure concrete to retain moisture and maintain specified temperature at the surface for a minimum of 7 days after placement. Curing methods to be used are as follows:
   a. Water Curing: Keep entire concrete surface wet by ponding, continuous sprinkling or covered with saturated burlap. Begin wet cure as soon as concrete attains an initial set and maintain wet cure 24 hours a day.
   b. Sheet Material Curing: Cover entire surface with sheet material. Securely anchor sheeting to prevent wind and air from lifting the sheeting or entrapping air under the sheet. Place and secure sheet as soon as initial concrete set occurs.
   c. Liquid Membrane Curing: Apply over the entire concrete surface except for surfaces to receive additional concrete. Curing compound shall NOT be placed on any concrete surface where additional concrete is to be placed, where concrete sealers or surface coatings are to be used, or where the concrete finish requires an integral floor product. Curing compound shall be applied as soon as the free water on the surface has disappeared and no water sheen is visible, but not after the concrete is dry or when the curing compound can be absorbed into the concrete. Application shall be in compliance with the manufacturer's recommendations.

2. Specified applications of curing methods.
   a. Slabs for Water Containment Structures and Chemical Spill Basins: Water curing only.
   b. Slabs on Grade and Footings (not used to contain water): Water curing, sheet material curing or liquid membrane curing.
   c. Structural Slabs (other than water containment): Water curing or liquid membrane curing.
   d. Horizontal Surfaces which will Receive Additional Concrete, Coatings, Grout or Other Material that Requires Bond to the substrate: Water curing.
   e. Formed Surfaces: None if nonabsorbent forms are left in place 7 days. Water cure if absorbent forms are used. Sheet cure or liquid membrane cure if forms are removed prior to 7 days. Exposed horizontal surfaces of formed walls or columns shall be water cured for 7 days or until next placement of concrete is made.
   f. Concrete Joints: Water cured or sheet material cured.

C. Finished surfaces and slabs shall be protected from the direct rays of the sun to prevent checking and crazing.

D. Cold Weather Concreting:

1. "Cold weather" is defined as a period when for more than 3 successive days, the average daily outdoor temperature drops below 40 degrees F. The average daily temperature shall be calculated as the average of the highest and the lowest temperature during the period from midnight to midnight.

2. Cold weather concreting shall conform to ACI 306.1 and the additional requirements specified herein. Temperatures at the concrete placement shall be recorded at 12 hour intervals (minimum).

3. Discuss a cold weather work plan with the Engineer. The discussion shall encompass the methods and procedures proposed for use during cold weather including the production, transportation, placement, protection, curing and temperature monitoring of the concrete. The procedures to be implemented upon abrupt changes in weather conditions or equipment failures shall also be discussed. Cold weather concreting shall not begin until the work plan is acceptable to the Engineer.

4. During periods of cold weather, concrete shall be protected to provide continuous warm, moist curing (with supplementary heat when required) for a total of at least 350 degree days of curing.
   a. Degree days are defined as the total number of 24 hour periods multiplied by the weighted average daily air temperature at the surface of the concrete (e.g.: 5 days at an average 70 degrees F = 350 degree days).
   b. To calculate the weighted average daily air temperature, sum hourly measurements of the air temperature in the shade at the surface of the concrete taking any measurement less than 50 degrees F as 0 degrees F. Divide the sum thus calculated by 24 to obtain the weighted average temperature for that day.

5. Salt, manure or other chemicals shall not be used for protection.

6. The protection period for concrete being water cured shall not be terminated during cold weather until at least 24 hours after water curing has been terminated.

E. Hot Weather Concreting

1. "Hot weather" is defined as any combination of high air temperatures, low relative humidity and wind velocity which produces a rate of evaporation estimated in accordance with ACI 305R, approaching or exceeding 0.2 lbs/sq ft/hr.

2. Concrete placed during hot weather, shall be batched, delivered, placed, cured and protected in compliance with the recommendations of ACI 305R and the additional requirements specified herein.
   a. Temperature of concrete being placed shall not exceed 90 degrees F and every effort shall be made to maintain a uniform concrete mix temperature below this level. The temperature of the concrete shall be such that it will cause no difficulties from loss of slump, flash set or cold joints.
   b. All necessary precautions shall be taken to promptly deliver, to promptly place the concrete upon its arrival at the site and to provide vibration immediately after placement.
   c. The Engineer may direct the Contractor to immediately cover plastic concrete with sheet material.

3. Discuss with the Engineer a work plan describing the methods and procedures proposed to use for concrete placement and curing during hot weather periods. Hot weather concreting shall not begin until the work plan is acceptable to the Engineer.

F. Do not apply unbalanced loads, such as hydrostatic pressure, [filter media], or backfill against structural components until the concrete has attained its design strength.

3.06 REMOVAL OF FORMS

A. Except as otherwise specifically authorized by the Engineer, forms shall not be removed before the concrete has attained a strength of at least 30 percent of its specified design strength, nor before reaching the following number of day degrees of curing (whichever is the longer):

TABLE 3

MINIMUM TIME TO FORM REMOVAL

Forms for	Degree Days
Beams and slabs	500
Walls and vertical surfaces	100

(See definition of degree days in Paragraph 3.05D above).

B. Shores shall not be removed until the concrete has attained at least 60 percent of its specified design strength and also sufficient strength to support safely its own weight and construction live loads.

3.07 INSPECTION AND FIELD TESTING

A. The batching, mixing, transporting, placing and curing of concrete shall be subject to the inspection by the Engineer at all times. The Contractor shall advise the Engineer of his/her readiness to proceed at least 24 hours prior to each concrete placement. The Engineer will inspect the preparations for concreting including the preparation of previously placed concrete, the reinforcing steel and the alignment, cleanliness and tightness of formwork. No placement shall be made without the inspection and acceptance of the Engineer.

B. Sets of field control cylinder specimens will be taken by the Engineer (or inspector) during the progress of the work, in compliance with ASTM C31. The number of sets of concrete test cylinders taken of each class of concrete placed each day shall not be less than one set per day, nor less than one set for each 150 cu yds of concrete nor less than one set for each 5,000 sq ft of surface area for slabs or walls.

1. A "set" of test cylinders consists of four cylinders: one to be tested at 7 days and two to be tested and their strengths averaged at 28 days. The fourth may be used for a special test at 3 days or to verify strength after 28 days if 28 day test results are low.

2. When the average 28 day compressive strength of the cylinders in any set falls below the specified design strength or below proportional minimum 7 day strengths (where proper relation between seven and 28 day strengths have been established by tests), proportions, water content, or temperature conditions shall be changed to achieve the required strengths.

C. Cooperate in the making of tests by allowing free access to the work for the selection of samples, providing an insulated closed curing box for specimens, affording protection to the specimens against injury or loss through the operations and furnish material and labor required for the purpose of taking concrete cylinder samples. All shipping of specimens will be paid for by the Owner. Curing boxes shall be acceptable to the Engineer.

D. Slump tests will be made in the field immediately prior to placing the concrete. Such tests will be made in accordance with ASTM C143. If the slump is outside the specified range, the concrete will be rejected.

E. Air Content: Test for air content will be made on fresh concrete samples. Air content for concrete made of ordinary aggregates having low absorption will be made in compliance with either the pressure method complying with ASTM C231 or by the volumetric method complying with ASTM C173. If lightweight aggregates or aggregates with high absorptions are used, the latter test method will be used.

F. The Engineer may have cores taken from any questionable area in the concrete work such as construction joints and other locations as required for determination of concrete quality. The results of tests on such cores shall be the basis for acceptance, rejection or determining the continuation of concrete work.

G. Cooperate in obtaining cores by allowing free access to the work and permitting the use of ladders, scaffolding and such incidental equipment as may be required. Repair all core holes. The work of cutting and testing the cores will be at the expense of the Owner.

3.08 FAILURE TO MEET REQUIREMENTS

A. Should the strengths shown by the test specimens made and tested in compliance with the previous provisions fall below the values given in Table 1, the Engineer shall have the right to require changes in proportions outlined to apply to the remainder of the work. Furthermore, the Engineer shall have the right to require additional curing on those portions of the structure represented by the test specimens which failed. The cost of such additional curing shall be at the Contractor's expense. In the event that such additional curing does not give the strength required, as evidenced by core and/or load tests, the Engineer shall have the right to require strengthening or replacement of those portions of the structure which fail to develop the required strength. The cost of all such core borings and/or load tests and any strengthening or concrete replacement required because strengths of test specimens are below that specified, shall be entirely at the expense of the Contractor. In such cases of failure to meet strength requirements the Contractor and Engineer shall confer to determine what adjustment, if any, can be made in compliance with Sections titled "Strength" and "Failure to Meet Strength Requirements" of ASTM C94. The "purchaser" referred to in ASTM C94 is the Contractor in this Section.

B. When the tests on control specimens of concrete fall below the specified strength, the Engineer will permit check tests for strengths to be made by means of typical cores drilled from the structure in compliance with ASTM C42 and C39. In the case of cores not indicating adequate strength, the Engineer, in addition to other recourses, may require, at the Contractor's expense, load tests on any one of the slabs, beams, piles, caps, and columns in which such concrete was used. Tests need not be made until concrete has aged 60 days.

C. Should the strength of test cylinders fall below 60 percent of the required minimum 28 day strength, the concrete shall be rejected and shall be removed and replaced.

3.09 PATCHING AND REPAIRS

A. Surface defects which do not impair the structural integrity shall be repaired as approved by the Engineer. Defective concrete and honeycombed areas as determined by the Engineer shall be replaced or repaired using methods specified in Section 03740.

B. As soon as the forms have been stripped and the concrete surfaces exposed, fins and other projections shall be removed; recesses left by the removal of form ties shall be filled; and surface defects which do not impair structural strength shall be repaired. Clean all exposed concrete surfaces and adjoining work stained by leakage of concrete, to approval of the Engineer.

C. Immediately after the forms have been stripped and before the concrete has changed color, carefully remove all fins and projections. Promptly fill holes upon stripping as follows: Moisten the hole with water, followed by a 1/16 in brush coat of neat cement slurry mixed to the consistency of a heavy paste. Immediately plug the hole with a 1 to 1.5 mixture of cement and concrete sand mixed slightly damp to the touch (just short of "balling"). Hammer the grout into the hole until dense, and an excess of paste appears on the surface in the form of a spiderweb. Trowel smooth with heavy pressure. Avoid burnishing.

D. When patching defects in exposed surfaces the same source of cement and sand as used in the parent concrete shall be employed. Adjust color if necessary by addition of proper amounts of white cement. Rub lightly with a fine Carborundum stone at an age of 1 to 5 days if necessary to bring the surface down with the parent concrete. Exercise care to avoid damaging or staining the virgin skin of the surrounding parent concrete. Wash thoroughly to remove all rubbed matter.

3.10 CONCRETE SCHEDULE

A. Concrete class and design strength shall be as shown on the Drawings and in accordance with the specifications.

B. The following (Table 4) are the general applications for the various concrete classes and design strengths:

TABLE 4
CONCRETE SCHEDULE

Class	Design Strength (psi)	Description
A	2500	Concrete Fill and duct encasement
B	3000	Where specified or noted
D	4000	Walls, slabs on grade, suspended slab and beam systems, columns, grade beams and all other structural concrete

END OF SECTION1

SECTION 03350
CONCRETE FINISHES

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals required and finish cast in place concrete surfaces as shown on the Drawings and as specified herein.

1.02 MEASUREMENT AND PAYMENT

A. No separate payment will be made for work performed under this Section. Include the cost for this work in the lump sum Base Bid Item in Section 00410.

1.03 RELATED WORK

A. Concrete Formwork is included in Section 03100.

B. Cast-In-Place Concrete is included in Section 03300.

C. Modifications to Existing Concrete are included in Section 03740.

D. Grout is included in Section 03600.

E. Painting, toppings and special surfaces are included in Division 9.

1.04 SUBMITTALS

A. Submit, in accordance with Section 01330, shop drawings and product data showing materials of construction and details of installation for:

1. Concrete sealer. Confirmation that the sealer is compatible with additionally applied coatings shall also be submitted.

2. Chemical hardener. Confirmation that the hardener is compatible with sealer shall also be submitted.

1.05 REFERENCE STANDARDS

A. American Society for Testing and Materials (ASTM)

1. ASTM C33 - Standard Specification for Concrete Aggregates.

B. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.06 QUALITY ASSURANCE

A. Finishes

1. For concrete which will receive additional applied finishes or materials, the surface finish specified is required for the proper application of the specified manufacturer's products. Where alternate products are approved for use, determine if changes in finishes are required and provide the proper finishes to receive these products.

2. Changes in finishes made to accommodate products different from those specified shall be performed at no additional cost to the Owner. Submit the proposed new finishes and their construction methods to the Engineer for approval.

B. Services of Manufacturer's Representative

1. Make available at no additional cost to the Owner, upon 72 hours notification, the services of a qualified field representative of the manufacturer of sealer or hardener to instruct the user on the proper application of the product under prevailing job conditions.

PART 2 PRODUCTS

2.01 MATERIALS

A. Chemical hardener shall be Lapidolith by Sonneborn; Hornolith by Tamms Industries; Penalith by W.R. Meadows or equal fluosilicate base material.

B. Concrete sealer shall be "Kure N Seal", by Sonneborn, Minneapolis, MN or equal acrylic sealer.

PART 3 EXECUTION

3.01 FORMED SURFACES

A. Forms shall not be removed before the requirements of Section 03300, have been satisfied.

B. Exercise care to prevent damaging edges or obliterating the lines of chamfers, rustications or corners when removing the forms or performing any other work adjacent thereto.

C. Prepare the exposed surface as specified in Section 03300.

D. Rough Form Finish

1. No additional finishing is required.

E. Rubbed Finish

1. While the wall is still damp apply a thin coat of medium consistency neat cement slurry by means of bristle brushes to provide a bonding coat within all pits, air holes or blemishes in the parent concrete. Avoid coating large areas with the slurry at one time.

2. Before the slurry has dried or changed color, apply a dry (almost crumbly) grout proportioned by volume and consisting of 1 part cement to 1 1/2 parts of clean masonry sand having a fineness modulus of approximately 2.3 and complying with the gradation requirements of ASTM C33 for such a material. Grout shall be uniformly applied by means of damp pads of coarse burlap approximately 6 in square used as a float. Scrub grout into the pits and air holes to provide a dense mortar in all imperfections.

3. Allow the mortar to partially harden for 1 or 2 hours depending upon the weather. If the air is hot and dry, keep the wall damp during this period using a fine, fog spray. When the grout has hardened sufficiently so it can be scraped from the surface with the edge of a steel trowel without damaging the grout in the small pits or holes, cut off all that can be removed with a trowel. (Note: Grout allowed to remain on the wall too long will harden and will be difficult to remove.)

4. Allow the surface to dry thoroughly and rub it vigorously with clean dry burlap to completely remove any dried grout. No visible film of grout shall remain after this rubbing. The entire cleaning operation for any area must be completed the day it is started. Do not leave grout on surfaces overnight. Allow sufficient time for grout to dry after it has been cutoff with the trowel so it can be wiped off clean with the burlap.

5. On the day following the repair of pits, air holes and blemishes, the walls shall again be wiped off clean with dry, used pieces of burlap containing old hardened mortar which will act as a mild abrasive. After this treatment, there shall be no built up film remaining on the parent surface. If, however, such a film is present, a fine abrasive stone shall be used to remove all such material without breaking through the surface film of the original concrete. Such scrubbing shall be light and sufficient only to remove excess material without changing the texture of the concrete.

6. A thorough wash down with stiff bristle brushes shall follow the final bagging or stoning operation. No extraneous materials shall remain on the surface of the wall. The wall shall be sprayed with a fine fog spray periodically to maintain a continually damp condition for at least 3 days after the application of the repair grout.

3.02 FLOORS AND SLABS

A. Floated Finish

1. Machine Floating
   a. Screed floors and slabs with straightedges to the established grades shown on the Drawings. Immediately after final screeding, a dry cement/sand shake in the proportion of two sacks of portland cement to 350 lbs of coarse natural concrete sand

shall be sprinkled evenly over the surface at the rate of approximately 500 lbs /1,000 sq ft of floor. Do not sprinkle neat, dry cement on the surface.

b. The application of the cement/sand shake may be eliminated at the discretion of the Engineer if the base slab concrete exhibits adequate fattiness and homogeneity and the need is not indicated. When the concrete has hardened sufficiently to support the weight of a power float without its digging into or disrupting the level surface, thoroughly float the shake into the surface with a heavy revolving disc type power compacting machine capable of providing a 200 lb compaction force distributed over a 24 in diameter disc.

c. Start floating along walls and around columns and then move systematically across the surface leaving a matte finish.

d. The compacting machine shall be the "Kelly Power Float with Compaction Control" as manufactured by Kelley Industries of SSP Construction Equipment Inc., Pomona, CA or equal. Troweling machines equipped with float (shoe) blades that are slipped over the trowel blades may be used for floating. Floating with a troweling machine equipped with normal trowel blades will not be permitted. The use of any floating or troweling machine which has a water attachment for wetting the concrete surface during finishing will not be permitted.

2. Hand Floating

a. In lieu of power floating, small areas may be compacted by hand floating. The dry cement/sand shake previously specified shall be used unless specifically eliminated by the Engineer. Screed the floors and slabs with straightedges to the established grades shown on the Drawings. While the concrete is still green, but sufficiently hardened to support a finisher and kneeboards with no more than 1/4 in indentation, wood float to a true, even plane with no coarse aggregate visible. Use sufficient pressure on the wood floats to bring moisture to the surface.

3. Finishing Tolerances

a. Level floors and slabs to a tolerance of plus or minus 1/8 in when checked with a 10-ft straightedge placed anywhere on the slab in any direction. Where drains occur, pitch floors to drains such that there are no low spots left undrained. Failure to meet either of the above requirements shall be cause for removal, grinding, or other correction as directed by the Engineer.

B. Broom Finish

1. Screed slabs with straightedges to the established grades indicated on the Drawings. When the concrete has stiffened sufficiently to maintain small surface indentations, draw a stiff bristle broom lightly across the surface in the direction of drainage, or, in the case of walks and stairs, perpendicular to the direction of traffic to provide a non slip surface.

C. Steel Trowel Finish

1. Finish concrete as specified in Paragraph 3.02A. Then, hand steel trowel to a perfectly smooth hard even finish free from high or low spots or other defects.

D. Concrete Sealer

1. Prepare and seal surfaces [indicated on the Drawings to receive a sealer] as follows:
   a. Finish concrete as specified in the preceding paragraphs and in accordance with the Schedule of Finishes in Paragraph 3.05 below.
   b. Newly Placed Concrete: Surface must be sound and properly finished. Surface is application ready when it is damp but not wet and can no longer be marred by walking workmen.
   c. Newly Cured Bare Concrete: Level any spots gouged out by trades. Remove all dirt, dust, droppage, oil, grease, asphalt and foreign matter. Cleanse with caustics and detergents as required. Rinse thoroughly and allow to dry so that surface is no more than damp, and not wet.
   d. Aged Concrete: Restore surface soundness by patching, grouting, filling cracks and holes, etc. Surface must also be free of any dust, dirt and other foreign matter. Use power tools and/or strippers to remove any incompatible sealers or coatings. Cleanse as required, following the procedure indicated under cured concrete.
   e. Methods: Apply sealer so as to form a continuous, uniform film by spray, soft bristle pushbroom, long nap roller or lambswool applicator. Ordinary garden type sprayers, using neoprene hose, are recommended for best results.
   f. Applications: For curing only, apply first coat evenly and uniformly as soon as possible after final finishing at the rate of 200 to 400 sq ft per gallon. Apply second coat when all trades are completed and structure is ready for occupancy at the rate of 400 to 600 sq ft per gallon.
   g. To seal and dustproof, two coats are required. For sealing new concrete, both coats shall be applied full strength. On aged concrete, when renovating, dustproofing and sealing, the first coat should be thinned 10 to 15 percent with reducer per manufacturer's directions.

3.03 CONCRETE RECEIVING CHEMICAL HARDENER

A. After 28 days, minimum, concrete cure, apply chemical hardener in three applications to a minimum total coverage of the undiluted chemical of 100 sq ft per gallon and in accordance with manufacturer's recommendations as reviewed.

3.04 APPROVAL OF FINISHES

A. All concrete surfaces, when finished, will be inspected by the Engineer.

B. Surfaces which, in the opinion of the Engineer, are unsatisfactory shall be refinished or reworked.

C. After finishing horizontal surfaces, regardless of the finishing procedure specified, the concrete shall be cured in compliance with Section 03300 unless otherwise directed by the Engineer.

3.05 SCHEDULE OF FINISHES

A. Concrete shall be finished as specified either to remain as natural concrete to receive an additional applied finish or material under another section.

B. Concrete for the following conditions shall be finished as noted on the Drawings and as further specified herein:

1. Concrete to receive dampproofing or waterproofing: Rough form finish. See Paragraph 3.01D above.

2. Concrete not exposed to view and not scheduled to receive an additional applied finish or material: Rough form finish. See Paragraph 3.01D above.

3. Exterior vertical concrete above grade exposed to view: Rubbed finish. See Paragraph 3.01E above.

4. Interior vertical concrete exposed to view except in water containment areas: Rubbed finish. See Paragraph 3.01E above.

5. Vertical concrete in water containment areas. Rubbed finish on exposed surfaces and extending to two feet below normal operating water level: Rough form finish on remainder of submerged areas. See Paragraphs 3.01E and 3.01D above.

6. Interior and exterior underside of concrete exposed to view: Rubbed finish. See Paragraph 3.01E above.

7. Exterior surfaces exposed to view and indicated to have an abrasive blast finish. See Paragraph 3.01F above.

8. Interior or exterior horizontal concrete not requiring floor hardener or sealer: Floated finish. See Paragraph 3.02A above.

9. Concrete for exterior walks, interior and exterior stairs: Broomed finish perpendicular to direction of traffic. See Paragraph 3.02B above.

10. Concrete slabs on which process liquids flow or in contact with sludge: Steel trowel finish. See Paragraph 3.02C above.

11. Concrete to receive hardener: See Paragraph 3.03A above.

12. Concrete to receive floor sealer: See Paragraph 3.02D above.

13. Concrete tank bottoms to be covered with grout: See Section 03600.

14. Concrete to be coated or painted: See Division 9.

END OF SECTION

Section 03600
GROUT

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals required and install grout complete as shown on the Drawings and as specified herein.

1.02 MEASUREMENT AND PAYMENT

A. No separate payment will be made for grout. Include payment in the lump sum base bid.

B. Payment for extra unit price work shall be as defined in the extra unit price schedule.

1.03 RELATED WORK

A. Grout for tunnels, dams and slab jacking is included in Division 2.

B. Formwork is included in Section 03100.

C. Concrete Reinforcement is included in Section 03200.

D. Concrete Joints and Joint Accessories are included in Section 03250.

E. Cast-in-Place Concrete is included in Section 03300.

F. Modifications to Existing Concrete are included in Section 03740.

G. Miscellaneous Metals are included in Section 05580.

1.04 SUBMITTALS

A. Submit to the Engineer, in accordance with Section 01330, shop drawings and product data showing materials of construction and details of installation for:

B. Commercially manufactured nonshrink cementitous grout. The submittal shall include catalog cuts, technical data, storage requirements, product life, working time after mixing, temperature considerations, conformity to required ASTM standards and Material Safety Data Sheet.

C. Commercially manufactured nonshrink epoxy grout. The submittal shall include catalog cuts, technical data, storage requirements, product life, working time after mixing, temperature considerations, conformity to required ASTM standards and Material Safety Data Sheet.

D. Cement grout. The submittal shall include the type and brand of the cement, the gradation of the fine aggregate, product data on any proposed admixtures and the proposed mix of the grout.

E. Concrete grout. The submittal shall include data as required for concrete as delineated in Section 03300 and for fiber reinforcement as delineated in Section 03200. This includes the mix design, constituent quantities per cubic yard and the water/cement ratio.

F. Samples

1. Samples of commercially manufactured grout products when requested by the Engineer.

2. Aggregates for use in concrete grout when requested by the Engineer.

G. Laboratory Test Reports

1. Submit laboratory test data as required under Section 03300 for concrete to be used as concrete grout.

H. Certifications

1. Certify that commercially manufactured grout products and concrete grout admixtures are suitable for use in contact with potable water after 30 days curing.

2. Certify that the Contractor is not associated with the independent testing laboratory, nor does the Contractor or its officers have a beneficial interest in the laboratory.

I. Qualifications

1. Grout manufacturers shall submit documentation that they have at least 10 years experience in the production and use of the proposed grouts which they will supply.

1.05 REFERENCE STANDARDS

A. American Society for Testing and Materials (ASTM)

1. ASTM C531 - Standard Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical Resistant Mortars, Grouts and Monolithic Surfacings and Polymer Concretes

2. ASTM C579 - Standard Test Method for Compressive Strength of Chemical Resistant Mortars, Grouts and Monolithic Surfacings and Polymer Concretes

3. ASTM C827 - Standard Test Method for Change in Height at Early Ages of Cylindrical Specimens from Cementitious Mixtures

4. ASTM C1107 - Standard Specification for Packaged Dry, Hydraulic Cement Grout (Nonshrink)

5. ASTM D695 - Standard Test Method for Compressive Properties of Rigid Plastics

B. U.S. Army Corps of Engineers Standard (CRD)

1. CRD C-621 - Corps of Engineers Specification for Nonshrink Grout

C. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.06 QUALITY ASSURANCE

A. Qualifications

1. Grout manufacturer shall have a minimum of 10 years experience in the production and use of the type of grout proposed for the work.

B. Pre installation Conference

1. Well in advance of grouting, hold a pre installation meeting to review the requirements for surface preparation, mixing, placing and curing procedures for each product proposed for use. Parties concerned with grouting shall be notified of the meeting at least 10 days prior to its scheduled date.

C. Services of Manufacturer's Representative

1. A qualified field technician of the nonshrink grout manufacturer, specifically trained in the installation of the products, shall attend the pre installation conference and shall be present for the initial installation of each type of nonshrink grout. Additional services shall also be provided, as required, to correct installation problems.

D. Field Testing

1. The field testing of Concrete Grout shall be as specified for concrete in Section 03300.

1.07 DELIVERY, STORAGE AND HANDLING

A. Deliver materials to the jobsite in original, unopened packages, clearly labeled with the manufacturer's name, product identification, batch numbers and printed instructions.

B. Store materials in full compliance with the manufacturer's recommendations. Total storage time from date of manufacture to date of installation shall be limited to 6 months or the manufacturer's recommended storage time, whichever is less.

C. Material which becomes damp or otherwise unacceptable shall be immediately removed from the site and replaced with acceptable material at no additional expense to the Owner.

D. Nonshrink cement based grouts shall be delivered as preblended, prepackaged mixes requiring only the addition of water.

E. Nonshrink epoxy grouts shall be delivered as premeasured, prepackaged, three component systems requiring only blending as directed by the manufacturer.

1.08 DEFINITIONS

A. Nonshrink Grout: A commercially manufactured product that does not shrink in either the plastic or hardened state, is dimensionally stable in the hardened state and bonds to a clean base plate.

PART 2 PRODUCTS

2.01 GENERAL

A. The use of a manufacturer's name and product or catalog number is for the purpose of establishing the standard of quality desired.

B. Like materials shall be the products of one manufacturer or supplier in order to provide standardization of appearance.

2.02 MATERIALS

A. Nonshrink Cementitious Grout

1. Nonshrink cementitious grouts shall meet or exceed the requirements of ASTM C1107, Grades B or C and CRD C-621. Grouts shall be portland cement based, contain a pre proportioned blend of selected aggregates and shrinkage compensating agents and shall require only the addition of water. Nonshrink cementitious grouts shall not contain expansive cement or metallic particles. The grouts shall exhibit no shrinkage when tested in conformity with ASTM C827.
   a. General purpose nonshrink cementitious grout shall conform to the standards stated above and shall be SikaGrout 212 by Sika Corp.; Set Grout by Master Builders, Inc.; Gilco Construction Grout by Gifford Hill & Co.; Euco NS by The Euclid Chemical Co.; NBEC Grout by U. S. Grout Corp. or equal.
   b. Flowable (Precision) nonshrink cementitious grout shall conform to the standards stated above and shall be Masterflow 928 by Master Builders, Inc.; Hi Flow Grout by the Euclid Chemical Co.; SikaGrout 212 by Sika Corp.; Supreme Grout by Gifford Hill & Co.; Five Star Grout by U. S. Grout Corp. or equal.

B. Nonshrink Epoxy Grout

1. Nonshrink epoxy based grout shall be a pre proportioned, three component, 100 percent solids system consisting of epoxy resin, hardener, and blended aggregate. It shall have a compressive strength of 14,000 psi in 7 days when tested in conformity with ASTM D695 and have a maximum thermal expansion of 30 x 10 6 when tested in conformity with ASTM C531. The grout shall be Ceilcote 648 CP by Master Builders Inc.; Five Star Epoxy Grout by U.S. Grout Corp.; Sikadur 42 Grout Pak by Sika Corp.; High Strength Epoxy Grout by the Euclid Chemical Co. or equal.

C. Cement Grout

1. Cement grouts shall be a mixture of one part portland cement conforming to ASTM C150, Types I, II, or III and 1 to 2 parts sand conforming to ASTM C33 with sufficient water to place the grout. The water content shall be sufficient to impart workability to the grout but not to the degree that it will allow the grout to flow.

D. Water

1. Potable water, free from injurious amounts of oil, acid, alkali, organic matter, or other deleterious substances.

PART 3 EXECUTION

3.01 PREPARATION

A. Grout shall be placed over cured concrete which has attained its full design strength unless otherwise approved by the Engineer.

B. Concrete surfaces to receive grout shall be clean and sound; free of ice, frost, dirt, grease, oil, curing compounds, laitance and paints and free of all loose material or foreign matter which may affect the bond or performance of the grout.

C. Roughen concrete surfaces by chipping, sandblasting, or other mechanical means to ensure bond of the grout to the concrete. Remove loose or broken concrete. Irregular voids or projecting coarse aggregate need not be removed if they are sound, free of laitance and firmly embedded into the parent concrete.

1. Air compressors used to clean surfaces in contact with grout shall be the oilless type or equipped with an oil trap in the air line to prevent oil from being blown onto the surface.

D. Remove all loose rust, oil or other deleterious substances from metal embedments or bottom of baseplates prior to the installation of the grout.

E. Concrete surfaces shall be washed clean and then kept moist for at least 24 hours prior to the placement of cementitious or cement grout. Saturation may be achieved by covering the concrete with saturated burlap bags, use of a soaker hose, flooding the surface, or other method acceptable to the Engineer. Upon completion of the 24 hour period, visible water shall be removed from the surface prior to grouting. The use of an adhesive bonding agent in lieu of surface saturation shall only be used when approved by the Engineer for each specific location of grout installation.

F. Epoxy based grouts do not require the saturation of the concrete substrate. Surfaces in contact with epoxy grout shall be completely dry before grouting.

G. Construct grout forms or other leakproof containment as required. Forms shall be lined or coated with release agents recommended by the grout manufacturer. Forms shall be of adequate

strength, securely anchored in place and shored to resist the forces imposed by the grout and its placement.

1. Forms for epoxy grout shall be designed to allow the formation of a hydraulic head and shall have chamfer strips built into forms.

H. Level and align the structural or equipment bearing plates in accordance with the structural requirements and the recommendations of the equipment manufacturer.

I. Equipment shall be supported during alignment and installation of grout by shims, wedges, blocks or other approved means. The shims, wedges and blocking devices shall be prevented from bonding to the grout by appropriate bond breaking coatings and removed after grouting unless otherwise approved by the Engineer.

3.02 INSTALLATION - GENERAL

A. Mix, apply and cure products in strict compliance with the manufacturer's recommendations and this Section.

B. Have sufficient manpower and equipment available for rapid and continuous mixing and placing. Keep all necessary tools and materials ready and close at hand.

C. Maintain temperatures of the foundation plate, supporting concrete, and grout between 40 and 90 degrees F during grouting and for at least 24 hours thereafter or as recommended by the grout manufacturer, whichever is longer. Take precautions to minimize differential heating or cooling of baseplates and grout during the curing period.

D. Take special precautions for hot weather or cold weather grouting as recommended by the manufacturer when ambient temperatures and/or the temperature of the materials in contact with the grout are outside of the 60 and 90 degrees F range.

E. Install grout in a manner which will preserve the isolation between the elements on either side of the joint where grout is placed in the vicinity of an expansion or control joint.

F. Reflect all existing underlying expansion, control and construction joints through the grout.

3.03 INSTALLATION - CEMENT GROUTS AND NONSHRINK CEMENTITIOUS GROUTS

A. Mix in accordance with manufacturer's recommendations. Do not add cement, sand, pea gravel or admixtures without prior approval by the Engineer.

B. Avoid mixing by hand. Mixing in a mortar mixer (with moving blades) is recommended. Pre wet the mixer and empty excess water. Add premeasured amount of water for mixing, followed by the grout. Begin with the minimum amount of water recommended by the manufacturer and then add the minimum additional water required to obtain workability. Do not exceed the manufacturer's maximum recommended water content.

C. Placements greater than 3-in in depth shall include the addition of clean, washed pea gravel to the grout mix when approved by the manufacturer. Comply with the manufacturer's recommendations for the size and amount of aggregate to be added.

D. Place grout into the designated areas in a manner which will avoid segregation or entrapment of air. Do not vibrate grout to release air or to consolidate the material. Placement should proceed in a manner which will ensure the filling of all spaces and provide full contact between the grout and adjoining surfaces. Provide grout holes as necessary.

E. Place grout rapidly and continuously to avoid cold joints. Do not place cement grouts in layers. Do not add additional water to the mix (retemper) after initial stiffening.

F. Just before the grout reaches its final set, cut back the grout to the substrate at a 45 degree angle from the lower edge of bearing plate unless otherwise approved by the Engineer. Finish this surface with a wood float (brush) finish.

G. Begin curing immediately after form removal, cutback, and finishing. Keep grout moist and within its recommended placement temperature range for at least 24 hours after placement or longer if recommended by the manufacturer. Saturate the grout surface by use of wet burlap, soaker hoses, ponding or other approved means. Provide sunshades as necessary. If drying winds inhibit the ability of a given curing method to keep grout moist, erect wind breaks until wind is no longer a problem or curing is finished.

3.04 INSTALLATION - NONSHRINK EPOXY GROUTS

A. Mix in accordance with the procedures recommended by the manufacturer. Do not vary the ratio of components or add solvent to change the consistency of the grout mix. Do not overmix. Mix full batches only to maintain proper proportions of resin, hardener and aggregate.

B. Monitor ambient weather conditions and contact the grout manufacturer for special placement procedures to be used for temperatures below 60 or above 90 degrees F.

C. Place grout into the designated areas in a manner which will avoid trapping air. Placement methods shall ensure the filling of all spaces and provide full contact between the grout and adjoining surfaces. Provide grout holes as necessary.

D. Minimize "shoulder" length (extension of grout horizontally beyond base plate). In no case shall the shoulder length of the grout be greater than the grout thickness.

E. Finish grout by puddling to cover all aggregate and provide a smooth finish. Break bubbles and smooth the top surface of the grout in conformity with the manufacturer's recommendations.

F. Epoxy grouts are self-curing and do not require the application of water. Maintain the formed grout within its recommended placement temperature range for at least 24 hours after placing, or longer if recommended by the manufacturer.

3.05 INSTALLATION - CONCRETE GROUT

A. Screed underlying concrete to the grade shown on the Drawings. Provide the surface with a broomed finish, aligned to drain. Protect and keep the surface clean until placement of concrete grout.

B. Remove the debris and clean the surface by sweeping and vacuuming of all dirt and other foreign materials. Wash the tank slab using a strong jet of water. Flushing of debris into tank drain lines will not be permitted.

C. Saturate the concrete surface for at least 24 hours prior to placement of the concrete grout. Saturation may be maintained by ponding, by the use or soaker hoses, or by other methods acceptable to the Engineer. Remove excess water just prior to placement of the concrete grout. Place a cement slurry immediately ahead of the concrete grout so that the slurry is moist when the grout is placed. Work the slurry over the surface with a broom until it is coated with approximately 1/16 to 1/8-in thick cement paste. (A bonding grout composed of 1 part portland cement, 1.5 parts fine sand, an approved bonding admixture and water, mixed to achieve the consistency of thick paint, may be substituted for the cement slurry.)

D. Place concrete grout to final grade using the scraper mechanism as a guide for surface elevation and to ensure high and low spots are eliminated. Unless specifically approved by the equipment manufacturer, mechanical scraper mechanisms shall not be used as a finishing machine or screed.

E. Provide grout control joints as indicated on the Drawings.

F. Finish and cure the concrete grout as specified for cast in place concrete.

3.06 SCHEDULE

A. The following list indicates where the particular types of grout are to be used:

1. General purpose nonshrink cementitious grout: Use at all locations where non shrink grout is called for on the plans except for base plates greater in area than 3-ft wide by 3-ft long and except for the setting of anchor rods, anchor bolts or reinforcing steel in concrete.

2. Flowable nonshrink cementitious grout: Use under all base plates greater in area than 3-ft by 3-ft. Use at all locations indicated to receive flowable nonshrink grout by the Drawings. The Contractor, at his/her option and convenience, may also substitute flowable nonshrink grout for general purpose nonshrink cementitious grout.

3. Nonshrink epoxy grout: Use for the setting of anchor rods, anchor bolts and reinforcing steel in concrete and for all locations specifically indicated to receive epoxy grout.

4. Cement grout: Cement grout may be used for grouting of incidental base plates for structural and miscellaneous steel such as post base plates for platforms, base plates for beams, etc. It shall not be used when nonshrink grout is specifically called for on the Drawings or for grouting of primary structural steel members such as columns and girders.

5. Concrete grout: Use for overlaying the base concrete under scraper mechanisms of clarifiers, under scraper mechanisms of sedimentation basins or in screw pump troughs to allow more control in placing the surface grade.

END OF SECTION

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SECTION 03740
MODIFICATIONS AND REPAIR TO CONCRETE

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals required and cut, remove, repair or otherwise modify parts of existing concrete structures or appurtenances as shown on the Drawings and as specified herein. Work under this Section shall also include bonding new concrete to existing concrete.

B. Work under this Section shall also include connecting new concrete to existing concrete.

C. In general, work under this Section will be performed as a remedy for improperly placed or poorly placed concrete. Such work shall be performed only after receiving written directions from the Engineer.

1.02 MEASUREMENT AND PAYMENT

A. No separate payment will be made for work performed under this Section. Include the cost for this work in the lump sum Base Bid Item in Section 00410.

1.03 RELATED WORK

A. Concrete Formwork is included in Section 03100.

B. Concrete Reinforcement is included in Section 03200.

C. Concrete Joints and Accessories are included in Section 03250.

D. Cast-in-Place Concrete is included in Section 03300.

E. Grout is included in Section 03600.

F. Miscellaneous Metals are included in Section 05580.

1.04 SUBMITTALS

A. Submit, in accordance with Section 01330, a Schedule of Demolition and the detailed methods of demolition to be used at each location.

B. Submit manufacturer's technical literature on all product brands proposed for use, to the Engineer for review. The submittal shall include the manufacturer's installation and/or application instructions.

C. When substitutions for acceptable brands of materials specified herein are proposed, submit brochures and technical data of the proposed substitutions to the Engineer for approval before delivery to the project.

1.05 REFERENCE STANDARDS

A. American Society for Testing and Materials (ASTM)

1. ASTM C881 - Standard Specification for Epoxy Resin Base Bonding Systems for Concrete.

2. ASTM C882 - Standard Test Method for Bond Strength of Epoxy Resin Systems Used with Concrete by Slant Sheer.

3. ASTM C883 - Standard Test Method for Effective Shrinkage of Epoxy Resin Systems Used with Concrete.

4. ASTM D570 - Standard Test Method for Water Absorption of Plastics.

5. ASTM D638 - Standard Test Method for Tensile Properties of Plastics.

6. ASTM D695 - Standard Test Method for Compressive Properties of Rigid Plastics.

7. ASTM D732 - Standard Test Method for Shear Strength of Plastics by Punch Tool.

8. ASTM D790 - Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.

B. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.06 QUALITY ASSURANCE

A. No existing structure or concrete shall be shifted, cut, removed, or otherwise altered until authorization is given by the Engineer.

B. When removing materials or portions of existing structures and when making openings in existing structures, all precautions shall be taken and all necessary barriers, shoring and bracing and other protective devices shall be erected to prevent damage to the structures beyond the limits necessary for the new work, protect personnel, control dust and to prevent damage to the structures or contents by falling or flying debris. Unless otherwise permitted, shown or specified, line drilling will be required in cutting existing concrete.

C. Manufacturer Qualifications: The manufacturer of the specified products shall have a minimum of 10 years experience in the manufacture of such products and shall have an ongoing program of training, certifying and technically supporting the Contractor's personnel.

1.07 DELIVERY, STORAGE AND HANDLING

A. Deliver the specified products in original, unopened containers with the manufacturer's name, labels, product identification and batch numbers.

B. Store and condition the specified product as recommended by the manufacturer.

PART 2 PRODUCTS

2.01 MATERIALS

A. General

1. Materials shall comply with this Section and any state or local regulations.

2. All materials used within water basins shall be approved for use in contact with potable water after 30 days (non toxic and free of taste or odor).

3. When tested following the procedure prescribed by the Environmental Control Administration of the U.S. Public Health Service, the cured material shall be in conformity with the Federal Regulation requiring water extractables of less than 18 mg/sq in of exposed surface for potable water containers.

B. Epoxy Bonding Agent

1. General
   a. The epoxy bonding agent shall be a two component, solvent free, asbestos free moisture insensitive epoxy resin material used to bond plastic concrete to hardened concrete complying with the requirements of ASTM C881, Type II, Grade 2 and the additional requirements specified herein.

2. Material
   a. Properties of the cured material:
      1) Compressive Strength (ASTM D695): 8500 psi minimum at 28 days.
      2) Tensile Strength (ASTM D638): 4000 psi minimum at 14 days.
      3) Flexural Strength (ASTM D790 - Modulus of Rupture): 6,300 psi minimum at 14 days.
      4) Shear Strength (ASTM D732): 5000 psi minimum at 14 days.
      5) Water Absorption (ASTM D570 - 2 hour boil): One percent maximum at 14 days.
      6) Bond Strength (ASTM C882) Hardened to Plastic: 1500 psi minimum at 14 days moist cure.
      7) Effective Shrinkage (ASTM C883): Passes Test.
      8) Color: Gray.

3. Approved products and manufacturers include: Sikadur 32, Hi Mod by Sika Corporation, Lyndhurst, NJ; Epoxy Adhesive CR631 by Sto Concrete Restoration Division, Amherst, MA; Euco 452MV by Euclid Chemical Co., Cleveland, OH, or equal.

C. Epoxy Paste

1. General
   a. Epoxy Paste shall be a two component, solvent free, asbestos free, moisture insensitive epoxy resin material used to bond dissimilar materials to concrete such as setting railing posts, dowels, anchor bolts and all threads into hardened concrete and shall comply with the requirements of ASTM C881, Type I, Grade 3 and the additional requirements specified herein. It may also be used to patch existing surfaces where the glue line is 1/8-in or less.

2. Material
   a. Properties of the cured material:
      1) Compressive Properties (ASTM D695): 10,000 psi minimum at 28 days.
      2) Tensile Strength (ASTM D638): 3,000 psi minimum at 14 days. Elongation at Break - 0.3 percent minimum.
      3) Flexural Strength (ASTM D790 Modulus of Rupture): 3,700 psi minimum at 14 days.
      4) Shear Strength (ASTM D732): 2,800 psi minimum at 14 days.
      5) Water Absorption (ASTM D570): 1.0 percent maximum at 7 days.
      6) Bond Strength (ASTM C882): 2,000 psi at 14 days moist cure.
      7) Color: Concrete gray.

3. Approved manufacturers include:
   a. Overhead applications: Sikadur Hi mod LV 31 by Sika Corporation, Lyndhurst, NJ; Concresive 1490 by BASF (formerly Master Builders, Inc.), Cleveland, OH or equal.
   b. Sikadur Hi mod LV 32 by Sika Corporation, Lyndhurst, N.J.; Concresive 1420 by BASF (formerly Master Builders, Inc.), Cleveland, OH or equal.

D. Non Shrink Precision Cement Grout, Non Shrink Cement Grout, Non Shrink Epoxy Grout and Polymer Modified mortar are included in Section 03600.

E. Adhesive Anchor System

1. Provide an adhesive anchor system utilizing an injection adhesive material used for the installation of drilled-in reinforcing steel dowels where indicated on the Drawings

2. Injection Adhesive Material
   a. Injection adhesive material shall be a two-component system which includes a hardener and a resin, furnished in pre-measured side-by-side cartridges which keep the two components separate. Side-by-side cartridges shall be designed to accept a static mixing nozzle which thoroughly blends the two components and allows injection directly into the drilled hole. Adhesive shall be made for use in contact with potable water.

3. Adhesive anchor system shall be Hilti HIT RE 500 Epoxy Adhesive Anchor; Simpson Strong-Tie Epoxy SET; Powers Power-Fast, or equal.

F. Acrylic Latex Bonding Agent

1. See Specification 03250, Section 2.02, Paragraph F, Point 2 for description.

G. Crack Repair Epoxy Adhesive

1. General
   a. Crack Repair Epoxy Adhesive shall be a two component, solvent free, moisture insensitive epoxy resin material suitable for crack grouting by injection or gravity feed. It shall be formulated for the specific size of opening or crack being injected.
   b. All concrete surfaces containing potable water or water to be treated for potable use that are repaired by the epoxy adhesive injection system shall be coated with an acceptable epoxy coating approved by the FDA for use in contact with potable water.

2. Material
   a. Properties of the cured material
      1) Compressive Properties (ASTM D695): 10,000 psi minimum at 28 days.
      2) Tensile Strength (ASTM D638): 5,300 psi minimum at 14 days. Elongation at Break 2 to 5 percent.
      3) Flexural Strength (ASTM D790 Modulus of Rupture): 12,000 psi minimum at 14 days (gravity); 4,600 psi minimum at 14 days (injection)
      4) Shear Strength (ASTM D732): 3,700 psi minimum at 14 days.
      5) Water Absorption (ASTM D570 2 hour boil): 1.5 percent maximum at 7 days.
      6) Bond Strength (ASTM C882): 2,400 psi at 2 days dry; 2,000 psi at 14 days dry plus 12 days moist.
      7) Effective Shrinkage (ASTM 883): Passes Test.

3. Approved manufacturers include:
   a. For standard applications: Sikadur Hi Mod by Sika Corporation, Lyndhurst, NJ; Concressive Standard LVI by BASF (formerly Master Builders Inc., Cleveland, OH) or equal.
   b. For very thin applications; Sikadur Hi Mod LV by Sika Corporation, Lyndhurst, NJ; Concressive 1360 by BASF (formerly Master Builders Inc., Cleveland, OH) or equal.

PART 3 EXECUTION

3.01 GENERAL

A. Cut, repair, reuse, demolish, excavate or otherwise modify parts of the existing structures or appurtenances, as indicated on the Drawings, specified herein, or necessary to permit completion of the Work. Finishes, joints, reinforcements, sealants, etc, are specified in respective Sections. All work shall comply with other requirements of this of Section and as shown on the Drawings.

B. All commercial products specified in this Section shall be stored, mixed and applied in strict compliance with the manufacturer's recommendations.

C. In all cases where concrete is repaired in the vicinity of an expansion joint or control joint the repairs shall be made to preserve the isolation between components on either side of the joint.

D. When drilling holes for dowels/bolts at new or existing concrete, drilling shall stop if rebar is encountered. As approved by the Engineer, the hole location shall be relocated to avoid rebar. Rebar shall not be cut without prior approval by the Engineer. Where possible, rebar locations shall be identified prior to drilling using "rebar locators" so that drilled hole locations may be adjusted to avoid rebar interference.

3.02 CONCRETE REMOVAL

A. Concrete designated to be removed to specific limits as shown on the Drawings or directed by the Engineer, shall be done by line drilling at limits followed by chipping or jack hammering as appropriate in areas where concrete is to be taken out. Remove concrete in such a manner that surrounding concrete or existing reinforcing to be left in place and existing in place equipment is not damaged. Sawcutting at limits of concrete to be removed shall only be done if indicated on the Drawings, or after obtaining written approval from the Engineer.

B. Where existing reinforcing is exposed due to saw cutting/core drilling and no new material is to be placed on the sawcut surface, a coating or surface treatment of epoxy paste shall be applied to the entire cut surface to a minimum thickness of 1/4 in.
In all cases where the joint between new concrete or grout and existing concrete will be exposed in the finished work, except as otherwise shown or specified, the edge of concrete removal shall be a 1 in deep saw cut on each exposed surface of the existing concrete.

C. Concrete specified to be left in place which is damaged shall be repaired by approved means to the satisfaction of the Engineer.

D. The Engineer may from time to time direct the Contractor to make additional repairs to existing concrete. These repairs shall be made as specified or by such other methods as may be appropriate.

3.03 CONNECTION SURFACE PREPARATION

A. Connection surfaces shall be prepared as specified below for concrete areas requiring patching, repairs or modifications as shown on the Drawings, specified herein, or as directed by the Engineer.

B. Remove all deteriorated materials, dirt, oil, grease, and all other bond inhibiting materials from the surface by dry mechanical means, i.e. sandblasting, grinding, etc, as approved by the Engineer. Be sure the areas are not less than 1/2 in in depth. Irregular voids or surface stones need not be removed if they are sound, free of laitance, and firmly embedded into parent concrete, subject to the Engineer's final inspection.

C. If reinforcing steel is exposed, it must be mechanically cleaned to remove all contaminants, rust, etc, as approved by the Engineer. If half of the diameter of the reinforcing steel is exposed, chip out behind the steel. The distance chipped behind the steel shall be a minimum of 1/2 in. Reinforcing to be saved shall not be damaged during the demolition operation.

D. Reinforcing from existing demolished concrete which is shown to be incorporated in new concrete shall be cleaned by mechanical means to remove all loose material and products of corrosion before proceeding with the repair. It shall be cut, bent or lapped to new reinforcing as shown on the Drawings and provided with 1-in minimum cover all around.

E. The following are specific concrete surface preparation "methods" to be used where called for on the Drawings, specified herein or as directed by the Engineer.

1. Method A: After the existing concrete surface at connection has been roughened and cleaned, thoroughly moisten the existing surface with water. Brush on a 1/16 in layer of cement and water mixed to the consistency of a heavy paste. Immediately after application of cement paste, place new concrete or grout mixture as detailed on the Drawings.

2. Method B: After the existing concrete surface has been roughened and cleaned, apply epoxy bonding agent at connection surface. The field preparation and application of the epoxy bonding agent shall comply strictly with the manufacturer's recommendations. Place new concrete or grout mixture to limits shown on the Drawings within time constraints recommended by the manufacturer to ensure bond.

3. Method C: Drill a hole 1/4 in larger than the diameter of the dowel. The hole shall be blown clear of loose particles and dust just prior to installing epoxy. The drilled hole shall first be filled with epoxy paste, then dowels/bolts shall be buttered with paste then inserted by tapping. Unless otherwise shown on the Drawings, deformed bars shall be drilled and set to a depth of ten bar diameters and smooth bars shall be drilled and set to a depth of fifteen bar diameters. If not noted on the Drawings, the Engineer will provide details regarding the size and spacing of dowels.

4. Method D: Combination of Method B and C.

5. Method E: Adhesive anchor system shall be set in existing concrete by drilling holes to the required depth to develop the full tensile and shear strengths of the anchor material being used. The anchor bolts system shall be installed per the manufacturer's recommendation in holes sized as required.. The anchor stud bolt, rebar or other embedment item shall be installed per the adhesive anchor manufacturer's recommendations. The anchor may be installed in horizontal, vertical and overhead positions.

3.04 GROUTING

A. Grouting shall be as specified in Section 03600.

3.05 CRACK REPAIR

A. Cracks on horizontal surfaces shall be repaired by gravity feeding crack sealant into cracks per manufacturer's recommendations. If cracks are less than 1/16 in in thickness they shall be pressure injected.

B. Cracks on vertical surfaces shall be repaired by pressure injecting crack sealant through valves sealed to surface with crack repair epoxy adhesive per manufacturer's recommendations.

END OF SECTION

SECTION 04150
MASONRY ACCESSORIES

PART 1 GENERAL

1.01 DESCRIPTION

A. Work Included: Furnish and install specified joint reinforcement, anchors, ties, control joints, and related masonry accessories.

1.02 MEASUREMENT AND PAYMENT

A. No separate payment will be made for work performed under this Section. Include the cost for this work in the lump sum Base Bid.

1.03 RELATED DOCUMENTS

A. Applicable portions of the Agreement, Conditions of the Contract (General, Supplementary, and other Conditions), Drawings, Specifications, and Addenda issued prior to the execution of the Contract, other documents listed in the Agreement and Modifications issued after the execution of the Contract shall apply to this Section. The general requirements for this work are located in Division 1 of the Specifications.

1.04 SUBMITTALS AND SUBSTITUTIONS

A. In accordance with Section 01330.

1.05 PRODUCT HANDLING

A. Protection: Protect masonry accessory materials before, during, and after installation. Protect installed work and materials of other trades.

B. Replacements: In event of damage, immediately make replacements necessary to approval of Architect and at Contractor's expense.

PART 2 PRODUCTS

2.01 METAL ACCESSORIES

A. Wall Reinforcement

1. Reinforcement shall be ladder truss type, fabricated with single pair of galvanized 9-gauge side rods and continuous 9-gauge diagonal cross-rods spaced not more than 16 inches O.C. Construct to allow cross-rods to provide CMU cores completely open with no rods crossing to allow free grouting and vertical wall reinforcement spaces.

2. Reinforcement shall be manufactured by Dur-O-Wal, a Hohmann & Barnard Company; Masonry Reinforcing Corp. of America; or equal.

B. Wall Ties and Anchors

1. Ties to steel at tops of CMU partitions and walls shall be miscellaneous steel shapes and fasteners as detailed. Ties to steel columns shall be 3/16-inch diameter galvanized trapezoidal ties, 8 inches long, Dur-O-Wal No. D/A 730 spaced at 16 inches O.C. with ¼-inch wire D/A 207 galvanized column anchors welded to structural steel. Use same anchor to beam webs spaced 32 inches O.C. horizontally. Miscellaneous corrugated metal ties shall be 1-1/2-inch wide, 16-gauge galvanized steel, length to provide embedment as shown or as approved, spaced at 16 inches O.C.

2. Provide and install miscellaneous anchors and attachment members, required both for the anchorage of work of this Section and that of other trades requiring attachment to masonry, which are not specifically provided under separate Sections.

3. All galvanizing shall be mill type conforming to ASTM A641, Class III.

4. Ties and anchors shall be manufactured by Dur-O-Wal, a Hohmann & Barnard Company; Masonry Reinforcing Corp. of America; or equal.

C. Control joint material shall be as specified in Section 04200 "Masonry".

D. Through-wall Flashing

1. Through-wall flashing shall be factory-assembled material composed of two layers of asphalt saturated square woven glass fabric sandwiching electro-sheet copper, bonded to fabric with asphalt mastic.

2. Electro sheet copper shall consist of a full sheet of copper weighing 3 oz./ft^2.

3. Manufacturers: AFCO Products, Inc.; York Manufacturing; or equal.

E. Reinforcing Bars: Where shown, Grade 60 conforming to ASTM A615.

2.02 FINISHES FOR METAL ACCESSORIES

A. Finish metal accessories according to the following requirements as set forth in ASCE6/ACI 530.1:

1. Joint Reinforcement, Interior Wall: ASTM A641 Class 1.

2. Joint Reinforcement, wire ties or anchors, in exterior walls or interior walls exposed to moist environment: ASTM A153 Class B2.

3. Sheet metal ties or anchors completely embedded in mortar or grout: ASTM A525 Class G60.

4. Wire ties or anchors in interior walls: ASTM A641 Class 3.

5. Sheet metal ties and anchors in exterior walls or interior walls exposed to moist environment: ASTM A153.

2.03 CONTROL JOINTS IN CONCRETE MASONRY UNITS

A. In addition to locations shown on Drawings, locate control joints so that spacing does not exceed 1.5 times height of wall or 30 ft-0 inches O.C. for reinforced CMU or 25 ft-0 inches O.C. for non-reinforced CMU.

B. Provide preformed gaskets placed in sash grooves of concrete masonry using Dur-O-Wal D/A 2001/2025, or approved equal. Factory extrude from solid section of natural or synthetic rubber conforming to ASTM D-2000 2AA-805, with minimum curometer hardness of not less than 80 when tested in accordance with ASTM D 2240.

C. At exposed face of CMU, provide backer rod and sealant in addition to extruded sash groove control joint.

PART 3 EXECUTION

3.01 INSTALLATION OF MASONRY ACCESSORIES

A. Install masonry accessories at proper stages of masonry construction specified in Section 04200, "Unit Masonry", and as required for performance of proper masonry workmanship.

END OF SECTION

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SECTION 04200
MASONRY

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals required and construct all masonry work as shown and as specified herein.

B. The work under this Section includes, but is not necessarily limited to, the following:

1. Concrete masonry units (CMU).

2. Grouting as specified herein.

3. Vertically applied membrane flashing where and as detailed.

1.02 MEASUREMENT AND PAYMENT

A. No separate payment will be made for work performed under this Section. Include the cost for this work in the lump sum Base Bid.

1.03 RELATED WORK

A. Masonry Accessories are included in Division 4.

B. Vertical and horizontal deformed steel reinforcing bars for wall reinforcing and CMU lintel reinforcing are furnished under Division 3.

C. Grouting of base plates and equipment is included in Division 3.

D. Miscellaneous metals are included in Division 5.

E. Fabric through-wall flashings are included in Division 7.

F. Caulking is included in Division 7.

1.04 PERFORMANCE REQUIREMENTS

A. Provide unit masonry that develops the following net-area compressive strengths (f'm) at 28 days. Determine compressive strength of masonry from net-area compressive strengths of masonry units and mortar types (using mortar type specified herein) according to Tables 1 and 2 in ACI 530.1/ASCE 6/TMS 602-95.

B. For concrete masonry unit construction: As indicated on Structural Drawings.

1.05 SAMPLES

A. Submit to the Architect for approval, representative samples of all required masonry and accessory materials. Submit manufacturer's technical information on masonry cleaning product. Submit with samples, manufacturer's technical information, all certifications and test data required to prove compliance with the Specifications and building code.

B. Resubmit as required until approved.

C. Before commencing with the laying of any architectural masonry, construct on the site, where directed by and for the approval of the Architect & Engineer, a sample 6-ft x 6-ft mockup wall panel incorporating all CMU finishes and colors in design and reinforcements and showing color, type and tooling of mortar and bond.

D. Include special shapes, sills, and corners; include one complete exterior and interior vertical control joint to be caulked under Division 7. Include one length of through-wall flashing to be installed under Division 7 and weep holes as specified. Reconstruct as ordered until approved. This sample wall, when approved, shall become the standard of acceptance for masonry appearance and shall remain in place for the duration of the masonry work. Remove sample panel at the completion of the work as directed by the Architect and Engineer.

1.06 PRE-CONSTRUCTION TESTING

A. Pre-construction Testing Service: Owner will engage a qualified independent testing agency to perform preconstruction testing indicated below. Retesting of materials that fail to comply with specified requirements shall be done at Contractor's expense.

1. Masonry Unit Test: For each type of unit required, according to ASTM C 140 for compressive strength.

2. Mortar Test (Property Specification): For each mix required, according to ASTM C 109/C 109M for compressive strength , ASTM C 1506 for water retention, and ASTM C 91 for air content.

3. Mortar Test (Property Specification): For each mix required, according to ASTM C 780 for compressive strength.

4. Grout Test (Compressive Strength): For each mix required, according to ASTM C 1019.

5. Prism Test: For each type of construction required, according to ASTM C 1314.

1.07 PROTECTION OF MATERIALS

A. All perishable materials for the work of this Section shall be delivered stored and handled so as to preclude damage of any nature. Manufactured materials, such as cement and lime, shall be delivered and stored in their original containers, plainly marked with identification of material and maker. Materials in broken containers, or in packages showing water marks or other evidence of damage, shall not be used and shall be removed from the site.

B. All masonry shall be shipped stacked with hay or straw protection or other suitable protective device, and shall be similarly stacked off the ground on the site. In addition, all masonry stored on the site shall be protected from the weather and staining with the use of tarpaulins or other covering approved by the Architect & Engineer.

C. All masonry shall be particularly well covered and protected during manufacture, storage, shipping and while on the job site to prevent contamination which may lead to efflorescence in the finished work. If efflorescence occurs in the finished work, the Architect & Engineer may order the removal and replacement of areas so affected.

1.08 COLD AND HOT WEATHER CONSTRUCTION

A. Masonry construction in cold and in hot weather shall conform to the applicable requirements of ACI530.1/ASCE6/TMS 602-95 except where more stringent requirements are specified herein. Heat and enclosures will be the only protection method allowed and no mortar additives shall be used for freezing protection in cold weather.

B. Cold-Weather Cleaning - Use liquid cleaning methods only when air temperature is 40 degrees F and above and will remain so, until masonry has dried, but not less than 7 days after completing cleaning.

1.09 REFERENCE STANDARDS

A. American Concrete Institute (ACI)

1. ACI-530.1/ASCE6/TMS 602-95 - Specifications for Masonry Structures

B. American Society for Testing and Materials (ASTM)

1. ASTM A82 - Standard Specification for Steel Wire, Plain, for Concrete Reinforcement

2. ASTM A153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware

3. ASTM A167 - Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet and Strip

4. ASTM C33 - Standard Specification for Concrete Aggregates

5. ASTM C67 - Standard Test Methods of Sampling and Testing Brick and Structural Clay Tile

6. ASTM C90 - Standard Specification for Loadbearing Concrete Masonry Units

7. ASTM C140 - Standard Test Methods of Sampling and Testing Concrete Masonry Units

8. ASTM C144 - Standard Specification for Aggregate for Masonry Mortar

9. ASTM C150 - Standard Specification for Portland Cement

10. ASTM C207 - Standard Specification for Hydrated Lime for Masonry Purposes

11. ASTM C270 - Standard Specification for Mortar for Unit Masonry

12. ASTM C426 - Standard Test Method for Drying Shrinkage of Concrete Block

13. ASTM C476 - Standard Specification for Grout for Masonry

C. Where reference is made to one of the above standard or other standards cited below, the revision in effect at the time of bid opening shall apply except for ACI standard specified above.

PART 2 PRODUCTS

2.01 MATERIALS - MASONRY

A. Concrete Masonry Units (CMU)

1. CMU shall conform to ASTM C90, light weight, Type II, hollow, two-core, load bearing units of 8-inch x 16-inch and 4-inch x 16-inch, nominal face size, and bed dimensions as shown.

2. CMU shall be free from substances that will cause staining or pop-outs, and shall be fine, even texture with straight and true edges. All units shall be air cured in covered storage for not less than 28 days before delivery.

3. Units shall be obtained from one manufacturer to insure even color and texture.

4. Provide special units required by the Drawings, including solid, corner, control joint units, lintel, bond beam and jamb units.

5. Provide units that meet equivalent thickness requirements of the building code where required for fire-rated construction.

6. Shapes: Provide shapes indicated and as follows:
   a. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.
   b. Provide square-edged units for outside corners, unless otherwise indicated.

7. Integral Water Repellent: Provide units made with integral water repellent.
   a. Integral Water Repellent: Liquid polymeric, integral water-repellent admixture that does not reduce flexural bond strength. Units made with integral water repellent, when tested as a wall assembly made with mortar containing integral water-repellent manufacturer's mortar additive according to ASTM E 514, with test period extended to 24 hours, show no visible water or leaks on the back of test specimen.
      1) Products:
         a) ACM Chemistries; RainBloc.

b) BASF Aktiengesellschaft; Rheopel Plus.
c) Grace Construction Products, W. R. Grace & Co. - Conn.; Dry-Block.
d) Or equal.

8. Color and Texture:
   a. All surfaces exposed to the exterior shall be as noted on the Drawings.
   b. Integrally Colored Split Face CMU: Featherlite "Sonoma Brown".
   c. Integrally Colored Smooth Face CMU: Featherlite "Off White".
   d. Integrally Colored Split Ribbed CMU: Featherlite "Canyon Red".
      1) All colors referred to above are based on Featherlite Rockface units El Paso Plant. Colors are best representations to match existing buildings on site and are subject to final approval by Architect and Owner.

2.02 REINFORCING, TIES, ANCHORS AND MISCELLANEOUS

A. Wall Reinforcement: See Section 04150, Masonry Accessories.

B. Wall Ties and Anchors: See Section 04150, Masonry Accessories.

C. Compressible filler for use in conjunction with masonry shall be pre-molded, 35 percent compressible, neoprene foam strips complying with ASTM D1056, Grade 2A1. Thickness shall be 3/8-inch or as otherwise shown by width required for joint and wall conditions, allowing 3/4-inch depth for backer rod and sealant where shown.

2.03 MORTAR AND GROUT MATERIALS

A. Portland cement shall conform to ASTM C150 Type I. Masonry cements shall NOT be used.

B. Lime for masonry mortar shall be hydrated, conforming to ASTM C207, Type S.

C. Sand shall be carefully graded and washed natural sands or manufactured granite, marble, quartz or limestone sands meeting ASTM C33, except that gradation may vary to achieve desired finish and texture. Sand for grout shall conform to ASTM C144 or C33 as required.

D. Water shall be free from injurious amounts of oils, acids, alkalis or organic matter, and shall be clean and fresh.

E. Mortar Coloring

1. Pigment for coloring masonry mortar shall be chemically pure, inorganic oxides in compounds suitably prepared for use in masonry mortar as approved.

2. Color shall be as selected by the Architect.

F. Integral type waterproofing for use in all exterior mortar shall be metallic stearate type, Hydrocide Powder by Sonneborn Contech; Omicron Mortarproofing by Master Builders Company; Integral Waterpeller by Euclid Chemical; or equal.

G. Non-shrink grout shall be Masterflow 713 as manufactured by the Master Builders Company; Euco N-S by Euclid Chemical Co.; Five Star Grout by U.S. Grout Corporation; or equal. Grout shall attain a 28-day compressive strength of 6800 psi.

2.04 MORTAR AND GROUT MIXES

A. Ingredients shall be accurately measured by volume in boxes especially constructed for the purpose. Measurement by shovel will not be allowed. Measure materials in a damp, loose condition.

B. Portland cement mortar shall conform to ASTM C270, Type S. Provide test data as required to substantiate strength requirements of 3050 psi at 28 days.

C. Grout for constructing CMU lintel blocks, bond beams and for grouting cores in CMU to receive embedded anchors or reinforcing shall conform to ASTM C476, Fine Grout, proportioned by volume: one part Portland cement, zero to 1/10 part lime, and sand equal to 2-1/4 to 3 times the sum of the volumes of cement and lime materials. Strength shall be 3050 psi minimum at 28 days. Mix grout to have a slump of 10 inches plus or minus 1 inch, at time of placement.

D. Non-shrink grout where required shall be mixed as recommended by the manufacturer to give the necessary consistency for placing and to give a minimum compressive strength of 3,000 lbs. per square inch in three days.

E. All other grout shall be one part Portland cement, one part sand.

PART 3 EXECUTION

3.01 MORTAR

A. Mortar shall be machine mixed in an approved type of mixer in which the quantity of water can be accurately and uniformly controlled. The mixing time shall not be less than five minutes, approximately two minutes of which shall be for mixing the dry materials and not less than three minutes for continuing the mixing after the water has been added. Where hydrated lime is used for mortar requiring lime content, there will be allowed the option of using the dry-mix method or first converting the hydrated lime into putty. Where the dry-mix method is employed, the materials for each batch shall be well turned over together until the even color of the mixed, dry materials indicates that the cementitious material has been thoroughly distributed throughout the mass, after which the water shall be gradually added until a thoroughly mixed mortar of the required plasticity is obtained.

B. Mortar boxes shall be cleaned out at the end of each day's work, and all tools shall be kept clean. Mortar that has begun to set shall not be used.

C. Colored mortar for face brickwork shall be uniform in color between batches as approved when in place and set up. Variations in color will be cause for removal and replacement of the affected area as ordered at no additional cost to the Owner.

3.02 MASONRY - INSTALLATION

A. No material that is frozen or covered with frost or snow shall be used in the construction, and no antifreeze salts or ingredients shall be mixed with the mortar. Masonry shall not be laid at temperatures below 40 degrees F, without the approval of the Engineer, and all work shall be done in such a manner as to insure the proper and normal hardening of all mortar. All masonry work shall be so protected and heated that the temperature at the surface will not fall below 50 degrees F for a period of 72 hours after placing. Any completed work found to be affected by freezing shall be taken down and rebuilt at no expense to the Owner.

B. All CMU shall be laid in a full bed of mortar, applied to shells only. Butter the vertical joint of unit already set in the wall and all contact faces of the unit to be set. Each unit shall be placed and shoved against the unit previously laid so as to produce a well compacted vertical mortar joint for the full shell thickness. Units shall set with all cells in a vertical position. The moisture content of the units when laid shall not exceed 35 percent of the total absorption as determined by laboratory test.

C. Maintain tolerances in the erection of masonry as prescribed in ACI 530.1 except single-wythe walls where ordered shall be constructed with one better face in regard to plumb and line. Elsewhere, at single-wythe walls where ordered, provide two good faces by splitting the difference in wythe dimension as approved. The erection tolerances shall be reduced at all locations to a minimum within the parameters of good workmanship and as approved.

D. Masonry Bonding

1. CMU shall be laid in stretcher (running) bond unless otherwise shown.

2. Fill all joints with mortar, dense and neat.

E. Sizes shall be as specified and called for on the Drawings, and where "Soaps" and "Splits" are used, the space between these members and the backup material shall be slushed full of mortar.

F. Joints of all masonry shall be tooled in accordance with the following:

1. Wait until unit mortar is thumbprint hard before tooling joint. This may require as much as three hours in the shade and one hour in the sun in the summertime.

2. The required personnel shall be kept on the job after hours, if necessary, to properly tool joints.

3. Both vertical and horizontal joints shall be maintained uniform in spacing.

4. Tool concave as approved, matching existing.

G. Install all frames required to be set in masonry, set masonry tightly against frames, build in all frame anchors, and fill frames with mortar.

H. Control joints with compressible filler shall be installed at the intersection of masonry walls with structural steel, precast concrete and cast-in-place concrete and elsewhere as detailed on the Drawings. The maximum length, horizontally, between vertical control joints shall be 30 ft (16 ft O.C. at CMU in parapets), but joints shall be located only as directed or shown. Joints shall be equal in width to the standard mortar joint.

I. All masonry slots, chases, or openings required for the proper installation of the work of other Sections shall be constructed as indicated on the Drawings or in accordance with information furnished before the work is started at the points affected. No chase shall cut into any wall constructed of hollow units after it is built, except as directed and approved by the Engineer.

J. Surfaces shall be brushed as work progresses and maintained as clean as it is practicable. Unfinished work shall be raked back where possible, and toothed only where absolutely necessary. Before leaving fresh or unfinished work, walls shall be fully covered and protected against rain and wind and before continuing work previously laid shall be swept clean. The tops of walls or other unfinished work shall be protected against all damage by frost or the elements by means of waterproof paper, tarpaulins, boards or other means approved by the Engineer.

K. Parge all structural steel that will be built into masonry or covered by precast concrete with asphalt emulsion as specified above. Where insulation is required on steel, provide additional daubs of emulsion and embed insulation in emulsion as approved.

L. Build in all miscellaneous items to be set in masonry for which placement is not specifically provided under separate Divisions, including anchor bolts, reglets, lintels, ties, electrical panel boxes, sleeves, vents, grilles, anchors, grounds, and exterior electric conduits and fixtures, and cooperate with other trades whose work is to be coordinated with the work under this Section.

M. All anchorage, attachment, and bonding devices shall be set so as to prevent slippage and shall be completely covered with mortar or grout.

N. All ties and reinforcing for masonry shall be furnished and installed under this Section. Continuous longitudinal wall reinforcing shall be provided in all CMU walls over 4 inches thick. Space at 16-inch O.C. vertically unless shown otherwise and 8-inch O.C. at parapets. Omit ties and joint reinforcing at joints containing through wall flashing and locate in adjacent open joint.

O. Build in and grout fully all vertical and horizontal wall reinforcing and CMU lintel reinforcement as shown in Drawings.

P. Bed and grout for items coming in contact with masonry where grouting is required, including, but not limited to, door bucks and frames set in masonry. Install all anchor bolts, base plates, and seats in masonry walls, and build in all items required for the completion of the building as they apply to masonry.

3.03 REPAIR, POINTING, AND FINAL CLEANING

A. Exposed masonry shall be protected against staining by wall coverings, and excess mortar shall be wiped off the surface as the work progresses to reduce need for cleaning at completion of the work.

B. Where ordered, remove masonry units which are loose, chipped, broken, stained or otherwise damaged, and units which do not match adjoining units and install new units in fresh mortar or grout, pointed to eliminate, as approved by the Owner, evidence of replacement.

C. Pointing

1. During the tooling of joints, enlarge any voids or holes, except weep holes, and completely fill with mortar matching color as approved by the Engineer and tool to match. Point-up all joints at corners, openings and adjacent work to provide a neat, uniform appearance and properly prepare joints for application of sealants where required.

2. Before final cleaning, repoint all unsatisfactory joints as specified above and as required by the Architect/Engineer.

D. Final Cleaning of Masonry

1. After mortar has thoroughly set and cured (three weeks minimum during the summer; five weeks minimum during the winter), a sample wall area (approximately 20 ft^2), shall be cleaned, with an approved commercial masonry cleaner, diluted and mixed with water as recommended by the manufacturer and as approved. The sample area may be the sample wall panel specified above or an area in the finish work as directed by the Engineer.

2. The Architect/Engineer's acceptance of sample cleaning shall be obtained before proceeding to clean remainder of masonry work. A minimum of one week of dry weather is required to evaluate effectiveness of cleaning and effect on masonry and mortar. Upon acceptance, all face brick masonry shall be cleaned by the same method to the satisfaction of the Architect/Engineer.

E. Acid solutions shall not be used for cleaning CMU. Upon completion of the work, all surfaces of CMU shall be washed with soap powder and warm water, applied with a scrubbing brush, and then rinsed thoroughly with clear water. Other cleaning methods may be ordered to obtain required appearance.

F. Masonry areas not satisfactorily cleanable will be ordered replaced at no extra cost to the Owner.

3.04 FIELD QUALITY CONTROL

A. Testing and Inspecting: Owner will engage special inspectors to perform tests and inspections and prepare reports. Allow inspectors access to scaffolding and work areas, as needed, to perform tests and inspections. Retesting of materials that fail to comply with specified requirements shall be done at Contractor's expense.

B. Inspections: Special inspections shall be done in accordance with Chapter 17 of the "International Building Code".

1. Begin masonry construction only after inspectors have verified proportions of site-prepared mortar.

2. Place grout only after inspectors have verified compliance of grout spaces and of grades, sizes, and locations of reinforcement.

3. Place grout only after inspectors have verified proportions of site-prepared grout.

C. Testing Prior to Construction: One set of tests.

D. Testing Frequency: One set of tests for each 5000 ft^2 of wall area or portion thereof.

E. Concrete Masonry Unit Test: For each type of unit provided, according to ASTM C140 for compressive strength.

F. Mortar Aggregate Ratio Test (Proportion Specification): For each mix provided, according to ASTM C780.

G. Mortar Test (Property Specification): For each mix provided, according to ASTM C780. Test mortar for mortar air content and compressive strength.

H. Grout Test (Compressive Strength): For each mix provided, according to ASTM C1019.

I. Prism Test: For each type of construction provided, according to ASTM C1314 at seven days and at 28 days.

END OF SECTION

SECTION 05580
MISCELLANEOUS METAL

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals required and install all miscellaneous metal complete as shown on the Drawings and as specified herein.

1.02 MEASUREMENT AND PAYMENT

A. No separate payment will be made for miscellaneous metal. Include payment in the lump sum base bid.

B. Payment for extra unit price work shall be as defined in the extra unit price schedule.

1.03 RELATED WORK

A. Concrete joint accessories are included in Section 03250.

1.04 SUBMITTALS

A. Submit to the Engineer, in accordance with Section 01330, shop drawings and product data showing materials of construction and details of installation for:

1. Shop drawings, showing sizes of members, method of assembly, anchorage and connection to other members.

B. Samples

1. Submit samples as requested by the Engineer during the course of construction.

C. Design Data

1. Submit calculations or test data demonstrating that the railings will resist the loads specified in the Standard Building Code at the post spacing provided.

2. Submit manufacturer's load and deflection tables for grating.

D. Test Reports

1. Certified copy of mill test reports on each steel, stainless steel and aluminum proposed for use showing the physical properties and chemical analysis.

E. Certificates

1. Submit certification that the railing system is in compliance with OSHA requirements and the Standard Building Code.

2. Certify that welders have been qualified under AWS, within the previous 12 months, to perform the welds required under this Section.

1.05 REFERENCE STANDARDS

A. Aluminum Association (AA)

1. AA M31C22A41
   a. M31: Mechanical Finish, Fine Satin
   b. C22: Finish, Medium Matte
   c. A41: Clear Anodic Coating, Class I

B. American Society for Testing and Materials (ASTM)

1. ASTM A36 - Standard Specification for Carbon Structural Steel.

2. ASTM A48 - Standard Specification for Gray Iron Castings.

3. ASTM A53 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.

4. ASTM A108 - Standard Specification for Steel Bars, Carbon, Cold Finished, Standard Quality.

5. ASTM A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

6. ASTM A153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

7. ASTM A167 - Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet and Strip.

8. ASTM A276 - Standard Specification for Stainless Steel, Steel Bars and Shapes.

9. ASTM A307 - Standard Specification for Carbon Steel Bolts and Studs, 60,000 Psi Tensile Strength.

10. ASTM A325 - Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.

11. ASTM A366 - Standard Specification for Steel, Sheet, Carbon, Cold-Rolled, Commercial Quality.

12. ASTM A500 - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.

13. ASTM A501 - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.

14. ASTM A536 - Standard Specification for Ductile Iron Castings.

15. ASTM A570 - Standard Specification for Steel, Sheet and Strip, Carbon, Hot-Rolled, Structural Quality.

16. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

17. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles and Tubes.

18. ASTM B429 - Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube.

C. American Iron and Steel Institute (AISI).

1. Specification for Structural Steel Buildings.

D. American Welding Society (AWS)

1. AWS D1.1 - Structural Welding Code Steel.

2. AWS D1.2 - Structural Welding Code Aluminum.

E. Federal Specifications

1. FS-FF-B-575C - Bolts, Hexagonal and Square

F. Occupational Safety and Health Administration (OSHA)

G. Building Officials and Code Administrators International, Inc. (BOCA)

1. The BOCA National Code

H. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.06 QUALITY ASSURANCE

A. The work of this Section shall be completely coordinated with the work of other Sections. Verify, at the site, both the dimensions and work of other trades adjoining items of work in this Section before fabrication and installation of items herein specified.

B. Furnish to the pertinent trades all items included under this Section that are to be built into the work of other Sections.

C. All welding shall be performed by qualified welders and shall conform to the applicable AWS welding code. Welding of steel shall conform to AWS D1.1 and welding of aluminum shall conform to AWS D1.2.

1.07 DELIVERY, STORAGE AND HANDLING

A. Deliver items to be incorporated into the work of other trades in sufficient time to be checked prior to installation.

B. Repair items which have become damage or corroded to the satisfaction of the Engineer prior to incorporating them into the work.

1.08 PROJECT/SITE REQUIREMENTS

A. Field measurements shall be taken at the site, prior to fabrication of items, to verify or supplement indicated dimensions and to ensure proper fitting of all items.

PART 2 PRODUCTS

2.01 GENERAL

A. The use of manufacturer's name and model or catalog number is for the purpose of establishing the standard of quality and general configuration desired.

B. Like items of materials shall be the end products of one manufacturer in order to provide standardization for appearance, maintenance and manufacturer's service.

2.02 MATERIALS

A. Unless otherwise noted, materials for miscellaneous metals shall conform to the following standards:

1.	Structural Steel	ASTM A36
2.	Structural Steel Tubing	ASTM A500, Grade B
3.	Welded and Seamless Steel Pipe	ASTM A501 or ASTM A53, Type E or S, Grade B Schedule 40. Use standard malleable iron fittings, galvanized for exterior work
4.	Steel Sheets	ASTM A366
5.	Gray Iron Castings	ASTM A48, Class 35
6.	Ductile Iron Castings	ASTM A536, Grade 65-45-12
7.	Aluminum Extruded Pipe	ASTM B429, Alloy 6063 T6

8.	Aluminum Extruded Shapes	ASTM B221, Alloy 6061 T6
9.	Aluminum Sheet and Plate	ASTM B209, Alloy 6061 T6
10.	Stainless Steel Plates, Sheets, and Structural Shapes	
	a. Exterior, Submerged or Industrial Use	ASTM A167, Type 316 (Type 316L for welded)
	b. Interior and Architectural Use	ASTM A167, Type 304
11.	Stainless Steel Bolts, Nuts, and Washers	ASTM A276, Type 316
12.	Carbon Steel Bolts and Studs	ASTM A307, Grade A (hot dip galvanized nuts and washers where noted)
13.	High Strength Steel Bolts, Nuts and washers	ASTM A325 (mechanically galvanized per ASTM B695, Class 50, where noted)
	a. Elevated Temperature Exposure	Type I
	b. General Application	Type I or Type II
14.	Galvanizing	ASTM A123, Zn w/0.5 percent minimum Ni
15.	Galvanizing, hardware	ASTM A153, Zn w/0.5 percent minimum Ni

2.03 ANCHORS, BOLTS AND FASTENING DEVICES

A. Anchor bolt material shall be ASTM A307 unless otherwise noted.

B. Unless otherwise noted, bolts for the connection of carbon steel or iron shall be steel machine bolts; bolts for the connection of galvanized steel or iron shall be galvanized steel or stainless steel machine bolts; and bolts for the connection of aluminum or stainless steel shall be stainless steel machine bolts.

C. Unless otherwise noted, expansion anchors shall be zinc plated carbon steel wedge type anchors complete with nuts and washers. Type 316 stainless steel, wedge type anchors shall be used where they will be submerged or exposed to the weather or where stainless steel wedge type anchors are required. When the length or embedment of the bolt is not noted on the Drawings, provide length sufficient to place the wedge and expansion sleeve portion of the bolt at least 1-in behind the concrete reinforcing steel. Expansion anchors shall be Hilti, Kwick-bolt II; ITW Ramset; Redhead trubolt, or equal.

D. Adhesive capsule anchors shall be a two-part stud and capsule chemical resin anchoring system. Capsules shall contain premeasured amounts of polyester or vinyl ester resin, aggregate and a hardener contained in a separate vial within the capsule. Stud assemblies shall consist of an all-

thread anchor rod with nut and washer. Adhesive capsule anchors shall be Hilti, HVA Adhesive Anchor; Molly, Parabond; Rawlplug, Rawl Chem-Stud or equal.

E. Machine bolts and nuts shall conform to Federal Specification FF-B-575C. Bolts and nuts shall be hexagon type. Bolts, nuts, screws, washers and related appurtenances shall be Type 316 stainless steel.

F. Toggle bolts shall be Hilti, Toggler Bolt or equal.

2.04 MISCELLANEOUS ALUMINUM

A. All miscellaneous metal work shall be formed true to detail, with clean, straight, sharply defined profiles and smooth surfaces of uniform color and texture and free from defects impairing strength or durability. Holes shall be drilled or punched. Edges shall be smooth and without burrs. Fabricate supplementary pieces necessary to complete each item though such pieces are not definitely shown or specified.

B. Connections and accessories shall be of sufficient strength to safely withstand the stresses and strains to which they will be subjected. Exposed joints shall be close fitting and jointed where least conspicuous. Threaded connections shall have the threads concealed where practical. Welded connections shall have continuous welds or intermittent welds as specified or shown. The face of welds shall be dressed flush and smooth. Welding shall be on the unexposed side as much as possible in order to prevent pitting or discoloration of the aluminum exposed surface. Provide holes for temporary field connections and for attachment of the work of other trades.

C. Miscellaneous aluminum items shall include: beams, angles, closure angles, grates, hatches, floor plates, stop plates, stair nosings, and any other miscellaneous aluminum called for on the Drawings and not otherwise specified.

D. Angle frames for hatches, beams, grates, etc, shall be complete with welded strap anchors attached.

E. Aluminum diamond plate and floor plate shall have a minimum thickness of 3/8-in. Frames and supports shall be of aluminum construction. Fastening devices and hardware shall be Type 316 stainless steel. Plates shall have a mill finish.

F. Stair treads for aluminum stairs shall have abrasive non-slip nosing as approved.

G. Aluminum nosing at concrete stairs shall be Wooster Products, Inc.; Alumogrit Treads, Type 116; similar by Barry Pattern and Foundry Co.; Andco or equal. Furnish with wing type anchors and flat head stainless steel machine screws, 12-in on center. Nosing shall also be used at concrete ladder openings. Nosing shall a single piece for each step extending to within 3-in at each side of stair or full ladder width. Set nosing flush with stair tread finish at concrete stairs. Furnish treads with heavy duty protective tape cover.

2.05 MISCELLANEOUS STEEL

A. All miscellaneous metal work shall be formed true to detail, with clean, straight, sharply defined profiles and smooth surfaces of uniform color and texture and free from defects impairing strength or durability. Holes shall be drilled or punched. Edges shall be smooth and without burrs. Fabricate supplementary pieces necessary to complete each item though such pieces are not definitely shown or specified.

B. Connections and accessories shall be of sufficient strength to safely withstand the stresses and strains to which they will be subjected. Exposed joints shall be close fitting and jointed where least conspicuous. Threaded connections shall have the threads concealed where practical. Welded connections shall have continuous welds or intermittent welds as specified or shown. The face of welds shall be dressed flush and smooth. Grind smooth continuous welds that will be exposed. Provide holes for temporary field connections and for attachment of the work of other trades.

C. Miscellaneous steel items shall include: beams, angles, lintels, metal stairs, support brackets, base plates for other than structural steel or equipment, closure angles, bridge crane rails, monorail hoist beams, holddown straps and lugs, door frames, splice plates, subframing at roof openings and any other miscellaneous steel called for on the Drawings and not otherwise specified.

D. Structural steel angle and channel door frames shall be shop coated with primer. Frames shall be fabricated with not less than three anchors on each jamb.

E. Steel pipe pieces for sleeves, lifting attachments and other functions shall be Schedule 40 pipe unless otherwise shown on the Drawings. Wall and floor sleeves, of steel pipe, shall have welded circumferential steel waterstops at mid-length.

F. Lintels, relief angles or other steel supporting masonry or embedded in masonry shall be shop coated with primer.

G. All steel finish work shall be thoroughly cleaned, by effective means, of all loose mill scale, rust and foreign matter and shall be given one shop coat of primer compatible with the finish coat after fabrication but before shipment. Paint shall be omitted within 3-in of proposed field welds. Paint shall be applied to dry surfaces and shall be thoroughly and evenly spread and well worked into joints and other open spaces.

H. Galvanizing, where required, shall be the hot-dip zinc process after fabrication. Coating shall be not less than 2 oz/sq ft of surface.

2.06 MISCELLANEOUS STAINLESS STEEL

A. All miscellaneous metal work shall be formed true to detail, with clean, straight, sharply defined profiles and smooth surfaces of uniform color and texture and free from defects impairing strength or durability. Holes shall be drilled or punched. Edges shall be smooth and without burrs. Fabricate supplementary pieces necessary to complete each item though such pieces are not definitely shown or specified.

B. Connections and accessories shall be of sufficient strength to safely withstand the stresses and strains to which they will be subjected. Exposed joints shall be close fitting and jointed where least conspicuous. Threaded connections shall have the threads concealed where practical. Welded connections shall have continuous welds or intermittent welds as specified or shown. The face of welds shall be dressed flush and smooth. Grind smooth continuous welds that will be exposed. Provide holes for temporary field connections and for attachment of the work of other trades.

C. Miscellaneous stainless steel items shall include: beams, angles, bar racks and any other miscellaneous stainless steel called for on the Drawings and not otherwise specified.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install all items except those to be embedded in concrete or other masonry which shall be installed under Division 3 and Division 4 respectively. Items to be attached to concrete or masonry after such work is completed shall be installed in accordance with the details shown. Fastening to wood plugs in masonry will not be permitted.

B. Abrasions in the shop primer shall be touched up immediately after erection. Areas left unprimed for welding shall be painted with primer after welding.

C. Zinc coating which has been burned by welding, abraded, or otherwise damaged shall be cleaned and repaired after installation. The damage area shall be thoroughly cleaned by wire brushing and all traces of welding flux and loose or cracked zinc coating removed prior to painting. The cleaned area shall be painted with two coats of zinc oxide-zinc dust paint conforming to the requirements of Military Specifications MIL-P-15145. The paint shall be properly compounded with a suitable vehicle in the ratio of one part zinc oxide to four parts zinc dust by weight.

D. Specialty products shall be installed in accordance with the manufacturer's recommendations.

E. Expansion bolts shall be checked for tightness a minimum of 24 hours after initial installation.

F. Install adhesive capsule anchors using manufacture's recommended drive units and adapters and in compliance with the manufacturer's recommendations.

G. Headed anchor studs shall be welded in accordance with manufacturer's recommendations.

H. All railings shall be erected to line and plumb.

I. All steel surfaces that come into contact with exposed concrete or masonry shall receive a protective coating of an approved heavy bitumastic troweling mastic applied in accordance with the manufacturer's instructions prior to installation.

J. Where aluminum contacts a dissimilar metal, apply a heavy brush coat of zinc-chromate primer followed by two coats of aluminum metal and masonry paint to the dissimilar metal.

K. Where aluminum contacts masonry or concrete, apply a heavy coat of approved alkali resistant paint to the masonry or concrete.

L. Where aluminum contacts wood, apply two coats of aluminum metal and masonry paint to the wood.

M. Between aluminum grating, aluminum stair treads, or aluminum handrail brackets and steel supports, insert 1/4-in thick neoprene isolator pads, 85 plus or minus 5 Shore A durometer, sized for full width and length of bracket or support.

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SECTION 07160
UNDERSLAB VAPOR RETARDER

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 MEASUREMENT AND PAYMENT

A. No separate payment will be made for work performed under this Section. Include the cost for this work in the lump sum Base Bid.

1.03 SUMMARY

A. Surface preparation

B. Application of underslab vapor retarder

C. Related Sections:

1. Division 3 Section- "Reinforcing" for support systems

2. Division 15 Section for Stub-ups through concrete and vapor retarder.

D. References:

1. American Society for Testing and Materials (ASTM)
   a. ASTM E1745- Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil Or Granular Full Under Concrete Slabs.
   b. ASTM E154- Standard Test Methods for Water Vapor Retarders Used in Contact with Earth under Concrete Slabs.
   c. ASTM E96- Standard Test Methods for Water Vapor Transmission of Materials.
   d. ASTM E1643- Standard Practice for Installation of Water Vapor Retarders Used in Contact with Earth of Granular Fill Under Concrete Slabs.
   e. ASTM F1249-01- Standard Test Method for Water Vapor Transmission Rate Through Plastic Film and Sheeting Using a Modulated Infrared Sensor.

2. American Concrete Institute (ACI)
   a. ACI 302.1R-96 Vapor Barrier Component (plastic membrane) is not less than 10 mils thick.

1.04 SUBMITTALS

A. Product Data: Include manufacturer's written instructions for preparing substrate, technical data, and tested physical and performance properties of vapor retarder.

B. Samples: For the following products:

1. 12-by-12-inch (300-by-300-mm) square of vapor retarder.

2. 12-inch section of tape.

C. Installer Certificates: Certification that Installer complies with requirements.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: A firm and employees that will work on this project have a minimum of 3 years experience working on commercial installations of similar magnitude, and are familiar with the listen ASTM and AI requirements. .

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name and manufacturer.

B. Store materials in a clean dry area in accordance with manufacturer's instructions.

C. Stack membrane on smooth ground or wood platform to eliminate warping

D. Protect materials during handling and application to prevent damage or contamination.

E. Environmental Requirements:

1. Product not intended for uses subject to abuse or permanent exposure to the elements.

2. Do not apply on frozen ground.

PART 2 PRODUCTS

2.01 SHEET VAPOR RETARDER

A. Available Products: Subject to compliance with requirements, other manufacturers and products that may be incorporated into the Work include, but are not limited to, the following:

B. Basis of Design Product:

1. Perminator 10 mil under slab vapor mat by W.R. Meadows Inc.

C. Plastic Vapor Retarder Requirements:

1. Vapor Retarder membrane must meet or exceed all requirements of ASTM E1745 Classes A, B, & C.
   a. Minimum Permeance ASTM E96: 0.024 pems.
   b. Water Vapor Transmission Rate ASTM F1249 calibrated to ASTM E 96 (water method): 0.012 grains/ft^2/hr.

c. Resistance to Organisms and Substrates in Contact with Soil ASTM E154, Section 13: 0.051 Perms.
d. Tensile Strength ASTM E154, Section 9: 52 lbs force/ inch
e. Puncture Resistance ASTM D 1709, Method B: 3,770 g.
f. Water Vapor Retarder ASTM E 1745: Meets or exceeds Class A, B, & C.
g. Thickness of Retarded (plastic) ACI 302.1R-96: Not less than 10 mils.

D. Seam Tape:

1. High Density Polyethylene Tape with pressure sensitive adhesive. Minimum width 4 inches.

2. Pipe Boobs
   a. Construct pipe boots from vapor barrier material and pressure sensitive tape per manufacturer's instructions.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates to receive membrane. Notify Architect if surfaces are not acceptable. Do not begin surface preparation or application until acceptable conditions have been corrected.

3.02 SURFACE PREPARATION

A. Prepare surfaces in accordance with manufacturer's instructions.

3.03 APPLICATION

A. Installation shall be in accordance with manufacturer's instructions and ASTM E 1643-98.

B. Unroll vapor barrier with the longest dimension parallel with the direction of the pour. General Superintendent and Concrete Contractors will determine this.

C. Lap vapor barrier over footings and seal with tape.

D. Overlap joints 6 inches and seal with manufacturer's tape.

E. Seal all penetrations (including pipes) with manufacturer's pipe boot and seal with tape.

F. No penetration of the vapor barrier is allowed except for reinforcing steel and permanent utilities.

G. Repair damaged areas by cutting patches of vapor barrier, overlapping damaged area 6 inches and taping all four sides with tape.

END OF SECTION

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SECTION 07190
WATER REPELLENTS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 MEASUREMENT AND PAYMENT

A. No separate payment will be made for work performed under this Section. Include the cost for this work in the lump sum Base Bid.

1.03 SUMMARY

A. Section includes penetrating water-repellent treatments for the following vertical and horizontal surfaces:

1. Concrete unit masonry.

B. Related Sections:

1. Division 04 Section "Unit Masonry" for integral water-repellent admixture for unit masonry assemblies.

1.04 PERFORMANCE REQUIREMENTS

A. General Performance: Water repellents shall meet performance requirements indicated without failure due to defective manufacture, fabrication, or installation.

1. Water Repellents: Comply with performance requirements specified, as determined by preconstruction testing on manufacturer's standard substrate assemblies representing those indicated for this Project.

B. Water Absorption: Minimum 90 percent reduction of water absorption after 24 hours in comparison of treated and untreated specimens.

1. Cast-in Place Concrete: ASTM C 642

2. Precast Concrete: ASTM C 642

3. Cast Stone: ASTM C 1195

4. Concrete Masonry Units: ASTM C 140

5. Natural Stone: ASTM C 97

C. Water-Vapor Transmission: Comply with one or both of the following:

1. Maximum 10 percent reduction in rate of vapor transmission in comparison of treated and untreated specimens, according to ASTM E 96/E 96M.

2. Minimum 80 percent water-vapor transmission in comparison of treated and untreated specimens, according to ASTM D 1653.

D. Water Penetration and Leakage through Masonry: Minimum 90 percent reduction in leakage rate in comparison of treated and untreated specimens, according to ASTM E 514.

E. Durability: Maximum 5 percent loss of water-repellent properties after 2500 hours of weathering according to ASTM G 154 in comparison to water-repellent-treated specimens before weathering.

F. Chloride-Ion Intrusion in Concrete: NCHRP Report 244, Series II tests.

1. Reduction of Water Absorption: 80 percent

2. Reduction in Chloride Content: 80 percent

1.05 SUBMITTALS

A. Product Data: For each type of product indicated.

1. Include manufacturer's printed statement of VOC content.

2. Include manufacturer's standard colors.

3. Include manufacturer's recommended number of coats for each type of substrate and spreading rate for each separate coat.

4. Printout of current "MPI Approved Products List" for each product category specified in Part 2 that specifies water repellents approved by MPI, with the proposed product highlighted.

B. Samples: For each type of water repellent and substrate indicated, 12 by 12 inches (300 by 300 mm) in size, with specified water-repellent treatment applied to half of each Sample.

C. Qualification Data: For qualified Applicator.

D. Product Certificates: For each type of water repellent, from manufacturer.

E. Pre-construction Testing Reports: For water-repellent-treated substrates.

F. Field quality control reports.

G. Warranty: Special warranty specified in this Section.

1.06 QUALITY ASSURANCE

A. Applicator Qualifications: An employer of workers trained and approved by manufacturer.

B. MPI Standards: Comply with MPI standards indicated and provide water repellents listed in its "MPI Approved Products List."

C. Mockups: Apply water repellent to each type of substrate required.

1. Locate each test application as directed by Architect.

2. Size: 25 ft^2 (2.3 m^2).

3. Final approval by Architect of color and water-repellent application will be from test applications.

D. Pre-installation Conference: Conduct conference at Project site.

1.07 PROJECT CONDITIONS

A. Limitations: Proceed with application only when the following existing and forecasted weather and substrate conditions permit water repellents to be applied according to manufacturer's written instructions and warranty requirements:

1. Concrete surfaces and mortar have cured for not less than 28 days.

2. Building has been closed in for not less than 30 days before treating wall assemblies.

3. Ambient temperature is above 40 deg F (4.4 deg C) and below 100 deg F (37.8 deg C) and will remain so for 24 hours.

4. Substrate is not frozen and substrate-surface temperature is above 40 deg F (4.4 deg C) and below 100 deg F (37.8 deg C).

5. Rain or snow is not predicted within 24 hours.

6. Not less than seven days have passed since surfaces were last wet.

7. Windy conditions do not exist that might cause water repellent to be blown onto vegetation or surfaces not intended to be treated.

1.08 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer and Applicator agree to repair or replace materials that fail to maintain water repellency specified in "Performance Requirements" Article within specified warranty period.

1. Warranty Period: Ten years from date of Substantial Completion.

PART 2 PRODUCTS

2.01 PENETRATING WATER REPELLENTS

A. Silane, Penetrating Water Repellent: Clear, containing 20 percent or more solids of alkyltrialkoxysilanes; with alcohol, mineral spirits, water, or other proprietary solvent carrier; and with 400 g/L or less of VOCs.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. BASF Construction Chemicals, LLC; Hydrozo 100 Plus
   b. Pecora Corporation; KlereSeal 940-S VOC KlereSeal 9100-S
   c. PROSOCO, Inc.; SLX100
   d. Tnemec Inc.; Dur A Pell 100

B. Siliconate, Penetrating Water Repellent: Clear, methyl siliconate water repellent with 400 g/L or less of VOCs.

1. Products: Subject to compliance with requirements, provide the following provide one of the following:
   a. BASF Construction Chemicals, LLC; Thoroclear Special
   b. PROSOCO, Inc.; Natural Stone Treatment WB

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements and conditions affecting performance of the Work.

1. Verify that surfaces are clean and dry according to water-repellent manufacturer's requirements. Check moisture content in three representative locations by method recommended by manufacturer.

2. Inspect for previously applied treatments that may inhibit penetration or performance of water repellents.

3. Verify that there is no efflorescence or other removable residues that would be trapped beneath the application of water repellent.

4. Verify that required repairs are complete, cured, and dry before applying water repellent.

B. Test pH level according to water-repellent manufacturer's written instructions to ensure chemical bond to silica-containing or siliceous minerals.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Cleaning: Before application of water repellent, clean substrate of substances that could impair penetration or performance of product according to water-repellent manufacturer's written instructions and as follows:

1. Cast-in-Place Concrete and Concrete Unit Masonry: Remove oil, curing compounds, laitance, and other substances that inhibit penetration or performance of water repellents according to ASTM E 1857.

B. Protect adjoining work, including mortar and sealant bond surfaces, from spillage or blow-over of water repellent. Cover adjoining and nearby surfaces of aluminum and glass if there is the possibility of water repellent being deposited on surfaces. Cover live vegetation.

C. Coordination with Mortar Joints: Do not apply water repellent until pointing mortar for joints adjacent to surfaces receiving water-repellent treatment has been installed and cured.

D. Coordination with Sealant Joints: Do not apply water repellent until sealants for joints adjacent to surfaces receiving water-repellent treatment have been installed and cured.

1. Water-repellent work may precede sealant application only if sealant adhesion and compatibility have been tested and verified using substrate, water repellent, and sealant materials identical to those required.

3.03 APPLICATION

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect the substrate before application of water repellent and to instruct Applicator on the product and application method to be used.

B. Apply a heavy saturation coating of water repellent on surfaces indicated for treatment, using 15-psi (103-kPa) pressure spray with a fan-type spray nozzle, roller or brush to the point of saturation. Apply coating in dual passes of uniform, overlapping strokes. Remove excess material; do not allow material to puddle beyond saturation. Comply with manufacturer's written instructions for application procedure unless otherwise indicated.

C. Apply a second saturation coating, repeating first application. Comply with manufacturer's written instructions for limitations on drying time between coats and after rainstorm wetting of surfaces between coats. Consult manufacturer's technical representative if written instructions are not applicable to Project conditions.

3.04 FIELD QUALITY CONTROL

A. Testing of Water-Repellent Material: Owner reserves the right to invoke the following procedure at any time and as often as Owner deems necessary during the period when water repellent is being applied:

1. Owner will engage the services of a qualified testing agency to sample water-repellent material being used. Samples of material delivered to Project site will be taken, identified, sealed, and certified in presence of Contractor.

2. Testing agency will perform tests for compliance of water-repellent material with product requirements.

3. Owner may direct Contractor to stop applying water repellents if test results show material being used does not comply with product requirements. Contractor shall remove noncomplying material from Project site, pay for testing, and correct deficiency of surfaces treated with rejected materials, as approved by Architect.

B. Coverage Test: In the presence of Architect, hose down a dry, repellent-treated surface to verify complete and uniform product application. A change in surface color will indicate incomplete application.

1. Notify Architect seven days in advance of the dates and times when surfaces will be tested.

2. Reapply water repellent until coverage test indicates complete coverage.

3.05 CLEANING

A. Immediately clean water repellent from adjoining surfaces and surfaces soiled or damaged by water-repellent application as work progresses. Correct damage to work of other trades caused by water-repellent application, as approved by Architect.

B. Comply with manufacturer's written cleaning instructions.

END OF SECTION

SECTION 07210
BUILDING INSULATION

PART 1 GENERAL

1.01 WORK INCLUDED

A. Thermal and draft stopping insulation required for the Work including board insulation in walls, ceilings, floors, soffits, and as shown.

B. Distribution: Unless otherwise shown

1. In masonry cavity walls, adhered board.

2. In exterior ceilings/soffits, adhered board.

3. In draft ways, as specified.

1.02 MEASUREMENT AND PAYMENT

A. No separate payment will be made for work performed under this Section. Include the cost for this work in the lump sum Base Bid Item in Section 00410.

1.03 EXTENT OF WORK

A. It is intended that thermal insulation be continuous from floor to floor, floor to roof, and across chases, shafts and abutting partitions in exterior walls, and from wall to wall in ceilings, soffits, and roofs, butted tight edge to edge and to surrounding framing, cut tight around recess lite fixtures and penetrating ducts and pipes, and backing up and enclosing recess cabinets, electric boxes, piping running in framed walls, etc. and that packing and foaming close all specified and remaining openings.

1.04 SUBMITTALS

A. Product data - Each product and use.

1.05 STANDARD

A. The International Energy Code governs the requirements for thermal insulation and draft stopping and the code compliance analysis lists required values accordingly.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS/PRODUCTS

A. Subject to compliance with these specifications include those listed below and with item specifications, or approved equal unless otherwise shown.

2.02 BOARD

A. Polyiso: Closed cell rigid foam board for walls and roof applied at thickness indicated on the drawings to achieve R-value indicated.

1. RESISTA as manufactured by Firestone, or Engineer-approved equal.

2. R2+ Silver as manufactured by Carlisle Coatings and Waterproofing, or Engineer-approved equal.

2.03 ACCESSORIES

A. Fasteners: Metal pins with friction washers or metal arrows designed to impale the insulation and hold it in place. The fastener base shall permit attachment to its supporting surface mechanically by nailing or by adhering with adhesive.

B. Adhesive: Solvent disbursed rubber-based mastic whose carrier will not attack the material on which it is used as recommended by the insulation manufacturer, damp proof where used in exterior walls.

C. Mastic: Trowel grade asphalt emulsion, ASTM 1277, Type 1, fibered.

PART 3 EXECUTION

3.01 BOARD

A. Polyiso

1. In cavity walls and Roofs – Install boards on the back of masonry with adhesive spots not over, 12-in. centers each way, pushed tight to the wall. Install on roof decking with manufacturer recommended fasteners. Completely cover surface with insulation. Butt joints between boards tightly. Fit boards close around cut outs and penetrations.

3.02 DRAFT STOPPING

A. General

1. Where not otherwise sealed for fire or sound rated constructions, insulate incidental opening in walls and roof to complete insulation system coverage and prevent infiltration of outside air, or exfiltration of inside air, or transfer of air between conditioned and unconditioned spaces and to complete smoke barrier constructions.

B. Wall/Partition Tops: Pack between deck flutes, joist ends and other openings above exterior wall framing and exterior wall and barrier wall and partition tops. Between joist ends and under rectangular deck flutes, use unfaced mineral wool blanket cut oversize and folded into place for a compression fit, top, bottom and ends. Stuff corrugated deck flutes tight with unfaced mineral wool wads.

C. Openings – From interior, seal the annular space inside window door, louver, fan, stack, duct, hatch and other exterior wall and roof rough opening frames, and around all electrical and communication boxes and similar unframed penetrations with packed mineral wool or foamed in place insulation.

END OF SECTION

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SECTION 07412
STANDING-SEAM METAL ROOF PANELS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals required and install intumescent paints complete as shown on the drawings and as specified herein.

B. Section includes standing-seam metal roof panels, soffit panels and all other accessories.

1.02 MEASUREMENT AND PAYMENT

A. No separate payment will be made for work performed under this Section. Include the cost for this work in the lump sum Base Bid.

1.03 RELATED WORK

A. Joint Sealers are included in Section 07900.

1.04 SUBMITTALS

A. Submit in accordance with Section 01330.

B. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel and accessory.

C. Shop Drawings:

1. Include fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details.

2. Accessories: Include details of the flashing, trim, soffit panels and anchorage systems, at a scale of not less than 1-1/2 inches per 12 inches (1:10).

D. Samples for Initial Selection: For each type of metal panel indicated with factory-applied color finishes.

1. Include similar Samples of trim and accessories involving color selection.

E. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below.

1. Metal Panels and Soffit Panels: 12 inches (305 mm) long by actual panel width. Include clips, fasteners, closures, and other metal panel accessories.

F. Qualification Data: For Installer.

G. Product Test Reports: For each product, for tests performed by a qualified testing agency.

H. Field quality-control reports.

I. Sample Warranties: For special warranties.

J. Maintenance Data: For metal panels to include in maintenance manuals.

1.05 REFERENCED STANDARDS

A. American Architectural Manufacturers Association

1. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum

2. AAMA 620 - Voluntary Specification for High Performance Organic Coatings on Coil Coated Architectural Aluminum Substrates

3. AAMA 621 - Voluntary Specification for High Performance Organic Coatings on Coil Coated Architectural Hot Dipped Galvanized (HDG) and Zinc-Aluminum Coated Steel Substrates

B. ASTM International

1. ASTM A 240/A 240M - Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications

2. ASTM A 653/A 653M - Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

3. ASTM A 755/A 755M - Specification for Steel Sheet, Metallic Coated by the Hot-Dip Process and Prepainted by the Coil-Coating Process for Exterior Exposed Building Products

4. ASTM A 792/A 792M - Specification for Steel Sheet, 55 Percent Aluminum-Zinc Alloy-Coated by the Hot-Dip Process

5. ASTM B 209 - Specification for Aluminum and Aluminum-Alloy Sheet and Plate

6. ASTM B 209M - Specification for Aluminum and Aluminum-Alloy Sheet and Plate [Metric]

7. ASTM B 370 - Specification for Copper Sheet and Strip for Building Construction

8. ASTM B 882 - Specification for Pre-Patented Copper for Architectural Applications

9. ASTM C 645 - Specification for Nonstructural Steel Framing Members

10. ASTM C 754 - Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products

11. ASTM C 920 - Specification for Elastomeric Joint Sealants

12. ASTM C 1311 - Specification for Solvent Release Sealants

13. ASTM D 226/D 226M - Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing

14. ASTM D 1970 - Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection

15. ASTM D 2244 - Practice for Calculation of Color Differences from Instrumentally Measured Color Coordinates

16. ASTM D 4214 - Test Methods for Evaluating the Degree of Chalking of Exterior Paint Films

17. ASTM E 283 - Test Method for Determining Rate of Air Leakage through Exterior Windows, Curtain Walls, and Doors under Specified Pressure Differences across the Specimen

18. ASTM E 331 - Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference

19. ASTM E 1514 - Specification for Structural Standing Seam Steel Roof Panel Systems

20. ASTM E 1592 - Test Method for Structural Performance of Sheet Metal Roof and Siding Systems by Uniform Static Air Pressure Difference

21. ASTM E 1637 - Specification for Structural Standing Seam Aluminum Roof Panel Systems

22. ASTM E 1646 - Test Method for Water Penetration of Exterior Metal Roof Panel Systems by Uniform Static Air Pressure Difference

23. ASTM E 1680 - Test Method for Rate of Air Leakage through Exterior Metal Roof Panel Systems

24. ASTM E 1980 - Practice for Calculating Solar Reflectance Index of Horizontal and Low-Sloped Opaque Surfaces

25. ASTM E 2140 - Test Method for Weather Penetration of Metal Roof Panel Systems by Static Water Pressure Head

C. Cool Roof Rating Council

1. CRRC-1 - CRRC Product Rating Program

D. FM Global

1. FMG 4471 - Approval Standard, Class I Panel Roofs

2. Approval Guide.

E. Sheet Metal and Air Conditioning Contractors' National Association

1. Architectural Sheet Metal Manual.

F. Underwriters Laboratories Inc.

1. UL 580 - Tests for Uplift Resistance of Roof Assemblies

G. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.06 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

B. UL-Certified, Portable Roll-Forming Equipment: UL-certified, portable roll-forming equipment capable of producing metal panels warranted by manufacturer to be the same as factory-formed products. Maintain UL certification of portable roll-forming equipment for duration of work.

1.07 DELIVERY, STORAGE AND HANDLING

A. Deliver components, metal panels, and other manufactured items so as not to be damaged or deformed. Package metal panels for protection during transportation and handling.

B. Unload, store, and erect metal panels in a manner to prevent bending, warping, twisting, and surface damage.

C. Stack metal panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal panels to ensure dryness, with positive slope for drainage of water. Do not store metal panels in contact with other materials that might cause staining, denting, or other surface damage.

D. Retain strippable protective covering on metal panels during installation.

E. Copper Panels: Wear gloves when handling to prevent fingerprints and soiling of surface.

1.08 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal panels to be performed according to manufacturers' written instructions and warranty requirements.

1.09 COORDINATION

A. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

B. Coordinate metal panel installation with rain drainage work, flashing, trim, construction of soffits, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.10 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal panel systems that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
   a. Structural failures including rupturing, cracking, or puncturing.
   b. Deterioration of metals and other materials beyond normal weathering.

2. Warranty Period: Two years from date of Substantial Completion.

B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
   a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
   b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
   c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 20 years from date of Substantial Completion.

C. Special Weathertightness Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace standing-seam metal roof panel assemblies that fail to remain weathertight, including leaks, within specified warranty period.

1. Warranty Period: 20 years from date of Substantial Completion.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E 1592:

1. Wind Loads: As indicated on Drawings.

2. Other Design Loads: As indicated on Drawings.

3. Deflection Limits: For wind loads, no greater than 1/240 of the span.

B. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E 1646[or ASTM E 331] at the following test-pressure difference:

1. Test-Pressure Difference: 6.24 lbf/sq. ft. (300 Pa).

C. Hydrostatic-Head Resistance: No water penetration when tested according to ASTM E 2140.

D. Wind-Uplift Resistance: Provide metal roof panel assemblies that comply with UL 580 for wind-uplift-resistance class indicated.

1. Uplift Rating: UL 90.

E. FM Global Listing: Provide metal roof panels and component materials that comply with requirements in FM Global 4471 as part of a panel roofing system and that are listed in FM Global' s "Approval Guide" for Class 1 or noncombustible construction, as applicable. Identify materials with FM Global markings.

1. Fire/Windstorm Classification: Class 1A-105.

F. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.02 STANDING-SEAM METAL ROOF PANELS

A. General: Provide factory-formed metal roof panels designed to be installed by lapping and interconnecting raised side edges of adjacent panels with joint type indicated and mechanically attaching panels to supports using concealed clips in side laps. Include clips, cleats, pressure plates, and accessories required for weathertight installation.

1. Steel Panel Systems: Unless more stringent requirements are indicated, comply with ASTM E 1514.

Vertical-Rib, Seamed-Joint, Standing-Seam Metal Roof Panels: Formed with vertical ribs at panel edges and a flat pan between ribs; designed for sequential installation by mechanically attaching panels to supports using concealed clips located under one side of panels, engaging opposite edge of adjacent panels, and mechanically seaming panels together.

2. Basis-of-Design Product: Subject to compliance with requirements, provide 238T Symmetrical Panel by Architectural Components or comparable product by one of the following:
   a. Advanced Architectural Products.
   b. AEP Span; a BlueScope Steel company.
   c. Architectural Building Components.
   d. Architectural Metal Systems; a Nucor company.
   e. ATAS International, Inc.
   f. Berridge Manufacturing Company.
   g. CENTRIA Architectural Systems.
   h. Dimensional Metals, Inc.
   i. Englert, Inc.
   j. Fabral.
   k. Firestone Metal Products, LLC.
   l. Flexospan Steel Buildings, Inc.
   m. Garland Company, Inc. (The)
   n. IMETCO.
   o. MBCI; a division of NCI Building Systems, L.P.
   p. McElroy Metal, Inc.
   q. Merchant & Evans.
   r. Metal-Fab Manufacturing, LLC.
   s. Metal Sales Manufacturing Corporation.
   t. Morin; a Kingspan Group company.
   u. Petersen Aluminum Corporation.
   v. Ryerson, Inc.
   w. Ultra Seam, Inc.
   x. Union Corrugating Company
   y. Or equal.

3. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A 653/A 653M, G90 (Z275) coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A 792/A 792M, Class AZ50 (Class AZM150) coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
   a. Nominal Thickness: 0.028 inch (0.71 mm).
   b. Exterior Finish: Two coat coil applied, baked-on full-strength (70% resin, PVF2) fluorocarbon coating consisting of a nominal 0.25 mil dry film thickness primer, and a nominal dry film thickness of 0.7 - 0.8 mil color coat for a total 0.9 to 1.1 mil total system dry film thickness. Finish to be selected from manufacturer's standard color

selection. The back side of the material should be 0.25 mil primer and 0.25 mil polyester wash coat.

c. Color: As selected by Engineer from manufacturer's full range <Insert color>.

4. Clips: One-piece fixed to accommodate thermal movement.
   a. Material: 0.064-inch- (1.63-mm-) nominal thickness, zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet.

5. Joint Type: As standard with manufacturer.

6. Panel Coverage: 16 inches (406 mm).

7. Panel Height: 2.375 inches (60.325 mm).

2.03 UNDERLAYMENT MATERIALS

A. Self-Adhering, High-Temperature Underlayment: Provide self-adhering, cold-applied, sheet underlayment, a minimum of 30 mils (0.76 mm) thick, consisting of slip-resistant, polyethylene-film top surface laminated to a layer of butyl or SBS-modified asphalt adhesive, with release-paper backing. Provide primer when recommended by underlayment manufacturer.

1. Thermal Stability: Stable after testing at 240 deg F (116 deg C); ASTM D 1970.

2. Low-Temperature Flexibility: Passes after testing at minus 20 deg F (29 deg C); ASTM D 1970.

3. Products: Provide one of the following:
   a. Carlisle Residential, a division of Carlisle Construction Materials; WIP 300HT.
   b. Grace Construction Products, a unit of W. R. Grace & Co.
   c. Henry Company; Blueskin PE200 HT.
   d. Kirsch Building Products, LLC; Sharkskin Ultra SA.
   e. Metal-Fab Manufacturing, LLC; MetShield.
   f. Owens Corning; WeatherLock Metal High Temperature Underlayment.
   g. Or equal.

B. Slip Sheet: Manufacturer's recommended slip sheet, of type required for application.

2.04 MISCELLANEOUS MATERIALS

A. Miscellaneous Metal Subframing and Furring: ASTM C 645; cold-formed, metallic-coated steel sheet, ASTM A 653/A 653M, G90 (Z275 hot-dip galvanized) coating designation or ASTM A 792/A 792M, Class AZ50 (Class AZM150) coating designation unless otherwise indicated. Provide manufacturer's standard sections as required for support and alignment of metal panel system.

B. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, copings, fasciae, soffit panels, mullions, sills, corner units, clips, flashings,

sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.

1. Closures: Provide closures at eaves and ridges, fabricated of same metal as metal panels.

2. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.

3. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch- (25-mm-) thick, flexible closure strips; cut or premolded to match metal panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.

C. Flashing and Trim: Provide flashing and trim formed from same material as metal panels as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, eaves, rakes, corners, bases, framed openings, ridges, fasciae, and fillers. Finish flashing and trim with same finish system as adjacent metal panels.

D. Soffit Panels: Provide soffit panels formed from same material as metal panels. Soffit panels to be solid and roll-formed to exact lengths. Finish soffit panels with same finish system as adjacent metal panels.

E. Gutters: Formed from same material as roof panels, complete with end pieces, outlet tubes, and other special pieces as required. Fabricate in minimum 96-inch (2400-mm) long sections, of size and metal thickness according to SMACNA's "Architectural Sheet Metal Manual." Furnish gutter supports spaced a maximum of 36 inches (914 mm) o.c., fabricated from same metal as gutters. Provide wire ball strainers of compatible metal at outlets. Finish gutters to match metal roof panels.

F. Downspouts: Formed from same material as roof panels. Fabricate in 10-foot- (3-m-) long sections, complete with formed elbows and offsets, of size and metal thickness according to SMACNA's "Architectural Sheet Metal Manual." Finish downspouts to match gutters.

G. Roof Curbs: Fabricated from same material as roof panels, 0.048-inch (1.2-mm) nominal thickness; with bottom of skirt profiled to match roof panel profiles and with welded top box and
integral full-length cricket. Fabricate curb subframing of 0.060-inch (1.52-mm) nominal thickness, angle-, C-, or Z-shaped steel sheet. Fabricate curb and subframing to withstand indicated loads of size and height indicated. Finish roof curbs to match metal roof panels.

1. Insulate roof curb with 1-inch (25-mm) thick, rigid insulation.

H. Panel Fasteners: Self-tapping screws designed to withstand design loads.

I. Panel Sealants: Provide sealant type recommended by manufacturer that are compatible with panel materials, are nonstaining, and do not damage panel finish.

1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch (13 mm) wide and 1/8 inch (3 mm) thick.

2. Joint Sealant: ASTM C 920; elastomeric polyurethane or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal panels and remain weathertight; and as recommended in writing by metal panel manufacturer.

3. Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C 1311.

2.05 FABRICATION

A. General: Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.

B. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.

C. Fabricate metal panel joints with factory-installed captive gaskets or separator strips that provide a weathertight seal and prevent metal-to-metal contact, and that minimize noise from movements.

D. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.

1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.

2. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.

3. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.

4. Sealed Joints: Form non-expansion, but movable, joints in metal to accommodate sealant and to comply with SMACNA standards.

5. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.

6. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended in writing by metal panel manufacturer.

a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal panel manufacturer for application, but not less than thickness of metal being secured.

2.06 FINISHES

A. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in same piece are unacceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

C. Steel Panels and Accessories:

1. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

2. Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester backer finish consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil (0.013 mm).

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal panel supports, and other conditions affecting performance of the Work.

1. Examine primary and secondary roof framing to verify that rafters, purlins, angles, channels, and other structural panel support members and anchorages have been installed within alignment tolerances required by metal roof panel manufacturer.

2. Examine solid roof sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal roof panel manufacturer.
   a. Verify that air- or water-resistive barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.

B. Examine roughing-in for components and systems penetrating metal panels to verify actual locations of penetrations relative to seam locations of metal panels before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages according to ASTM C 754 and metal panel manufacturer's written recommendations.

3.03 UNDERLAYMENT INSTALLATION

A. Self-Adhering Sheet Underlayment: Apply primer if required by manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation. Apply at locations indicated [below] [on Drawings], wrinkle free, in shingle fashion to shed water, and with end laps of not less than 6 inches (152 mm) staggered 24 inches (610 mm) between courses. Overlap side edges not less than 3-1/2 inches (90 mm).[Extend underlayment into gutter trough.] Roll laps with roller. Cover underlayment within 14 days.

1. Apply over the entire roof surface.

B. Slip Sheet: Apply slip sheet over underlayment before installing metal roof panels.

3.04 METAL PANEL INSTALLATION

A. General: Install metal panels according to manufacturer's written instructions in orientation, sizes, and locations indicated. Install panels perpendicular to supports unless otherwise indicated. Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.

1. Shim or otherwise plumb substrates receiving metal panels.

2. Flash and seal metal panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until air- or water-resistive barriers and flashings that will be concealed by metal panels are installed.

3. Install screw fasteners in predrilled holes.

4. Locate and space fastenings in uniform vertical and horizontal alignment.

5. Install flashing and trim as metal panel work proceeds.

6. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.

7. Align bottoms of metal panels and fasten with blind rivets, bolts, or self-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws.

8. Provide weathertight escutcheons for pipe- and conduit-penetrating panels.

B. Fasteners:

1. Steel Panels: Use stainless-steel fasteners for surfaces exposed to the exterior; use galvanized-steel fasteners for surfaces exposed to the interior.

C. Anchor Clips: Anchor metal roof panels and other components of the Work securely in place, using manufacturer's approved fasteners according to manufacturers' written instructions.

D. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by metal panel manufacturer.

E. Standing-Seam Metal Roof Panel Installation: Fasten metal roof panels to supports with concealed clips at each standing-seam joint at location, spacing, and with fasteners recommended in writing by manufacturer.

1. Install clips to supports with self-tapping fasteners.

2. Install pressure plates at locations indicated in manufacturer's written installation instructions.

3. Seamed Joint: Crimp standing seams with manufacturer-approved, motorized seamer tool so clip, metal roof panel, and factory-applied sealant are completely engaged.

4. Watertight Installation:
   a. Apply a continuous ribbon of sealant or tape to seal joints of metal panels, using sealant or tape as recommend in writing by manufacturer as needed to make panels watertight.
   b. Provide sealant or tape between panels and protruding equipment, vents, and accessories.
   c. At panel splices, nest panels with minimum 6-inch (152-mm) end lap, sealed with sealant and fastened together by interlocking clamping plates.

F. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.

1. Install components required for a complete metal panel system including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items. Provide types indicated by metal roof panel manufacturers; or, if not indicated, types recommended by metal roof panel manufacturer.

G. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.

1. Install exposed flashing and trim that is without buckling and tool marks, and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal

flashing and trim to fit substrates and achieve waterproof and weather-resistant performance.

2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet (3 m) with no joints allowed within 24 inches (610 mm) of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently weather resistant and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with mastic sealant (concealed within joints).

H. Gutters: Join sections with riveted and soldered or lapped and sealed joints. Attach gutters to eave with gutter hangers spaced not more than 36 inches (914 mm) o.c. using manufacturer's standard fasteners. Provide end closures and seal watertight with sealant. Provide for thermal expansion.

I. Downspouts: Join sections with telescoping joints. Provide fasteners designed to hold downspouts securely 1 inch (25 mm) away from walls; locate fasteners at top and bottom and at approximately 60 inches (1524 mm) o.c. in between.

1. Provide elbows at base of downspouts to direct water away from building.

J. Roof Curbs: Install flashing around bases where they meet metal roof panels.

K. Pipe Flashing: Form flashing around pipe penetration and metal roof panels. Fasten and seal to metal roof panels as recommended by manufacturer.

3.05 ERECTION TOLERANCES

A. Installation Tolerances: Shim and align metal panel units within installed tolerance of 1/4 inch in 20 feet (6 mm in 6 m) on slope and location lines as indicated and within 1/8-inch (3-mm) offset of adjoining faces and of alignment of matching profiles.

3.06 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect metal roof panel installation, including accessories. Report results in writing.

B. Remove and replace applications of metal roof panels where tests and inspections indicate that they do not comply with specified requirements.

C. Additional tests and inspections, at Contractor's expense, are performed to determine compliance of replaced or additional work with specified requirements.

D. Prepare test and inspection reports.

3.07 CLEANING AND PROTECTION

A. Remove temporary protective coverings and strippable films, if any, as metal panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.

B. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION

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SECTION 07900
JOINT SEALERS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all materials, labor, equipment and incidentals required to install all sealants, caulking joint fillers, and accessories as shown on the Drawings and as specified herein.

B. Seal joints as indicated in the schedule at the end of this Section. Joints noted on the drawings for "sealant," "caulk," or "caulking" shall be sealed as specified herein. Joints of a similar nature to those in the schedule shall be sealed in accordance with the schedule, whether so indicated on the Drawings or not.

1. Seal all exterior joints between adjacent materials, joints between frames or louvers and adjacent materials, copings, masonry control joints, and all other joints shown on the Drawings or required for completion of the work.

2. Seal all interior joints between frames and masonry, at tops of masonry walls, between masonry and structural concrete, between floor joints in tile, joints in rooms to be airtight, joints around plumbing fixtures, and all other joints shown on the Drawings or required for completion of the work.

1.02 MEASUREMENT AND PAYMENT

A. No separate payment will be made for work performed under this Section. Include the cost for this work in the lump sum Base Bid Item in Section 00410.

1.03 RELATED WORK

A. Concrete Joint and Joint Accessories are included in Section 03250.

1.04 DEFINITIONS

A. Substrate type shall be as defined in ASTM C920 and as follows:

1. Type M: Concrete, concrete masonry units, brick, mortar and natural stone. The term masonry shall be defined to include brick, stone, and concrete masonry work.

2. Type G: Glass and transparent plastic glazing sheets.

3. Type A: Metals, porcelain, glazed tile, and smooth plastics.

4. Type O: Wood, unglazed tile, and substrates not included in preceding categories.

1.05 SUBMITTALS

A. Materials and accessories for concrete joints are specified in Division 3. Materials and accessories for masonry joints are specified in Division 4. Submit sealers for concrete and masonry joints together with required joint accessories in a single package. Materials used together in the same joint shall be compatible.

B. Shop drawings and product data, in accordance with Section 01330, showing materials of construction and details of installation for:

1. Sealers. Manufacturer's catalog cuts, specification data, color chart, and installation instructions. Demonstrate compliance with ASTM standards specified including specific type, grade, and class. Identify end use and location of each material submitted. Include manufacturer's cautions regarding substrates, substrate preparation, or materials that will inhibit bond or otherwise damage the sealer.

C. Samples

1. Sealers exposed to view. Submit two sets of cured samples of actual products in full range of manufacturer's standard colors.

2. Submit for review two sets of representative samples of any or all other materials required for the work of this Section when requested by the Engineer.

1.06 REFERENCE STANDARDS

A. American Society for Testing and Materials (ASTM)

1. ASTM C920 - Standard Specification for Elastomeric Joint Sealants.

2. ASTM C1193 - Standard Guide for Use of Joint Sealants.

B. National Sanitation Foundation (NSF)

1. Standard 61 - Drinking Water System Components Health Effects.

2. Listings - Drinking Water System Components.

C. Where reference is made to one of the preceding standards, the revision in effect at the time of bid opening shall apply unless specifically indicated otherwise.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in unbroken, sealed original containers with legible labels showing manufacturer, product name or designation, color, shelf life, and installation instructions.

B. Store sealers in accordance with the manufacturer's instructions. Do not use sealers that have been stored for a period of time exceeding the recommended shelf life of the materials.

1.08 PROJECT/SITE REQUIREMENTS

A. Environmental Requirements

1. Do not install sealers if any of the following conditions exist:
   a. Air or substrate temperature exceeds the range recommended by the sealer manufacturer, or is below 40°F.
   b. Substrate is wet, damp, or covered with snow, ice, frost, or other deleterious material.

B. Dimensional Requirements

1. Provide sealer depth as recommended by the manufacturer. If no other recommendations are provided, sealer depth shall be equal to one-half the width of the joint being sealed.

2. Do not install sealers if joint dimensions are less than or greater than that recommended by the sealer manufacturer. In such cases, obtain sealer manufacturer's recommendations for alternative procedures, and advise Architect/Engineer of anticipated modifications.

1.09 WARRANTY

A. Submit written warranty signed by General Contractor, Installer, and Product Manufacturer, jointly guaranteeing to correct failures in sealer work that occur within 5 years after substantial completion, without reducing or otherwise limiting any other rights to correction that the Owner may have under the provisions of these Contract Documents. Failure is defined to mean failure to remain watertight due to faulty materials or workmanship.

PART 2 PRODUCTS

2.01 GENERAL

A. The use of a manufacturer's name and model or catalog number is for the purpose of establishing the standard of quality and general configuration desired.

B. Like items of materials/equipment shall be the end products of one manufacturer in order to provide standardization for appearance.

C. Provide only materials that are compatible with the substrates, with each other, and with other construction to be incorporated into the joints.

D. Sealer colors shall be as selected by the Architect/Engineer from manufacturer's standard colors.

2.02 MATERIALS

A. Elastomeric Sealant. Sealant shall comply with the requirements of ASTM C920 including specific Type, Grade, Class, and Uses indicated. Sealants for use in contact with potable water shall be listed by NSF as complying with the requirements of NSF Standard 61 and shall be resistant to chlorine concentrations of up to 4 milligrams per liter (mg/L).

1. Polyurethane or Polysulfide Sealant
   a. Exterior and interior sealant for joints on the horizontal plane shall be a two-part, pourable, self-leveling polyurethane or polysulfide-based sealant conforming to the requirements of ASTM C920, Class 25. Use shall be NT, M, G, A, or O as required by the substrate.
   b. Exterior and interior sealant for joints on surfaces other than horizontal shall be a one-part, non-sag or gun-grade polyurethane or polysulfide-based conforming to the requirements of ASTM C920, Class 25. Use shall be NT, M, G, A, or O as required by the substrate.

2. Silicone Sealants
   a. Medium Movement Silicone Sealant: One- or two-part non-acid-curing, Grade NS, Class 25, Use NT. Sealant shall provide movement capability of more than 25 percent, but less than 50 percent, in both extension and compression.
   b. Mildew-Resistant Silicone Sealant: One-part, Type S, Grade NS, Class 25, Use NT. Sealant shall be formulated with fungicide and suitable for interior use on nonporous surfaces.

B. Sealant Backers

1. Backers shall be non-staining and as recommended by the sealant manufacturer for their specific use.

2. Backer Rod, unless otherwise restricted by the sealant manufacturer, shall be flexible, non-absorbent, non-gassing closed cell compressible polyurethane foam preformed to the appropriate size and shape.

3. Bond-Breaker Tape, unless otherwise restricted by the sealant manufacturer, shall be self-adhesive polyethylene or other plastic tape suitable for preventing sealant adhesion.

C. Miscellaneous Materials

1. Primers shall be as recommended by the sealant manufacturer.

2. Cleaners shall be as recommended by the sealant manufacturer. Cleaners shall not damage the finish of materials adjacent to the sealed area.

3. Masking tape shall be non-absorbent and non-staining.

4. Tooling agents shall be as recommended by the sealant manufacturer, and shall be non-staining to the sealant or substrate.

PART 3 EXECUTION

3.01 PREPARATION

A. Verification of Conditions

1. Examine joints for characteristics that may affect sealer performance, including configuration and dimensions.

2. Do not begin installation of joint sealers until unsatisfactory conditions have been corrected.

B. Surface Preparation

1. Cleaning. Just before beginning sealer installation, clean out joints in accordance with the recommendations of the sealer manufacturer and as follows:
   a. Remove all materials that might impair adhesion, including dust, dirt, coatings, paint, oil, and grease.
   b. Thoroughly dry damp and wet surfaces.
   c. Clean substrates using methods that will not leave residues or impair adhesion.
      1) Clean type M and type O substrates by suitable mechanical or chemical methods. Remove laitance and form-release coatings from concrete. Remove loose particles by vacuuming or blowing with oil-free compressed air.
      2) Clean type A and type G substrates by chemical or other methods that will not damage the substrate.

2. Masking. Install masking tape to keep primers and sealers off adjacent surfaces that would be damaged by contact or cleanup, and to provide a neat, finished edge. Remove tape as soon as practical.

3. Priming. Prime substrate as recommended by the sealer manufacturer

4. Install fillers where needed to provide proper joint depth or support for sealant backers.

3.02 INSTALLATION

A. Comply with sealer manufacturers' installation instructions and recommendations, except where more restrictive requirements are specified.

B. Backers. Install backers at depth required to provide shape and depth of installed sealant that allows the greatest joint movement without sealant failure. Make backers continuous without gaps, tears, or punctures. Do not stretch or twist backers. If backers become wet or damp before installation of sealant, thoroughly dry before proceeding.

C. Bond-breaker tape. Use bond breaker tape where indicated or necessary to prevent sealant from adhering to back or third side of joint.

D. Sealants. Install sealants in accordance with ASTM C1193. Using methods recommended by the manufacturer, completely fill the joints. Unless otherwise recommended by the sealant

manufacturer or detailed on the Drawings, install sealant with a 2 to 1 ratio of width to thickness. Make full contact with bonding surfaces. Tool non-sag sealants to smooth surfaces, eliminating air pockets. Tooling shall be to concave joint shape shown in Figure 5A of ASTM C1193 unless otherwise indicated.

3.03 PROTECTION AND CLEANING

A. Maintain surfaces of all materials adjoining sealed joints free of smears or soiling due to sealing operations. Clean surfaces adjacent to joints as work progresses and before sealants set using methods and materials approved by manufacturers of sealers and of surfaces to be cleaned.

B. Protect joint sealers from contamination and damage.

C. Remove and replace damaged sealers.

3.04 SCHEDULES

A. General

1. Unless otherwise indicated, joints around the perimeter of frames shall be sealed using sealer specified for the substrate adjacent to the frame.

B. Expansion and control joints in exterior and interior surfaces of cast-in-place concrete or masonry walls:

1. Non-sag polyurethane or polysulfide sealant; concave joint configuration.

2. Backer rod or bond-breaker tape.

C. Expansion and control joints in exterior and interior surfaces of cast-in-place concrete slabs:

1. Self-leveling polyurethane or polysulfide sealant.

2. Backer rod or bond-breaker tape.

D. Interior joints at wet areas above Finish Floor (including perimeter of bath fixtures, counter tops, glazed ceramic tile areas):

1. Mildew-resistant silicone sealant; concave joint configuration.

2. Bond-breaker tape where appropriate.

E. Exterior or interior joints for which no other sealer is indicated:

1. Medium movement silicone sealant; concave joint configuration.

2. Backer rod or bond-breaker tape.

END OF SECTION

SECTION 08111
STANDARD STEEL DOORS AND FRAMES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 MEASUREMENT AND PAYMENT

A. No separate payment will be made for work performed under this Section. Include the cost for this work in the lump sum Base Bid.

1.03 SUMMARY

A. This Section includes the following:

1. Standard hollow-metal steel doors.

2. Standard hollow-metal steel frames.

B. Related Sections include the following:

1. Division 4 Section "Unit Masonry" for building anchors into and grouting standard steel frames in masonry construction.

2. Division 8 Sections for door hardware for standard steel doors.

3. Division 9 painting Sections for field painting standard steel doors and frames.

1.04 DEFINITIONS

A. Minimum Thickness: Minimum thickness of base metal without coatings.

1.05 SUBMITTALS

A. Product Data: Include construction details, material descriptions, core descriptions, label compliance, fire-resistance and temperature-rise ratings, and finishes for each type of steel door and frame specified.

B. Shop Drawings: In addition to requirements below, provide a schedule of standard steel doors and frames using same reference numbers for details and openings as those on Drawings:

1. Elevations of each door design.

2. Details of doors, including vertical and horizontal edge details.

3. Frame details for each frame type, including dimensioned profiles.

4. Details and locations of reinforcement and preparations for hardware.

5. Details of each different wall opening condition.

6. Details of anchorages, accessories, joints, and connections.

7. Details of glazing frames and stops showing glazing.

8. Details of conduit and preparations for electrified door hardware and controls.

C. Coordination Drawings: Drawings of each opening, including door and frame, drawn to scale and coordinating door hardware. Show elevations of each door design type, showing dimensions, locations of door hardware, and preparations for power, signal, and electrified control systems.

D. Samples for Initial Selection: For units with factory-applied color finishes.

E. Samples for Verification: For each type of exposed finish required, prepared on Samples of not less than 3 by 5 inches (75 by 125 mm).

F. Qualification Data: For Installer.

1.06 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers trained and approved by manufacturer.

B. Source Limitations: Obtain standard steel doors and frames through one source from a single manufacturer.

C. Smoke-Control Door Assemblies: Comply with NFPA 105 or UL 1784.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver doors and frames palletized, wrapped, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.

1. Provide additional protection to prevent damage to finish of factory-finished doors and frames.

B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.

C. Store doors and frames under cover at Project site. Place units in a vertical position with heads up, spaced by blocking, on minimum 4-inch- (102-mm-) high wood blocking. Avoid using non-vented plastic or canvas shelters that could create a humidity chamber.

1. If wrappers on doors become wet, remove cartons immediately. Provide minimum 1/4-inch (6-mm) space between each stacked door to permit air circulation.

1.08 PROJECT CONDITIONS

A. Field Measurements: Verify openings by field measurements before fabrication and indicate measurements on shop drawings.

1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish opening dimensions and proceed with fabricating standard steel frames without field measurements. Coordinate wall construction to ensure that actual opening dimensions correspond to established dimensions.

1.09 COORDINATION

A. Coordinate installation of anchorages for standard steel frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Amweld Building Products, LLC.
2. Benchmark Doors; a division of General Products Co., Inc.
3. Ceco Door Products; an ASSA ABLOY Group Company.
4. CURRIES Company; an ASSA ABLOY Group Company.
5. Deansteel Manufacturing, Inc.
6. Fleming Door Products Ltd.; an ASSA ABLOY Group Company.
7. Kewanee Corporation (The).
8. Mesker Door Inc.
9. Pioneer Industries, Inc.
10. Republic Builders Products Company.
11. Steelcraft; an Ingersoll-Rand Company.

2.02 MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.

B. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.

C. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum A40 (ZF120) zinc-iron-alloy (galvannealed) coating designation.

D. Electrolytic Zinc-Coated Steel Sheet: ASTM A 591/A 591M, Commercial Steel (CS), Class B coating; mill phosphatized.

E. Supports and Anchors: After fabricating, galvanize units to be built into exterior walls according to ASTM A 153/A 153M, Class B.

F. Inserts, Bolts, and Fasteners: Provide items to be built into exterior walls, hot-dip galvanized according to ASTM A 153/A 153M.

G. Powder-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching standard steel door frames of type indicated.

H. Grout: Comply with Division 4 Section "Unit Masonry."

I. Grout: Comply with ASTM C 476, with a slump of 4 inches (102 mm) for standard steel door frames built into concrete or masonry, as measured according to ASTM C 143/C 143M.

J. Mineral-Fiber Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool with 6- to 12-lb/ft^3 (96- to 192-kg/m^3) density; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics.

K. Glazing: Comply with requirements in Division 8 Section "Glazing."

L. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil (0.4-mm) dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.03 STANDARD STEEL DOORS

A. General: Provide doors of design indicated, not less than thickness indicated; fabricated with smooth surfaces, without visible joints or seams on exposed faces, unless otherwise indicated. Comply with ANSI A250.8.

1. Design: Flush panel.

2. Core Construction: Manufacturer's standard Kraft-paper honeycomb, polystyrene, polyurethane, mineral-board, or vertical steel-stiffener core that produces doors complying with ANSI A250.8.
   a. Fire Door Core: As required to provide fire-protection and temperature-rise ratings indicated.
   b. Thermal-Rated (Insulated) Doors: Where indicated, provide doors fabricated with thermal-resistance value (R-value) of not less than 4.0 deg F x h x ft^2/Btu (0.704 K x m^2/W) when tested according to ASTM C 1363.
      1) Locations: Exterior doors and interior doors unless otherwise indicated.

3. Vertical Edges for Single-Acting Doors: Square edge and Beveled edge unless square edge is indicated.
   a. Beveled Edge: 1/8 inch in 2 inches (3 mm in 50 mm).

4. Vertical Edges for Double-Acting Doors: Round vertical edges with 2-1/8-inch (54-mm) radius.

5. Top and Bottom Edges: Closed with flush or inverted 0.042-inch- (1.0-mm-) thick end closures or channels of same material as face sheets.

6. Tolerances: Comply with SDI 117, "Manufacturing Tolerances for Standard Steel Doors and Frames."

B. Exterior Doors: Face sheets fabricated from metallic-coated steel sheet. Provide doors complying with requirements indicated below by referencing ANSI A250.8 for level and model and ANSI A250.4 for physical endurance level:

1. Level 2 and Physical Performance Level B (Heavy Duty), Model 1 (Full Flush) and 2 (Seamless).

C. Hardware Reinforcement: Fabricate reinforcement plates from same material as door face sheets to comply with the following minimum sizes:

1. Hinges: Minimum 0.123 inch (3.0 mm) thick by 1-1/2 inches (38 mm) wide by 6 inches (152 mm) longer than hinge, secured by not less than six spot welds.

2. Lock Face, Flush Bolts, Closers, and Concealed Holders: Minimum 0.067 inch (1.7 mm) thick.

3. All Other Surface-Mounted Hardware: Minimum 0.067 inch (1.7 mm) thick.

D. Fabricate concealed stiffeners and hardware reinforcement from either cold- or hot-rolled steel sheet.

2.04 STANDARD STEEL FRAMES

A. General: Comply with ANSI A250.8 and with details indicated for type and profile.

B. Exterior Frames: Fabricated from metallic-coated steel sheet.

1. Fabricate frames with mitered or coped and welded face corners and seamless face joints.

C. Interior Frames: Fabricated from cold-rolled steel sheet, unless otherwise indicated to comply with exterior frame requirements.

1. Fabricate frames with mitered or coped and welded face corners and seamless face joints, unless otherwise indicated.

D. Hardware Reinforcement: Fabricate reinforcement plates from same material as frames to comply with the following minimum sizes:

1. Hinges: Minimum 0.123 inch (3.0 mm) thick by 1-1/2 inches (38 mm) wide by 6 inches (152 mm) longer than hinge, secured by not less than 6 spot welds.

2. Lock Face, Flush Bolts, Closers, and Concealed Holders: Minimum 0.067 inch (1.7 mm) thick.

3. All Other Surface-Mounted Hardware: Minimum 0.067 inch (1.7 mm) thick.

E. Supports and Anchors: Fabricated from electrolytic zinc-coated or metallic-coated steel sheet.

F. Jamb Anchors:

1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, not less than 0.042 inch (1.0 mm) thick, with corrugated or perforated straps not less than 2 inches (50 mm) wide by 10 inches (250 mm) long; or wire anchors not less than 0.177 inch (4.5 mm) thick.

2. Compression Type for Slip-on Frames: Adjustable compression anchors.

G. Floor Anchors: Formed from same material as frames, not less than 0.042 inch (1.0 mm) thick, and as follows:

1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.

2. Separate Topping Concrete Slabs: Adjustable-type anchors with extension clips, allowing not less than 2-inch (50-mm) height adjustment. Terminate bottom of frames at finish floor surface.

H. Fabricate concealed stiffeners and hardware reinforcement from either cold- or hot-rolled steel sheet.

I. Ceiling Struts: Minimum 3/8-inch-thick by 2-inch- (9.5-mm-thick by 50-mm-) wide steel.

2.05 STOPS AND MOLDINGS

A. Moldings for Glazed Lites in Doors: Minimum 0.032 inch (0.8 mm) thick, fabricated from same material as door face sheet in which they are installed.

B. Fixed Frame Moldings: Formed integral with standard steel frames, minimum 5/8 inch (16 mm) high, unless otherwise indicated.

C. Loose Stops for Glazed Lites in Frames: Minimum 0.032 inch (0.8 mm) thick, fabricated from same material as frames in which they are installed.

2.06 FABRICATION

A. General: Fabricate standard steel doors and frames to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.

B. Standard Steel Doors:

1. Exterior Doors: Provide weep-hole openings in bottom of exterior doors to permit moisture to escape. Seal joints in top edges of doors against water penetration.

2. Glazed Lites: Factory cut openings in doors.

C. Standard Steel Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.

1. Welded Frames: Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and invisible.

2. Sidelight and Transom Bar Frames: Provide closed tubular members with no visible face seams or joints; fabricated from same material as door frame. Fasten members at crossings and to jambs by butt welding.

3. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners, unless otherwise indicated.

4. Plaster Guards: Weld guards to frame at back of hardware mortises in frames installed in concrete or masonry.

5. Where installed in masonry, leave vertical mullions in frames open at top for grouting.

6. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.

7. Jamb Anchors: Provide number and spacing of anchors as follows:
   a. Masonry Type: Locate anchors not more than 18 inches (457 mm) from top and bottom of frame. Space anchors not more than 32 inches (813 mm) O.C. and as follows:
      1) Two anchors per jamb up to 60 inches (1524 mm) in height.
      2) Three anchors per jamb from 60 to 90 inches (1524 to 2286 mm) in height.
      3) Four anchors per jamb from 90 to 120 inches (2286 to 3048 mm) in height.
      4) Four anchors per jamb plus 1 additional anchor per jamb for each 24 inches (610 mm) or fraction thereof more than 120 inches (3048 mm) in height.

8. Door Silencers: Except on weather-stripped doors, drill stops to receive door silencers as follows. Provide plastic plugs to keep holes clear during construction.
   a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
   b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.

D. Hardware Preparation: Factory prepare standard steel doors and frames to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping, according to the Door Hardware Schedule and templates furnished as specified in Division 8 Section "Door Hardware."

1. Reinforce doors and frames to receive nontemplated mortised and surface-mounted door hardware.

2. Comply with applicable requirements in ANSI A250.6 and ANSI/DHI A115 Series specifications for door and frame preparation for hardware. Locate hardware as indicated on shop drawings or, if not indicated, according to ANSI A250.8.

E. Stops and Moldings: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with butted or mitered hairline joints.

1. Single Glazed Lites: Provide fixed stops and moldings welded on secure side of door or frame.

2. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.

3. Provide loose stops and moldings on inside of doors and frames.

4. Coordinate rabbet width between fixed and removable stops with type of glazing and type of installation indicated.

2.07 STEEL FINISHES

A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

1. Finish standard steel door and frames after assembly.

B. Metallic-Coated Steel Surface Preparation: Clean surfaces with nonpetroleum solvent so surfaces are free of oil and other contaminants. After cleaning, apply a conversion coating suited to the organic coating to be applied over it. Clean welds, mechanical connections, and abraded areas, and apply galvanizing repair paint specified below to comply with ASTM A 780.

1. Galvanizing Repair Paint: High-zinc-dust-content paint for re-galvanizing welds in steel, complying with SSPC-Paint 20.

C. Steel Surface Preparation: Clean surfaces to comply with SSPC-SP 1, "Solvent Cleaning"; remove dirt, oil, grease, or other contaminants that could impair paint bond. Remove mill scale and rust, if present, from uncoated steel; comply with SSPC-SP 3, "Power Tool Cleaning," or SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."

D. Factory Priming for Field-Painted Finish: Apply shop primer specified below immediately after surface preparation and pretreatment. Apply a smooth coat of even consistency to provide a uniform dry film thickness of not less than 0.7 mils (0.018 mm).

1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with ANSI A250.10 acceptance criteria; recommended by primer manufacturer for substrate; compatible with substrate and field-applied finish paint system indicated; and providing a sound foundation for field-applied topcoats despite prolonged exposure.

E. Factory-Applied Paint Finish: Manufacturer's standard, complying with ANSI A250.3 for performance and acceptance criteria.

1. Color and Gloss: As selected by Architect from manufacturer's full range.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of standard steel doors and frames.

1. Examine roughing-in for embedded and built-in anchors to verify actual locations of standard steel frame connections before frame installation.

2. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.

3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Remove welded-in shipping spreaders installed at factory.

B. Prior to installation and with installation spreaders in place, adjust and securely brace standard steel door frames for squareness, alignment, twist, and plumb to the following tolerances:

1. Squareness: Plus or minus 1/16 inch (1.6 mm), measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.

2. Alignment: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a horizontal line parallel to plane of wall.

3. Twist: Plus or minus 1/16 inch (1.6 mm), measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.

4. Plumbness: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a perpendicular line from head to floor.

C. Drill and tap doors and frames to receive nontemplated mortised and surface-mounted door hardware.

3.03 INSTALLATION

A. General: Provide doors and frames of sizes, thicknesses, and designs indicated. Install standard steel doors and frames plumb, rigid, properly aligned, and securely fastened in place; comply with Drawings and manufacturer's written instructions.

B. Standard Steel Frames: Install standard steel frames for doors, sidelights, transoms, borrowed lights and other openings, of size and profile indicated. Comply with SDI 105.

1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.
   a. At fire-protection-rated openings, install frames according to NFPA 80.
   b. Where frames are fabricated in sections due to shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
   c. Install frames with removable glazing stops located on secure side of opening.
   d. Install door silencers in frames before grouting.
   e. Remove temporary braces necessary for installation only after frames have been properly set and secured.
   f. Check plumb, squareness, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
   g. Apply bituminous coating to backs of frames that are filled with mortar, grout, and plaster containing antifreezing agents.

2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor and secure with postinstalled expansion anchors.
   a. Floor anchors may be set with powder-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on shop drawings.

3. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with mortar as specified in Division 4 Section "Unit Masonry Assemblies."

4. Ceiling Struts: Extend struts vertically from top of frame at each jamb to supporting construction above, unless frame is anchored to masonry or to other structural support at each jamb. Bend top of struts to provide flush contact for securing to supporting construction above. Provide adjustable wedged or bolted anchorage to frame jamb members.

5. Installation Tolerances: Adjust standard steel door frames for squareness, alignment, twist, and plumb to the following tolerances:
   a. Squareness: Plus or minus 1/16 inch (1.6 mm), measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
   b. Alignment: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a horizontal line parallel to plane of wall.
   c. Twist: Plus or minus 1/16 inch (1.6 mm), measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
   d. Plumbness: Plus or minus 1/16 inch (1.6 mm), measured at jambs at floor.

C. Standard Steel Doors: Fit hollow-metal doors accurately in frames, within clearances specified below. Shim as necessary.

1. Non-Fire-Rated Standard Steel Doors:
   a. Jambs and Head: 1/8 inch (3 mm) plus or minus 1/16 inch (1.6 mm).
   b. Between Edges of Pairs of Doors: 1/8 inch (3 mm) plus or minus 1/16 inch (1.6 mm).
   c. Between Bottom of Door and Top of Threshold: Maximum 3/8 inch (9.5 mm).
   d. Between Bottom of Door and Top of Finish Floor (No Threshold): Maximum 3/4 inch (19 mm).

2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.

3. Smoke-Control Doors: Install doors according to NFPA 105.

D. Glazing: Comply with installation requirements in Division 8 Section "Glazing" and with standard steel door and frame manufacturer's written instructions.

1. Secure stops with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches (230 mm) O.C., and not more than 2 inches (50 mm) O.C. from each corner.

3.04 ADJUSTING AND CLEANING

A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including standard steel doors or frames that are warped, bowed, or otherwise unacceptable.

B. Clean grout and other bonding material off standard steel doors and frames immediately after installation.

C. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat, and apply touch up of compatible air-drying primer.

D. Galvannealed Surfaces: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.

END OF SECTION

SECTION 08710
DOOR HARDWARE

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Provide finish hardware throughout the Work, indicated and specified hereinafter and as needed for a complete and proper installation. As needed, hardware shall be of the type and quality suitable to the service required and comparable to other hardware, as specified.

B. "Finish Hardware" includes items known commercially as finish hardware which are required for swing, sliding and folding doors, except special types of unique and non matching hardware specified in the same section as the door and door frame.

C. Extent of finish hardware required is indicated on Drawings and in schedules.

D. Types of finish hardware required include the following:

1. Butt Hinges
2. Continuous Hinges
3. Lock Cylinders and Keys
4. Lock and Latch Sets
5. Exit Devices
6. Closers
7. Electronic Door Control Devices
8. Overhead Holders
9. Door Trim Units

1.02 MEASUREMENT AND PAYMENT

A. No separate payment will be made for work performed under this Section. Include the cost for this work in the lump sum Base Bid Item in Section 00410.

1.03 RELATED SECTIONS

A. Standard Steel Doors and Frames are included in Section 08111.

B. Electrical is included in Division 16.

1.04 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data for each item of hardware in accordance with Division 1 Section "Submittals". Include whatever information may be necessary to show compliance with requirements, and include instructions for installation and for maintenance of operating parts and finish.

B. Hardware Schedule: Submit final hardware schedule in a vertical format as recognized by the Door and Hardware Institute (DHI). Horizontal schedule format will not be accepted. Coordinate hardware with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of hardware.

1. Final Hardware Schedule Content: Based on finish hardware indicated, organize hardware schedule into "hardware sets" indicating complete designations of every item required for each door or opening. Include the following information:
   a. Type, style, function, size and finish of each hardware item.
   b. Name and manufacturer of each item.
   c. Fastenings and other pertinent information.
   d. Index to include location of hardware set cross referenced to indications on Drawings both on floor plans and in door and frame schedule.
   e. Explanation of all abbreviations, symbols, codes, etc., contained in schedule.
   f. Mounting locations for hardware.
   g. Door and frame sizes and materials.
   h. Keying information.
   i. Wiring diagrams with theory of operation.

C. Submittal Sequence: Submit schedule in accordance to Division 1, particularly where acceptance of hardware schedule must precede fabrication of other work (e.g., hollow metal frames) which is critical in the Project construction schedule. Include with schedule the product data, samples, shop drawings of other work affected by finish hardware, and other information essential to the coordinated review of hardware schedule.

D. Keying Schedule: Submit separate detailed schedule indicating clearly how the Owner's final instructions on keying of locks has been fulfilled.

E. Samples if Requested: Prior to submittal of the final hardware schedule and prior to final ordering of finish hardware, submit one sample of each type of exposed hardware unit, finish as required, and tagged with full description for coordination with schedule.

F. Templates: Furnish hardware templates to each fabricator of doors, frames and other work to be factory prepared for the installation of hardware. Upon request, check shop drawings of such other work, to confirm that adequate provisions are made for proper location and installation of hardware.

1.05 QUALITY ASSURANCE

A. Manufacturer: Obtain each type of hardware (latch and lock sets, etc.) from a single manufacturer.

B. Supplier: A recognized architectural finish hardware supplier, with warehousing facilities, who has been furnishing hardware in the Project's vicinity for a period of not less than two years, and who is, or who employs an experienced architectural hardware consultant who is available, at reasonable times during the course of the Work, for consultation about Project's hardware requirements, to Owner, Architect and Contractor.

C. Fire Rated Openings: Provide hardware for fire rated openings in compliance with NFPA Standard No. 80 and local building code requirements. Provide only hardware which has been tested and listed by UL or an approved testing agency for types and sizes of doors required and complies with requirements of door and door frame labels.

D. Where emergency exit devices are required on fire rated doors (with supplementary marking on doors with labels indicating "Fire Door to be Equipped with Fire Exit Hardware") provide labels on exit devices indicating "Fire Exit Hardware

E. This supplier shall be responsible to field check existing openings for proper application of hinge and strikes sizes for all openings.

1.06 REGULATORY REQUIREMENTS

A. Regulatory Requirements

1. Conform to the 2012 International Building Code and Americans With Disabilities Act (ADA).

2. Conform to the U.L. Standards of the Underwriters Laboratories, Inc.

3. Conform to the American National Standards Institute (A.N.S.I.), A115-IG (Installation Guide for Doors and Hardware).

4. Conform to Steel Door Institute (SDI).

B. Substitutions: Requests shall be in accordance with requirements of the General Conditions of these Specifications the Project Manual. Finish hardware substitutions will not be accepted without written approval of the City Engineer or the Consultant. Substituted hardware without City approval shall be removed and replaced with specified hardware, at no added cost to the City.

C. Manufacture: Unless specified otherwise, each type of finish hardware used throughout the Work shall be of the same make or manufacture, although several may be indicated as equal product complying with requirements unless otherwise specified.

D. Hardware Supplier: Supplier must be a recognized builder hardware supplier who has been furnishing hardware in the projects vicinity for a period of not less than two years. Supplier must be or employ an experienced Hardware Consultant who is available, at reasonable times during the course of the Work, for consultation about the project's hardware requirements to the Engineer or Consultant at no additional cost to the Owner.

E. Pre-scheduled Conferences: Prior to final approval of the submittals and installation of the cylinders and keys, the Contractor and Hardware Supplier shall meet in the field with the Engineer, or the Owner's authorized representative and the Consultant to finalize all finish hardware information, the keying schedules and keying requirements, and obtain final instructions in writing.

1.07 PRODUCT HANDLING

A. Tag each item or package separately, with identification related to final hardware schedule, and include basic installation instructions with each item or package.

B. Inventory hardware jointly with representatives of hardware supplier and hardware installer until each is satisfied that count is correct.

C. Deliver individually packaged hardware items at the proper times to the proper locations (shop or project site) for installation.

D. Provide secure lock up for hardware delivered to the Project, but not yet installed. Control handling and installation of hardware items which are not immediately replaceable, so that completion of the Work will not be delayed by hardware losses, both before and after installation.

1.08 GUARANTEES

A. All hardware shall be guaranteed for a period specified below of two years from date of acceptance of the Work. Correct defects in materials and workmanship and operation occurring during the guarantee period to the complete satisfaction of the City at no added cost to the City. All surface door closers shall be guaranteed for five years. Submit guaranty certification for review prior to start of Work.

1. Door Closer: Five years, except electronic closers (two years).

2. Exit Devices: Three years.

3. Hinges: 10 years.

4. All other Hardware: Two years.

1.09 CLEAN-UP

A. In addition to the requirements noted in Division 1, Contractor, upon completion of the Work of this Section, shall remove all oil, grease, or other soiling from exposed surfaces of finish hardware; shall remove all cartons, wrapping, and other debris resulting from work herein; and shall leave the building in a neat, clean, and acceptable condition to the approval of the City Engineer or the Consultant.

PART 2 PRODUCTS

2.01 GENERAL

A. The following materials may be suitable or other materials maybe selected for use during the detailed design at the discretion of the Design-Builder subject to the approval of the Owner.

B. The use of a manufacturer's name and/or equipment model number is for the purpose of establishing the standard of quality and general configuration desired and is not intended as a recommendation or approval of the specific name or model number for the Design-Builder's design.

2.02 SCHEDULED HARDWARE

A. Requirements for design, grade, function, finish, size, and other distinctive qualities of each type of finish hardware are indicated in the Finish Hardware Data Sheet and Hardware Schedule at the end of this Section. Products are identified by using hardware designation numbers of the following.

B. Manufacturer's Product Designations

1. Butt Hinges: Hager
2. Continuous Hinges: Hager
3. Trim Sets: Von Duprin
4. Locksets: Schlage Lock Co.
5. Electromechanical Locks: Stanley/Best
6. Exit Devices: Von Duprin
7. Closers: Dor-O-Matic
8. Automatic Door Operators: LCN Closers
9. Access Control: Sielox (provided by others)
10. Overhead Holders: Glynn-Johnson
11. Kickplates: Ives
12. Silencers: Ives
13. Floor/Wall Stops: Ives
14. Threshold and Weatherstrip: National Guard Products

15. Drip and Storm Guard: Pemko

C. Obtain each type of hardware from only one manufacturer. The identification of each hardware item in the following schedules is that of the first approved manufacturers listed for the item, if not otherwise noted.

D. Provided numbers listed in the following specifications are taken from the catalogs of manufacturers listed as follows:

1. (V) Von Duprin, Inc.; Indianapolis, Indiana
2. (D) Dor-O-Matic; Hardwood Heights, Illinois
3. (R) Rockwood Manufacturing; Rockwood, Pennsylvania
4. (NG) National Guard Products; Memphis, Tennessee
5. (SC) Schlage; Brisbane, California
6. (ST) Stanley Best Access System; Indianapolis, Indiana
7. (H) Hager Companies; St. Louis, Missouri
8. (P) Pemko; Memphis, TN
9. (HID) HID Global (provided with access security control)

2.03 MATERIALS AND FABRICATION

A. General

1. Hand of door: Drawings show direction of slide, swing or hand of each door leaf. Furnish each item of hardware for proper installation and operation of door movement as shown.
2. Manufacturer's Name Plate: Do not use manufacturer's products which have manufacturer's name or trade name displayed in a visible location (omit removable nameplates), except in conjunction with required UL labels and as otherwise acceptable to Architect.
3. Manufacturer's identification will be permitted on rim of lock cylinders only.
4. Finish: All hardware finish shall match US26D unless otherwise indicated. Closer bodies, covers and arms shall be powder coated finish.
5. Lockset Design: Lever handle design shall be similar to SPA as manufactured by Schlage Lock Co.

6. Fasteners: Provide hardware manufactured to conform to published templates, generally prepared for machine screw installation. Do not provide hardware which has been prepared for self tapping sheet metal screws, except as specifically indicated.

7. Furnish screws for installation, with each hardware item. Provide Phillips flat head screws except as otherwise indicated. Finish exposed (exposed under any condition) screws to match hardware finish or, if exposed in surfaces of other work, to match finish of such other work as closely as possible, including "prepared for paint" in surfaces to receive painted finish.

8. Provide concealed fasteners for hardware units which are exposed when door is closed, except to extent no standard units of type specified are available with concealed fasteners. Do not use thru bolts for installation where bolt head or nut on opposite face is exposed in other work, except where it is not feasible to adequately reinforce the Work. In such cases, provide sleeves for each thru bolt or use sex screw fasteners.

9. Tools and Maintenance Instructions for Maintenance: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of finish hardware.

2.04 HINGES, BUTTS, AND PIVOTS

A. Templates: Except for hinges and pivots to be installed entirely (both leaves) into wood doors and frames, provide only template produced units.

B. Screws: Furnish Phillips flat head or machine screws for installation of units, except furnish Phillips flat head or wood screws for installation of units into wood. Finish screw heads to match surface of hinges or pivots.

C. Hinge Pins: Except as otherwise indicated, provide hinge pins as follows:

1. Steel Hinges: Steel pins.

2. Non-ferrous Hinges: Stainless steel pins.

3. Out swing Corridor Doors: Non-removable pins.

4. Interior Doors: Non-rising pins.

5. Tips: Flat button and matching plug, finished to match leaves.

6. Number of hinges: Provide number of hinges indicated but not less than three hinges per door leaf for doors 90-in. or less in height and one additional hinge for each 30-in. of additional height.

D. Acceptable Manufacturers

1. Ives

2. McKinney

3. Hager

E. Supplier shall be responsible for the correct hinge size to fit any existing frames or doors.

F. Furnish hinges in sizes and types as required by architect's details to achieve maximum degree of opening.

2.05 CONTINUOUS HINGES

A. Hinge shall be a pinless assembly of three interlocking extrusions applied to the full height of the door and frame without mortising. The door leaf and jamb leaf shall be geared together for the entire length of the hinge and joined by a channel. Hinge knuckle shall be monolithic in appearance. Continuous hinge with visible knuckle separations are not acceptable. Vertical door loads shall be carried on minimum 3/4" acetal bearings through a full 180 degrees. The door leaf and jamb leaf shall have templated screw hole locations for future replacement needs. All heavy duty hinges (HD) shall have a minimum of 32 bearings for a 7-ft. length.

B. Acceptable Manufacturers

1. Ives

2. Hager Roton

3. Select Products

2.06 LOCK CYLINDERS AND KEYING

A. General: Supplier will meet with Owner to finalize keying requirements and obtain final instructions in writing.

B. Review the keying system with the Owner and provide the type required (master, grandmaster or great grandmaster), either new or integrated with Owner's existing system

C. Furnish Schlage Everest Restricted Patented Keyway Removable Core cylinders for all doors unless specified otherwise, keyed as directed by the Owner.

D. Furnish temporary keyed cores for the construction period, and remove these when directed. The construction cores remain property of the supplier and shall be returned to the supplier when they are removed. Contractor shall install the permanent cores in the presence of the Owner's representative.

E. Metals: Construct lock cylinder parts from brass/bronze, stainless steel or nickel silver.

F. Comply with Owner's instructions for masterkeying and, except as otherwise indicated, provide individual change key for each lock which is not designated to be keyed alike with a group of related locks.

G. Permanently inscribe each key and cylinder with Visual Key Control that identifies cylinder manufacturer key symbol, and inscribe key with the notation "DO NOT DUPLICATE".

H. Key Material: Provide keys of nickel silver only.

I. Key Quantity

1. Furnish three change keys for each lock.

2. Three master keys for each master system.

3. One grandmaster keys for each grandmaster system.

4. One extra blank for each lock.

5. Three Control Keys (Construction and Permanent).

6. Four Construction master keys.

J. Deliver keys as directed by the Owner.

K. Key Control System: Provide a key control system including envelopes, labels tags with self-locking clips, receipt forms, three-way visible card index, and standard metal cabinet, with a capacity for 150 percent of the number of locks required for this Project.

1. Key cabinet and system shall be provided as a part of this contract by the hardware supplier. Cabinet shall be indexed and set up by supplier with the Owner's representative.

2.07 LOCKS, LATCHES, AND BOLTS

A. Locks shall meet these certifications:

1. Cylindrical Locks - ANSI A156.2 Series 4000, Grade 1 Strength and Operational requirements. Meets A117.1 Accessibility Codes. Latch bolts shall be steel with minimum 1/2-in. throw, deadlocking on keyed and exterior functions; 3/4-in. throw anti-friction latchbolt on pairs of fire doors. Strikes: Provide manufacturer's standard wrought box strike for each latch or lock bolt, with curved lip extended to protect frame. Locksets to be tested to exceed 3,000,000 cycles. Lock case shall be steel. Lock shall incorporate one piece spring cage and spindle. Provide 5/8-in. minimum throw of latch and deadbolt used on pairs of doors. Provide seven-year warranty.
   a. Lock design shall be Schlage L series "L9000" design – Finish to be 626.

B. Comply with UL requirements for throw of bolts and latch bolts on rated fire openings.

C. Lock Manufacturers: Subject to compliance with requirements, provide lockset products of the following approved manufacturers:

1. Schlage Lock Co., "L Series"

2. Stanley/Best Locks, 40H, Full Mortise

D. Flush Bolt Heads: Minimum of 1/2-in. diameter rods of brass, bronze or stainless steel, with minimum 12-in. long rod for doors up to 7-ft., 0-in. in height. Provide longer rods as necessary for doors exceeding 7-ft., 0-in. in height.

E. Provide dust-proof strikes for foot bolts, except where special threshold construction provides non-recessed strike for bolt.

2.08 CLOSERS AND DOOR CONTROL DEVICES

A. Where manual closers are indicated for doors required to be accessible to the physically challenged, provide adjustable units complying with ANSI A117.1 provisions for door opening force and delayed action closing.

B. Shall conform to ANSI A156.4, Grade 1, NFPA 80, NFPA 101 and UL10C.

C. Closers shall be aluminum construction with steel lever arms, independent adjusting valves for closing, latching and back check. Hydraulic regulation controlled by tamper-proof, non-critical screw valves. All closer adjustments shall be shielded by plastic cover plate after installation. Pressure relief valve, PRV, door closers will not be permitted.

D. Full rack-and-pinion type closer with full complement bearings, single piece forged piston, chrome silicon steel spring, non-critical screw valves; back check, sweep and latch.

E. Closers to be non-sized, field adjustable from size 1 to 6.

F. Furnish all large cylinder non-sized closers with minimum 1-1/2-in. diameter piston. Furnish all medium cylinder non-sized closers with minimum 1-3/8-in. diameter piston.

G. Install closers to allow maximum degree of opening, position back check to activate well in advance of the stop position to cushion the opening swing and prevent door and frame damage. Do not use door closer to stop door travel. Unless specified, install closers with through bolt mounting method on metal and wood doors. Do not through-bolt if there has been special blocking specified in the wood door specification. Coordinate with the wood door specification.

H. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include:

Dor-O-Matic	Sargent	Norton
SC71	351	7501

2.09 EXIT DEVICES

A. General: All devices and mullions shall be of one manufacturer to provide for proper installation and servicing. Devices shall be furnished non handed and capable of direct field conversion for all available trim functions. All devices shall carry a three year warranty against

manufacturing defects and workmanship. Exit device(s) being submitted for approval shall have been manufactured for at least 10 years. A list of 10-year-old projects using submitted exit device shall be available upon request.

1. Furnish maintenance kit VonDuprin #050046 to Owner at closeout of project.

2. Furnish mullion stabilizer similar to Von Duprin #154 for all mullions.

3. Furnish cylinders for all locking function exit devices.

4. Exit device shall be tested to ANSI/BHMA A156.3 test requirements by a BHMA certified independent testing laboratory. A written certification showing successful completion of a minimum of 1,000,000 cycles for surface and concealed vertical rod devices; 5,000,000 cycles for rim devices; and 10,000,000 cycles for mortise devices.

5. Furnish Von Duprin exit devices with integrated exit monitor switch as required.

B. Surface-mounted/Concealed Vertical Rod Exit Devices:

1. Devices shall be push through type touch pad design with a straight or horizontal motion to eliminate pinch points. The angular motion type pad with end cavity exposed when depressed is unacceptable. Latch bolt shall have a self lubricating coating which reduces friction and wear. Plated latch bolts are unacceptable. Device housing shall be heavy duty extruded aluminum

2. Mechanism Case or Housing: Shall have an average minimum thickness of (.140-in.) EXTRUDED aluminum, and shall have the adaptability to convert from standard hex key dogging to a high security cylinder dog operation in the field.

3. No exposed screws shall be seen from the back side (pull side) of the device through a glass lite.
   a. The use of plastic parts to retract the latchbolt is unacceptable.

4. Springs: Only minimum (1/16-in.) diameter compression springs are acceptable. All internal parts shall be zinc dichromate coated to prevent rusting.

5. Quiet Feature: All devices shall incorporate a hydraulic sound damper to which decelerates the touchpad on its return stroke and eliminates noise associated with exit device operation.

6. Touch Pad: Shall be architectural metal with a minimum height of 2-3/16-in. Plastic is not acceptable.

7. Outside Trim: Shall be heavy duty type and fastened by means of concealed welded lugs and thru bolts from the inside. Lever trim shall be forged brass with a minimum average thickness on the escutcheon of (.130-in.). Plate with pull shall be minimum average thickness of (.090-in.) and have forged pulls. Lever trim shall be furnished with "Break-Away Levers" (994L Trim).

8. End caps shall be sloped and of heavy-duty metal alloy construction and provide horizontal adjustment to provide flush alignment with device cover plate. When device end cap is installed, no raised edges will protrude. End cap shall be cast metal or forged aluminum and have a minimum thickness of (.250-in.). Plastic or metal stamping will not be acceptable.

9. All devices with US28 finish to have stainless steel touch bars with US26D trim.

10. All floor strikes on interior vertical rod panic devices to be similar to Von Duprin 385A.

11. Provide all shim kits and filler plates to allow flush mounting of exit devices on all types of doors used in this Project.

12. Furnish all exit devices with deadlocking latchbolts.

13. Surface Vertical Rod Series Exit Device shall be tested to ANSI/BHMA A156.3 test requirements by a BHMA certified independent testing laboratory; a written certification showing successful completion of a minimum of 5,000,000 cycles must be provided by the independent laboratory. Rim Series Exit Device shall be tested to ANSI/BHMA A156.3 test requirements by a BHMA certified independent testing laboratory; a written certification showing successful completion of a minimum of 5,000,000 cycles must be provided by the independent laboratory. Mortise Series Exit Device shall be tested to ANSI/BHMA A156.3 test requirements by a BHMA certified independent testing laboratory; a written certification showing successful completion of a minimum of 10,000,000 cycles must be provided by the independent laboratory. Concealed Vertical Rod Series Exit Device shall be tested to ANSI/BHMA A156.3 test requirements by a BHMA certified independent testing laboratory; a written certification showing successful completion of a minimum of 1,000,000 cycles must be provided by the independent laboratory.

C. Acceptable Manufacturers: Subject to compliance with requirements, provide exit device products of the following manufacturers:

1. Von Duprin - No substitution.

2. Von Duprin – Coordinated with exit devices with integrated exit monitor switches.

2.10 DOOR TRIM UNITS

A. Fasteners: Provide manufacturer's standard exposed fasteners for door trim units (kick plates, edge trim, viewers, knockers, mail drops and similar units); either machine screws or self-tapping screws.

B. Fabricate protection plates (armor, kick or mop) not more than 1-1/2-in. less than door width on stop side and not more than 1/2-in. less than door width on pull side, x the height indicated. All protection plates shall have all edges beveled (B4E).

C. Metal Plates: Stainless steel, .050-in. (U.S. 18 ga.).

D. All pull plates and handles to be thru-bolted. Install pull plate prior to push plate to conceal thru-bolts. Provide concealed fasteners for all push/pull applications.

E. Acceptable Manufacturers

1. Ives.

2. Rockwood.

3. Quality.

4. Securitech as required at access control doors.

2.11 WEATHERSTRIP AND GASKETING

A. General: Except as otherwise indicated, provide continuous weather stripping at each leaf of every exterior door. Provide type, sizes and profiles shown or scheduled. Provide non-corrosive fasteners as recommended by manufacturer for application indicated.

B. Replaceable Seal Strips: Provide only those units where resilient or flexible seal strips is easily replaceable and readily available from stocks maintained by the manufacturer.

C. Acceptable Manufacturers

1. Pemko Mfg. Co.

2. Reese

3. National Guard Products

2.12 THRESHOLDS

A. General: Except as otherwise indicated provide standard aluminum threshold unit of type, size, and profile as shown or detailed.

B. Provide welded custom thresholds where scheduled and noted in the hardware sets. Provide cover plates where scheduled.

C. Provide thresholds that are 1-in. wider than depth of frame unless specified or detailed otherwise.

D. Acceptable Manufacturers

1. Pemko Mfg. Co.

2. Reese

3. National Guard Products

2.13 DOOR SILENCERS

A. All hollow metal frames shall have grey resilient type silencers. Quantity three on single doors, and quantity two on pairs of doors.

PART 3 EXECUTION

3.01 INSTALLATION

A. Mount hardware units at heights indicated in "Recommended Locations for Builders Hardware for Standard Steel Doors and Frames" by the Door and Hardware Institute, except as specifically indicated or required to comply with governing regulations, and except as may be otherwise directed by Architect.

B. Install each hardware item in compliance with the manufacturer's instructions and recommendations. Wherever cutting and fitting is required to install hardware onto or into surfaces which are later to be painted or finished in another way, coordinate removal, storage and reinstallation or application of surface protections with finishing work specified in the Division 9 Sections. Do not install surface-mounted items until finishes have been completed on the substrate.

C. Set units level, plumb and true to line and location. Adjust and reinforce the attachment substrate as necessary for proper installation and operation.

D. Drill and countersink units which are not factory prepared for anchorage fasteners. Space fasteners and anchors in accordance with industry standards.

E. Set thresholds for exterior doors in full bed of butyl rubber or polyisobutylene mastic sealant.

3.02 ADJUST AND CLEAN

A. Adjust and check each operating item of hardware and each door, to ensure proper operation or function of every unit. Replace units which cannot be adjusted to operate freely and smoothly as intended for the application made.

B. Clean adjacent surfaces soiled by hardware installation.

C. Final Adjustment: Wherever hardware installation is made more than one month prior to acceptance or occupancy of a space or area, return to the work during the week prior to acceptance or occupancy, and make final check and adjustment of all hardware items in such space or area. Clean operating items as necessary to restore proper function and finish of hardware and doors. Adjust door control devices to compensate for final operation of heating and ventilating equipment.

D. Instruct Owner's Personnel in proper adjustment and maintenance of hardware and hardware finishes, during the final adjustment of hardware.

E. Continued Maintenance Service: Approximately six months after the acceptance of hardware in each area, the Installer, accompanied by the representative of the latch and lock manufacturer, shall return to the Project and re adjust every item of hardware to restore proper function of doors and hardware. Consult with and instruct Owner's personnel in recommended additions to the maintenance procedures. Replace hardware items which have deteriorated or failed due to faulty design, materials or installation of hardware units. Prepare a written report of current and predictable problems (of substantial nature) in the performance of the hardware.

3.03 HARDWARE SETS

A. The following is a general listing of the minimum hardware requirements. Any item of hardware normally required by good practice, or as to meet state or local codes, shall be furnished even though it may not be specifically mentioned.

HW-1
Each to have:

(H)6	EA	HINGES	BB1191 4 ½ X 4 ½
(SC)1	EA	CYLINDER PRIVACY	ND405 SPAR
(D)1	EA	CLOSER	SC81-STD
(H)1	EA	STOP	242F
(R)1	EA	KICK PLATE	1905 10X34.5

HW-2 (FOR DOUBLE DOORS)
Each to have:

(V)1	EA	EXIT DEVICE	99L X 996L R&V
(V)2	EA	TRIM SET	
(H)6	EA	HINGES	BB1191 4 ½ X 4 ½
(SC)1	EA	LOCKSET	
(SC)1	EA	CYLINDER	
(R)2	EA	FLUSH BOLT	555-12"
(D)1	EA	CLOSER	SC81-STD-FULL-H/PA
(R)1	EA	KICK PLATE	1905 10X34.5

MOUNT ON ACTIVE LEAF

(R)2	EA	STOPS	471
(NG)1	EA	THRESHOLD	898V
(NG)1	EA	WEATHERSTRIP	160V
(NG)2	EA	SWEEPS	200NA
(P)2	EA	RAIN DRIP/STORM GUARD	

HW-3
Each to have:

(V)1	EA	EXIT DEVICE	99L X 996L R&V
(V)2	EA	TRIM SET	
(H)3	EA	HINGES	BB1191 4 ½ X 4 ½
(SC)1	EA	LOCKSET	
(SC)1	EA	CYLINDER	

(D)1	EA	CLOSER	SC81-STD-FULL-H/PA
(R)1	EA	KICK PLATE	1905 10X34.5
(R)1	EA	STOP	471

HW-4
Each to have:

(H)6	EA	HINGES	BB1191 4 ½ X 4 ½
(SC)1	EA	LOCKSET	
(D)1	EA	CLOSER	SC81-STD-FULL-H/PA
(R)1	EA	KICK PLATE	1905 10X34.5
(H)1	EA	STOP	242F

END OF SECTION

SUPPLEMENTARY SPECIFICATION

SECTION 09901S
PROTECTIVE COATINGS

The following supplement modifies Section 09901 – Protective Coatings. Where a portion of the Specification is modified or deleted by this Supplementary Specification, the unaltered portions of the Specification shall remain in effect.

1. Delete paragraph 2.02 B.1.b) and replace with the following paragraph:

   "b) Products: IP-BarRust 231, PPG 385,Carboguard 60, Tnemec 69, VyGuard V75, SW Macropoxy 646 FC Epoxy, or equal."

2. Delete paragraph 2.02 C.2.b) and replace with the following paragraph:

   "b) IP-BarRust 231, PPG 385, Carboguard 60 series, VyGuard V75 or equal."

3. Delete paragraph 2.02 D.1.b) and replace with the following paragraph:

   "b) Products: IP-Cathacoat 305, PPG Dimetcote 21-5, Carboguard 11WB,VyGuard 13F6 or 13F7, S.W. Zinc Clad XI, or equal."

4. Delete paragraph 2.02 F.1.b) and replace with the following paragraph:

   "b) Products: IP-Devran 224V, PPG 385PA, Carbomastic 90, Tnemec 69, VyGuard V75, Sherwin Williams Macropoxy 646 FC, or equal."

5. Delete paragraph 2.02 F.2.b) and replace with the following paragraph:

   "b) Products: IP-Devran 224V, PPG 370, Carbomastic 90, Tnemec 161, VyGuard V75, Sherwin Williams Recoatable Epoxy Primer or equal."

6. Delete paragraph 2.02 F.3.b) and replace with the following paragraph:

   "b) Products: IP-Devran 224V, PPG 385, Carboguard 60, Tnemec 69, VyGuard V75, Sherwin Williams Macropoxy 646 FC, or equal."

7. Delete paragraph 2.02 G.1 and replace with the following paragraph:

   "1. Prime Coat (Tie Coat): IP-BarRust 231, PPG 385, Carboguard 60, Tnemec P66, VyGuard V75, Macropoxy 646 FC, or equal."

8. Delete paragraph 2.02 H.1.b) and replace with the following paragraph:

   "b) Products: IP-Devguard 4180, PPG 5105, Carbcoat 115, Tnemec P4-55, VyGuard 13R29, kem Kromik Universal, or equal."

9. Delete paragraph 2.02 H.2.b) and replace with the following paragraph:

   "b) Products: IP-Devguard 4308, PPG 5401HAS, Carbocoat 45, Tnemec 2H, VyGuard V20, Sherwin Williams Indusrial Enamel, or equal."

10. Delete paragraph 2.02 I.1 and replace with the following paragraph:

    "1. Products: IP-BarRust 231,Tnemec P66, PPG 385, Carboguard 60, Tnemec P66, VyGuard V75, Sherwin Williams Macropoxy 646 FC,or equal."

11. Delete paragraph 2.02 J.1.b) and replace with the following paragraph:

    "b) Products: IP-Intertherm 50, Tnemec 39-1061, PPG 878, Carboline 4631, Thermaline 4700 Aluminum, VyGuard V437A1, Sherwin Williams Steel Master 9500, or equal."

12. Delete paragraph 2.02 K.1.b) and replace with the following paragraph:

    "b) Products: IP-Cathacoat 313, Ameron (PPG) 68HS, Carbozinc 859 VyGuard 13F4, Sherwin Williams Zinc Clad III, or equal."

13. Delete paragraph 2.03 B.1.b) and replace with the following paragraph:

    "b) Products: IP-BarRust 233H, PPG Amercoat 395, Carboguard 891HS, Tnemec 139, Sherwin Williams Tank Clad H.S,or equal."

14. Delete paragraph 2.03 C.1.b) and replace with the following paragraph:

    "b) Products: IP-BarRust 233H, Tnemec 20, Carboline Carboguard 60, VyGuard 78PR, Sherwin Williams Macropoxy 646 NSF, or equal."

15. Delete paragraph 2.03 D.1.a) and replace with the following paragraph:

    "a) Products: PPG Amercoat 83HS, Carboline Bitumastic 300M, Tnemec P66, VyGuard V75, Sherwin Williams Copoxy Primer, or equal."

16. Delete paragraph 2.03 D.2.b) and replace with the following paragraph:

    "b) Products: IP-Devtar 5A, PPG 78HB, Carboline Bitumastic 300M, Tnemec 46H413, VyGuard 64, Sherwin Williams Targuard Coal Tar Epoxy or equal."

17. Add the following paragraph:

"2.04 INTERNAL LINING REPAIR FOR EXISTING STEEL PIPES

A. Material Sources: The manufacturers listed in this paragraph are materials, which satisfy the material descriptions of this paragraph and have a documented successful record for long-term submerged or severe service conditions. Proposed substitute products will be considered as indicated under paragraphs 2.01.E.

B. System 200 – 100% Solids Epoxy: Use a two-component, cross-linked epoxy lining suitable for application over carbon steel or cement mortar. Use lining material suitable for long-term immersion in potable water and NSF 61 certified.

1. Prime Coat and Finish Coats (1-2 coats):

DFT = 15-30 mils (375 to 750 microns).

Products: Phenoline 341, or equal.

2. Surface Preparation: Prepare the interior pipe surface in accordance with SSPC-SP-11."

18. Add the following paragraph to 3.08 and renumber accordingly:

"A. Coatings are to be applied to items requiring coating prior to placement into service. At no time will an equipment item be placed into service prior to receiving the finish coating."

19. Delete paragraph 3.11 B.1.b) and replace with the following paragraph:

"b) As pipe markers, use semi-rigid outdoor grade acrylic plastic UV resistant with UV resistant ink, Seton Name Plate Corp., SetMark, or equal. Use Type SNA for outside diameters 3/4 through 5-7/8 inches and Type STR for 6-inch outside diameter or larger. For pipes less than 3/4-inch in diameter, use applied marker of brass identification tags 1-1/2 inches square with depressed letters 1/4-inch high, black-filled. Apply tightly to pipeline with metal or plastic straps. Pipe markers shall meet ANSI A13.1 – 2007.

c) For pipelines with operating temperatures above 150°F; Contractor shall paint pipe labeling with approved stencils."

20. Delete paragraph 3.11 C in its entirety and replace with the following:

"C. Pipe and Equipment Identification Color Schedule:

1. Color identification shall be in accordance with TCEQ Chapter 290.42(d)(13)A and Chapter 217.329.

2. For **pipe and equipment** coatings, use the colors listed in the following identification color schedule:

PIPE AND EQUIPMENT SYSTEMS IDENTIFICATION COLOR SCHEDULE

WATER TREATMENT PLANT (WTP)/FACILITY SYSTEMS	***COLOR***
Plant Potable Water	Light Blue
Plant Process Water	Light Blue with Dark Blue Bands
Filter or Membrane Effluent	Light Blue
Filter or Membrane Backwash Supply	Light Blue
Filter or Membrane Backwash Waste	Dark Grey
Settled Water	Green
Raw Water	Tan
Filter Backwash Air	Dark Green
Raw Sludge	Yellow Brown
Thickened Sludge	Brown
Centrifuge Centrate	Light Brown
CHEMICAL SYSTEMS	***COLOR***
Chlorine (gas liquid, or vent)	Yellow
Chlorine (solution) or Sodium Hypochlorite	Yellow with Red Bands
Chlorine Dioxide	Yellow with Blue Bands
Ammonia (Gas, Aqueous, or Liquid Ammonium Sulfate)	Yellow with Brown Bands
Ozone	Stainless Steel with White Bands
Liquid Alum or PACl	Yellow with Orange Bands
Alum or PACl Solution	Yellow with Green Bands
Ferric Chloride	Brown with Red Bands
Ferric Sulfate	Brown with Yellow Bands
Polymers	White with Green Bands
Liquid Caustic	White with Red Bands
Caustic (solution)	White with Orange Bands
Fluoride	White with Yellow Bands
Oxygen	Orange
Sulphur Dioxide Gas	Lime Green with Yellow Bands
Sodium BiSulfite	Lime Green with Brown Bands
WASTEWATER TREATMENT PLANT (WWTP) SYSTEMS	***COLOR***
Raw Sewage	Gray
Grit	Dark Gray
Cyclone Return	Gray
Classifier Return	Gray
Heavy Solids	Dark Brown

Return Sludge	Brown
Waste Sludge	Yellow-Brown
Scum	Light Brown
Non-Potable Water	Purple with "Non-Potable Water"
Plant Air (from blowers to process basins)	Dark Green
Effluent after clarification	Dark Green
OTHER SYSTEMS	***COLOR***
Fire Mains	Red
Diesel Fuel	Dark Orange
Natural Gas	Red
Heating Water	Pink
Domestic Hot	Blue with Red Bands spaced 30 in apart
Reclaimed Water	Purple
Chilled Water Supply (CWS)	Blue-Green
Chilled Water Return (CWR)	Blue-Green
Condensing Water Supply (Cond-WS)	Light Pastel Green
Condensing Water Return (Cond-WS)	Light Pastel Green
Vent	Light Gray
Compressed Air (typically 100 psig service)	Light Green
Instrument Air	Light Green with Dark Green Bands
Drain	Dark Grey
Vacuum (Vac)	Off-White
Deionized water (DW)	Light Blue
Power Conduit	In compliance with the National Electric Code

3. For pipe identification colors not listed above, follow American National Standard (ANSI A13.1-2007) Color Schedule:
   a. Materials inherently hazardous, flammable or explosive; chemically active or toxic; extreme temperature or pressure; radioactive: Yellow Field with Black Letters.
   b. Material of inherently low hazard – liquid or liquid admixture: Green Field with White Letters; gas or gaseous admixture: Blue Field with White Letters.
   c. Fire quenching materials, water, foam, carbon dioxide, Halon, etc.: Red Field with White Letters.
   d. For polymer systems provide different band sizes and/or alternate schemes to di

e. For other systems not covered by this specification develop color code chart for review by Owner and Engineer."

END OF SECTION

Approved by:

10/1/15

Sonny Do, P.E.
Acting Assistant Director
Engineering and Construction Division
Department of Public Works and Engineering

Date

Section 09901

PROTECTIVE COATINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Preparing surfaces, providing adequate conditions for proper workmanship, and furnishing and applying the protective coating materials required for metallic, concrete, masonry and plastic surfaces.

B. Color code painting of piping and piping identification signs and markers.

C. Refer to Section 09900 – Painting for Decorative and Protective Coatings to be used on Interior and Exterior Architectural Surfaces, such as wood, gypsum board and masonry.

D. Refer to Section 09971 – Painting and Protective Coatings for Potable Water Storage Tanks for painting and protective coatings to be used on potable water storage tanks.

1.02 MEASUREMENT AND PAYMENT

A. Unit Prices

1. No separate payment will be made for protective coatings unless specifically listed in Document 00410 – Bid Form. Include payment for protective coatings in unit prices for items to which coatings are applied.

2. Measurement for protective coatings, when included as a separate pay item, is on a square-foot basis for completed protective coating systems.

3. Refer to Section 01270 – Measurement and Payment for unit price procedures.

1.03 REFERENCES

A. ANSI A13.1 – Color Schedule

B. ANSI/AWWA C213 – Fusion-bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines

C. Federal Specification TT-P-28 – Paint, Aluminum, Heat Resisting 1200 degrees F

D. Federal Standard 595A – Federal Standard Colors

E. Military Specification DOD-P-23236 – Paint Coating Systems, Steel Ship Tank, Fuel and Salt Water Ballast, Class 2

F. NSF Standard 61 – Drinking Water System Components – Health Effects

G. SSPC-PA 1 – Paint Application Specification No. 1 - Shop, Field and Maintenance Painting

H. SSPC-PA 2 – Paint Application Specification No. 2 – Measurement of Dry Paint Thickness with Magnetic Gages

I. SSPC-Paint 16 – Coal Tar Epoxy-Polyamide Black (or Dark Red) Paint

J. SSPC-SP 1 – Solvent Cleaning

K. SSPC-SP 2 – Hand Tool Cleaning

L. SSPC-SP 3 – Power Tool Cleaning

M. SSPC-SP 5/NACE 1 – White Metal Blast Cleaning

N. SSPC-SP 6/ NACE 3 – Commercial Blast Cleaning

O. SSPC-SP 7/NACE 4 - Brush-Off Blast Cleaning

P. SSPC-SP 10/NACE 2 – Near White Metal Blast Cleaning

Q. SSPC-SP 11 – Power Tool Cleaning to Bare Metal

R. SSPC-VIS 1-89 – Visual Standard for Abrasive Blast Cleaned Steel

S. SSPC-VIS 3 – Visual Standard for Power-and Hand-Tool Cleaned Steel

T. SSPC-QP 1 – Standard Procedure for Evaluating Qualifications of Painting Contractors

U. SSPC-QP 2 - Standard Procedure for Evaluating Qualifications of Painting Contractors to Remove Hazardous Paint

V. SSPC-SP12/NACE 5 – Surface Preparation and Cleaning of Steel and Other Hard Materials by High-and Ultrahigh-Pressure Water Jetting Prior to Recoating

1.04 DEFINITIONS

A. Paint, coatings, or finishes as used in this Section include surface treatments, emulsions, enamels, paints, epoxies, polyurethanes, acrylics, zincs, and other protective coatings with the exceptions of galvanizing or anodizing, whether used as a pretreatment, primer, intermediate coat, or finish coat.

B. DFT means minimum dry film thickness.

C. VOC means Volatile Organic Components

1.05 PERFORMANCE REQUIREMENTS

A. See the Drawings and other Specifications to determine how coatings under this Section will be applied. Paint or coat new and modified surfaces in conformance with this Section.

B. Coating system schedules summarize surfaces to be coated, required surface preparation, and coating systems to be applied. Coating notes on Drawings are used to show exceptions to schedules, to show or extend limits of coating systems, or to clarify or show details for application of coating systems.

C. Do not apply protective coatings to the following surfaces unless specifically named or shown to be coated:

1. Concrete
2. Stainless steel, bronze, or brass
3. Machined surfaces
4. Grease fittings
5. Glass
6. Equipment nameplates
7. Platform gratings, stair treads, door thresholds, and other walk surfaces
8. Galvanized steel electrical conduit and associated galvanized and factory-coated junction boxes and electrical panels
9. Galvanized surfaces inside buildings and not exposed to view
10. Manhole and valve covers and rings, storm water inlet gratings, covers, and frames

D. Provide decorative and protective coatings for interior architectural surfaces such as wood, gypsum board, and masonry in accordance with Section 09900 – Painting.

1.06 SUBMITTALS

A. Make submittals in accordance with Section 01330 – Submittal Procedures.

B. Submit the following information at least 10 days prior to protective coating work:

1. Coating Materials List: Eight copies of a coating materials list naming the manufacturer and the coating number, keyed to the coating systems described in this Section. Submit the list prior to or at the time of sample submittal.

2. Paint Manufacturer's Information: For each coating system to be used, submit the following data:
   a) Paint manufacturer's Product Data Sheet for each product proposed, including statements on the suitability of the material for the intended use.

b) Technical and performance information that demonstrates compliance with the system performance and material requirements.
c) Paint manufacturer's instructions and recommendations on surface preparation, application and curing.
d) Colors available for each product, where applicable.
e) Compatibility of shop and field applied coatings, where applicable.
f) Material Safety Data Sheets for each product used.
g) VOC of each paint or coating proposed, stated in grams per litre.

3. Samples
a) Submit color samples of paint, finishes, and other coating materials on 8-1/2 inch by 11-inch sheet metal or heavy cardstock. Have each sheet completely coated over its entire surface with one protective coating material, type, and color.
b) Provide two sets of color samples to match each color selected by the City Engineer from the manufacturer's standard color sheets. If custom-mixed colors are indicated, prepare color samples using color formulations prepared to match the color samples furnished by the City Engineer.
c) Submit one 15-pound sample of each abrasive proposed to be used for surface preparation for submerged and severe service coating systems.

1.07 QUALIFICATIONS

A. Submit five (5) references which show that the painting Contractor has previous successful experience with the indicated or comparable coating systems. Include the name, address, and the telephone number for the owner of each installation for which the painting Contractor provided the protective coating. As an alternative, submit proof of certification in accordance with SSPC-QP 1.

B. For any project which involves removal or repair of lead based paints, submit proof of certification in accordance with SSPC-QP 2.

1.08 ENVIRONMENTAL RESTRICTIONS

A. Ventilate area where coating is being applied. Post and enforce NO SMOKING OR OPEN FLAME signs until coating has cured.

B. Provide lighting level of 80-foot candles (860 1x) measured mid-height at substrate surface.

C. Restrict worker access and construction traffic from area where coating is being applied or is curing.

D. Comply with City of Houston and all applicable OSHA confined space entry regulations including but not limited to OSHA Permit-Required Confined Space Standard 1910.146.

1.09 WARRANTY INSPECTION AND MAINTENANCE

A. Warranty Inspection:

1. A warranty inspection may be conducted during the eleventh month following completion of coating and painting. The Contractor and a representative of the coating material manufacturer must attend the inspection. At the option of the City, the City may be represented by a NACE certified coating inspector.

2. The City Engineer may, by written notice to the Contractor, reschedule the warranty inspection to another date within the one-year correction period, or may cancel the warranty inspection altogether. Cancellation of the warranty inspection does not relieve the Contractor of his responsibilities under the Contract Documents.

3. Repair defective work discovered during the warranty inspection in accordance with these Specifications.

B. Extended Maintenance of Chemical Tank Lining Systems: Promptly repair defects in the chemical resistant sheet lining system for a period of 2 years after the lining has been placed into service. Such maintenance includes repair of the chemical tank and any equipment or facilities damaged by the corrosive action of the chemicals.

PART 2 PRODUCTS

2.01 COATINGS CRITERIA

A. Suitability: Use suitable coating materials as recommended by the manufacturer. Recommendations must be accompanied by test methods used to determine suitability and results of these tests.

B. Compatibility: In any coating system, use only compatible materials from a single manufacturer. Give particular attention to compatibility of primers, intermediate coats and finish coats. If necessary, apply a barrier coat or tie coat between existing prime coat and subsequent field coats to ensure compatibility.

C. Containers: Supply coating materials in sealed containers that plainly show the designated name, formula or specification number, batch number, color, date of manufacture, and name of manufacturer, all plainly legible at the time of use.

D. Colors: Use colors and shades of colors of all coats of paint as indicated on the coating schedules or as selected by the City Engineer. Make each coat a contrasting shade to the previous and following coats to facilitate inspection of surface coverage of each coat. The City Engineer will select finish colors from the manufacturer's standard color samples.

E. Substitute or Equal Products:

1. To establish equality under Section 01630 – Product Substitution Procedures, furnish satisfactory documentation from the manufacturer of the proposed substitute product

that the material meets the indicated requirements and is equivalent to or better in the following properties:

a) Resistance to abrasion and physical damage.
b) Resistance to chemical attack.
c) Life expectancy.
d) Ability to recoat in the future.
e) Solids content by volume.
f) Dry film thickness per coat.
g) Compatibility with other coatings.
h) Suitability for the intended service.
i) Temperature limitations in service and during application.
j) Type and quality of recommended undercoats and topcoats.
k) Ease of application.
l) Ease of repairing damaged areas.
m) Stability of colors.
n) VOC content expressed in grams per liter.

2. For substitutions, submit protective-coating materials which are standard products produced by recognized manufacturers who are regularly engaged in production of such materials for essentially identical service conditions. Where requested, provide the City Engineer with the names of not less than 10 successful applications of the proposed manufacturer's products, which comply with these requirements. Applications must be in similar service environments to the job being contracted.

2.02 INDUSTRIAL COATING SYSTEMS

A. Material Sources: Each of the following manufacturers is capable of supplying many of the specified industrial coating materials. Manufacturers and specific paint designations (numbers) are listed to indicate the required type and quality of coating. Contractors are to base their bid on the use of products supplied by one of the named manufacturers. These named manufacturers are designated to establish a level of acceptable product quality or manufacturing experience and are not to be construed as the only manufacturers of products acceptable for use. Other manufacturers will be considered on an individual basis, and may be submitted for consideration in accordance with Document 0700, Article 3.8, Product Options and Substitutions (excluding 3.8.3), Section 01330 – Submittal Procedures, Section 01630 – Products Substitution Procedures, and this Section.

1. AKZO/International Coatings
2. Ameron International
3. Carboline Coatings Company
4. Hempel Coatings USA, Inc.
5. ICI/Devoe Coatings
6. Sigma Coatings USA, Inc.
7. Tnemec Company
8. Sherwin Williams Co.

B. System 1 – Aliphatic Polyurethane Finish Coat: Use a two-component aliphatic acrylic polyurethane coating that provides superior color and gloss retention, resistance to splash from acid and alkaline chemicals, resistance to chemical fumes and severe weathering, and has a minimum solids content of 58 percent by volume. As primer, use a rust inhibitive 2-component epoxy coating with minimum solids content of 66 percent by volume.

1. Prime Coat:
   a) DFT = 4-6 mils (100-150 microns).
   b) Products: Ameron 385, Carboline 893, Tnemec 69, VyGuard V75, SW Macropoxy 646 FC Epoxy, or equal.
2. Finish Coats (one or more):
   a) DFT = 2-4 mils (50-100 microns).
   b) Products: Ameron 450 GL, Carboline 134 HG, Tnemec 74, VyGuard V54, Sherwin Williams Hi-Solids Polyurethane, or equal.
3. Total System = 6-10 mils (150-250 microns).
4. Apply more than one finish coat as necessary to produce a finish with uniform color and texture.

C. System 2 – Inorganic Zinc/Epoxy Polyurethane: For prime coat, use a 2-component water or solvent-based inorganic zinc silicate which contains at least 85 percent of metallic zinc by weight in the dried film, and is recommended by the coating manufacturer as a primer for this system. As intermediate coat, use a high-build, 2-component epoxy with a solids content of at least 70 percent by volume. For finish coat, use a 2-component aliphatic acrylic or polyester polyurethane coating material that provides superior color and gloss retention, resistance to chemical fumes and severe weathering, and has a minimum solids content of 58 percent by volume.

1. Prime Coat:
   a) DFT = 2.5-4.0 mils (65-100 microns).
   b) Products: Ameron Dimetcote 21-5 or 21-9, Carbozinc 11 or D7WB, VyGuard 13F6 or 13F7, SW Zinc Clad II L.V. or equal.
2. Intermediate Coat:
   a) DFT = 4-6 mils (100-150 microns).
   b) Ameron 385, Carboline 893, VyGuard V75, or equal.
3. Finish Coats (one or more):
   a) DFT = 2.5 to 4.0 mils (65-100 microns).
   b) Ameron 450 GL, Carboline 134 HG, VyGuard V54, Sherwin Williams Hi-Solids Polyurethane, or equal.
4. Total System DFT = 9-14 mils (225-600 microns).
5. Apply intermediate coat in excess of 4 mils (100 microns) DFT using the mist coat/full coat technique to completely cover the inorganic zinc primer and prevent bubbling of the epoxy or polyurethane finish coat.
6. Apply more than one finish coat as necessary to produce a finish with uniform color and texture.
7. If inorganic zinc primer is used as a pre-construction or shop-applied primer, and there are damaged or uncoated areas, spot blast the damaged areas with abrasive to an SSPC-SP 10 Near White Metal Standard and then coat with the specified material.

D. System 3 – Inorganic Zinc: Use a 2-component water-based inorganic zinc silicate which contains at least 85 percent of metallic zinc by weight in the dried film.

1. Prime Coat and Finish Coat (one).
   a) DFT = 2.5 to 4.0 mils (65-100 microns).
   b) Products: Ameron Dimetcote 21-5, Carbozinc D7WB, VyGuard 13F6 or 13F7, S.W. Zinc Clad XI, or equal.
2. Total System DFT = 2.5 to 4.0 mils (65-100 microns).

E. System 4 – Acrylic Latex: Use a single component, water-based acrylic latex with a fungicide additive having a minimum solids content of 35 percent by volume. Apply a prime coat as recommended by manufacturer. Select coating material, which is available in ANSI safety colors.

1. Prime Coat
   a) DFT = 2-3 mils (50-75 microns).
   b) Products: Carboline D3358, Ameron 148, Hemucryl 1803, Sherwin Williams DTM Primer/Finish.
2. Finish Coats (2 or more):
   a) DFT = 6-8 mils (150-200 microns).
   b) Products: Carboline D3359, Ameron 220, Hemucryl 4803, Sherwin Williams DTM Acrylic Coating or equal.
3. Total System DFT = 8-11 mils (200-275 microns).

F. System 5 – Epoxy: Use a two-component, rust inhibitive, polyamide-cured epoxy coating material with a recoatable finish that is available in a wide selection of colors. Use a coating with a minimum solid content of 66 percent by volume and resistant to service conditions of condensing moisture, splash and spillage of lubricating oils, and frequent washdown and cleaning.

1. Prime Coat:
   a) DFT = 3-5 mils (75-125 microns).
   b) Products: Ameron 385PA, Carboline 193, Tnemec 69, VyGuard V75, Sherwin Williams Macropoxy 646 FC, or equal.
2. Prime Coat (where shop applied):
   a) DFT = 3-5 mils (75-125 microns).
   b) Products: Ameron 370, Carboline 193, Tnemec 161, VyGuard V75, Sherwin Williams Recoatable Epoxy Primer, or equal.
3. Finish Coats (2 or more):
   a) DFT = 5- 7 mils (125-175 microns).
   b) Products: Ameron 385, Carboline 893, Tnemec 69, VyGuard V75, Sherwin Williams Macropoxy 646 FC,or equal.
4. Total System DFT = 8-12 mils (200-300 microns).

G. System 6 – Aliphatic Polyurethane, Fiberglass: Use a two-component aliphatic polyurethane coating material with superior color and gloss retention, resistance to splash from acid and alkaline chemicals, and resistance to chemical fumes and severe weathering. Use a primer, tie coat, or mist coat as recommended by the manufacturer.

1. Prime Coat (Tie Coat): Ameron 385, Carboline 893, Tnemec P66, VyGuard V75, Macropoxy 646 FC, or equal.
2. Finish Coats (2 or more):
   a) DFT = 2-4 mils (50-75 microns).
   b) Products: Ameron Amershield, Carbothane 134 HG, Tnemec 74, VyGuard V54, or equal.

H. Section 7 – Alkyd Enamel: Use a high quality, gloss, or semi-gloss, medium long oil alkyd finish with a minimum solids content of 49 percent by volume. Apply primer as recommended by manufacturer.

1. Prime Coat:
   a) DFT = 2-3 mils (50 to 75 microns).
   b) Products: Ameron 5105, Carboline AD29, Tnemec P4-55, VyGuard 13R29, kem Kromik Universal, or equal.
2. Finish Coats (2 or more):
   a) DFT = 2-4 mils (50-75 microns).
   b) Products: Ameron 5401HAS, Carboline GP62, Tnemec 2H, VyGuard V20, Sherwin Williams Indusrial Enamel, or equal.
3. Total System DFT = 4-7 mils (100-175 microns).

I. System 8 – Aluminum Metal Isolation: Use one coat of a high-build polyamide epoxy paint.

1. Products: Tnemec P66, Ameron 385, Carboline 893, Tnemec P66, VyGuard V75, Sherwin Williams Macropoxy 646 FC, or equal.
2. Total System DFT = 6-8 mils (150-200 microns).

J. System 9 – Aluminum Silicone Resin: Use an aluminum silicone resin material suitable for a service temperature of up to 1000 degrees F (538 degrees C). Coating must comply with Federal Specification DOD-P-28.

1. Prime Coat and Finish Coat (2 or more):
   a) DFT = 2-4 mils (50-100 microns)
   b) Products: Tnemec 39-1061, Ameron 878, Carboline 4631, VyGuard V437A1, Sherwin Williams Steel Master 9500, or equal
   c) Total System DFT = 2-4 mils (50-100 microns)

K. System 10 – Zinc Rich Epoxy: Use a polyamide Epoxy resin material that contains at least 76 percent zinc in the dried film.

1. Prime Coat and Finish Coat (2 or more):
   a) DFT = 3-5 mils (75-125 microns)
   b) Products: Ameron 68HS, Carboline 858, VyGuard 13F4, Sherwin Williams Zinc Clad III,or equal
   c) Total System DFT = 3-5 mils (75-125 microns)

2.03 SUBMERGED AND SEVERE SERVICE COATING SYSTEMS

A. Material Sources: The manufacturers listed in this paragraph are materials, which satisfy the material descriptions of this paragraph and have a documented successful record for long-term submerged or sever service conditions. Proposed substitute products will be considered as indicated under paragraphs 2.01.5.

B. System 100 – Amine-Cured Epoxy: Use a high-build amine-cured epoxy with a solids content of at least 80 percent by volume. Use a coating suitable for long-term immersion in potable water and municipal wastewater. For potable water service, select a coating material listed in the NSF 61 Standard.

1. Prime Coat and Finish Coats (3 or more):
   a) DFT = 16-19 mils (400 to 475 microns).
   b) Products: Ameron Amercoat 395, Carboline 891, Tnemec 139, Sherwin Williams Tank Clad H.S,or equal.
2. For coating of valves and non-submerged equipment, DFT = 12-14 mils (300-350 microns).

C. System 101 – Polyamide Cured Epoxy: Use a high-build, polyamide epoxy resin with a solids content of at least 56 percent by volume. Use a coating suitable for long-term immersion in potable water or municipal wastewater. For potable water service, select a coating material listed under NSF 61 Standard.

1. Prime Coat and Finish Coats (3 or more):
   a) DFT = 12-14 mils (300-350 microns).
   b) Products: Tnemec 20, VyGuard 78PR, Sherwin Williams Macropoxy 646 NSF,or equal.

D. System 102 – Coal Tar Epoxy: Use a high-build, 2-component amine or polyamide-cured coal tar epoxy with a solids content of at least 68 percent by volume. Use a coating suitable for long-term immersion in wastewater or for coating of buried surfaces. Coating must conform to Mil Spec DOD-P-23236, or to SSPC Paint 16. Prime coats are for use as a shop primer only. Omit prime coat when both surface preparation and coating are performed in the field.

1. Prime Coat: DFT = 1.5-2.5 mils (38-65 microns).
   a) Products: Ameron Amercoat 83HS, Tnemec P66, VyGuard V75, Sherwin Williams Copoxy Primer, or equal.
2. Finish Coats (2 or more):
   a) DFT = 14-18 mils (350-450 microns).
   b) Products: Ameron 78HB, Carbomastic 14, Tnemec 46H413, VyGuard 64, Sherwin Williams Targuard Coal Tar Epoxy,or equal.
   c) Total System DFT = 15.5-20.5 mils (387-513 microns).

E. System 103 – Fusion Bonded Epoxy: Use a 100 percent powder epoxy applied in accordance with ANSI/AWWA C213, except prepare surface as specified in the coating system schedule in this Section. Apply the coating using the fluidized bed process.

1. Liquid Epoxy: For field repairs, use a 100 percent solids liquid epoxy as recommended by the powder epoxy manufacturer to provide a DFT of 15-17 mils (375-425 microns).
2. Powder Coating:
   a) DFT = 15-17 mils (375-425 microns).
   b) Products: Scotchkote 134 or 206N, Napgard 7-0008 or 7-2500, or equal.
   c) Total System DFT = 15-17 mils (375-425 microns).
   d) For coating of valves, DFT =11-12 mils (275-300 microns).

F. System 104 – Chemical Resistant Sheet Lining:

1. Materials: Use natural rubber, chlorobutyl rubber, ethylene propylene diene monomer (EPDM) rubber, chloroprene polymer (neoprene) rubber, or chlorosulfonated polyethylene (Hypalon) rubber sheet lining material. Submit shop drawings containing technical information that confirms the suitability of the lining material system for long-term immersion in each chemical to be stored. Service temperatures are expected to be up to 150^0 F (65^0 C).
   a) Neoprene Sheet Lining Material: Use a synthetic rubber formulated for steam curing at atmospheric pressure. Provide a minimum lining thickness of 3/16 inch. Supply B.F. Goodrich compound 59688, or equal.
   b) Chlorobutyl Sheet Lining Material: Use a synthetic rubber formulated for steam curing at atmospheric pressure. Supply B.F. Goodrich compound 60924, or equal.
   c) Natural Rubber (soft) Sheet Lining Material: Use a soft natural rubber formulated for steam curing at atmospheric pressure. Provide a minimum lining thickness of 3/16 inch. Supply B.F. Goodrich compound 83160, or equal.
   d) Natural Rubber (hard) Sheet Lining Material: Use a hard, natural rubber resistant to oxidizing agents and formulated for autoclave curing. Provide a minimum lining thickness of 3/16 inch. Supply B.F. Goodrich compound 8631, or equal.
   e) EPDM Sheet Lining Material: Use synthetic rubber suitable for use as a lining for 50 percent sulphuric acid solution and formulated for autoclave or steam curing under pressure.
   f) Hypalon Sheet Lining Material: Use synthetic rubber suitable for use as a lining for 50 percent sulfuric acid solution.

2. Primers: Use primers, adhesives, activators, accelerators, and other necessary materials as recommended by the sheet material manufacturer.

3. Metal Surface Preparation: Prior to abrasive blast cleaning, prepare the base metal as required by the sheet lining material manufacturer's installation instructions. If the instructions differ from these specifications, provide the highest degree of cleaning and surface preparation required by either instructions or specifications. Perform abrasive blast cleaning in accordance with this section.

4. Installation: Install lining materials in accordance with the material manufacturer's written installation instructions. Line interior surfaces including piping, vents, fittings, flange faces, manhole covers, and blind flanges.

5. Testing: Test the lining system for holidays in accordance with this Section before and after curing.

6. Curing: Cure the lining system by steam using the time and temperature as required by the material manufacturer.

G. System 105 – Vinyl Ester: Use vinyl ester resin coating material with an inert flake pigment that is suitable for immersion service in 30 percent hydrochloric acid and 30 percent sulfuric acid solutions.

1. Coating (2 or more coats):
   a) DFT = 40-45 mils (1000-1125 microns).
   b) Products: Plasite 4100, Sherwin Williams Magnalux 304 FF,or equal.
   c) Prime Coat: As recommended by the material manufacturer.

H. System 106 – 100% Solids Epoxy: Use a solventless epoxy resin coating suitable for severe service areas subject to splash, spillage or intermittent immersion in wide range of industrial chemicals and wastewater. Coating to resist normal abrasion from rolling vehicles.

1. Coating (2 or more coats):
   a) DFT = 15-20 mils (325-500 microns).
   b) Products: Ameron, Carboline, Sherwin CorCote HCR.
   c) Prime Coat: As recommended by manufacturer.

I. System 107 – 100% solids Epoxy Sealer: Use a clear, unpigmented solventless epoxy suitable for application over marginal surfaces, including damp surfaces, tight rust and tight old coatings. Coating serves as primer for alkyd, acrylic, epoxy, and polyurethane finish coats.

1. Coating (1 coat only):
   a) DFT = 1-2 mils (25-50 microns).
   b) Products: ICI/Devoe 167 PrePrime, Carboline Rust Bond, Sherwin Williams 920 PrePrime, or equal.

PART 3 EXECUTION

3.01 MANUFACTURER'S SERVICES

A. Require the protective coating manufacturer to furnish a qualified technical representative to visit the project site for technical support as may be necessary to resolve field problems attributable to or associated with manufacturer's products.

B. For submerged and severe service coating systems, require the paint manufacturer to furnish the following services:

1. Provide at least 6 hours of on-site instruction on the proper surface preparation, use, mixing, application, and curing of the coating systems.

2. Observe the start of surface preparation, mixing, and application and curing of the coating systems.

3. Provide the services of a NACE Certified Coating Inspector at all times during the surface preparation, mixing, application, curing and testing of all coatings applied in submerged or acid spill areas.

3.02 WORKMANSHIP

A. Use skilled craftsmen and experienced supervision. For all jobs involving lead based paint removal or repair, require the presence of a certified Competent Person, Lead per OSHA requirements.

B. Apply coating to produce an even film of uniform thickness. Give special attention to edges, corners, crevices, and joints. Ensure thorough cleaning and an adequate thickness of coating material. Apply coatings to produce finished surfaces free from runs, drips, ridges, waves, laps, brush marks, and variations in color, texture and finish. Effect complete hiding so that the addition of another coat would not increase the hiding. Give special attention to ensure that edges, corners, crevices, welds, and similar areas receive a film thickness equivalent to adjacent areas. Apply a brushed stripe coat to all edges and welds after priming submerged or severe service areas.

C. Remove, mask or otherwise protect hardware, lighting fixtures, switch plates, machined surfaces, couplings, shafts, bearings, name plates on machinery, and other surfaces not to be painted. Provide drop cloths to prevent coating materials from falling on or marring adjacent surfaces. Protect the working parts of mechanical and electrical equipment from damage during surface preparation and coating operations. Mask openings in motors to prevent entry of coating or other materials.

D. Do not damage adjacent work during blast cleaning operations. Perform spray painting under carefully controlled conditions. Promptly repair any damage to adjacent work or adjoining property occurring from blast cleaning or coating operations.

E. Coordinate cleaning and coating so that dust and other contaminants from the cleaning process will not fall on wet, newly-coated surfaces.

3.03 SURFACE PREPARATION STANDARDS

A. The following referenced surface preparation standards of the Society for Protective Coatings (SSPC) form a part of this Specification:

1. Solvent Cleaning (SSPC-SP1): Removal of oil, grease, soil, drawing and cutting compounds, and other soluble contaminants from steel surfaces by cleaning with solvent, vapor degreasing, emulsion or alkaline cleaners, or steam.

2. Hand Tool Cleaning (SSPC-SP2): Removal of all loose rust, loose mill scale, loose paint, and other loose detrimental foreign matter by hand chipping, scraping, sanding, and wire brushing.

3. Power Tool Cleaning (SSPC-SP3): Removal of loose rust, loose mill scale, loose paint, and other loose detrimental foreign matter, by rotary or impact power tools, power wire brushing, or power abrading.

4. White Metal Blast Cleaning (SSPC-SP5/NACE 1): Removal of all visible oil, grease, soil, dust, dirt, mill scale, rust, coating, oxides, corrosion products, and other foreign matter by blast cleaning.

5. Commercial Blast Cleaning (SSPC-SP6/NACE 3): Removal of all visible oil, grease, dust, dirt, mill scale, rust, coating, oxides, corrosion products, and other foreign matter, except limit random staining to no more than 33 percent of each unit area of surface.

6. Brush-Off Blast Cleaning (SSPC-SP7/NACE 4): Removal of all visible oil, grease, dirt, dust, loose mill scale, loose rust, and loose coating, all of which are considered tightly adherent if they cannot be removed by lifting with a dull putty knife.

7. Near-white Blast Cleaning (SSPC-SP10/NACE 2): Removal of all visible oil, grease, dirt, mill scale, rust, coating, oxides, corrosion products, and other foreign matter, except limit random staining to no more than 5 percent of each unit area of surface.

3.04 METAL SURFACE PREPARATION (UNGALVANIZED)

A. Provide the minimum abrasive-blasted surface preparation as indicated in the coating system schedules at the end of this Section. Where there is a conflict between these specifications and the coatings manufacturer's printed recommendations for the intended service, the higher degree of cleaning applies.

B. Perform metal surface preparation in conformance with the current SSPC/NACE Standards and this Section. Blast cleaned surfaces must match standard samples in SSPC-VIZ 1.

C. Remove oil, grease, welding fluxes, and other surface contaminants prior to blast cleaning using solving cleaning as per SSPC-SP1.

D. Round or chamfer sharp edges. Grind to smooth finish burrs, surface defects, and weld splatter prior to blast cleaning.

E. Select the type and size of abrasive to produce a surface profile that meets the coating manufacturer's recommendation for the particular coating and service conditions. As

abrasives for submerged and severe service coating systems use clean, hard, sharp cutting crushed slag. Do not use automated blasting systems and metal shot or grit for surfaces that will be in submerged service, even if subsequent abrasive blasting is planned with hard, sharp-cutting slag.

F. Do not reuse abrasive except when an automated blasting system is used for surfaces that will be in non-submerged service. For automated blasting systems, use clean, oil-free abrasives. In the abrasive mix, use at least 50 percent steel grit. Replenish abrasive mix with new shot/grit combination as necessary to maintain the anchor profile within ½ mil (13 microns) of the specified profile.

G. Comply with the applicable federal, state, and local air pollution control regulations for blast cleaning.

H. For air-blast cleaning, supply compressed air at adequate pressure from well-maintained compressors equipped with oil and a moisture separator which delivers oil and water-free air as checked with white blotter, white cloth, or plastic sheets at the beginning of each blasting sequence.

I. Clean surfaces of dust and residual particles of the cleaning operation using dry air-blast cleaning, vacuuming, or another approved method prior to painting. Vacuuming must be the final cleaning method immediately prior to painting areas that will go into submerged service.

J. In enclosed areas and other areas where dust may settle, vacuum the surface clean and wipe it with a tack cloth.

K. Remove damaged or defective coating by the specified blast or power tool cleaning to meet the clean surface requirements before recoating.

L. If the specified abrasive blast cleaning will damage adjacent work, the area to be cleaned is less than 100 square feet, and the coated surface will not be in submerged service, then SSPC-SP2 – Hand Tool Cleaning or SSPC-SP3 – Power Tool Cleaning, may be used. If the coated area to be cleaned is less than 100 square feet, and will be in submerged service, then SSPC-SP11 Power Tool Cleaning to Bare Metal may be used.

M. Completely remove shop-applied coatings of unknown composition before the specified coatings are applied. Examine valves, castings, ductile or cast iron pipe, and fabricated pipe or equipment for the presence of shop-applied temporary coatings. Completely remove temporary coatings by solvent cleaning per SSPC-SP1 method before starting abrasive blast cleaning. Alternate cleaning methods such as Baking Soda Blasting or Sponge Jet Blasting may be used as appropriate.

N. Use the solvent cleaning method (SSPC-SP1) to clean shop-primed equipment in the field before finish coats are applied.

3.05 SURFACE PREPARATION FOR GALVANIZED FERROUS METAL

A. For galvanized ferrous metal, use the alkaline cleaning method per SSPC-SP1 to remove oil, grease, and other contaminants detrimental to adhesion of protective coatings. Alternate methods with biodegradable surfactant type cleaners followed by fresh water washing may be used as appropriate.

B. Apply pretreatment coatings of surfaces in accordance with the printed recommendations of the coating manufacturer.

3.06 SURFACE PREPARATION OF FERROUS SURFACES WITH EXISTING COATINGS

A. Remove grease, oil, heavy chalk, dirt, or other contaminants by solvent or detergent cleaning prior to abrasive blast cleaning. Determine the generic type of the existing coatings by laboratory testing.

B. Provide the degree of cleaning specified in the coating system schedule for the entire surface to be coated. If the degree of cleaning is not indicated in the schedule, remove deteriorated coatings by abrasive blast cleaning to meet the requirements of SSPC-SP6 Commercial Blast Cleaning. Clean areas of tightly adhering coatings to meet the requirements of SSPC-SP7 Brush-Off Blast Cleaning, with the remaining thickness of pre-existing coating not to exceed 3 mils.

C. If coatings to be applied are not compatible with existing coatings, apply intermediate coatings conforming to the paint manufacturer's recommendation for the indicated coating system or completely remove the existing coating prior to abrasive blast cleaning. Make a small trial application for compatibility prior to painting large areas. Allow the trial application to cure for 7 days at 50° F (10° C) or higher before determining compatibility.

D. Completely remove coatings of unknown composition prior to application of new coatings.

E. Where specified or where job site conditions do not permit dry-abrasive blasting for industrial coating systems due to dust or air pollution considerations, water jetting or wet-abrasive blasting may be used. In both methods, use inhibitors approved by the manufacturer of the coating system, which will be applied over the cleaned area. Begin the coating application as soon as the surface has dried, and before the formation of any flash rusting. Perform water jetting with or without abrasive injection, as appropriate, to achieve the specified degree of surface cleanliness. Do not use water-jetting methods for submerged or severe-service coating systems, unless specified for that area.

3.07 PLASTIC, FIBERGLASS, AND NONFERROUS METALS SURFACE PREPARATION

A. Unless otherwise indicated, for equipment or parts of equipment which are not submerged in service, shop-prime, and then finish-coat in the field after installation. For methods, materials, application equipment, and other details of shop painting, comply with this Section. If the shop primer requires topcoating within a specified period of time, apply the finish coating in the shop and then touch-up the paint after installation.

B. Perform surface preparation and coating work in the field for equipment, or parts and surfaces of equipment which are submerged or inside an enclosed hydraulic structure when in service, with the exception of pumps and valves.

C. For certain pieces of equipment, it may be undesirable or impractical to apply finish coatings in the field. Such equipment may include engine generator sets, equipment such as electrical control panels, switch gear or main control boards, submerged parts of pumps, ferrous metal passages in valves, or other items where it is not possible to obtain the required quality in the field. For such equipment, prime and finish-coat in the shop and touch-up in the field after installation. Use the identical material for touch-up that was used for shop painting. Require the manufacturer of each such piece of equipment to certify as part of its shop drawings that the surface preparation is in accordance with these specifications. Submit the coating material product data sheet with the shop drawings for the equipment.

D. For certain small pieces of equipment, the manufacturer will have a standard coating system, which is suitable for the intended service conditions. In such cases, the final determination of suitability will be made during review of the shop drawing submittals. Equipment of this type generally includes only indoor equipment such as instruments, small compressors, and chemical metering pumps.

E. Protect shop-painted surfaces during shipment and handling. Protect surfaces with padding or blocking. Lift equipment with canvas or nylon slings. Before being topcoated, do not expose primed surfaces to the weather for more than 2 months or less when recommended by the coating manufacturer.

F. Repair damage to shop-applied coatings in accordance with this Section and the coating manufacturer's printed instructions.

G. Make certain that the shop primers and field topcoats are compatible and meet the requirements of this Section. Submit copies of applicable coating manufacturer's product data sheets with equipment shop drawings.

3.08 APPLICATION OF COATINGS

A. Apply protective coatings to steel substrates in accordance with SSPC-PA1 – Paint Application Specification No. 1. Shop, Field and Maintenance Painting.

B. Inspect cleaned surfaces and each coat prior to succeeding coats. Schedule inspections with the City Engineer in advance.

C. Paint blast-cleaned ferrous metal surfaces before rusting or other deterioration of the surface occurs. Limit blast cleaning to only those surfaces that can be coated in the same working day unless the area to be coated is protected by humidity control equipment set to maintain humidity below 50 percent at all times.

D. Apply coatings in accordance with the manufacturer's instructions and this Section, whichever has the most stringent requirements.

E. Give special attention to edges, angles, weld seams, flanges, nuts and bolts, and other places where insufficient film thickness is likely to occur. Use stripe painting by brush, after application of the primer, for these areas.

F. Give special attention to materials, which will be joined so closely that proper surface preparation and application are not possible. Coat such contact surface prior to assembly or installation. Use only inorganic zinc primers on faying surfaces.

G. Apply finish coats, including touch-up and damage repair coats, in a manner which will present uniform texture and color-matched appearance.

H. Do not apply coatings under the following conditions:
1. Temperature outside of the manufacturer's recommended minimum and maximum range.
2. Dust or smoke laden atmosphere.
3. Substrate or air temperature less than 5° F (3° C) above the due point.
4. Air temperature is expected to drop below 40°F (14° C) or less than 5° F (3° C) above the dew point within 8 hours after application of the coating.
5. Wind conditions in excess of 15 MPH or dust laden.

I. Determine the dew point by use of a sling psychrometer in conjunction with the U.S. Department of Commerce, Weather Bureau psychometric tables.

J. For steel piping which will not be buried, have the surface abrasive blast cleaned and primed before installation.

K. Apply finish coats after concrete, masonry, and equipment installation is complete and the work areas are clean and dust free. Concrete must have cured for a minimum of 28 days @ 75° F (24° C) unless an approved epoxy sealer has been applied to green concrete within 12 hours of finishing the concrete.

3.09 CURING OF COATINGS

A. Maintain curing conditions in accordance with the recommendations of the coating material manufacturer and this Section, whichever is the most stringent. Complete curing before placing the coating systems into service.

B. In the case of enclosed areas, forced air ventilation using heated air may be required until the coatings have fully cured.

C. Forced air ventilation is required for the application and curing of coatings on the interior surfaces of enclosed hydraulic structures. During application and curing periods, continuously exhaust air from the lowest level of the structure using portable ducting to force air into all compartments and around baffles. After interior coating operations have been completed, provide a final curing period that meets the minimum temperature and time requirements of the manufacturer of the coating system being applied, while operating the forced air ventilation system continuously.

3.10 SHOP AND FIELD INSPECTION AND TESTING

A. Give the City Engineer a minimum of 3 days advance notice of the start of any field surface preparation work or coating application work, and a minimum of 7 days advance notice of the start of any shop surface preparation work.

B. Perform surface preparation and coating applications in the presence of the City Engineer, or his appointed NACE certified coating inspector, unless the City Engineer has granted prior approval to perform the work in their absence.

C. Inspection by the City Engineer or the NACE certified inspector, or the waiver of inspection of any particular portion of the work, does not relieve the Contractor of his responsibility to perform the Work in accordance with these Specifications.

D. Erect and move scaffolding where requested by the City Engineer to facilitate inspection. Provide additional illumination to light areas to be inspected. Remove or grind smooth all scaffolding clips welded to the structure prior to surface preparation of the structure.

E. Until final acceptance of the coatings, furnish inspection devices in good working condition for the detection of holidays and measurement of dry-film thickness (DFT) of protective coatings. Make DFT gauges available for the City Engineer's use throughout the coating process until final acceptance of the coatings. Provide the services of a NACE certified coating inspector for all holiday detection work until the final acceptance of the coatings. Operate holiday inspection devices in the presence of the City Engineer.

F. Perform holiday tests on coated ferrous surfaces inside a steel reservoir, other surfaces that will be submerged in water or other liquids, or surfaces which are enclosed in a vapor space in such structures. Perform holiday tests on surfaces coated with any of the submerged and severe service coating systems. Mark and repair or recoat areas which contain holidays in accordance with the coating manufacturer's printed instructions and then retest. DO NOT PERFORM HOLIDAY TESTING AFTER STRUCTURE HAS BEEN SUBMERGED.

1. Coatings with Thickness Exceeding 20 mils (500 microns): For surfaces having a total DFT exceeding 20 mils (500 microns); use a pulse-type holiday Detector such as Elcometer 136, or equal. Adjust and operate in accordance with NACE RP0188.

2. Coatings with Thickness of 20 mils (500 microns) or Less: For surfaces having a total DFT of 20 mils or less, use Elcometer 269 non-destructive type holiday detector, or equal. Instrument must operate at less than 75 volts. For thicknesses between 10 and 20 mils (250 and 500 microns), a non-sudsing type wetting agent such as Kodak Photo-Flo, or equal, may be added to the water prior to wetting the detector sponge. For submerged or severe service areas, the residue of the wetting agent must be removed with clean, fresh water prior to application of any additional coats.

G. On ferrous metals, measure the DFT in accordance with SSPC-PA2 Measurement of Dry Film Thickness with magnetic gauges using either a pull-off type gauge (Elcometer 211) or

constant pressure gauge (Elcometer 345F), or equal. Test each coat for the correct thickness. Calibrate the DFT gauge at the beginning of each workday or shift in accordance with the directions of the manufacturer of the gauge. Do not take measurements until at least 8 hours after coating application. On non-ferrous metals, measure the DFT with positive pressure eddy current gages (Elcometer 345N) or equal.

H. Evaluation of blast-cleaned surface preparation work will be based upon comparison with photographic samples contained in SSPC-VIZ 1.

I. Evaluation of surface profile will be based upon the use of TesTex pressure sensitive tapes.

3.11 PAINTING AND IDENTIFICATION OF PIPING

A. Painting and Color Coding:

1. Use colors and signs to identify all piping which is exposed to view in buildings or tunnels, above suspended ceilings or exposed above grade, and all outdoor piping. Identify each pipe by a color complying with the following schedule of colors and by applied markers.

2. Coat pipes with the number of coats and type of material specified. Base coats for pipeline painting may be a neutral color. Make each succeeding base coat a contrasting color. For the final coat, comply with the pipe identifying color schedule.

3. Apply pipe identification markers to exposed piping, except for the following pipe at wastewater lift stations:
   a) Discharge piping for wastewater pumps.
   b) Vent piping.
   c) Any piping inside wet wells.

B. Pipe Identification Markers:

1. Identify all pipes with applied signs or markers at 15-foot centers, at both sides of penetrated walls or floors, adjacent to valves, at connected equipment, at branch fittings, and in congested pipe layouts.
   a) Apply markers consisting of signs with legends as follows:

OUTSIDE DIAMETER OF PIPE OR COVERING (INCHES)	LENGTH OF COLOR FIELD (INCHES)	SIZE OF LETTERS (INCHES)
3/4 to 1- 1/4	8	1/2
1- 1/2 to 2- 3/8	8	3/4
2- 1/2 to 5- 7/8	12	1- 1/4
6 to 7- 7/8	12	1- 1/4
8 to 10	24	2- 1/2
Over 10	32	3- 1/2

   b) As pipe markers, use semi-rigid outdoor grade acrylic plastic, Seton Name Plate Corp., SetMark, or equal. Use Type SNA for outside diameters 3/4 through 5- 7/8

inches and Type STR for 6-inch outside diameter or larger. For pipes less than 3/4-inch in diameter, use applied marker of brass identification tags 1-1/2 inches square with depressed letters 1/4-inch high, black-filled. Apply tightly to pipeline with metal or plastic straps.

C. Pipe Identification Color Schedule:

1. For wastewater facilities refer to current version of TCEQ chapter 217. For piping systems not found in TCEQ chapter 217, use the colors listed in the following pipe identification color schedule:

PIPE IDENTIFICATION COLOR SCHEDULE

PIPING SYSTEM	COLOR	FED. STD. NO.
Fire Mains	Red	11105
Oxygen	Orange	12246
Sodium Hypochlorite	Yellow	13655
Raw Polymer	Pink	11156
Diluted Polymer	Purple	17142
Natural Gas	Yellow	13655
Heating Water	Pink	11158
Domestic Hot	Light Pink	11668
Potable Water	Blue	15102
Non-Potable Water	White	17875
Instrument Air	Green	14187
Plant Air	Dark Green	14110
Raw Sewage	Gray	16473
Grit	Dark Gray	16187
Cyclone Return	Gray	16473
Classifier Return	Gray	16473
PIPING SYSTEM	COLOR	FED. STD. NO.
Heavy Solids	Dark Brown	10080
Return Sludge	Brown	10091
Waste Sludge	Yellow-Brown	10266
Scum	Light Brown	10334
Chilled Water Supply (CWS)	Blue-Green	14329
Chilled Water Return (CWR)	Blue-Green	14325
Condensing Water Supply (Cond-WS)	Light Green	14533
Condensing Water Return (Cond-WR)	Light Green	14533
Deionized Water (DW)	Light Blue	15526
Vacuum (Vac)	White	17875
Vent	Light Gray	16492

2. For pipe identification colors not listed above, follow American National Standard (ANSI A13.1-81) Color Schedule:
   a) Materials inherently hazardous, flammable or explosive; chemically active or toxic; extreme temperature or pressure; radioactive: Yellow Field with Black Letters.

b) Material of inherently low hazard – liquid or liquid admixture: Green Field with White Letters; gas or gaseous admixture: Blue Field with White Letters.
c) Fire quenching materials, water, foam, carbon dioxide, Halon, etc.: Red Field with White Letters.

3.12 COATING SYSTEM SCHEDULES – FERROUS METALS

A. Coating System Schedule, Ferrous Metal – Not Galvanized

SCHEDULE NO. AND APPLICATION	SURFACE PREPARATION	SYSTEM NO./ DESCRIPTION
FM-1: Surfaces indoors and outdoors, exposed or covered, except those listed below.	Near White Metal blast cleaning SSPC-SP10/NACE 2	(2) Inorganic zinc/epoxy/ polyurethane
FM-2: Surfaces in chlorination room, chlorine storage room, sodium hypochlorite storage room	Near White Metal blast cleaning SSPC-SP10/NACE 2	(100) Amine-cured epoxy
FM-3: Surfaces of pumps and equipment and other ferrous surfaces submerged or intermittently submerged in potable water, utility water, and wastewater; including surfaces lower than 2 feet above high-water level in hydraulic structures, and surfaces inside enclosed hydraulic structures, pump state wet wells, and vents (excluding shop-coated valves, couplings, and pumps).	White Metal Blast Cleaning SSPC-SP5/ NACE 1	(100) Amine-cured epoxy
FM-4: Surfaces exposed to high temperature between 150^0 and 600^0 F (65^0 and 315^0 C).	Near White Metal blast cleaning SSPC-SP10/NACE 2	(3) Inorganic Zinc, water-based
FM-5: Surfaces exposed to high temperature between 600^0 and 1000^0 F.	Near White Metal blast cleaning SSPC-SP10/NACE 2	(9) Aluminum silicon resin
FM-6: Where indicated, ferrous surfaces in water passages of valves 4-inch size and larger, exterior surfaces of submerged valves.	White Metal Blast Cleaning SSPC-SP5/ NACE 1	(101) Polyamide-cured epoxy
FM-7: Where indicated, ferrous surfaces in water passages of pumps which have discharge size of 4 inches or larger; exterior, submerged surfaces of pumps.	White Metal Blast Cleaning SSPC-SP5/ NACE 1	(101) Polyamide-cured epoxy
FM-8: Ferrous surfaces of sleeve couplings.	White Metal Blast Cleaning SSPC-SP5/ NACE 1	(103) Fusion-bonded epoxy
FM-9: Ferrous surfaces of sluice gates, flap gates, and shear gates, including wall thimbles.	White Metal Blast Cleaning SSPC-SP5/ NACE 1	(101) Polyamide-cured epoxy
FM-10: Structural steel, miscellaneous metal work, and supports for prefabricated metal buildings, not exposed to view in finished building.	Commercial Blast Cleaning (SSPC-SP6/NACE 3	(10) Zinc Rich Epoxy
FM-12: Ferrous metal exposed to view, inside	Near White Metal	(2)

and outside of buildings.	blast cleaning SSPC-SP10/NACE 2	Inorganic zinc/ epoxy/polyurethane
FM-13: Surfaces of indoor equipment not submerged.	Commercial Blast Cleaning SSPC-SP6/ NACE 3	(5) Epoxy, equipment
FM14: Exterior (exposed) surfaces shop-coated with fusion-bonded epoxy.	Light abrasive blast to roughen surface	(6) Aliphatic polyurethane

B. Coating System Schedule, Ferrous Metal – Galvanized: Apply pretreatment coatings, barrier coatings, or washes as recommended by the coating manufacturer.

SCHEDULE NO. AND APPLICATION	SURFACE PREPARATION	SYSTEM NO./ DESCRIPTON
FMG-1: Exposed surfaces indoors and outdoors, except those listed below.	Alkaline cleaning SSPC-SP1	(1) or (4) Aliphatic Polyurethane, or Acrylic
FMG-2: Surfaces in chlorination room, chlorine storage room, and sodium hypochlorite storage room.	Alkaline Cleaning SSPC-SP1	(100) Amine-cured epoxy
FMG-3: Surfaces submerged in water or wastewater, including surfaces lower than 2 feet above high-water level and surfaces inside hydraulic structures and vents	Alkaline cleaning SSPC-SP1 followed by Brush-Off blast cleaning SSPC-SP7/ NACE 4	(100) Amine-cured epoxy
FMG-4: Surface exposed to view, inside and outside of building.	Alkaline Cleaning SSPC-SP1	(1) or (4) Aliphatic polyurethane, or Acrylic

C. Coating System Schedule, Interior Surface of Welded Steel Tanks: Coat interior surfaces, including tank nozzles, manholes, nozzle necks, and flange faces. For steel tank exterior coating systems, see paragraph 3.15.1, Coating System Schedule, Ferrous Metal – Not Galvanized.

PRODUCT STORED	SURFACE PREPARATION	SYSTEM NO. /DESCRIPTION
Zinc Orthophosphate	White metal blast cleaning SSPC-SP5/NACE1	(104) Natural rubber (soft) or neoprene
Liquid Alum	White metal blast cleaning SSPC-SP5/NACE1	(104) Natural rubber (soft) or neoprene
Polymer	White metal blast cleaning SSPC-SP5/NACE1	(104) Natural rubber (soft) or neoprene
Sodium Bisulfite	White metal blast cleaning SSPC-SP5/NACE1	(104) Natural rubber (soft) or neoprene
Ferric Chloride	White metal blast cleaning SSPC-SP5/NACE1	(104) Natural rubber (hard)
Aqueous Ammonia	White metal blast cleaning SSPC-SP5/NACE1	(104) Chlorobutyl rubber
Caustic Soda	Commercial Blast Cleaning SSPC-SP6/NACE 3	No Coating
Sodium Hypochlorite	White metal blast cleaning SSPC-SP5/NACE1	(104) Chlorobutyl Rubber

Sulfuric Acid (max. 45% concentration)	White metal blast cleaning SSPC-SP5/NACE1	(107) Hypalon
Sulfuric Acid (above 40% concentration)	White metal blast cleaning SSPC-SP5/NACE1	(107) Viton
Hydrofluosilicic Acid	White metal blast cleaning SSPC-SP5/NACE1	(107) Chlorobutyl Rubber
Water, Potable Water, Utility Water	White metal blast cleaning SSPC-SP5/NACE1	(100) Amine-Cured Epoxy

3.13 COATING SYSTEM SCHEDULES, NONFERROUS METAL, PLASTIC, FIBERGLASS

Where isolated non-ferrous parts are associated with equipment or piping, use the coating system for the adjacent connected surfaces. Do not coat handrails, gratings, frames, or hatches. Use primers recommended by coating manufacturer.

SCHEDULE NO. AND APPLICATIONS	SURFACE PREPARATION	SYSTEM NO./ DESCRIPTION
NFM-1: Exposed surfaces, indoors and outdoors, except those listed below.	Solvent cleaned SSPC-SP1	(1) Aliphatic Polyurethane
NFM-2: Chlorination room, chlorine storage room, sodium hypochlorite storage room.	Solvent cleaned SSPC-SP1	(100) Amine-Cured Epoxy
NFM-3: Aluminum surfaces in contact with concrete, or with any other metal except galvanized ferrous metal.	Solvent cleaned SSPC-SP1	(8) Aluminum Metal Isolation
NFM-4: Polyvinyl chloride plastic, indoors and outdoors, not submerged.	Solvent cleaned SSPC-SP1	(4) Acrylic
NFM-5: Fiberglass surfaces.	Per paragraph 3.09, Plastic, Fiberglass, and Non-Ferrous Metals Surface Preparation	(6) Aliphatic Polyurethane Fiberglass

END OF SECTION

SECTION 09910
PAINTING

PART 1 GENERAL

1.01 WORK INCLUDED

A. Except for job applied finishes specified in other Sections, provide paint or transparent finishes for all new visible exterior and interior materials unless they are noted or specified to be delivered already finished, or they are specifically noted or specified as requiring no paint or transparent finish, and for concealed surfaces where specified.

1.02 MEASUREMENT AND PAYMENT

A. No separate payment will be made for work performed under this Section. Include the cost for this work in the lump sum Base Bid Item in Section 00410.

1.03 DEFECTS

A. This work shall remain in first-class condition as determined by the Architect's observation exempting only damage from usage or wear. Failure of work will necessitate repainting of surface involved as well as similar surfaces within the area involved.

1.04 SUBMITTALS

A. Schedule of systems - Manufacturers complete published schedule of recommended finish systems, marked for identification of top of the line systems proposed for each system specified. Schedules shall include all under coats required for each finish.

B. Product data - Product data for each product proposed in schedule of systems and as otherwise specified, including component analysis by weights and VOC and VOS acceptability information, each product.

C. Room Schedule - A room-by-room schedule of finish systems and luster for each surface to be coated. Similar rooms may be grouped. Exterior surfaces shall be included individually.

D. Color system - Manufacturers full range for each scheduled system for selection where colors are not shown.

E. Samples

1. A representative area of each type surface preparation, paint, finish, color and luster finished on the project for approval. Such approved surfaces will be the standard for like work throughout the job.

1.05 OMISSIONS

A. The omission of Specifications of a finish system for a particular material does not determine that such finish is not required unless such material is specifically noted or specified as not requiring finish. Submit notice of such omissions during bidding. Failure to do so shall not relieve the Contractor from the responsibility for providing a first-class finish as directed, on all visible materials and surfaces not specifically exempted.

1.06 SUBSURFACES

A. Inspect surfaces that are required to be coated. Submit notice of unsuitable conditions in sufficient time for defects to be corrected. Start of work implies acceptance of such surfaces as satisfactory as for application of this work.

B. Equipment - Where painting is required behind items of equipment, the installing trade is to remove such work temporarily and reconnect them after completion of painting. Notify such trades in sufficient time to permit proper coordination of the work.

C. Doors - Conform to the requirements for job finishing, including surface condition, preparation and sealing of surfaces and edges, stated in the Standard Door Guarantee of the National Woodwork Manufacturers Association.

1.07 CONTAINERS AND LABELS

A. Materials specified or approved as to manufacturer, brand, and quality must be delivered in unbroken original packages or containers. Such packages or containers must bear brand and manufacturer's name and, where special directions are given, apply materials strictly in accordance with same.

B. When applicable due to the composition of any paint material, each container of the product shall have attached a label stating the limitations on use of the material, i.e., "This paint contains more than .5% lead content and shall not be used on surfaces accessible to children." The material manufacturer is required to state the lead contents as a percentage of total solids.

1.08 VOC, VOS LIMITATIONS

A. Conform to all applicable regulations limiting volatile organic compounds and substances (VOC, VOS) used in this work. Where either are included in a specified system, provide specified products of acceptable characteristics, or provide compatible substitutes of equivalent performance where such acceptable products are not available.

1.09 MATERIALS AND SURFACES REQUIRING NO FIELD APPLIED FINISH

A. The following materials and surfaces, in addition to factory finished (not primed only) items, do not require paint or transparent finishes under the work of this Section, unless specifically noted or specified otherwise:

1. Copper, aluminum, (except visible pipe and conduit in finish spaces not otherwise excepted, and roof, wall and ground mounted equipment items) and stainless steel, and chrome-plated metal.

2. Finish hardware of plastic or having natural metal finish. (Prime coated and metallic lacquer finish items such as door closers, butts, etc., shall be painted.)

3. Acoustic board or tile and exposed grids.

4. Plastic and plastic finish surfaces except exposed piping and conduit in finish spaces not otherwise excepted.

5. Metal grilles having natural metal or factory-applied enamel finish, except that mars shall be touched up, and factory primed-coated and metallic lacquer finish grilles shall be field painted.

6. Architectural precast concrete.

7. Visible acoustic blanket.

8. Floorings.

9. Ceramic tile.

10. Stucco.

11. Factory finished casework.

12. Woven wire fencing and gates.

13. Exterior insulated finish systems.

1.10 COLORS

A. General: Field applied primers shall be white. Touch up shop primers shall be a let down of the shop coat. Under coats shall be let downs of selected colors other than tints (off whites) which shall have neutral gray tint under coat.

B. Schedule: It is intended that the color for every visible finish applied under the work of this Section be selected in advance. If a color selection has been omitted, request selections in sufficient time to permit review by the Owner and revision of the selection when necessary. Base bid on use of at least 2 deep colors and 3 tints for exterior work, 8 deep colors and 12 tints plus 6 bright, clean primary colors for accent walls for interior work, plus wood stains and clear finishes as required.

C. Selection and mixing: If another manufacturer's paint than that for which colors have been scheduled is approved for use, colors shall match scheduled colors exactly. Colors, regardless

of quantity, shall be mixed by the manufacturer, using equipment and methods that provide accurate and repeatable proportioning of pigments. No colors shall be mixed on the job.

PART 2 PRODUCTS

2.01 FINISH SYSTEMS - GENERAL

A. Except for specified products, only top of the line products as recommended in manufacturers published schedule of systems corresponding to each finish system shown. Only one manufacturer's materials shall be used unless otherwise shown.

2.02 ACCEPTABLE MANUFACTURERS/PRODUCTS

A. Subject to compliance with these specifications include those listed below and with item specifications, or approved equal, unless otherwise shown.

1. ICI
2. PPG Industries
3. The Sherwin-Williams Co.

2.03 MATERIALS - GENERAL

A. Putty, spackle: Architectural grade oil-base caulk, vinyl paste spackling compound or water putty.

B. Raw linseed oil: ASTM D234.

C. Thinner: As recommended by manufacturer of product to be thinned.

D. Shellac: ASTM D360, light body white shellac.

E. Varnish: Generally oleoresinous for standing interior work, polyurethane for interior floors and exterior work.

F. Cleaning solvent for galvanized surfaces: ASTM D362.

G. Zinc-rich coating: An approved specially formulated compound that will provide a coating of approximately 3 mils thickness containing not less than 95% zinc when applied in one coat according to the manufacturer's directions.

H. Rust inhibitor: A phosphoric acid compound.

I. Etching solution for galvanized surfaces: A premixed solution meeting or exceeding requirements of Navy Specification MIL-P-21035 (ships).

J. Epoxy concrete floor paint: Semstone 145 ACF 60 mil. with slip proof aggregate in chemical feed building, in pump rooms.

K. Epoxy wall paints: Semstone 145 FC, 30 mil. for chemical feed building, epoxy-polyester otherwise.

L. Waterproofing Wall Coating System: Thoroseal Cement Coating with Acryl 60 acrylic emulsion additive first coat; Thorosheet 56% solids, acrylic emulsion second coat in selected colors, 40 DMT total, or approved equal.

M. Block filler: Vinyl - acrylic latex base filler for general use, acrylic latex base filler for high humidity and intermittently moist or steam cleaned areas, acrylic epoxy base filler for high humidity and steam cleaned areas and under acrylic epoxy HIPAC coatings.

N. Texture - undercoat: A water mixed product designed for roller application over gypsum wallboard.

1. National Gypsum Co. - Gold Bond Texture.

2. United States Gypsum - Multi-Purpose Texture.

O. High performance (HIPAC) coating

1. Epoxy-Polyester – For new construction generally, a 2 part solvent base finish designed for roller or spray application.

P. Epoxy-urethane coating: A recoatable system composed of epoxy-polyamide base coat and aliphatic polyurethane enamel finish coat.

Q. Clear polyurethane: A 2 component finish modified as required to provide an eggshell sheen to match approved sample.

R. Electro-static painting system:

1. Sprayer - DeVilviss Co. - Model EHL-600 Electrostatic Hand Gun and Assembly.

2. Paint - Two component epoxy polyamide enamel made and labeled for electro-static application.

2.04 FINISH SYSTEMS

A. New surfaces: The following systems are required in addition to shop primers, block fillers, textures, sealers, etc. required above or following. Paint and stain shall be of selected approved colors.

B. Coverage: The number of coats required under Finish systems shall be considered a minimum only and additional coats shall be provided where necessary to achieve full coverage. Some accent colors may require an additional base coat in white to achieve full coverage.

C. Following classification of areas is used in interior finish system and luster selection unless otherwise shown:

1. Wet and high humidity - Shower stalls and rooms, toweling rooms, common baths, sculleries, pump rooms, janitor's closets, autoclave rooms, kitchens, laundry washer rooms, lodging bathrooms.

2. Abuse and hard use - Service corridors and lobbies, receiving and shipping areas, maintenance and shop areas, boiler and machine rooms, electrical closets, transformer and switchgear rooms, service stairs, storage rooms, handrails.

3. General - All other commercial, educational, or institutional areas.

4. Closets, alcoves, vestibules classify with the spaces they serve unless otherwise shown.

D. Luster: Specified finish systems shall have the following finish luster unless otherwise shown:

1. Interior surfaces
   a. Walls
      1) Wet and high humidity, and hard use and abuse areas - Gloss
      2) All others semi-gloss
   b. Painted wood and metal work:
      1) Wet, high humidity, abuse areas and handrails – Gloss
      2) All others - Semi-gloss
      3) All others: Semi-gloss

E. Schedule: Provide systems as follows in scheduled luster for designated surfaces in various areas unless otherwise shown. Finish material and total number of field coats define the systems. Undercoats shall be in accordance with the surface and its condition as approved in manufacturer's systems submittal, and shall be in addition to shop primers, textures, special sealers, fillers, etc., required in fabrication or preparation.

1. Interior surfaces
   a. Primed metals including metal fabrications, hollow metal, structural framing and joists.
      1) Generally, 2 coat alkyd resin paint system.
   b. Concrete masonry units
      1) Block fill all painted CMU.
      2) 2 coat, epoxy – wall paint.

PART 3 EXECUTION

3.01 WORKMANSHIP REQUIREMENTS

A. Application: Skilled mechanics shall apply these materials. Execute this work in accordance with best practices recognized for the class of work and grade, type, and kinds of materials specified, only on dry materials and under acceptable weather conditions. Unless otherwise specified or approved, or otherwise recommended by its manufacturer, apply paints by the following methods:

1. Walls, ceilings and soffits - Brush or roller.

2. Metal trim, Metal doors - Roller or spray.

3. Other finishes - Brush or spray.

B. Drying: Do not apply a succeeding coat until preceding coat is dry and hard.

C. Back-priming: Back-prime or seal exterior woodwork and interior wood frames, millwork, trim, and plywood. Apply priming and sealing as soon as work is delivered to the job. After they are fitted by carpenter, give unfinished edge of Wood and Plastic Doors one coat of Sealer and 2 coats of Lacquer or one coat of primer and 2 coats of paint as required to match face of door.

D. Paint: Use without thinning or adulterating, unless specified otherwise.

E. Electro-static paint: Apply with approved equipment at approximately 6,000 DC negative charge after proper preparation, masking and grounding of the target material by approved, experienced firm only, working in code approved ventilating conditions.

F. Sanding: Sand each undercoat on interior wood or metal finishes thoroughly and uniformly with No. 00 sandpaper.

G. Texture: Unless otherwise directed, cross roll with short nap rollers to a fine sand finish matching approved field sample.

H. Block filler: Double roll with short nap rollers and add coats as required to fill all pores leaving no pinholes and no coating texture.

I. Brushes: Lay out brush-applied coats to remove all brush marks.

J. Rollers: Double roll each coat by cross-rolling in a 90 degree pattern.

K. Paint film thickness: Not less than 2 wet mils per coat and as recommended by product manufacturer.

L. Water base coatings: Before application of water base coatings, prime bare ferrous metal in such surfaces with an oil base prime coat to prevent rusting.

M. Caulked joints: Painting shall be completed before application of sealant beads and joints in painted surfaces. Painting shall be returned into open joints for sealant to contact.

N. Hardware: Paint prime coated and metallic lacquer finish hardware items to match finish of doors, or as directed. Do not paint hardware having a natural metal finish.

O. Grilles

1. Spray paint prime coated and metallic lacquer finish grilles as follows before installation:
   a. Doors - Approved color to blend with or match doors.
   b. Other - Match adjacent surface color.

2. Paint structure, duct interiors, blocking, etc., that is visible behind grilles, vents, etc., flat black so as to make them invisible.

P. Surfaces behind equipment: Paint surfaces visible behind fixed equipment, surfaces behind movable equipment and surfaces behind fixed equipment not in place at time of painting.

Q. Ground, wall and roof mounted equipment: Paint such equipment regardless of factory finish when the equipment is visible from the ground at any distance, or from occupied spaces in the building, as well as when it is noted to be painted.

R. Compatibility: Provide barrier coats over incompatible primers, or remove and repaint with compatible products.

3.02 PREPARATION

A. General: Complete the work required in the following subparagraphs before applying any of the coats specified under finish or workmanship requirements. Surfaces shall be clean, smooth, and dry at the time of painting. Do not apply paint or transparent finishes under conditions of weather or temperature unsuitable for executing a first-class job. Obtain correction of surfaces or under coat unsuitable for the application of following coats or acceptable finishes. Remove electrical plates, hardware etc. and replace on completion.

B. Wood to be painted: Seal knots, pitch streaks, and sap streaks with Western Pine Association Formula WP578 for exterior work and shellac for interior work. After application of first paint coat, fill holes, dents, scratches, etc., flush with surface, using Paste Filler. After filler is dry, sandpaper surface smooth.

C. Visible structural, miscellaneous and ornamental steel and iron; hollow metal: Remove rust, scale, primer runs, etc. with a wire brush, scraper and emery cloth. Retouch shop paint damage and paint field welds, bolts, etc., with same primer. Fill dents, depressions and flush head fasteners flush with body putty and prime to match. Sand all surfaces after repair and touch-up to a smooth surface suitable for enamel work.

D. Galvanized steel: Wipe surfaces with Cleaning Solvent to remove oil and grease. Etch with solution of copper sulfate crystals or Etching Solution.

E. Concrete: Remove grease, form oil, and other foreign matter with benzine or naphtha. Remove salty incrustations and etch painted floors with 5% muriatic acid, neutralize and rinse clean after reaction. Remove loose particles and dirt with wire brush. When painting is done within 9 months of placing of concrete, neutralize surface with solution consisting of 3-1/2 lbs. of zinc sulfate crystals per gallon of water. After solution has dried, rinse with clear water and remove any surface deposit. Do not use on surfaces that have received metallic waterproofing.

F. Masonry: Remove plaster and mortar daubs and loose particles with wire brush. Wash off efflorescence with a 5 to 10 per cent solution of muriatic acid which shall be allowed to stand until efflorescending ceases, and then shall be thoroughly rinsed off with clear water.

G. Gypsum board: Unless otherwise shown, apply texture coat to all gypsum board.

H. Concrete unit masonry: For paint finishes, provide block fill, first coat.

I. Painted walls and ceilings: If surfaces to be painted have uneven absorption that would cause a visible effect when painting is finished, prime or seal the surface in addition to the finish system required, so as to overcome this condition.

3.03 PROTECTIONS

A. Other work: Protect work of other trades against damage or injury. Work damaged as a result of execution of painting and finishing work shall be satisfactorily repaired or, if it cannot be properly repaired, it shall be replaced with new work. During painting operations, mask finish hardware that is not required to be painted.

B. Workspace: Any space used for mixing or storing materials for the work of this Section shall be carefully protected from damage, staining, etc., and shall be left in first-class condition.

C. Concrete floors: Where concrete floors are scheduled to be left visible, they shall be carefully covered and protected from paint spots, spills, etc. Any paint on such floors must be completely removed.

3.04 CLEAN-UP

A. Upon completion of this work, remove paint from other finished or prefinished surfaces such as transparent finish wood, ceiling grid, etc., and from unfinished surfaces such as tile, glass, aluminum, hardware, etc. Remove rubbish and accumulated materials connected with this work from the premises.

END OF SECTION

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SECTION 09915
SURFACE PREPARATION AND SHOP PRIME PAINTING

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment, and incidentals required for the surface preparation and application of shop primers on ferrous metals, excluding stainless steels, as specified herein.

1.02 MEASUREMENT AND PAYMENT

A. No separate payment will be made for work performed under this Section. Include the cost for this work in the lump sum Base Bid Item.

1.03 SUBMITTALS

A. Submit to the Engineer, in accordance with Section 01330 for shop drawings, manufacturer's specifications and data on the proposed primers and detailed surface preparation, application procedures and dry mil thicknesses.

B. Submit representative physical samples of the proposed primers, if required by the City Engineer.

1.04 REFERENCE STANDARDS

A. Steel Structures Painting Council (SSPC)

1. SSPC-SP-6, Surface Preparation Specification No. 6 Commercial Blast Cleaning.

2. SSPC-SP-10, Surface Preparation Specification No. 10 Near White Blast Cleaning.

3. NSF Standard 61

B. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

PART 2 PRODUCTS

2.01 MATERIALS

A. All painting materials shall be equal to those manufactured by the Tnemec Company, Inc. or equal. The painting schedule has been prepared on the basis of Tnemec products (unless otherwise noted) and Tnemec recommendations for application. No brand other than those named will be considered for approval unless the brand and type of paint proposed for each item in the following schedule together with sufficient data substantiated by certified tests conducted at no expense to the Owner, to demonstrate its equality to the paint(s) named, is submitted to the City Engineer in writing for approval within 30 days after the signing of the Contract Agreement. The type and number of tests performed shall be subject to the Engineer's approval.

B. All painting materials shall be delivered to the fabrication site in unbroken packages, bearing the manufacturer's brand and name. They shall be used without adulteration and mixed, thinned, and applied in strict accordance with manufacturer's directions for the applicable materials and surface and with the Engineer's approval before using.

C. No paint containing lead will be allowed. Oil shall be pure boiled linseed oil.

D. Materials shall be in full compliance with the requirements of pertinent codes and fire regulations.

2.02 PAINTING SCHEDULE

A. All colors will be selected by the City Engineer based on the color shown herein. The following surfaces shall have the types of paints specified below applied at the minimum dry film thickness (DFT) in mils per coat.

B. The following types of paints by Tnemec, unless otherwise indicated, have been used as a basis for the paint schedule:

1. Hydro-Zinc (Series 91 H_2O 2000) – organic vehicle zinc-rich (NSF Standard 61 Certified)N/A

2. Tneme-Zinc (Series 90-97) – zinc-rich urethane primer/ Carbozinc 859

C. All ferrous metals shall be shop coated according to the following areas of placement:

1. Submerged

1 Coat Series 91 H_2O 2000 (3.0-5.0 DFT)

2. All Non-Submerged

3. 1 Coat Series 90-97 (3.0-5.0 DFT) Carbozinc 859

D. Non-Primed Surfaces – Gears, bearing surfaces, and other similar surfaces obviously not to be painted shall be given a heavy shop coat of grease or other suitable rust-resistant coating. This coating shall be maintained as necessary to prevent corrosion during all periods of storage and erection and shall be satisfactory to the Engineer up to the time of the final acceptance test.

E. Compatibility of Coating Systems – Shop priming shall be done with primers that are guaranteed by the manufacturer to be compatible with their corresponding primers and finish coats specified in Section 09901 for use in the field and which are recommended for use together.

PART 3 EXECUTION

3.01 SURFACE PREPARATION AND PRIMING

A. Non-submerged components scheduled for priming, as defined above, shall be sandblasted clean in accordance with SSPC-SP-6, Commercial Blast Cleaning, immediately prior to priming.

B. Submerged components scheduled for priming, as defined above, shall be sandblasted clean in accordance with SSPC-SP-10, Near White Blast Cleaning, immediately prior to priming.

C. Surfaces shall be dry and free of dust, oil, grease and other foreign material before priming.

D. Shop prime in accordance with approved manufacturer's recommendations.

END OF SECTION

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SECTION 10400
SIGNAGE

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment, and incidentals required and install signage as shown, as scheduled and specified herein.

B. The types to be furnished are as follows:

1. Room identification signs
2. Cast aluminum letters – site building identification
3. Traffic signs
4. Restrictive signs/hazardous materials warning signs

1.02 MEASUREMENT AND PAYMENT

A. No separate payment for the signage will be made under this section. Include the cost for this work in the lump sum base bid.

1.03 RELATED WORK

A. Field painting, piping, and equipment identification is included in Section 09901.

B. Illuminated exit signs and electrical connections for illuminated signs are Division 16.

1.04 SUBMITTALS

A. Submit, in accordance with Section 01330, shop drawings showing details of construction and erection. Submittal shall include the following:

1. Manufacturer's complete color range and type styles.
2. Sign layout with shop drawings including:
   a. Scale layout of cast letter signs.
   b. Full-size layout of typical Room Identification, Restrictive, and Chemical Fill signs.
   c. Full-size layout and test of Plaques.
3. Two each of the following samples. Samples shall be resubmitted as required until approved.
   a. A full-size cast letter with proposed mounting hardware.
   b. A full-size sample of proposed plastic restrictive sign and chemical fill sign with proposed mounting.

c. A 6-inch minimum corner sample of proposed plaque showing material, edge detail, lettering and proposed mounting device.
d. A 6-inch minimum square sample of proposed pressure sensitive vinyl for Room Identification cut into letters in the colors proposed for the required color scheme.

4. Schedules – list room ID, toilet room, stair, area of rescue and assistance, telephone, assistive listening, room capacity, elevator lobby, stair and other signs by the plan location to which they apply, and the text/graphic each.

5. Layout – Provide full size typical layout each type sign, and text/graphic for area of rescue and assistance sign set, elevator lobby signs, stair signs, building title sign, orientation panel.

6. Cleaning and maintenance instruction for all signage components.

1.05 REFERENCES

A. National Fire Protection Association (NFPA)

1. NFPA 49 – Hazardous Chemicals Data

2. NFPA 325 – Guide to Fire Hazard Properties of Flammable Liquid, Gases, and Volatile Solids

3. NFPA 704 – Identification of Fire Hazards of Materials

B. Occupational Safety and Health Administration (OSHA)

C. Where applicable, signage shall comply with ADA, TEAB and local codes whether shown or not.

PART 2 PRODUCTS

2.01 MATERIALS

A. Signs shall be manufactured by ASI Sign Systems, Dallas, TX (214-352-9140); equal by Architectural Graphics Inc., Norfolk, VA or equal. Catalog numbers indicated are those of Architectural Signing Inc. (ASI), unless otherwise indicated. All lettering shall be Helvetica Medium, sized and both in upper and lower case as specified and scheduled.

B. Room Identification Signs and other associated instructions and with graphic representations shall be ASI LTV Series, pressure sensitive letters applied directly to doors. All numbers and letters shall be 1-1/2-inch high Helvetica Medium, upper and lower case. Numbers and letters shall be die-cut from 3.5-mils thick, pressure sensitive vinyl film and prespaced on carrier tape. The adhesive and finish surface shall be protected with one piece removable liners. Graphics and text shall be as scheduled. Color shall be dark blue to match exterior equipment color. See Section 09901.

C. Restrictive/Caution Signs and Hazard Identification System shall be ASI Group 1 SPF constructed of 0.080-inch vinyl laminated to a 0.080-inch acrylic backing. Letters or symbols shall be screen printing or ASP process both in subsurface locations. Restrictive/Caution Signs shall have 1-inch radius rounded corners. Minimum size of sign: 10 inches by 14 inches, adjust as necessary to fit text. Color of acrylic and letters shall be in accordance with OSHA standards. All other aspects of the Restrictive/Caution Sign shall be in accordance with OSHA standards. Hazard identification system shall conform to National Fire Protection Association (NFPA) NFPA 704 with a large diamond shape made up of four smaller diamonds with numbers on the diamonds corresponding to the labels for the chemical represented. Small diamonds are to be 5 inches on a side with 4-inch letters. The overall diamond shall be 10 inches on a side. The health diamond shall be blue with a white number. The flammability diamond shall be red with a white number. The Reactivity diamond shall be yellow with a blue number. The unusual reactivity diamond shall be white with a red symbol. Health diamond is on the left. Flammability diamond is on the top. Reactivity diamond is on the right. Special reactivity diamond is on the bottom. Reference for the contents of these signs for each chemical is NFPA 49. If OSHA standards do not apply, the color of the acrylic shall be red with white letters 1 inch high. Signs shall be wall surface mounted generally by the SA method fastening of ASI or equal, continuous across sign with concealed fasteners. Other means of fastening may be used on fences and other unusual mounting locations such as tanks. Signs shall be suitable for interior or exterior use.

D. Exterior Signs

1. The exterior signs shall be made of thermosetting polyester resin reinforced with chopped glass fiber strands and fabricated in a 6-inch, 8-inch, or 12-inch profile seamless construction depending upon the standard design that is reinforced to eliminate cupping and warping plus withstand a 50-psf windload. Graphics shall be subsurface, integral with the molded sign face structure, protected with a polyurethane resign coating system containing ultraviolet inhibitors, and using Helvetica Regular upper and lower case letters as detailed on the Drawings. Unless otherwise noted, medium bronze or blue letters and arrows on a tan background shall be used for the site signs as scheduled with blue noted and all other medium bronze. Lettering shall appear on both faces of the signs indicated in the schedule by sides marked "a" and "b." Size shall be as scheduled for the plant sign and site signs. The following colors by ASI Sign Systems are for reference:

White	SC/901	Green	SC/502
Tan	SC/801	Red	SC/201
Light Beige	SC/806	Dark Yellow	SC/401
Medium Bronze	SC/804	Yellow	SC/400
Black	SC/904	Orange	SC/301
Dark Blue	SC/603	Peacock	SC/532
Medium Blue	SC/602	Turquoise	SC/531
Blue	SC/601	Aqua	SC/521

2. Mounting position shall be as detailed utilizing a concrete foundation and aluminum anchoring system with aluminum supports finished as specified above for plaque.

E. Building Exterior Identification

1. A.R.K. – Ramos cast aluminum thin ribbon style No. 506, 6-inch high letters shall be Aluminum Association Alloy 514.2 or A514.2, with oxidized sides, polished face, and 2-inch minimum depth. Provide arrows where shown of same construction. Provide two minimum aluminum studs in drilled and tapped holes in back of castings and mount flush, set into holes drilled in masonry wall. Set with approved waterproof adhesive. Painted letters will not be acceptable.

PART 3 EXECUTION

3.01 INSTALLATION

A. Signage shall be installed at the locations shown on the Drawings or as directed herein, in accordance with the manufacturers' recommendations and shop drawings.

B. Exterior surface mounted work: Fasten to mounting surface as required by Drawings or as specified herein. Use FASTENERS required for mounting surface involved so that the work is capable of withstanding wind load for local area (minimum 120 mph) without permanent damage and deflection. Conceal Fasteners wherever possible.

C. Bronze plaques shall be installed into holes drilled in masonry with waterproof cement and in gypsum with approved expansion and anchors and concealed screw heads, all in accordance with the approved shop drawings. Plaques shall be flush with wall. Locate on interior as directed. For metal buildings the Contractor shall coordinate the mounting of plaque with the Pre-Engineered Metal Building Manufacturer.

D. Damaged items shall be removed and replaced at no additional cost to the Owner.

E. Signage shall be cleaned to the satisfaction of the Engineer using the approved methods, and upon completion of the installation and again, just prior to acceptance of the project.

F. Sign Schedule:

1. Building Exterior Identification
   a. Location: New Electrical Building
      1) Quantity: 1
      2) Sign Text: HIGH SERVICE PUMP STATION ELECTRICAL BUILDING
      3) Details: Locate building identification sign on the north side of the building. Refer to Architectural Drawings.

2. Restrictive Signs

Quantity	Sign Copy	Location
As required	DANGER: HIGH VOLTAGE 480V, 4,160V	Each new Electrical MCCs; Voltage as applicable

NOTE: Sign sizes are to be adjusted to suit the number of letters in each sign with a 1-1/2-inch border minimum all around. Two lines are permitted. Left-hand justify the letters. Include electrical voltage on danger signs mounted on MCC equipment.

END OF SECTION

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SECTION 11300
CRITICAL SPEED ANALYSES FOR HIGH SERVICE PUMPS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment, and incidentals required to perform critical speed analyses on the existing high speed service pumps proposed to be equipped with Adjustable Speed Drives (HSP-1, HSP-3, HSP-6, and HSP-8), to verify if there are any critical speeds that the equipment should not run at within the proposed speed range.

B. All necessary and desirable accessory equipment and auxiliaries, whether specifically mentioned in this Section or not, shall be furnished and installed as required for an installation incorporating the highest standards for this type of service. Also included shall be supervisory services during installation and field testing of each unit.

1.02 MEASUREMENT AND PAYMENT

A. No separate payment will be made for work under this section. Include the costs for this work in the base bid item requiring such work.

1.03 RELATED WORK

A. Section 16010 – Basic Electrical Requirements.

B. Section 16485 – Medium Voltage Adjustable Speed Drives.

C. Electrical work, except as specified herein, is included in Division 16.

1.04 SUBMITTALS

A. Submit, in accordance with Section 01330, shop drawings and product data. Submittals shall include the following:

1. A report detailing the results of the analysis for each pump proposed to be equipped with Adjustable Speed Drives (HSP-1, HSP-3, HSP-6, and HSP-8) and updated lateral and torsional critical speed provided by the pump manufacturer incorporating the newly supplied components on the project.

1.05 REFERENCE STANDARDS

A. Design, manufacturing and assembly of elements of the equipment herein specified shall be in accordance with, but not limited to, published standards of the following, as applicable:

1. American National Standards Institute (ANSI)

2. American Society for Testing and Materials (ASTM)

3. Hydraulic Institute Standards (HI)

B. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.06 QUALITY ASSURANCE

A. The **original equipment pump manufacturer** shall perform lateral and torsional critical speed analyses to identify and ensure that (a) the first lateral critical speed shall be at least 25 percent above the maximum pump speed, and that (b) no torsional natural frequencies occur within a range extending from 25 percent below to 25 percent above the specified operating speed range and that (c) any blade excited resonant frequency shall be no closer than plus or minus 25 percent of the natural frequency of any part of the installed pumping unit with motors.

1.07 COORDINATION

A. Contractor to take all necessary measurements in the field to determine the exact dimensions required for performing all work under this Section. All pertinent data and dimensions shall be verified and included in the submittal.

B. Contractor shall coordinate results of the critical speed analyses and updated lateral and torsional critical speed with ASD supplier and lock-out identified critical speed prior to the 7-day functional testing. The 7-day operating period of the pump system will be required to confirm the new ASDs are functional with the existing HSP pumps before acceptance. See Section 16010 for Demonstration Testing Requirements.

1.08 SYSTEM DESCRIPTION

A. Existing Equipment: Each existing High Service Pump is a Model 34 DKL vertical turbine pump manufactured by Floway Pumps.

1. Service: Finished water at NEWPP High Service Pump Station

2. Pump Rated Capacity: 13,888 gpm @ 191 ft TDH

3. Pump Speed: 890 rpm (maximum)

4. Pump Speed Range: 100% - 60% of maximum

5. Motor:
   a. Size: 800 HP
   b. Speed: 900 rpm
   c. Voltage: 3 Ph/60 Hz/4,160 volt

B. Proposed Improvements: Each existing High Service Pump and motor shall remain in service. Existing pumps HSP-1, HSP-3, HSP-6, and HSP-8 will be furnished with new Adjustable Speed Drives. Existing pumps HSP-2, HSP-4, HSP-5, and HSP-7 will remain as constant speed.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION – NOT USED

END OF SECTION

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SECTION 11500
TEMPORARY BYPASS PIPING SYSTEMS

PART 1 GENERAL

1.01 SUMMARY

A. Under this item the Contractor is required to furnish all materials, labor, equipment, power, maintenance, etc. to implement a temporary piping system including piping and fittings, valves, and pipe supports as shown for the purpose of diverting the existing flow around the work area in order to complete the work. Engineer identified work areas that will require bypass piping systems:

1. UV Building-1
2. UV Building-2
3. Treated Water Flow Meter Station

B. The design, installation and operation of the temporary piping systems shall be the Contractor's responsibility. The Contractor shall employ the services of a vendor who can demonstrate to the Engineer that he specializes in the design and operation of temporary bypass piping systems. The vendor shall provide at least five (5) references of projects of a similar size and complexity as this project performed by his firm within the past three years. The bypass system shall meet the requirements of all codes and regulatory agencies having jurisdiction. Alternatively, the Contractor may provide his own method of bypass piping provided the system meets all of the requirements of this specification. The Contractor shall submit at least five (5) references of similar projects (size and complexity) where his firm employed a particular method of bypass piping.

C. Removal of temporary piping system upon completion of work.

1.02 MEASUREMENT AND PAYMENT

A. No separate payment will be made for work performed under this Section. Include the cost for this work in the lump sum Base Bid.

1.03 SUBMITTALS

A. The Contractor shall submit to the Engineer a detailed plan describing installation methods for review.

B. The plan shall include but not be limited to details of the following:

1. Plugging method and types of plugs used.
2. Number, size, dimensions, material, location, and method of installation of piping including section and plan view drawing.

3. Statement or literature indicating the design pressure rating of the piping, valves, and fittings.

4. Any temporary pipe supports and anchoring required.

5. Schedule for installation of and maintenance of bypass lines.

6. ANSI/NSF 61 certifications for the piping, valves and fittings.

PART 2 PRODUCTS

2.01 PIPING

A. Piping shall be temporarily constructed of welded carbon steel pipe conforming to ANSI/ NSF 61 for potable water use.

2.02 SYSTEM DESCRIPTION

A. Specifications of the existing pipe at UV Building-1:

1. Pipe size: 48"/30"

2. Wall Thickness: 0.25"/0.25"

3. Pipe Material: AWWA C200 welded carbon steel

4. Design pressure: 125 psig

5. Operating pressure: 20-60 psig

B. Specifications of the existing pipe at UV Building-2:

1. Pipe size: 48"/30"

2. Wall Thickness: 0.25"/0.25"

3. Pipe Material: AWWA C200 welded carbon steel

4. Design pressure: 125 psig

5. Operating pressure: 20-60 psig

C. Specifications of the existing pipe at the Flow Meter Station:

1. Pipe size: 8"

2. Wall thickness: 0.257"

3. Pipe Material: AWWA C200 welded carbon steel

4. Design pressure: 250 psig

5. Operating pressure: 60-85 psig

D. Tie-in locations for the temporary piping systems are shown on the Drawings.

PART 3 EXECUTION

3.01 FIELD QUALITY CONTROL AND MAINTENANCE

A. Testing: The Contractor shall perform leakage and pressure tests of the temporary piping using clean water prior to actual operation. The Engineer will be given 24-hours notice prior to testing.

B. Inspection: The Contractor shall inspect the bypass piping systems every eight hours to ensure that the system is working correctly.

C. Maintenance Service: The Contractor shall insure that the temporary piping system is properly maintained and supported.

D. Extra Materials

1. Spare parts for piping shall be kept on site as required.

3.02 PREPARATION

A. Contractor is responsible for field verifying locations of any existing utilities in the work area.

B. During all bypass operations, the Contractor shall protect existing facilities and equipment from damage inflicted by any equipment. The Contractor shall be responsible for all physical damage to the existing facilities and equipment.

3.03 INSTALLATION AND REMOVAL

A. Plugging or blocking of flows shall incorporate a primary and secondary plugging device. When plugging or blocking is no longer needed for performance and acceptance of work, it is to be removed in a manner that permits the flow to slowly return to normal without surge, to prevent surcharging or causing other major disturbances downstream. Upon completion of the work, Contractor shall remove temporary bypass piping system in its entirety and install blind flanges on the temporary bypass connection. The joint connection shall be protected in accordance with Section 02518.

B. When working with the discharge piping, the Contractor shall exercise caution and comply with OSHA requirements when working in the presence of confined spaces.

END OF SECTION

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SECTION 11501
SAFETY DEVICES/EQUIPMENT

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals required and install safety devices as specified herein.

1.02 MEASUREMENT AND PAYMENT

A. No separate payment will be made for work performed under this Section. Include the cost for this work in the lump sum Base Bid Item in Section 00410.

1.03 SUBMITTALS

A. Submit to the Engineer, in accordance with Section 01330, shop drawings showing materials, construction, finishes, hanging devices and details, description of kit contents and ratings for all equipment specified herein.

1.04 DELIVERY, STORAGE AND HANDLING

A. Deliver materials in manufacturer's original unopened and undamaged packages with labels legible and intact. Store materials in unopened packages in a manner to prevent damage from the environment and construction operations. Handle in accordance with manufacturer's instructions.

1.05 REFERENCE STANDARDS

A. American National Standards Institute (ANSI)

B. Where reference is made to one the above standards, the revision in effect at the time of bid opening shall apply.

PART 2 PRODUCTS

2.01 FIRST AID EQUIPMENT

A. Furnish one Industrial First Aid Kit, Model 8162 by Johnson and Johnson; or equal. Provide with approved stainless steel wall fastening devices. Locate in each room of the Electrical Building as directed by the Engineer and the Owner in writing.

2.02 FIRE EXTINGUISHER

A. Fire extinguisher shall be UL Listed 20-lb capacity carbon dioxide unit suitable for Class B (liquids) and Class C fires (energized electrical equipment). Extinguisher shall be red-powder coated steel or aluminum cylinder with indicating gauge and wall hanger and shall be Kiddie Model Pro 20 CD-M-4 or Engineer approved or equal.

B. Provide two units in each room of the Electrical Building.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install all devices specified in conformance with approved shop drawings at locations directed by the Engineer.

END OF SECTION

SECTION 13300
INSTRUMENTATION AND CONTROLS – GENERAL PROVISIONS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. The Contractor shall procure the services of a Process Control System Supplier (PCSS) to furnish and install all materials, equipment, labor and services, required to achieve a fully integrated and operational system as specified herein, in the Specification Sections listed below, and in related drawings, except for those services and materials specifically noted.

1.

Section No	Title
13301	I&C – Testing
13303	I&C – Training
13305	I&C – Control Descriptions
13306	I&C – Applications Engineering Services
13311	I&C – PLC Hardware and Software
13320	I&C – Control and Data Network Equipment
13321	I&C – Fiber Optic Cabling and Equipment
13330	I&C – Control Panels and Panel Mounted Equipment
13335	I&C – Uninterruptible Power Supply (1 Phase)
13340	I&C – Instruments
13900	Pump Operation and Optimization Software

2. An Application Engineering System Supplier (AESS) shall perform the PLC and HMI programming for the work described here and for integrating it with the existing system. An addition to programming High Service Pump Station (HSPS) PLC-3, AESS shall also be responsible for programming the following pump PLCs as specified in section 16349 and 16485:
   a. HS-P1-PLC
   b. HS-P2-PLC
   c. HS-P3-PLC
   d. HS-P4-PLC
   e. HS-P5-PLC
   f. HS-P6-PLC
   g. HS-P7-PLC
   h. HS-P8-PLC

B. Furnish and install one (1) transit time flow meter for temporary UV bypass piping. The termination I/O point for existing flow meter shall be reconnected to the new flow meter to allow monitoring capability from the HMI. Refer to electrical sheet E-29 and E-30 for additional information.

C. Coordination with Pump Operation and Optimization Software vendor to provide an integrated system for SCADA monitoring of pump optimization data per specification section 13900. Coordination shall be consistent through factory and field testing.

D. Auxiliary and accessory devices necessary for system operation or performance, such as transducers, relays, signal amplifiers, intrinsic safety barriers, signal isolators, software, and drivers to interface with existing equipment or equipment provided by others under other Sections of these specifications, shall be included whether they are shown on the Drawings or not.

E. Demolition of existing PLC-3 cabinet as shown on contract drawings. Furnish and install a new free standing NEMA 12 PLC-3 cabinet located in new electrical building. Existing PLC cabinet shall be converted into a termination cabinet for terminating and routing local I/O and to new PLC-3 panel as shown on contract drawings.

F. New Siemens S7-1500 Series PLC with required I/O modules to transfer all SCADA data from its source to its final destination.

G. Modbus TCP/IP Ethernet communication interface with switchgear power quality meter, HSP vendor provided PLC (see Division 16000)

H. All equipment and installations shall satisfy applicable Federal, State and local codes.

I. Use the equipment, instrument, and loop numbering scheme shown on the Drawings and specifications in the development of the submittals. Do not deviate from or modify the numbering scheme without the Engineer's approval.

1.02 MEASUREMENT AND PAYMENT

A. No separate payment will be made for work performed under this Section. Include the cost for this work in the lump sum Base Bid Item in Section 00410.

1.03 RELATED WORK

A. Instrumentation and Controls conduit systems are specified in Section 16111

B. Instrumentation signal cable and alarm and status wiring are specified in Section 16126.

C. Relevant equipment Sections in Divisions 11, 13, and 15.

1.04 SUBMITTALS

A. General Requirements:

1. Refer to Section 01330 for general submittal requirements.

2. Shop drawings shall demonstrate that the equipment and services to be furnished comply with the provisions of these specifications and shall provide a complete record of the equipment as manufactured and delivered.

3. Submittals shall be complete; giving equipment specifications, details of connections, wiring, ranges, installation requirements, and specific dimensions. Submittals consisting of only general sales literature shall not be acceptable.

4. Substitutions on functions or type of equipment specified shall not be acceptable unless specifically noted.

5. Separate submittals shall be made for each submittal listed below.

B. Project Plan, Deviation List, and Schedule Submittal:

1. Submit, within 45 calendar days after Notice to Proceed, a Project plan. The Project Plan shall be submitted and approved before further submittals shall be accepted. The Project Plan shall, at a minimum, contain the following:
   a. Overview of the proposed control system describing the understanding of the project work, a preliminary system architecture drawing, interfaces to other systems, schedule, startup, and coordination. A discussion of startup, replacement of existing equipment with new, switchover (Maintaining Plant Operations during system transition), approach to testing and training, and other tasks as required by these specifications shall be included as applicable.
   b. Preliminary list of HMI software, PLC software, and PLC hardware, including version numbers, solely to determine compliance with the requirements of the Contract Documents prior to beginning development of system programming. Review and approval of software and hardware systems as part of this Project Plan stage shall not relieve the PCSS of meeting all the functional and performance requirements of the system as specified herein. Substitution of manufacturer or model of these systems after the submittal is approved is not allowed without Engineer approval.
   c. Project personnel and organization including the PCSS project manager, project engineer, and lead project technicians. Include resumes of each these individuals and specify in writing their commitment to this project. These do not need to be submitted again if already submitted in the Qualification submittal.
   d. Sample formats of the shop drawings to be submitted and in conformance with the requirements of the Specifications. At a minimum include samples of panel fabrication drawings, loop, and I/O wiring diagrams.

2. Exceptions to the Specifications or Drawings shall be clearly defined in a Deviation List. The Deviation List shall consist of a paragraph by paragraph review of the Specifications indicating acceptance or any proposed deviations, the reason for exception, the exact nature of the exception and the proposed substitution so that an evaluation may be made by the Engineer. If no exceptions are taken to the specifications or drawings the PCSS shall make a statement as such. If there is no statement by the PCSS, then it is acknowledged that no exceptions are taken.

3. Project schedule shall be prepared in Gantt chart format clearly showing task linkages for all tasks and identifying critical path elements. PCSS schedule must be based on the General Contractor schedule and must meet all field installation, testing, and start-up milestones in that schedule. The project schedule shall illustrate I&C related major project milestones including the following:

a. Schedule for all subsequent project submittals. Include the time required for Contractor submittal preparation, Engineer's review time, and a minimum of two complete review cycles.
b. Proposed dates for all project coordination meetings.
c. Hardware purchasing, fabrication, and assembly (following approval of related submittals).
d. Software purchasing and configuration (following approval of related submittals).
e. Shipment of instrument and control system equipment.
f. Installation of instrument and control system equipment.
g. Testing: Schedule for all testing.
h. Schedule for system cutover, startup, and/or going on-line for each major system. At a minimum include the schedule for each process controller and HMI server/workstation provided under this Contract.
i. Schedule for all training including submittal and approval of O&M manuals, factory training, and site training.

C. Input/Output (I/O) List Submittal:

1. Submit, within 60 days after Notice to Proceed, a complete system Input/Output (I/O) address list for equipment connected to the control system under this Contract.

2. I/O list shall be based on the P&ID's, the Drawings, the design I/O list (if included), and requirements in the Specifications.

3. The I/O list shall be submitted in both a Microsoft Excel readable electronic file format and an 8-1/2 inch by 11-inch hard copy.

4. The I/O list shall reflect all active and spare I/O points. Add points to accommodate spare I/O as required in the specifications.

5. The I/O list shall be arranged such that each control panel has a dedicated worksheet. At a minimum, I/O worksheet shall include the following information:
   a. TAG NUMBER(S): As indicated on the Drawings, the identifier assigned to a device that performs a function in the control system. As part of this information, the loop number of the tag shall be broken out to allow for sorting by loop.
   b. DESCRIPTION: A description of the function of the device (text that includes signal source, control function, etc.) Include the text "Spare Points" for all I/O module points that are not connected to equipment.
   c. PHYSICAL LOCATION: The Control Panel designation of where the I/O point is wired to.
   d. Physical POINT ADDRESS: Rack, Slot, and Point (or Channel) assignment for each I/O point.
   e. I/O TYPE: use DO - Discrete Output, DI - Discrete Input, AO - Analog Output, AI - Analog Input, PI - Pulse Input, or PO – Pulse Output.
   f. RANGE/STATE: The range in engineering units corresponding to an analog 4-20 mA signal, or, the state at which the value of the discrete points are "1."
   g. ENGINEERING UNITS: The engineering units associated with the Analog I/O.

h. ALARM LIMITS: Include alarm limits based on the control descriptions and the Drawings.
i. P&ID – the P&ID or drawing where the I/O point appears on. Mark as "NA" (Not Applicable) if the I/O point is derived from a specification requirement and is not on the P&IDs.

6. The I/O list shall be sorted in order by:
   a. Physical location.
   b. I/O Type.
   c. Loop Number.
   d. Device Tag.

7. Once the I/O list is approved, the PLC I/O addresses shall not be modified without approval by the Engineer.

D. Field Instruments Submittal:

1. Refer to the Instruments section 13340 for submittal requirements.

E. Hardware and Software Packages Submittal:

1. Refer to the sections below for specific Hardware and Software Packages submittal requirements:
   a. 13311 - I&C - PLC Hardware and Software.
   b. 13320 - I&C - Control and Data Network Equipment.
   c. 13321 - I&C - Fiber Optic Cabling and Equipment
   d. 13335 - I&C - Uninterruptible Power Supply (1 Phase)
   e. 13340 - I&C - Instruments

2. For each hardware and software packages component specified in the sections above, submit a cover page that lists, at a minimum, date, specification number, product name, manufacturer, model number, Location(s), and power required. Preferred format for the cover page is ISA-TR20.00.01-2001 (updated in 2004-2006), general data sheet; however, other formats will be acceptable provided they contain all required information.

F. Panel Layout Drawings and Wiring Diagrams Submittal:

1. Refer to the Control Panels section for submittal requirements.

G. Testing Plan Submittals:

1. Refer to the 13301Testing Section for specific testing submittal requirements.

H. Training Plan Submittals:

1. Refer to Section 13303 for specific training requirements.

I. Spares, Expendables, and Test Equipment Lists Submittal:

1. Submit a list of, and descriptive literature for, spares, expendables, and test equipment.

2. Submit a list of, and descriptive literature for, additional spares, expendables, and test equipment recommended by the manufacturer.

3. Submit unit and total costs for the additional spare items specified or recommended for each subsystem.

J. Operations and Maintenance (O&M) Manuals:

1. Submit in accordance with Section 01782.

2. Furnish O&M manuals as specified herein.

3. The operations and maintenance manuals shall, at a minimum, contain the following information:
   a. Table of Contents:
      1) A Table of Contents shall be provided for the entire manual with the specific contents of each volume clearly listed. The complete Table of Contents shall appear in each volume.
   b. Instrument and Equipment Lists:
      1) The following lists shall be developed in Microsoft Excel format and provided not only as a hardcopy in O&M but also electronically on a CD.
      2) An instrument list for all devices supplied including tag number, description, specification section and paragraph number, manufacturer, model number, serial number, range, span, location, manufacturer phone number, local supplier name, local supplier phone number, completion year replacement cost, and any other pertinent data.
      3) An equipment list for all non-instrument devices supplied listing description, specification section and paragraph number, manufacturer, model number, serial number, location, manufacturer phone number, local supplier name, local supplier phone number, completion year replacement cost, and any other pertinent data.
   c. Equipment Operations and Maintenance Information:
      1) ISA-TR20.00.01-2001(updated in 2004-2006) data sheets shall be provided for all field instruments. For non-field instrumentation devices, provide a cover page for each device, piece of equipment, and OEM software that lists date, specification number, product name, manufacturer, model number, Location(s), and power required. Preferred format for the cover page is ISA-TR20.00.01-2001(updated in 2004-2006), general data sheet; however, other formats will be acceptable provided they contain all required information.
      2) Vendor O&M documentation for each device, piece of equipment, or OEM software shall be either new documentation written specifically for this project, or modified standard vendor documentation. All standard vendor documentation furnished shall have all portions that apply clearly indicated with arrows or circles. All portions that do not apply shall be neatly lined out or crossed out.

Groups of pages that do not apply at all to the specific model supplied shall be removed.

3) Provide the record documentation of the system audit as specified in the 13301 Testing section.
4) Include the calibration forms developed as specified in the 13301Testing section.

d. As-Built Drawings:
1) Complete as-built drawings, including all drawings and diagrams specified in this section under the "Submittals" section. These drawings shall include all termination points on all equipment the system is connected to, including terminal points of equipment not supplied by the PCSS.
2) As built documentation shall include information from submittals, as described in this Specification, updated to reflect the as-built system. Errors in or modifications to the system resulting from the Factory and/or Functional Acceptance Tests shall be incorporated in this documentation.

e. Original Licensed Software:
1) Submit original software diskettes or CD-ROMs of all software provided under this Contract. Submit original paper based and electronic documentation for all software provided. Submit license agreement information including serial numbers, license agreements, User Registration Numbers and related information. All software provided under this Contract shall be licensed to the Owner at the time of purchase. Provide media in software sleeves within O&M manual.

f. Electronic O&M Information:
1) In addition to the hard copy of O&M data, provide an electronic version of all equipment manuals and data sheets, along with any software back-up of configuration files, on CDROM or DVD. Electronic documents shall be supplied in Adobe Acrobat format.
2) Provide electronic files for all custom-developed manuals including training manuals. Text shall be supplied in both Microsoft Office format and Adobe Acrobat format.
3) Provide electronic files for all drawings produced. Drawings shall be in AutoCAD ".dwg" format and in Adobe Acrobat format. Drawings shall be provided using the AutoCAD eTransmit feature to bind external references, pen/line styles, fonts, and the drawing file into individual zip files.
4) Each computer system hardware device shall be backed up onto CDROM or DVD after Substantial Completion and shall be turned over to the Owner.
5) If specified in the training section, provide digital copies of all training videos. Videos shall be in a format that is readable by standard DVD players and by standard PC DVD drives. Format shall be a minimum of 800 by 600 pixels and shall include sound.

4. The cover and edge of each volume shall contain the information as specified in 01782.

1.05 COORDINATION MEETINGS

A. Schedule the mandatory coordination meetings as described herein. The meetings shall be held at the Owner's designated location and shall include attendance by the Owner, the Engineer, the Contractor, and the PCSS's Project Engineer. Other Division 13 specifications may require

additional meetings. Prepare and distribute an agenda for this meeting a minimum of one week before the scheduled meeting date. Meeting shall be scheduled a minimum of one week before the requested meeting date.

1. A project kickoff coordination meeting shall be held within two weeks after submitting the Project Plan. The purpose of the meeting shall be to discuss the PCSS's Project Plan, to summarize the PCSS's understanding of the project; discuss any proposed substitutions or alternatives; schedule testing and delivery deadline dates; provide a forum to coordinate hardware and software related issues; and request any additional information required from the Owner. The meeting will last up to one business day.

2. A submittal review coordination meeting shall be held after the Hardware, Panel Drawing, and Loop Drawing Submittal package has been reviewed by the Engineer and returned to the PCSS. The purpose of this meeting shall be to review comments made on the submittal package; to refine scheduled deadline dates; and coordinate equipment installation activities. The meeting will last up to one business day.

3. An Optimization Software coordination meeting shall be held within four weeks after submitting the Project Plan. The purpose of the meeting shall be to discuss data exchange requirements and establish a communication plan between the PCSS/AESS and the Optimization Software vendor. Two additional meetings shall be held, second meeting shall be to review I/O mapping assigments for communications. Third meeting shall be held before Factory testing to establish testing procedures for the integrated system.

4. Regular on-site meetings when the PCSS staff is at the plant site.

1.06 REFERENCE STANDARDS

A. Publications are referred to in the text by basic designation only. Where a date is given for reference standards, that edition shall be used. Where no date is given for reference standards, the latest edition in effect at the time of bid opening shall apply.

B. International Society of Automation (ISA):

1. ISA S5.2, Binary Logic Diagrams for Process Operations.

2. ISA S5.3, Graphic Symbols for Distributed Control/Shared Display Instrumentation Logic and Computer Systems.

3. ISA S5.4, Instrument Loop Diagrams.

4. ISA S20, Specification Forms for Process Measurement and Control Instruments, Primary Elements and Control Valves.

5. ISA RP60.3, Human Engineering for Control Centers.

6. ISA RP60.6, Nameplates, Labels, and Tags for Control Centers.

7. ISA-99, Industrial Automation and Control Systems Security.

C. National Electrical Manufacturers Association (NEMA).

D. National Fire Protection Agency (NFPA):

1. NFPA 70, National Electrical Code (NEC).

2. NFPA 79, Industrial Control Equipment.

E. Underwriters Laboratories, Inc. (UL):

1. UL 508 - Industrial Control Equipment - for custom fabricated equipment.

2. A nationally recognized testing laboratory, as approved by the Authority having jurisdiction, may substitute for UL listing on commercial off the shelf products.

1.07 QUALITY ASSURANCE

A. The Process Control System Supplier (PCSS) shall be a "systems integrator" regularly engaged in the design and the installation of instrumentation systems and their associated subsystems as they are applied to the municipal water and wastewater industry. For the purposes of this Specification Section, a "systems integrator" shall be interpreted to mean an organization that complies with all of the following criteria:

1. Employs personnel on this project who have successfully completed ISA or manufacturers training courses on general process instrumentation and configuration and implementation of the specific programmable controllers, computers, and software proposed for this project. Key personnel shall hold ISA CCST Level 1 certification or have a minimum of 10 years of verifiable plant startup experience. Key personnel shall include, as a minimum, the lead field technician.

2. Has successfully completed work of similar or greater complexity on at least three previous projects within the last five years. Successful completion shall be defined as a finished project completed on time, without any outstanding claims or litigation involving the PCSS. Potential references shall be for projects where the PCSS's contract was of similar size to this project.

3. Has been actively engaged in the type of work specified in this Section for a minimum of five years.

B. The PCSS shall maintain a permanent, fully staffed and equipped service facility within 200 miles of the project site with full time employees capable of designing, fabricating, installing, calibrating, and testing the systems specified herein. At a minimum, the PCSS shall be capable of responding to on-site problems within 12 hours of notice. Provide an on-site response within 4 hours of notification starting at two months before scheduled startup to two months after startup completion.

C. PCSS shall hold a valid UL-508 certification for their panel fabrication facility.

D. Actual installation of the instrumentation system need not be performed by the PCSS's employees; however, the PCSS as a minimum shall be responsible for the technical supervision of the installation by providing on site supervision to the installers of the various components.

E. The selected PCSS shall be one of the following:

1. Boyer Inc.
   8904 Fairbanks N. Houston Dr.
   Houston, TX 77064
   Attn: Jack Levy
   Phone: 713-466-5395

2. Prime Controls
   10400 Westoffice, STE. 105
   Houston, TX 77042
   Attn: Garrett Crowell
   Phone: 713-244-9747

3. BLTI
   1730 S Cherry St,
   Tomball, TX 77375
   Attn: Robert Lee
   Phone: 832-698-8000

4. or pre-approved equal.

F. Being listed in this specification does not relieve any potential PCSS from meeting the qualifications specified in this Section. The listed PCSS may have to submit a qualifications submittal at the request of the owner. Suppliers interested in being listed as an equal to the above listed suppliers shall submit three copies of a qualifications proposal to the Owner no later than two weeks before the bid opening date. A list of approved equals will be issued no later than one week days before the bid opening date.

G. Specific Requirements for AESS:

1. The Application Engineering System Supplier shall be a firm with a minimum of 5 years of experience in programming control systems for advanced water and wastewater treatment process.

2. The AESS shall be experienced with the software application development packages which are used at NEWPP including a minimum 2 years of certification with IFIX HMI development packages.

3. The AESS shall have an existing office within Houston and shall maintain that office for the duration of the warranty of the project.

4. The selected AESS shall be one of the following:

   Pondhop Automation
   2313 West Sam Houston Pkwy N #127,
   Houston, TX 77043
   Attn: Duncan Sinclair
   Phone: 713-589-8760

   Automation Nation
   1700 Gazin St.
   Houston, TX 77020
   Attn: Richard Kendall
   Phone: 713-675-4999

1.08 DELIVERY, STORAGE, AND HANDLING

A. Delivery, storage, and handling shall be in accordance with Section 01600.

B. Shipping Precautions:

1. After completion of shop assembly, factory test, and approval of all equipment, the cabinets, panels and consoles shall be packed in protective crates and enclosed in heavy duty (5 mil) polyethylene envelopes or secured sheeting to provide protection from damage, dust and moisture. Dehumidifiers shall be placed inside the polyethylene coverings. The equipment shall then be skid-mounted for final transport. Lifting rings shall be provided for moving without removing protective covering. Boxed weights shall be shown on shipping tags together with instructions for unloading, transporting, storing and handling at the job site.

2. Manufacturer's special instructions for field handling, storage and installation required for protection, shall be securely attached to the packaging for each piece of equipment prior to shipment. The instructions shall be stored in resealable plastic bags or other means of protection.

3. None of the HMI control and monitoring equipment shall be shipped to the site until the control room areas comply with specified ambient temperature and humidity. Have qualified personnel accept the equipment on delivery and supervise unloading within the control room areas.

4. If any apparatus has been damaged, such damage shall be repaired at no additional cost to the Owner.

1.09 NOMENCLATURE AND IDENTIFICATION

A. Field Instrument Tags:

1. See Section 13340.

B. Panel Nameplates:

1. See Section 13330.

1.10 WARRANTY

A. Provide warranty per Section 01740, Warranties and Bonds, and as specified herein.

1.11 PROJECT/SITE REQUIREMENTS

A. Environmental Requirements. Refer to Section 16000. and Electrical Drawings for specific environmental and hazardous area classifications.

B. Elevation: Equipment shall be designed to operate at the project ground elevation.

C. Temperature:

1. Outdoor areas' equipment shall operate between -30 to 50 C degrees ambient.

2. Equipment located in indoor locations shall operate between 10 to 35 C degrees ambient minimum.

3. Storage temperatures shall range from 0 to 50 C degrees ambient minimum.

4. Additional cooling or heating shall be furnished if required by the equipment as specified herein.

D. Relative Humidity. Air conditioned area equipment shall operate between 20 to 95 percent relative, non-condensing humidity. All other equipment shall operate between 5 to 100 percent relative, condensing humidity.

PART 2 PRODUCTS

2.01 GENERAL

A. All instrumentation and electronic equipment shall be of the manufacturer's latest design, utilizing printed circuitry and epoxy or equal coating to prevent contamination by dust, moisture and fungus. The field mounted equipment and system components shall be designed for installation in dusty, humid and slightly corrosive service conditions.

B. All instruments shall be provided with mounting hardware and floor stands, wall brackets, or instrument racks unless otherwise noted. Fasteners for securing control panels and enclosures to walls and floors shall be either hot-dipped galvanized after fabrication or stainless steel. Provide stainless steel fasteners only in corrosive areas rated NEMA 4X on the Drawings or as defined under Section 16000. Provide minimum size anchor of 3/8-inch.

C. All indicators shall be linear in process units, unless otherwise noted. All transmitters shall be provided with indicators in process units, accurate to two percent or better.

D. All equipment, cabinets and devices furnished shall be heavy-duty type, designed for continuous industrial service. The system shall contain similar products of a single manufacturer, and shall consist of equipment models, which are currently in production. All equipment provided shall be of modular construction and shall be capable of field expansion.

E. All electronic/digital equipment shall be provided with radio frequency interference protection.

F. Electrical:

1. Equipment shall operate on a 60 Hertz alternating current power source at a nominal 120 volts, plus or minus 10 percent, except where specifically noted. Regulators and power supplies required for compliance with the above shall be provided between power supply and interconnected instrument loop. Where equipment requires voltage regulation, constant voltage transformers shall be supplied.

2. With the exception for field device network connected devices, all electronic instrumentation shall utilize linear transmission signals of isolated 4 to 20 mA DC (milliampere direct current) capable of driving a load up to 750 ohms, unless specified otherwise. However, signals between instruments within the same panel or cabinet may be 1-5 VDC (volts direct current).

3. Outputs of equipment that are not of the standard signals as outlined, shall have the output immediately raised and/or converted to compatible standard signals for remote transmission. No zero based signals will be allowed.

4. All switches shall have double-pole, double-throw contacts rated at a minimum of 600 VA, unless noted otherwise.

5. Switches and/or signals indicating an alarm, failure or upset condition shall be wired in a fail-safe manner. A fail-safe condition is an open circuit when in an alarm state.

6. Materials and equipment shall be UL approved whenever such approved equipment and materials are available.

7. All equipment furnished shall be designed and constructed so that in the event of power interruption, the systems specified herein shall go through an orderly shutdown with no loss of memory, and shall resume normal operation without manual resetting when power is restored, unless otherwise noted.

2.02 ELECTRICAL SURGE PROTECTION

A. General - Surge protection shall be provided to protect the electronic instrumentation system from induced surges propagating along the signal and power supply lines from lightning, utility, or the plant electrical system. The protection systems shall be such that the protective level shall not interfere with normal operation, but shall be lower than the instrument surge withstand level. Protection shall be maintenance free and self-restoring. Devices shall have a response time of less than 50 nanoseconds and be capable of handling a discharge surge current (at an

8x20µs impulse waveform) of at least 8 kA. Ground wires for all instrumentation device surge protectors shall be connected to a low resistance ground in accordance with Section 16170.

B. Provide protection of all analog signal (4-20 mA) circuits where any part of the circuit is outside of the building envelope. Circuits shall be protected at both the transmitter and the control system end of the circuit. Protection devices located near the transmitter shall be mounted in a separate NEMA 4X stainless steel enclosure (plastic is not acceptable) or conduit mounted,, and shall be Phoenix Contact PT Series, MTL Surge Technologies (Telematic) TP48, Citel TSP-10 series, or equal. Substitution of a single device to protect both 120 VAC and 4-20 mA wires to an instrument is acceptable. Protection devices in control panels shall be MTL Surge Technologies (Telematic) SD Series, Phoenix Contact PT Series, Citel DLA series, or equal.

C. Provide protection of all 120 VAC power feeds into control panels, instruments, and control room equipment. Surge arresters shall be Transtector ACP-100BW Series, Phoenix Contact "Mains-PlugTrab", MCG Surge Protection 400 Series, Citel DS40 series, or equal.

D. Non-Fiber Based Data Highway or Communications Circuits – Provide protection on all communication and data highway circuits that leave a building or are routed external to a building. Circuit protection shall be provided at both ends of the line. Surge protection devices shall be Phoenix Contact PlugTrab Series, Transtector FSP Series, MTL Surge Technologies (Telematic) NP Series, Citel DLA series or MJ8 series, or equal.

E. RF Coaxial Cable – Provide protection on communication cables between radios and antennas, mounted either inside the panel, or in the wall of the enclosure in accordance with NEMA and UL standards. Surge protection devices shall be Citel P8AX series, Polyphaser, or equal.

F. Inductive Loads – Provide coil surge suppression devices, such as varistors or interposing relays, on all process controller outputs or switches rated 120 VA or less that drive solenoid, coil, or motor loads.

G. Telephone Circuits - At a minimum, provide Telephone Company approved line protection units for all telephone lines used for telemetry or SCADA system use under this Contract.

2.03 SPARE PARTS

A. All spare parts shall be wrapped in bubble wrap, sealed in a polyethylene bag complete with dehumidifier, then packed in cartons and labeled with indelible markings. Complete ordering information including manufacturer's contact information (address and phone number), part name, part number, part ordering information, and equipment name and number(s) for which the part is to be used shall be supplied with the required spare parts. The spare parts shall be delivered and stored in a location directed by the Owner or Engineer.

B. Furnish one of each type of installed Surge protection devices.

C. Other spare parts are specified in each section. An overview follows:

1. Devices within Control Panels - See the control panels section 13335.

2. PLC spare parts - See the PLC section 13311.

3. Network and Communications System - See the Control and Data Network Equipment section 13320.

4. Instrument related Spare Parts - see the Instrument section 13340.

2.04 TEST EQUIPMENT

A. Provide all test equipment, instruction manuals, carrying/storage cases, unit battery charger, special tools, calibration fixtures, cord extenders, patch cords, test leads, and miscellaneous items for checking field operation of all supplied equipment.

B. All test equipment shall be wrapped in bubble wrap, sealed in a polyethylene bag with a dehumidifier, then packed in cartons and labeled with indelible markings. Complete ordering information including manufacturer's part number, and equipment name shall be supplied. The test equipment shall be delivered and stored in a location directed by the Engineer.

PART 3 EXECUTION

3.01 GENERAL INSTALLATION

A. Instrumentation and accessory equipment shall be installed in accordance with manufacturer instructions. The indicated locations of equipment, transmitters, alarms and similar devices indicated are approximate only. Exact locations of all devices shall be as approved by the Engineer during construction. Obtain in the field, all information relevant to the placing of process control equipment and in case of interference with other work, proceed as directed by the ENGINEER and furnish all labor and materials necessary to complete the work in an approved manner at no additional cost to the Owner.

B. Provide brackets and hangers required for mounting of equipment.

C. The shield on each process instrumentation cable shall be continuous from source to destination and be grounded at only one ground point for each shield.

D. Investigate each space in the building through which equipment must pass to reach its final location. If necessary, ship material in sections sized to permit passing through restricted areas in the building. Provide on-site service to oversee the installation, the placing and location of system components, their connections to the process equipment panels, cabinets and devices, subject to the Engineer's approval. Certify that field wiring associated with the equipment is installed in accordance with best industry practice. Coordinate work under this Section with that of the electrical work specified under applicable sections of Division 16.

E. Provide sunshades for equipment mounted outdoors in direct sunlight. Sunshades shall include standoffs to allow air circulation around the cabinet. Orient equipment outdoors to face to the North or as required to minimize the impact of glare and ultraviolet exposure on digital readouts.

3.02 TESTING

A. Refer to Section 13301.

3.03 TRAINING

A. Refer to Section 13303.

3.04 PROCESS CONTROLLER INPUT/OUTPUT (I/O) SCHEDULE

A. Process controller I/O schedule itemizes the process controller Local and Remote I/O associated with the hardware provided under this contract. Provide additional I/O signals and hardware as required to furnish a complete and functional system and submit that revised list as defined in the submittal section.

B. If assigned in this I/O schedule, do not modify the PLC I/O addresses without approval by the Engineer.

END OF SECTION

SECTION 13301
INSTRUMENTATION AND CONTROLS – TESTING

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals required to complete the testing of all devices and systems furnished and installed as detailed on the Drawings, and as specified herein.

B. Refer to Section 13300 for other general requirements.

1.02 MEASUREMENT AND PAYMENT

A. No separate payment will be made for work performed under this Section. Include the cost for this work in the lump sum Base Bid Item in Section 00410.

1.03 RELATED WORK

A. Refer to Section 13300.

B. Division 1 "Equipment Testing and Start-up" section

1.04 SUBMITTALS

A. Refer to Section 13300.

B. Testing Submittals - Submit, in one submittal, the following testing related documents:

1. Status signoff forms
   a. Develop and submit project specific I/O Status signoff forms to be used during factory and field testing to organize and track each loop's inspection, adjustment, calibration, configuration, and testing status and sign off. Include sign-off forms for each testing phase showing all loops.
      1) Example forms are shown in the Appendices.
      2) Separate forms for factory and field testing can be used, or they can be combined, at the discretion of the PCSS.
      3) Submit testing forms prior to start of testing.

2. Testing Procedures
   a. Submit detailed procedures proposed to be followed for the PCSS portion of each of the tests specified herein. The test procedures shall serve as the basis for the execution of the required tests to demonstrate that the system meets and functions as specified. At a minimum, the following test procedures shall be provided:
      1) Network and Communications Testing
      2) I/O Testing
      3) UPS

4) Control panel power, indictors, and hardwired logic tests

b. The documents shall be structured in an orderly and easy to follow manner to facilitate an efficient and comprehensive test.

c. The test procedures shall indicate all pre-testing setup requirements, all required test equipment, and simulation techniques to be used.

d. Testing shall not start until all Testing Submittals have been approved.

C. Test Documentation

1. Upon completion of each required test, document the test by submitting a copy of the signed off Testing Status forms. Testing shall not be considered complete until the signed-off forms have been submitted and approved. Submittal of other test documentation, including "highlighted" wiring diagrams with field technician notes, are not acceptable substitutes for the formal test documentation.

1.05 MAINTENANCE

A. Refer to Section 13300.

1.06 COORDINATION MEETINGS

A. Refer to Section 13300.

B. A data exchange coordination meet shall be held with the Pump Operation and Optimization Software vendor (Section 13900) four weeks prior to the start of factory acceptance testing. The purpose of this meeting is to verify and finalize and coordinate PLC data registers for data exchange.

C. A factory testing coordination meeting shall be held two weeks prior to factory acceptance testing. The purpose of this meeting is to discuss the specifics of the PCSS's proposed tests. The meeting will last up to one (1) business day.

D. A field-testing coordination meeting shall be held two weeks prior to the start of field acceptance testing. The purpose of this meeting is to discuss the specifics of the PCSS's proposed tests. The meeting will last up to one (1) business day.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 TESTING - GENERAL

A. Refer to Section 13300.

B. The results of all testing shall be tracked on a project specific status sign off form or similar document. The PCSS shall be responsible for maintaining the sheet. The Appendix of this section has an example template for this sheet.

C. The tests the PCSS is required to perform are as follows:

1. Factory Testing
   a. Unwitnessed Factory Test (UFT).
   b. System Integration Test (SIT).
   c. Witnessed Factory Test (WFT).

2. Field Testing
   a. Operational Readiness Test (ORT).
   b. Startup Acceptance Test (SAT).

D. Wherever possible, perform tests using actual process variables, equipment, and data. Where it is not practical to test with real process variables, equipment, and data, provide all special testing materials and equipment required for a suitable means of simulation.

E. The PCSS shall coordinate all required testing with the Contractor, all affected Subcontractors, the Engineer, and the Owner.

F. No equipment shall be shipped to jobsite until the Engineer and/or Owner has received all Factory Testing results and approved the system as ready for shipment.

G. The Engineer reserves the right to test or re-test any functions.

H. Correction of Deficiencies

1. All deficiencies in workmanship and/or items not meeting specified testing requirements shall be corrected to meet specification requirements at no additional cost to the Owner.

2. Testing, as specified herein, shall be repeated after correction of deficiencies is made until the specified requirements are met. This work shall be performed at no additional cost to the Owner.

3.02 FACTORY TESTING - UNWITNESSED FACTORY TEST (UFT)

A. The purpose of the UFT is for the PCSS to check the software and hardware portion of the system prior to the Factory test. This type of testing should be part of any quality firm's internal QA/QC procedures.

B. Temporary network connections will be required to confirm the network configuration. Temporary wiring of primary elements, final control elements, and field-mounted transmitters is not required.

C. The hardware to be tested shall include all control system devices shown on the System Architecture drawings and provided by the PCSS.

D. Tests to be performed shall include, but not be limited to, the following. Each of these tests shall be specifically addressed in the Test Procedure submittal.

1. All panels and enclosures being provided shall undergo a thorough inspection to verify the integrity of the cabinet enclosures, frame structures, paint work and finish, etc. Review the panel drawings to ensure they accurately reflect the panel layout and wiring.

2. Perform a system audit to verify all components have been staged for the test and have been documented properly with correct model numbers, serial numbers, etc. The following documentation of the audit shall be provided at the factory test and submitted as part of the O&M Manual Documentation:
   a. For each microprocessor-based component connected to the control communication backbone in the system (PLCs, managed switches, protocol converters, communication cards on final field devices, radios, etc.), list the firmware revision, vendor and local distributor information, and system, warranty information, configuration parameters (e.g., communication settings, fail position settings, etc.)

3. Panel wire pull tests shall be performed to ensure all wiring has been connected with the appropriate torque to prevent wires from coming loose.

4. UPS shall be tested to verify the UPS switch power correctly while keeping all UPS powered loads online. Testing of the UPS to determine if they have been sized correctly to maintain the specified run time shall be performed during field testing.

5. The control panels shall be powered up and a 100 percent I/O point checkout from the control panel terminals to the I/O registers in the PLC modules shall be performed to verify proper control panel wiring and PLC I/O module set-up. PCSS shall load "dummy" PLC configuration and programming, using their own PLC configuration software, to enable the test through to the I/O register. At a minimum, the I/O checkout shall consist of four steps.
   a. Discrete input signals shall be jumpered at the field terminal blocks in the control panels to verify proper status at the I/O register.
   b. Analog input signals shall be connected to a signal generator at the field terminal blocks in the control panels to verify proper status at the I/O register signals shall be verified at zero percent, 50 percent, and 100 percent of full scale.
   c. Discrete output signals shall be tested by forcing the output on in the output register, then verifying the output is on by connecting a digital multimeter to measure the continuity at the terminations.
   d. Analog output signals shall be tested by entering values in the output register to force the output to zero percent, 50 percent, and 100 percent of full scale, then verifying the output by utilizing a digital multimeter to measure the current or voltage generated at the termination points.

6. For each hardware enclosure, inspect cabinet enclosures, frame structure, paint work and finish, dimensions, and hardware operability (i.e., fans, door hinges, keylocks, etc.).

7. For each subpanel, inspect I/O subsystem physical layout, power supply sizing and mounting, cable routing, wire runs across hinges properly installed, fans and blowers unobstructed and mounted to maximize air flow, power conditioning correctly installed, and overall layout and installation of components meets manufacturer's recommendations and standard industry accepted practices.

8. All other control panel circuitry.

E. Upon successful completion of the UFT, the PCSS shall submit a record copy of the test results as specified in Part 1. As part of this test results submittal, notify the Engineer in writing that the system is ready for the SIT. No other notice of Factory test will be accepted..

3.03 FACTORY TESTING - SYSTEM INTEGRATION TEST (SIT)

A. The purpose of the SIT is to allow the PCSS to test the entire hardware and software system as a complete integrated system prior to the test being witnessed by the owner.

B. Required Documents for Test

1. Clean set of approved panel drawings and wiring diagrams.

2. Set of contract documents - all drawings and specifications.

3. All design change related documentation.

4. Master copy of the PCSS developed factory testing signoff forms.

C. Minimum testing to be performed during the SIT shall include, but not be limited to, the following:

1. Repeat of all Verification of proper scanning, communication, and complete data acquisition of the entire system.

2. Verification of all redundant functionality of components.

3. Verification of proper power failure recovery.

4. Verification of proper indication for communication error issues.

5. A complete I/O point checkout shall be performed to verify proper operation of each input/output point. The PCSS shall assist in this testing. The I/O checkout shall consist of four steps.
   a. Discrete input signals shall be jumpered at the field terminal blocks in the control panels to verify proper status in the HMI and OIT nodes.
   b. Analog input signals shall be connected to a signal generator at the field terminal blocks in the control panels to verify proper status in the HMI and OIT nodes and signals shall be verified at zero percent, 50 percent, and 100 percent of full scale.
   c. Discrete output signals shall be tested by switching the equipment to manual control at the HMI and OIT nodes and turning the output on or other means to turn the output on. Then verify the output is on by connecting a digital multimeter to measure the continuity at the terminations, thus verifying the command from the PLC has properly executed the contact closure.
   d. Analog output signals shall be tested by switching the equipment to manual control at the HMI and OIT nodes and turning the output on or other means to turn the output

on. Then verify the output by utilizing a digital multimeter to measure the current or voltage generated at the termination points.

6. All process control strategies shall be simulated to ensure proper operation.

7. Upon successful completion of the SIT, the PCSS shall submit a record copy of the test results to the Owner and Engineer and request the scheduling of the WFT.

3.04 FACTORY TESTING - WITNESSED FACTORY TEST (WFT)

A. The purpose of the WFT is to allow the Engineer and/or Owner representatives to witness the functionality, performance, and stability of the entire hardware and software system as a complete integrated system. The WFT shall be conducted at the PCSS's facility.

B. Required Documents for Test

1. Same as SIT documents

C. The system must operate continuously throughout the WFT without failure, except where initiated per the established test procedures. Any unanticipated failures may, at the Owner and/or Engineer's option, result in the overall WFT being deemed unsuccessful. All deficiencies identified during these tests shall be corrected and re-tested prior to completing the WFT or shipment of panels to jobsite as determined by the Owner/Engineer.

D. Tests to be performed during the WFT shall include, but not be limited to, the following:

1. A repeat of all tests specified in the SIT.

2. For the I/O test, a representative sampling of 5% of each type of I/O point shall be performed to demonstrate the I/O functionality. Repeat or add to the number of points tested to satisfy the Owner and/or Engineer.

E. The daily schedule during these tests shall be as follows:

1. Morning meeting to review the day's test schedule.

2. Scheduled tests and sign-offs.

3. End of day meeting to review the day's test results and to review or revise the next day's test schedule.

4. Unstructured testing period by the witnesses.

F. Upon successful completion of the WFT, the PCSS shall submit a record copy of the test results as specified in Part 1.

3.05 FIELD TESTING - OPERATIONAL READINESS TEST (ORT)

A. The purpose of the ORT is to check that the process equipment, instrument installation, instrument calibration, instrument configuration, field wiring, control panels, and all other related system components are ready to monitor and control the processes. This test will determine if the equipment is ready for operation.

B. This test shall take place prior to startup. Prior to starting this test, relevant process equipment shall be installed and mechanically tested, instruments installed, control panels installed, and field wiring complete.

C. Required Documents for Test

1. Master copy of the PCSS developed field testing signoff forms.

2. Testing procedures.

3. Calibration forms.

D. These inspections, calibrations, and tests do not require witnessing. However, the Engineer may review and spot-check the testing process periodically. Any deficiencies found shall be corrected by the PCSS prior to start-up.

E. The PCSS shall maintain the Sign-off forms and the Calibration forms at the job site and make them available to the Engineer/Owner at any time.

F. The following steps shall be performed as part of the ORT:

1. Instrument calibration, configuration, and set-up.

2. PCSS hardware and I/O testing

3. I/O Testing to the HMI.

4. Testing of Automatic control strategies.

G. Instrument calibration, configuration, and set-up

1. Calibrate, configure, and set-up all components and instruments to perform the specified functions.

2. Calibration form
   a. For any component or instrument requiring dip switch settings, calibration, or custom configuration, maintain a calibration form in the field documenting this information. These forms shall provide a summary of the actual settings used in the field to allow an Instrument technician to replace the device entirely and configure it to function as it did before.

b. This information shall be added to the Instrument data sheet, shall be added to a copy of the manufacturer's standard "Configuration Sheet", or a separate form shall be created.
   1) If a separate form, the form shall list the Project Name, Loop Number, ISA Tag Number, I/O Module Address, Manufacturer, Model Number/Serial Number, Output Range and Calibrated Value.
c. Some examples of required information are:
   1) For Discrete Devices: Actual trip points and reset points.
   2) For Instruments: Any configuration or calibration settings entered into instrument
   3) For Controllers: Mode settings (PID).
   4) For I/O Modules: Dip switch settings, module configuration (if not documented in the native programming documentation).
d. Maintain a copy of these forms in the field during testing, and make them available for inspection at any time.
e. For any device that allows a software back-up of configuration files to a laptop, make the configuration files available to the Engineer/Owner for inspection. Submit as part of the O&M Manual as specified in Section 13300.

H. PCSS hardware and I/O testing

1. The purpose of the PCSS hardware and I/O signal testing is to check that the process equipment, instrument installation, calibration, configuration, field wiring, and the control panels are set-up correctly to monitor and control the processes. This test is commonly referred to as a "loop test" or an I/O checkout.

2. This test shall follow installation of the process control system components.

3. PCSS shall test signals under process conditions. The preferred test method will always be to execute the test wherever possible to the end elements. For example, the preferred test will prove valve open/close limit switches by operating the valve, not by installing a jumper on the limit switch contacts. However if the equipment or process is not available to test signal over its entire calibrated range, the PCSS may test using a simulation methods and make a note on the sign-off form.

4. PCSS may load their own "dummy program" in the PLC in order to facilitate their ORT requirements.

5. An I/O Signal test shall be performed by the PCSS as part of the ORT to test the software:
   a. Discrete Input – At the device or instrument, change signal condition from the inactive to active state. Observe results on all indicators within the loop such as the PLC I/O register, pilot light, horn, beacon etc. as shown on the P&IDs.
   b. Discrete Output - Signals shall be tested by forcing the output on in the output register, then verify the equipment responds accordingly.
   c. Analog input - Test the analog signal over the entire engineering range at various intervals including 0, 50%, and 100% as well as on increasing and decreasing range. Observe results on all indicators within the loop such as the PLC I/O register, recorders, digital indicators, etc.

d. Analog output - Signals shall be tested by entering values in the output register to force the output to zero percent, 50 percent, and 100 percent of full scale, then verifying the equipment responds accordingly.

6. The PCSS shall maintain the Field Testing Spreadsheet at the job site and make them available to the Engineer/Owner at any time.

7. These inspections, calibrations, and tests do not require witnessing. However, the Engineer will review and spot-check the PCSS test process periodically. Any deficiencies found shall be corrected by the PCSS prior to start-up.

8. Prior to checkout of I/O to the HMI, the PCSS is required to submit a Field Testing Sign off spreadsheet with the ORT sections completed to engineer for review along with any instrument calibration and configuration reports for PCSS supplied instruments in order to document the calibration and configuration procedures of instruments and checkout of I/O.

I. Input/Output (I/O) Testing to the HMI.

1. The purpose of the I/O testing to the HMI is to check that the Instruments and field equipment are connected properly and work from the end device, through the PLC, to the HMI and OIT units.

2. PCSS in conjunction with the contractor shall test signals under process conditions.

3. The following I/O tests shall be performed:
   a. Discrete Input - At the device or instrument, change signal condition from the inactive to active state. Observe results on all indicators within the loop such as the HMI screens, the OIT screens, pilot lights, horns, beacons etc.
   b. Analog Input - Test the analog signal over the entire engineering range at various intervals including 0, 50%, and 100% as well as on increasing and decreasing range. Observe results on all indicators within the loop such as the HMI screens, the OIT screens, recorders, digital indicators, etc.
   c. Discrete output - Signals shall be tested by switching the equipment to manual control at the HMI and OIT nodes and turning the output on or using other means to turn the output on. Then verify the equipment responds accordingly.
   d. Analog output - Signals shall be tested by switching the equipment to manual control at the HMI and OIT nodes and ramping the output up and down. Then verify the equipment responds accordingly.

J. Testing of Automatic Control Strategies

1. All automatic control strategies shall be verified using actual process equipment and instruments, or other means, to verify the logic performs as expected. Verify faults and logical failure scenarios for control strategies such as instrument failures, equipment failures, loss of communication between the HMI Server and the PLC, loss of peer-to-peer communication, out of range testing for analog inputs, loss of power, and all other strategies specified in the control strategy document.

K. UPS shall be tested to verify the UPS switch power correctly while keeping all UPS powered loads online. Also, test the sizing of the UPS by switching off line power to the UPS and verify if they maintain the specified run time.

L. For all panels with enclosures modified by this contract, internal control panel temperature shall be tested under full running conditions to ensure proper cooling/ventilation is being provided.

M. After coordinating with Operations, a "Black Start" of the plant shall be performed to confirm the plant operation recovers as specified in the contract documents. Black start means shutting off power to the plant and turning it back on. Separate tests shall be performed by recovering the plant while on generator (if a generator is specified) and while on utility power.

N. Upon successful completion of the ORT, the PCSS shall submit a record copy of the test results as specified in Part 1 and request the scheduling of system startup.

3.06 FIELD TESTING - FUNCTIONAL DEMONSTRATION TEST (FDT)

A. A separate FDT is not required.

3.07 FIELD TESTING - SITE ACCEPTANCE TEST (SAT)

A. After the system is started-up and running the treatment process in automatic control to the extent possible, the system shall undergo a test as defined in the Division 1 "Equipment Testing and Start-up" section.

B. While this test is proceeding, the Engineer and Owner shall have full use of the system. Only plant operating personnel shall be allowed to operate equipment associated with live plant processes. Plant operations shall remain the responsibility of Owner and the decision of plant operators regarding plant operations shall be final.

C. During this test, PCSS personnel shall be present as required to address any potential issues that would impact system operation. The PCSS is expected to provide personnel for this test who have an intimate knowledge of the equipment supplied as part of this system. When PCSS personnel are not on-site, the PCSS shall provide cell phone/pager numbers that Owner personnel can use to ensure that support staff are available by phone and/or on-site within four hours of a request by operations staff.

D. Any malfunction during the test shall be analyzed and corrections made by the PCSS. In the event of rejection of any part or function, the PCSS shall perform repairs or replacement within 5 days.

E. Throughout the duration of the SAT, no software or hardware modifications shall be made to the system without prior approval from the Owner or Engineer.

3.08 CERTIFICATE OF INSTALLATION

A. Following successful completion of the SAT test, the PCSS shall submit a Certification of Installation for the system as required in the Division 1 "Equipment Testing and Start-up" section.

END OF SECTION

APPENDIX 13301-A: EXAMPLE INPUT/OUTPUT (I/O) STATUS SIGN OFF FORM

An example template for the I/O Status signoff form to be used for documenting testing results to the owner is attached. The PCSS is required, prior to testing, to create a project specific I/O Status signoff form based on the attached template or approved equal. The PCSS may obtain an electronic copy of the template from the Engineer or develop it on their own.

14-Oct-11 | [Project Name] Appendix A - Input/Output (I/O) Status Sign-Off Form

All Sections below are required to be filled out by PCSS as part of Field Testing.
Instrument Alarm Setpoint - Setpoint for any alarms set by PCSS
Wiring Complete - Signal wired from field device to PLC
I/O Tested - Signal tested from field device to SCADA HMI

PLC	Signal Tag	Description	Range or Active State when closed	P&ID	Signal	Rack	Slot	Channel	Instrument Alarm Setpoint	Calibrate, config., and Wiring complete	Date	PCSS I/O testing	Date	I/O Testing to the HMI	Date	Notes
PLC-SC	LIT-4000-1	Secondary Clarifier No. 1 Sludge Level	0-10 ft	8	AI	2	1	0								
PLC-SC	LIT-4010-3	Secondary Clarifier No. 3 Sludge Level	0-10 ft	8	AI	2	1	1								
PLC-SC	SI-4100-1	RAS Pump No. 1 Speed Feedback	0-100%	14	AI	2	1	2								
PLC-SC	SI-4100-4	RAS Pump No. 4 Speed Feedback	0-100%	15	AI	2	1	3								
PLC-SC	FIT-4102-1	RAS Flow Pumps 1-3	0-1900 GPM	14	AI	2	1	4								
PLC-SC	SI-4110-1	WAS Pump No. 1 Speed Feedback	0-100%	14	AI	2	1	5								
PLC-SC	N/A	Spare Slot	N/A	N/A	Spare	2	5	N/A								
PLC-SC	SC-4100-1	RAS Pump No. 1 Speed Setpoint	0-100%	14	AO	2	7	0								
PLC-SC	SC-4100-2	RAS Pump No. 2 Speed Setpoint	0-100%	14	AO	2	7	1								
PLC-SC	SC-4100-3	RAS Pump No. 3 Speed Setpoint	0-100%	14	AO	2	7	2								
PLC-SC	SC-4110-1	WAS Pump No. 1 Speed Setpoint	0-100%	14	AO	2	7	3								
PLC-SC	Spare	Spare	N/A	N/A	AO	2	7	4								
PLC-SC	Spare	Spare	N/A	N/A	AO	2	7	5								
PLC-SC	TSH-4000-1	Secondary Clarifier No. 1 High Temp	Normal	8	DI	3	1	0								
PLC-SC	XA-4000-1	Secondary Clarifier No. 1 Motor Overload	Normal	8	DI	3	1	1								
PLC-SC	WAH-4000-1	Secondary Clarifier No. 1 High Torque	Normal	8	DI	3	1	2								
PLC-SC	WAHH-4000-1	Secondary Clarifier No. 1 High High Torque	Normal	8	DI	3	1	3								
PLC-SC	YRI-4000-1	Secondary Clarifier No. 1 On/Off	On	8	DI	3	1	4								
PLC-SC	YCI-4000-1	Secondary Clarifier No. 1 In Remote	In Remote	8	DI	3	1	5								
PLC-SC	YFI-4100-1	RAS Pump No. 1 VFD Fault	Normal	14	DI	3	1	6								
PLC-SC	FAL-4100-1	RAS Pump No. 1 Low Flow	Normal	14	DI	3	1	7	50 GPM	RJM	12/18/2011	JAS	12/22/2011	MIC	12/29/2011	Example completed line
PLC-SC	Spare	Spare	Normal	14	DI	3	1	8								
PLC-SC	YRI-4100-1	RAS Pump No. 1 Running	Running	14	DI	3	1	9								
PLC-SC	YCI-4100-1	RAS Pump No. 1 In Remote	In Remote	14	DI	3	1	10								
PLC-SC	YFI-4110-1	WAS Pump No. 1 VFD Fault	Normal	14	DI	3	1	11								
PLC-SC	FAL-4110-1	WAS Pump No. 1 Low Flow	Normal	14	DI	3	1	12								
PLC-SC	Spare	Spare	Normal	14	DI	3	1	13								
PLC-SC	YRI-4110-1	WAS Pump No. 1 Running	Running	14	DI	3	1	14								
PLC-SC	YCI-4110-1	WAS Pump No. 1 In Remote	In Remote	14	DI	3	1	15								
PLC-SC	HSS-4000-2	Secondary Clanfier No. 2 Start Command	Start	8	DO	4	6	0								
PLC-SC	Spare	Spare	N/A	N/A	DO	4	6	1								
PLC-SC	HSS-4100-2	RAS Pump No. 2 Start Command	Start	14	DO	4	6	2								
PLC-SC	HSS-7000-2	Sludge Holding tank Tank Blower No. 2 Start Command	Start	17	DO	4	6	3								
PLC-SC	HSS-4100-5	RAS Pump No. 5 Start Command	Start	15	DO	4	6	4								
PLC-SC	Spare	Spare	N/A	N/A	DO	4	6	5								
PLC-SC	HSS-4105-1	Secondary Scum Pump No 2 Start/Stop	Start	15	DO	4	6	6								
PLC-SC	HSS-4110-2	WAS Pump No. 2 Start/Stop Command	Start	15	DO	4	6	7								
PLC-SC	7160-FQI-1	Sludge Loadout LCP Pumping Indicator	Pumping	17	DO	4	6	8								
PLC-SC	Spare	Spare	N/A	N/A	DO	4	6	9								
PLC-SC	HSS-7115-2	Sludge Holding Tank Mixer No. 2 Start	Start	17	DO	4	6	10								
PLC-SC	Spare	Spare	N/A	N/A	DO	4	6	11								
PLC-SC	HSO-7117-2	Sludge Holding Tank Discharge Valve No. 2 Open CMD	Open	17	DO	4	6	12								
PLC-SC	HSC-7117-2	Sludge Holding Tank Discharge Valve No. 2 Close CMD	Close	17	DO	4	6	13								
PLC-SC	HSS-7120-2	TS Transfer Pump No. 2 Start Command	Start	17	DO	4	6	14								
PLC-SC	Spare	Spare	N/A	N/A	DO	4	6	15								

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SECTION 13303
INSTRUMENTATION AND CONTROLS – TRAINING

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish training as specified herein.

B. This section covers the training requirements for all devices and systems furnished and installed as detailed on the Drawings.

C. Refer to Section 13300.

1.02 MEASUREMENT AND PAYMENT

A. No separate payment will be made for work performed under this Section. Include the cost for this work in the lump sum Base Bid Item in Section 00410.

1.03 RELATED WORK

A. Refer to Section 13300.

1.04 SUBMITTALS

A. Refer to Section 13300 for general submittal requirements.

B. Preliminary Training Plan Submittal

1. Prior to the preparation of the Final Training Plans, submit outlines of each training course including course objectives and target audience, resumes of instructors, prerequisite requirements for each class, and samples of handouts for review.

C. Final Training Plan Submittal

1. Upon receipt of the Engineer's comments on the preliminary training plan, submit the specific proposed training plan. The training plan shall include:
   a. Definitions, objectives, and target audience of each course.
   b. Schedule of training courses including proposed dates, duration and locations of each class.
   c. Complete copy of all proposed handouts and training materials. Training information shall be bound and logically arranged with all materials reduced to a maximum size of 11 inch by 17 inch, then folded to 8.5 inch by 11 inch for inclusion into the binder.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION

3.01 GENERAL

A. The cost of the training programs shall be included in the Contract price. The training and instruction shall be directly related to the system being supplied. The training program shall represent a comprehensive program covering all aspects of the operation and maintenance of the system.

B. All training schedules shall be coordinated with and at the convenience of the OWNER. Shift training may be required to correspond to the OWNER'S working schedule.

C. All onsite instructors must be intimately familiar with the operation and control of the OWNER'S facilities.

D. Provide detailed training manuals to supplement the training courses. The manuals shall include specific details of equipment supplied and operations specific to the project. The manuals shall be provided in hardcopy for each student. Provide electronic copy of each training manual in PDF format for OWNER'S future use.

E. The trainer shall make use of teaching aids, manuals, slide/video presentations, etc. After the training services, all training materials shall be delivered to OWNER.

F. The OWNER reserves the right to videotape all custom training sessions. All training tapes shall become the sole property of the OWNER.

G. Cost of Travel for off-site training

1. Cost of Travel for off-site training shall be paid directly by the entity employing the staff doing the traveling.

3.02 TRAINING SUMMARY

A. Definitions of audience roles

1. Administrator - personnel responsible for maintaining the HMI / SCADA system.

2. Maintenance - personnel responsible for maintaining the field controller hardware and instrumentation system.

3. Operations - personnel responsible for daily plant operations.

4. Management - non-daily operations personnel

3.03 ONSITE TRAINING

A. Training personnel shall be intimately familiar with the control system equipment, its manipulation, and configuration. Training personnel shall command knowledge of system

debugging, program modification, troubleshooting, maintenance procedure, system operation, and programming, and shall be capable of transferring this knowledge in an orderly fashion to technically oriented personnel.

B. Installed Control System Training

1. Provide training for the OWNER'S personnel in the functionality, maintenance, and troubleshooting, of the installed Control System. The training shall be held before the Functional Demonstrator Test (FDT), but not more than two months before.

2. Training and instruction shall be specific to the system that is being supplied.

3. Training shall consist of classroom instructions and hands-on instruction utilizing the OWNER'S system.

4. Detailed training shall be provided on the actual configuration and implementation for this Contract. Training shall cover all aspects of the system that will allow the OWNER'S personnel to maintain, modify, troubleshoot, and develop future additions/deletions to the system. The training shall cover the following subjects, as a minimum:
   a. System overview.
   b. System hardware components and specific equipment arrangements.
   c. Periodic maintenance.
   d. Troubleshooting and diagnosis.
   e. Network configuration, communications, and operation.
   f. TCP/IP addressing procedures for all Ethernet devices.

C. Programmable Logic Controller (PLC) Hardware and Software

1. Provide training for the OWNER'S personnel in the operation, maintenance, troubleshooting, etc. with the PLC hardware and software system. The training shall be held before the FDT, but not more than two months before.

2. Training and instruction shall be specific to the system that is being supplied.

3. Training shall consist of classroom instructions and hands-on instruction utilizing the OWNER'S system.

4. Detailed training shall be provided on the actual configuration and implementation for this Contract. Training shall cover all aspects of the PLC system that will allow the OWNER'S personnel to maintain, modify, troubleshoot, and develop future additions/deletions to the PLC system. The training shall cover the following subjects, as a minimum:
   a. PLC system overview.
   b. PLC system architecture.
   c. PLC system hardware components and specific equipment arrangements.
   d. PLC system startup, shut down, load, backup, and PLC failure recovery.
   e. Periodic maintenance.
   f. Troubleshooting and diagnosis down to the I/O card level.
   g. PLC configuration, communications, and operation.

D. Instrument Manufacturer Training

1. Manufacturer instrument training shall be provided for those instruments where specifically indicated in the Instruments section. This shall be on-site training provided by an authorized representative of the manufacturer. The manufacturer's representative shall be fully knowledgeable in the operation and maintenance of the equipment. .

E. Instrument Training

1. Provide instruction on the maintenance of the field and panel instrumentation for the OWNER'S instrumentation technicians. This training shall be conducted before the FDT, but no more than 1 month before and at a time suitable to the OWNER. This training shall take place at the OWNER'S facility. As a minimum the following shall be included:
   a. Training in standard hardware maintenance for the instruments provided.
   b. Specific training for the actual instrumentation configuration to provide a detailed understanding of how the equipment and components are arranged, connected, and set up for this Contract.
   c. Test, adjustment, and calibration procedures.
   d. Troubleshooting and diagnosis.
   e. Periodic maintenance.

F. Instruments - Operator familiarity

1. Provide operator level instruction on the use of the field and panel instrumentation for the OWNER'S operations staff. This training shall be conducted before the 30 day site acceptance test, but no more than 1 month before and at a time suitable to the OWNER. This training shall take place at the OWNER'S facility. Include hands on demonstration of the information each transmitter indicates and the method used to retrieve any operator information from the transmitter, including use of pushbuttons and interpretation of international graphic symbols used on the instruments.

G. Fiber Optic Training

1. Provide instruction on the maintenance of the fiber optic system for the OWNER'S instrumentation technicians. This training shall be conducted before the FDT, but no more than 1 month before and at a time suitable to the OWNER. This training shall take place at the OWNER'S facility. As a minimum the following shall be included:
   a. Fiber cable layout and basic of cable construction.
   b. Termination procedures
   c. "Jumper" installation
   d. Testing procedures.
   e. Troubleshooting and diagnosis.

END OF SECTION

SECTION 13305
INSTRUMENTATION AND CONTROLS – CONTROL DESCRIPTIONS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. This section is provided to clarify the control strategies to be used to program the system.

1.02 MEASUREMENT AND PAYMENT

A. No separate payment will be made for work performed under this Section. Include the cost for this work in the lump sum Base Bid Item in Section 00410.

1.03 RELATED WORK

A. Refer to Section 13300 for I&C – General Provisions.

B. Refer to Section 13306 for I&C – Applications Engineering Services.

C. Refer to Section 13900 for Operation and Optimization Software.

D. Refer to Section 16349 for Medium Voltage Motor Controller Switchgear.

E. Refer to Section 16485 for Medium Voltage Adjustable Speed Drives.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION

3.01 GENERAL

A. The control descriptions are sorted by loop number for each area. The loop index has three columns associated with it; Loop Number, Loop Description, and Page. Each loop is associated with a specific SCADA I/O cabinet location to which it shall communicate.

B. The control descriptions are broken into a hierarchical layer concept. There may be one layer or multiple layers per loop, depending upon that loop. An example of multiple layered loops is as follows. The lowest layer of control, local control, is at that piece of equipment or that piece of equipment's panel or drive. The second layer of control is at an intermediate control panel between the equipment and the SCADA I/O or vendor's PLC I/O. The third layer would be at the vendor's PLC or microprocessor touchscreen station. The highest layer of control is by the SCADA PLC System with its associated operator workstations (OWS) in the main control room, remote office locations, and satellite locations operator interface terminals (OITs). The SCADA PLC/ OWS refers to both the SCADA PLC, which does the actual monitoring and control logic for the process equipment and the SCADA operator workstation (OWS), which are computers that have graphical software that interface to the PLC software for monitoring and

implementing all operator-required tasks to control that process equipment. Any functions done in the operator workstations also take place at all the SCADA OITs.

3.02 CONTROL FUNCTION DEFINITIONS AND GENERAL CRITERIA

A. The hardware and/or software functions noted by this paragraph reference are to be implemented by the SCADA PLC/OWS control system specified herein.

B. The following list of ISA abbreviations is typical of those utilized. The description, following the abbreviation, summarize the basic function to be implemented in the SCADA PLC/OWS software.

1. HS: Represent selector switches or pushbuttons, which shall be implemented by keyboard entry. Function shall be similar to their hardware counterparts.

2. YL: Represents equipment status (i.e., availability, running, in remote, etc.) implemented by a change of color on the OWS symbol for this equipment. For motor driven equipment such as pumps, blowers, compressors, etc., availability contact represents remote operation and no alarm conditions.

3. PAL, AAH, UA, etc.: Represent high or low alarms implemented on the OWS.

4. FIC, PIC, AIC, etc.: Represent PID process controllers implemented in a computer logic algorithm incorporating proportional, integral, and/or derivative modes. Local/remote and manual/auto capabilities shall be provided.

5. FIK, PIK, AIK, etc.: Represent control stations implemented in logic (via keyboard entry and CRT display) to allow downloading of a set point to a FIC, PIC, AIC, etc., and display of the process variable or controller output.

6. FI, PI, AI, etc.: Represent digital output display on the CRT of a process variable in engineering units and/or a dynamic representation of the variable by symbol or graphical means.

7. FIR, PIR, AIR, Represent values stored on the hard disk to provide the data for historical trend graphics of process variables against time (or other selected variables).

8. ZSH, ZSL etc.: Represent high or low , open or close limit positions implemented on the OWS

C. Any interlocks that are represented, before the local operational descriptions, or are stated as hardwired interlocks, shall interlock all the controls locally and at the SCADA PLC/OWS or at the vendor PLCs. The SCADA PLC shall be programmed to shutdown that equipment if that hardwired interlock is also wired to the SCADA PLC.

D. Any interlocks that are represented in a particular layer of the operational descriptions, shall interlock all the controls in that layer and the layer after it. However the interlock shall not interlock the commands in the layer before it.

E. The SCADA system shall stop a motor or drive in its program if it does not receive the auto or remote status or one of its software interlocks trip. If the drive or motor is in hand or remote it will continue to run but the SCADA start/stop output will be open.

F. Any motor that is requested to start by an operator or an automatic program shall alarm if the run confirm status for that motor does not activate within two seconds. If a motor stops by an interlock or stops without any operator or SCADA intervention then that motor shall go into alarm. Any motors that are stopped by a program or the operator shall not go into an alarm.

G. Any valve that is requested to open by an operator or an automatic program shall alarm if the open feedback status for that valve does not activate within ten seconds. Any valve that is requested to close by an operator or an automatic program shall alarm if the close feedback status for that valve does not activate within ten seconds.

H. Motors that have an H/O/A shall indicate to the operator that the pump is being run in the "Hand" position. A motor is being run in "Hand" when the "Auto" position is not true and the run confirm status is true. If not in "Auto" the SCADA PLC shall open up its output contact to stop (shutdown) the pump from SCADA.

I. Terminology associated with interlocks is as follows:

1. When a contact or status is true, the SCADA computer will receive power to its input channel. The SCADA computer registers this as a binary bit of one.

2. When a contact or status is false, the SCADA computer will receive no power (open circuit) to its input channel. The SCADA computer registers this as a binary bit of zero.

J. When an analog signal goes outside the 4-20 mA range due to a failure at the instrument or PLC card, the following SCADA programming shall take place:

1. Alarm the signal in the HMI system.

2. If the analog signal is associated with a control loop or ratio control loop that loop shall go into manual.

3. If the analog signal is used in a calculation, that calculation shall use the last good analog signal. The computer shall place the control loop in manual if using the calculation.

K. Disable all alarms on analog inputs unless specifically called for in the drawings or specifications.

L. All interlocks that shutdown (Stop a piece of equipment and prevent it from being restarted or moved) shall be shown on the faceplate pop-up graphic for that piece of equipment.

M. The run confirms or on status of all motors and lamps shall be accumulated to calculate a run time status of the equipment on the HMI graphic. Each run time accumulation shall come with a reset button on the HMI screen.

N. All flow indications shall be totalized. Do not totalize if the analog signal is outside the 4-20 mA range. Each flow totalization shall come with a reset button on the HMI screen. Do not totalize if the value of the flow input is less than 2% of the full range of the input.

3.03 HIGH SERVICE PUMP STATION

A. General

1. Two Ground Storage Tanks (GST) receives water from the UV reactors and provide on-site storage for finished water before it is pumped to the Finished Water Transmission Main. The High Service Pump Station draws water from the storage tanks and pumps into the City of Houston transmission system.

2. Components of the High Service Pump Station are as follows:
   a. Pump 1 (08-P-01), Pump 1 Discharge Control Valve (08-V-01)
   b. Pump 2 (08-P-02), Pump 2 Discharge Control Valve (08-V-02)
   c. Pump 3 (08-P-03), Pump 3 Discharge Control Valve (08-V-03)
   d. Pump 4 (08-P-04), Pump 4 Discharge Control Valve (08-V-04)
   e. Diesel Driven Pump 5 (08-P-05), Pump 5 Discharge Control Valve (08-V-05)
   f. Pump 6 (08-P-06), Pump 6 Discharge Control Valve (08-V-06)
   g. Pump 7 (08-P-07), Pump 7 Discharge Control Valve (08-V-07)
   h. Pump 8 (08-P-08), Pump 8 Discharge Control Valve (08-V-08)

B. High Service Pumps/Pump Discharge Control Valves

1. Field/Local Control
   a. Adjustable Speed Drive (ASD) Pumps: (08-P-01, 08-P-03, 08-P-06, and 08-P-08)
      1) There is a local LOCAL-OFF-REMOTE (L-O-R) maintained contact selector switch located for each ASD.
      2) In the LOCAL position, the ASD pump is controlled locally by the momentary start/stop pushbuttons. Pressing the Start push button will activate an automatic pump/pump discharge control valve sequencing control as described below in Section 6.a.2. When the automatic sequence is complete, the pump speed control will be available from the keypad on the front of the ASD. Pressing the Stop push button will activate an automatic pump/valve sequencing control as described below in Section 6.a.3. An emergency stop (E-Stop) push-pull switch will be provided at the pump to cause immediate pump shutdown.
   b. Constant Speed Pumps: (08-P-02, 08-P-04, and 08-P-07)
      1) There is a local LOCAL-OFF-REMOTE (L-O-R) maintained contact selector switch located on the Medium Voltage Motor Control Center (MVMCC) for each constant speed pump.
      2) In the LOCAL position, the pump is controlled by the start/stop pushbuttons located at the MVMCC. Pressing the Start pushbutton will initiate an automatic pump/valve sequence as described below in Section 6.b.2. Pressing the Stop push button will activate an automatic pump/valve sequencing control as described below in Section 6.b.4. An emergency stop (E-Stop) push-pull switch will be located on the MVMCC for immediate pump shutdown.

c. Diesel Fuel Pump: (08-P-05)
   1) There is a local control panel located at the pump.
   2) The pump is controlled by the start/stop pushbuttons located at the local control panel. Pressing the Start pushbutton will initiate an automatic pump/valve sequence as described below in Section 6.c.2. Pressing the Stop push button will activate an automatic pump/valve sequencing control as described below in Section 6.c.4.
   Note: The intent is to operate the diesel fuel pump and associated discharge control valve in a local manual mode.

d. Pump Discharge Control Valves: (08-V-01, 08-V-02, 08-V-03, 08-V-04, 08-V-05, 08-V-06, 08-V-07, and 08-V-08).
   1) A local LOCAL-OFF-REMOTE (L-O-R) maintained contact selector switch will be provided as an integral component of the pump discharge control valve actuator.
   2) In the LOCAL position, the actuator open and close pushbuttons will function to open and close the pump control valve. The L-O-R selector switch Local position is intended for maintenance use only. Normal operation of the pump control valve will be with the L-O-R selector switch in the Remote position. In the REMOTE position, the pump discharge control valve will operate via an automatic pump/valve sequencing control as described below in Section 6.

2. Computer Manual Control: Note the remote manual control strategy is intended for use in conjunction with the pump optimization software (Specification Section 13900). The plant operations staff shall remotely start/stop pump(s) from the HMI as recommended by the pump optimization software. AESS will be required to coordinate with the optimization software vendor for data exchange requirements and HMI display layout preferences.
   a. ASD Pumps: (08-P-01, 08-P-03, 08-P-06, and 08-P-08)
      1) There is a local LOCAL-OFF-REMOTE (L-O-R) maintained contact selector switch located for each ASD.
      2) In the REMOTE position, Control will be accomplished by a Brick PLC (Siemens S7-1214C) located in an ASD low voltage compartment in the High Service Electrical Building (HSEB).
      3) The HMI operator is able to operate the pumps manually by selecting the MANUAL control mode on the HMI.
      4) The pump can be operated by clicking on the START/STOP push button on the HMI. Clicking the Start button will activate an automatic pump/valve sequencing control as described below in Section 6.a.2. When the automatic sequence is complete, the operator will be able to vary the pump speed from the HMI. Clicking the Stop button will activate an automatic pump/valve sequencing control as described below in Section 6.a.3.
   b. Constant Speed Pumps: (08-P-02, 08-P-04, and 08-P-07)
      1) There is a local LOCAL-OFF-REMOTE (L-O-R) maintained contact selector switch located on the MVMCC for each constant speed pump.
      2) In the REMOTE position, Control will be accomplished by a Brick PLC located in the MVMCC.
      3) The HMI operator is able to operate the pumps manually by selecting the MANUAL control mode on the HMI.

4) The pump can be operated by clicking on the START/STOP push button on the HMI. Clicking the Start button will activate an automatic pump/valve sequencing control as described below in Section 6.b.2. Clicking the Stop button will activate an automatic pump/valve sequencing control as described below in Section 6.b.4.

3. Computer Auto Control Philosophy
   a. The Auto control scheme is for the following:
      1) Pump 1 (08-P-01), Pump 1 Discharge Control Valve (08-V-01)
      2) Pump 2 (08-P-02), Pump 2 Pump Discharge Control Valve (08-V-02)
      3) Pump 3 (08-P-03), Pump 3 Pump Discharge Control Valve (08-V-03)
      4) Pump 4 (08-P-04), Pump 4 Pump Discharge Control Valve (08-V-04)
      5) Pump 6 (08-P-06), Pump 6 Pump Discharge Control Valve (08-V-06)
      6) Pump 7 (08-P-07), Pump 7 Pump Discharge Control Valve (08-V-07)
      7) Pump 8 (08-P-08), Pump 8 Pump Discharge Control e Valve (08-V-08)
   b. All pumps and valves shall normally be placed in the "REMOTE" position. If a pump/valve combination is not in the "REMOTE" position, the pump shall be removed from selection in the automatic control rotation list.
   c. In the "Automatic Mode of Operation" the pumps shall be staged to maintain the discharge pressure setpoint as entered by the Operator. The graphic display shall prompt the Operator to enter a pressure setpoint. (Note: The last pressure setpoint entered by the Operator shall be used as the default pressure setpoint.)
   d. A "Lead" pump (ASD)" will be operated to maintain the pressure setpoint as entered by the Operator utilizing the proportional and integral components of a PID loop.
   e. Staging the Pumps On (Failing Pressure) – If the "Lead" pump is running at maximum speed and cannot maintain the pressure setpoint for one minute or greater (operator adjustable); upon falling discharge pressure, the pumps shall be staged as indicated below:
      1) When the discharge pressure is less than the pressure setpoint the PLC shall initiate a pump "Start" command. The PLC shall command the "Lag 1" pump to start.
         a) The "Lead" pump shall ramp to its minimum speed, and adjust speed to maintain the pressure.
         b) If the "Lag 1" pump is an ASD, both pumps shall adjust speed in sequence to maintain the pressure.
      2) If the pump(s) are running at maximum speed and cannot maintain the pressure setpoint for one minute or greater (operator adjustable); the PLC shall command the "Lag 2" pump to start.
         a) The "Lead" pump shall ramp to its minimum speed, and modulate to maintain the pressure.
         b) If Lag 2 is an ASD pump, the PLC shall ramp to its minimum speed. All ASD pumps shall modulate in sequence to maintain the pressure setpoint.
      3) If the pumps are running at their maximum speed and cannot maintain the pressure setpoint for one minute or greater (operator adjustable); the PLC shall command the "Lag 3" pump to start.
         a) The "Lead" pump shall ramp to its minimum speed, and modulate to maintain the pressure.
         b) If Lag 3 is an ASD pump, the PLC shall ramp to its minimum speed. All ASD pumps shall modulate in sequence to maintain the pressure setpoint.

f. Staging the Pumps off (Rising Pressure) – Upon rising pressure the pumps shall be staged as indicated below:
   1) If the "Lead", "Lag 1", "Lag 2" and "Lag 3" pumps are running and the ASD pumps are at their minimum speed and cannot maintain the pressure setpoint for one minute or greater (operator adjustable); the PLC shall command the "Lead" pump to stop. The pumps shall then rotate their pump sequencing positions. The "Lag 1" pump shall become the "Lead" pump. The "Lag 2" pump shall become the "Lag 1" pump. The "Lag 3" pump shall then become the "Lag 2" pump. The original "Lead" pump shall then become the "Lag 3" pump. All three remaining pumps ("Lead", "Lag 1", and "Lag 2") shall operate to maintain the pressure setpoint.
   2) **Note:** The Lead pump must be an ASD pump. Therefore, for the pump sequencing rotation described, the original ASD Lead pump would remain Lead if Lag1, Lag2, & Lag3 were constant speed pumps. However, the constant speed pumps would still rotate positions for Lag1, Lag2 and Lag3.
   3) If the "Lead", "Lag 1", and "Lag 2" pumps are running and the ASD(s) are at their minimum speed and cannot maintain the pressure setpoint for one minute or greater (operator adjustable); the PLC shall command the "Lead" pump to stop. The pumps shall then rotate their pump sequencing positions. The two remaining pumps ("Lead" and "Lag 1") shall operate to maintain the pressure setpoint.
   4) If the "Lead" and "Lag 1" pumps are running at their minimum speed and cannot maintain the pressure setpoint for one minute or greater (operator adjustable); the PLC shall command the "Lead" pump to stop. The pumps shall then rotate their pump sequencing positions. The remaining "Lead" pump shall modulate to maintain the pressure setpoint.

4. Computer Auto Control – Advisory Mode: This mode will prompt the operator when to start/stop pump(s) based on operator entered pressure set point. Advisory mode will start requested pump after acknowledgement by operator.
   a. The respective H-O-R switch for the pump must be in the REMOTE position.
   b. The HMI operator is able to operate the pumps manually by selecting the AUTO control mode on the HMI. From the AUTO control popup display, select Auto 1 – Advisory Mode option.
   c. Control Setpoints:
      1) Lead/Lag1/Lag2/Lag3 Designation – Strategy will "PROMPT" operator when to START/STOP pumps. ASD pump speeds will be automatically adjusted to maintain pressure.

Lead (ASD)	Lag 1		Lag 2		Lag 3	
08-P-01 ●	08-P-01 ○	08-P-02 ○	08-P-01 ○	08-P-02 ●	08-P-01 ○	08-P-02 ○
08-P-03 ○	08-P-03 ●	08-P-04 ○	08-P-03 ○	08-P-04 ○	08-P-03 ○	08-P-04 ○
08-P-06 ○	08-P-06 ○	08-P-07 ○	08-P-06 ○	08-P-07 ○	08-P-06 ○	08-P-07 ○

Lead (ASD)	Lag 1		Lag 2		Lag 3	
08-P-08 ○	08-P-08 ○		08-P-08 ○		08-P-08 ●	

2) Discharge Pressure Setpoint – PLC control strategy will maintain the pump station discharge pressure based on the pressure setpoint and the lead/Lag1/lag2/Lag3 sequence assignments.

Pressure = XX.X PSI

3) Maximum Flow Setpoint - PLC control strategy will maintain the pump station discharge pressure based on the pressure setpoint and the lead/Lag1/lag2/Lag3 sequence assignments. The maximum flow setpoint will ALARM the operator and inhibit full pressure control function.

Flow = XXX.X MGD

5. Computer Auto Control – Full Auto Mode: This mode will start/stop pump(s) based on operator entered pressure set point.
   a. The respective L-O-R switch for the pump must be in the REMOTE position.
   b. The HMI operator is able to operate the pumps manually by selecting the AUTO control mode on the HMI. From the AUTO control popup display, select Auto 2 – Full Auto Mode option.
   c. Control Setpoints:
      Lead/Lag1/Lag2/Lag3 Designation – Strategy will "AUTOMATICALLY" START/STOP pumps. ASD pump speeds will be automatically adjusted to maintain pressure.

Lead (ASD)	Lag 1		Lag 2		Lag 3	
08-P-01 ●	08-P-01 ○	08-P-02 ○	08-P-01 ○	08-P-02 ●	08-P-01 ○	08-P-02 ○
08-P-03 ○	08-P-03 ●	08-P-04 ○	08-P-03 ○	08-P-04 ○	08-P-03 ○	08-P-04 ○
08-P-06 ○	08-P-06 ○	08-P-07 ○	08-P-06 ○	08-P-07 ○	08-P-06 ○	08-P-07 ○
08-P-08 ○	08-P-08 ○		08-P-08 ○		08-P-08 ●	

1) Discharge Pressure Setpoint – PLC control strategy will maintain the pump station discharge pressure based on the pressure setpoint and the pump Lag 1/lag sequence assignments.

Pressure = XX.X PSI

2) Maximum Flow Setpoint - PLC control strategy will maintain the pump station discharge pressure based on the pressure setpoint and the pump lead/lag sequence

assignments. The maximum flow setpoint will ALARM the operator and inhibit full pressure control function.

Flow = XXX.X MGD

6. Pump/Valve Sequence: **Note:** The pump/valve sequence described below requires both the pump and associated discharge control valve L-O-R selector switches be placed in the REMOTE position. The control strategy shall alert the operator when this condition is not true.
   a. ASD Pumps: (08-P-01, 08-P-03, 08-P-06, and 08-P-08)
      1) Control of ASD controlled pump motors will be accomplished by a Brick PLC (Siemens S7-1214C) located in an ASD low voltage compartment in the HSEB. The Brick PLC will communicate with PLC-3 via Profinet.
      2) A start command (either a local/field command or a PLC command) shall command the pump motor to start and ramp up to full speed (ramp up duration is adjustable). Once the motor is at full speed (based on ramp up time), the valve shall be commanded to open until a valve opened signal is received.
         a) If the pump discharge control valve does not reach a fully opened state in an operator adjustable time period, the pump motor is shall be commanded to stop and an alarm will be generated on the HMI.
         b) Upon receiving the discharge control valve opened signal, the pump shall begin to adjust the motor speed based on the Brick PLC control logic.
      3) After the pump has been running for an operator adjustable time period, pump back-pressure control shall be initiated to throttle the discharge control valve to maintain a desire discharge pressure RANGE.
         a) A high and low discharge pressure range will be entered at the HMI for each pump. The valve will maintain its current position as long as the discharge pressure is within the range entered at the HMI. When the discharge range is outside of the desired range, a PID controller shall throttle the valve to achieve the pressure. The PID controller's state shall freeze until the pressure goes back outside the desired conditions.
         b) There shall be an option to enable/disable the back-pressure control. **Note:** The pump back-pressure control will be disabled for ASD Pumps.
      4) A pump motor stop command (either a local/field command or a PLC command) shall command the pump discharge control valve to close. When a pump discharge control valve is closed to 90% (field adjustable), the pump motor speed shall be automatically ramped down to the minimum speed and the motor will be commanded to stop.
         a) If the pump discharge control valve does not reach a fully closed state in an operator adjustable time period, the pump motor is shall be commanded to stop and an alarm will be generated on the HMI.
   b. Constant Speed Pumps: (08-P-02, 08-P-04, and 08-P-07)
      1) Control of constant speed pump motors will be accomplished by a Brick PLC (Siemens S7-1214C) located in MVMCC in the HSEB. The Brick PLC will communicate with PLC-3 via Profinet.
      2) A start command (either a local/field command or a PLC command) shall command the pump motor to start and run for an operator adjustable time period before the valve is commanded to open.

a) If the pump discharge control valve does not reach a fully opened state within an operator adjustable time period, the pump motor is shall be commanded to stop and an alarm will be generated on the HMI.

3) After the pump has been running for an operator adjustable time period, pump back-pressure control shall be initiated to throttle the discharge control valve to maintain a desire discharge pressure RANGE.
   a) A high and low discharge pressure range will be entered at the HMI for each pump. The valve will maintain its current position as long as the discharge pressure is within the range entered at the HMI. When the discharge range is outside of the desired range, a PID controller shall throttle the valve to achieve the pressure. The PID controller's state shall freeze until the pressure goes back outside the desired conditions.
   b) There shall be an option to enable/disable the back-pressure control.
4) A pump motor stop command (either a local/field command or a PLC command) shall command the pump discharge control valve to close. When a pump discharge control valve is closed to 90% (field adjustable), the pump motor will be commanded to stop.
   a) If the pump discharge control valve does not reach a fully closed state within an operator adjustable time period, the pump motor is shall be commanded to stop and an alarm will be generated on the HMI.

c. Diesel Pump: (08-P-05)
1) Control of the diesel pump motor will be accomplished by a Brick PLC (Siemens S7-1214C) located in PLC-3 control panel in the HSEB. The Brick PLC will communicate with PLC-3 via Profinet.
2) A start command (either a local/field command or a PLC command) shall command the pump motor to start and run for an operator adjustable time period before the valve is commanded to open.
   a) If the pump discharge control valve does not reach a fully opened state within an operator adjustable time period, the pump motor is shall be commanded to stop and an alarm will be generated on the HMI.
3) After the pump has been running for an operator adjustable time period, pump back-pressure control shall be initiated to throttle the discharge control valve to maintain a desire discharge pressure RANGE.
   a) A high and low discharge pressure range will be entered at the HMI for each pump. The valve will maintain its current position as long as the discharge pressure is within the range entered at the HMI. When the discharge range is outside of the desired range, a PID controller shall throttle the valve to achieve the pressure. The PID controller's state shall freeze until the pressure goes back outside the desired conditions.
   b) There shall be an option to enable/disable the back-pressure control.
4) A pump motor stop command (either a local/field command or a PLC command) shall command the pump discharge control valve to close. When a pump discharge control valve closed signal is received, the pump motor will be commanded to stop.
   a) If the pump discharge control valve does not reach a fully closed state within an operator adjustable time period, the pump motor is shall be commanded to stop and an alarm will be generated on the HMI.

Note: The intent is to operate the diesel fuel pump and associated discharge control valve in a local manual mode.

7. Interlocks
   a. A pumps shall be disabled from operation upon receiving an "Incomplete Sequence Alarm". A manual RESET from the HMI will be required. The alarm shall be generated by the PLC if any of the following events should occur:
      1) The Pump fails to START/STOP after a predetermined amount of time.
      2) An uncommand pump operation occurs.
      3) The discharge control valve fails to OPEN/CLOSE after a predetermined amount of time.
      4) An uncommand discharge control valve operation occurs.
      5) Associated discharge control valve is not closed before initiating a pump start command.
      6) Pump High Discharge Pressure
      7) Pump Low Suction Pressure
      8) Pump RTDs (Stator and Bearings)
      9) Pump E-Stop

8. Notable Monitoring Signals, and Alarms
   a. Pump Run Status (DI)
   b. Pump Remote Status (DI)
   c. Pump Failure Status (DI)
   d. Pump Common Pressure Alarm (DI)
   e. Pump ASD Selector Mode Status (DI)
   f. Pump ASD Speed Control (AI)
   g. Pump ASD Speed Feedback Indication (AI)
   h. Pump Discharge Pressure Indication (AI)
   i. Discharge Control Valve Remote Status (DI)
   j. Discharge Control Valve Opened Position Status (DI)
   k. Discharge Control Valve Closed Position Status (DI)

C. Multilin Monitoring

1. Brick PLCs shall communicate with Multilin Device as shown on the contract drawings. Multilin registers shall be available to be accessed by PLC-3. The following data registers shall be monitored as a minimum:
   a. Current
   b. Voltage
   c. Power
   d. Power Factor
   e. Kilowatt Hour (Totalized)

D. Power Failure

1. Discharge Control Valve
   a. Valve actuators on pump discharge control valves include provisions to close pump discharge control valves when power fails (fail close mode).

2. Pump Motors
   a. If power fails, pump motors will coast to a stop.

3. Brick PLCs
   a. Brick PLCs in MVMC units will be powered from the 48VDC bus in the switchgear. Brick PLCs in ASD units will be powered by an individual UPS unit in each ASD low voltage compartment.

END OF SECTION

SECTION 13306
INSTRUMENTATION & CONTROLS – APPLICATIONS ENGINEERING SERVICES

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Refer to section 13300.

B. If referred to anywhere else in the project manual, Application Engineering (AE) or Applications Engineering System Supplier (AESS) services are those services specified in this section.

C. Provide all programming, configuration, and related services required to achieve a fully integrated and operational system as specified herein. All equipment shall be controlled in full conformity with the contract drawings, process control descriptions, specifications, engineering data, instructions, and recommendations of the equipment manufacturer. Coordinate the control system for proper operation with related equipment and materials furnished by other suppliers under other Sections of these specifications and with related existing equipment.

1. Provide configuration of the PLC provided for all equipment shown on the drawings, including controls equipment shown being provided as part of a vendor package system (refer to specification section 16349 and 16485).

2. Provide configuration of the existing HMI System Software, Operator Interface Terminals, and drivers provided for all equipment shown on the drawings, including equipment provided by vendor package systems.

3. Provide configuration of the SCADA Historian Software.

4. Provide for and test communications and functionality between all connected devices (such as PLCs) and the HMI software packages, including devices supplied by others, as depicted on the system architecture drawings in order to provide a comprehensive working system of data collection, storage and reporting.

5. Coordinate with Pump Operation and Optimization Software vendor to ensure required data exchange is accomplished between PLC-3 Specific Energy Panel. Refer to specification section 13900 for software I/O requirement. HMI configuration will be required to display information from the Specific Energy Panel.

D. All work shall be coordinated with plant operating personnel to minimize impacts on daily operation. Delays caused for any reason shall be noted and formally submitted to the Engineer and the Owner in the form of a letter.

1.02 MEASUREMENT AND PAYMENT

A. No separate payment will be made for work performed under this Section. Include the cost for this work in the lump sum Base Bid Item in Section 00410.

1.03 RELATED WORK

A. Refer to Section 13300.

1.04 SUBMITTALS

A. Provide all required submittals in accordance with Section 01300, Submittals. The submittals listed below shall be provided as a minimum.

1. System Standards and Conventions

2. Operator Interface

3. Controller Program

4. Historical Data Management

5. Software Maintenance documentation

6. Operations and Maintenance Manuals

B. Supplement to Project Plan Submittal

1. Supplement the "Project Plan, Deviation List, and Schedule" submittal in section 13300 by adding the following items to the submittal requirements:
   a. List of all graphics intended to be created for this project.
   b. List of all PLC programs that will be created or modified for this project.

C. Supplement to Input/Output (I/O) List Submittal

1. Supplement the "Input/Output (I/O) List " submittal in section 13300 by adding the following item to the submittal requirements:
   a. LOGICAL POINT ADDRESS: I/O address of each point.
   b. PEER-TO-PEER REGISTER DESIGNATION: PLC I/O Register Mapping for each Pump PLC and Specific Energy Panel data exchange.

D. System Standards and Conventions Submittal

1. The existing standards and conventions currently in use at the City of Houston NEWPP will be used for developing the new graphics. Hence the Standards and Conventions submittal may not include the graphics and naming standards. The submittal shall define, at a minimum:
   a. System configuration, including network addressing and PLC/RTU addressing. Multilin device network addressing shall also be provided.
   b. PLC/RTU standard programming modules, including analog input scaling, flow totalization, equipment runtime, motor start/stop, valve open/close, and any other standard logic planned to be used.

2. To facilitate the Owner's future operation and maintenance, the existing standards and conventions shall be used as the basis for programming and configuration of the system. System programming and configuration shall not begin prior to the System Standards and Conventions Submittal.

E. Operator Interface

1. Following the approval of the standards and conventions submittal, submit a draft of all proposed graphic displays, examples of each type of pop-up (faceplate) displays, and examples of trends. For those graphics which will be duplicated more than once for similar type of equipment, submit the graphics for the first equipment only.

2. Following the draft graphics review meeting and prior to the factory test, submit a ready-for testing version of all graphic displays. These graphics should be completely finished other than the incorporation of comments and changes resulting from testing.

3. Submitted graphic displays and trends shall be no less than 8.5 inches by 11 inches and in full color.

F. Controller Program Submittal

1. For each controller, submit the following using the controller manufacturer's built in printing functions. Electronic submission of Adobe Portable Document Format ("pdf") files in lieu of paper submittals is acceptable. Review will be for general program organization, level of documentation, and overall programming standards (basic pump and valve control, for example). The review will not attempt to confirm the logic works correctly for every loop.
   a. PLC programs showing ladder logic, function block, high level language or other controller language used. Include individual rung, network, and/or command descriptions with abundant comments to clearly identify function and intent of each code segment. Each logic segment shall be clearly presented, the function of each timer described, the purpose of each subroutine call labeled and defined, etc. Program documentation shall be sufficiently clear to allow determination of compliance with the process control requirements included in the control descriptions and with the Drawings. The submittal shall demonstrate that all logic provided under this project follows the same structure and format and reflects a common programming approach.
   b. Submit a memory usage report for the controller. This report shall indicate total memory capacity and unused memory capacity.
   c. Submit cross reference index of I/O allocation and controller memory address. Every physical I/O point as well calculated or virtual I/O required for the implementation of the process scheme shall be included.

2. Submit details of control system communication. Submit a "memory map" or other means showing which signals are exchanged between PLCs. Also submit a HMI tag database showing all signals exchanged between the PLCs and HMI. Any specific communication block memory addresses shall be defined.

G. Historical Data Management

1. Following the Historical Workshop, submit all aspects of the historical data management system and shall include as a minimum the following:
   a. A complete listing of all signals to be collected and stored. This listing shall include data sampling rate and duration for which the data will be immediately accessible.
   b. Data reduction methods, rates, and duration data will be immediately accessible.
   c. Storage space requirements and supporting calculations.
   d. Description of historical database design, including data flow diagram, table definitions, procedures used, and queries used. Method of accumulating and displaying run times and flow totals shall be described. Method of interfacing to the reporting system shall be defined. Methods of handling Data Quality Flags shall be defined. Method of storing and displaying trending information shall be defined.
   e. Description of methodology for restoring data collected locally during times that the historical data management system is not available. Description of database failure and recovery, including data correction.
   f. Description of selecting only the active real-time data source for systems that are utilizing redundant data acquisition nodes.
   g. List of data source interfaces to be used with the system (for example, OPC, file collection, historian-historian collector, HMI applications, etc.)

H. O&M Manuals - Software Maintenance Manuals

1. Include these manuals as part of 13300 "Final System Documentation". This required information is in addition to any requirements of Section 13300.

2. Software Listings and Databases- Submit hard copies of the same information required in the "Controller Program Submittal" except include files updated to reflect the as built system. Include PDF versions of these files in the CD specified below.

3. PID Loop Tuning Parameters - Submit annotated chart recorder traces or computer system trend screen printouts showing tuned control loop response to plus and minus 40 percent of full span step changes of loop setpoint for each individual loop. For cascade loops, submit charts showing response of the secondary loop with secondary setpoint on manual and also response of the entire cascade control loop in automatic mode. Include a description of tuning methodology used.

4. If available as part of the software provided, supply hardcopies of configuration information for the HMI systems, reporting systems, Historian Systems, and any other programs developed under this Contract.

5. Machine Readable Documentation - Provide two sets of as built software documentation on CD-ROMs in original electronic format for all PLC, HMI systems, reporting systems, Historian Systems, and any other programs developed under this Contract. Any changes made during or after testing, start-up, and commissioning shall be incorporated.

I. O&M Manuals - Operator Manuals

1. Provide Operator's Manuals prior to final acceptance of the system.

2. These manuals shall be separately bound and shall contain all information necessary for the operator to monitor and control the plant from the control system. The manuals shall be written in non-technical terms and shall be organized for quick access to each detailed description of the operator's procedure. Manuals shall contain, but not be limited to, the following information:
   a. A comprehensive table of contents of the manual.
   b. A simple overview of the entire system indicating the function and purpose of each piece of equipment.
   c. A detailed description of the operation of the HMI including all appropriate displays. Including a screenshot of each HMI display screen and annotating each function in text is an acceptable format for presenting this information.
   d. Step-by-step procedures for starting up or shutting down an individual component of the control system and also of the entire system.
   e. Login / logout procedures.
   f. Complete, step-by-step procedures for performing system or selected file backup and restoration including archiving historical data. Include recommended archiving schedule for historical data.
   g. Operational description for operating HMI computer equipment and peripherals including printers, CD-ROMs, removable bulk storage devices, UPS, etc. Description shall include procedures for typical maintenance and troubleshooting tasks.
   h. A complete glossary of terms and definition of acronyms.
   i. List of personnel to be contacted for warranty and emergency services, including name, address, telephone number, pager or cell phone number, fax number, and email address

3. Include these manuals as part of 13300 "Final System Documentation". This required information is in addition to any requirements of Section 13300.

1.05 MAINTENANCE

A. Refer to section 13300.

1.06 WARRANTY:

A. Refer to Section 13300 and supplement that with the requirements below.

B. All application work shall be warranted in accordance with Section 01770

C. Provide telephone technical support within 4 hours of warranty claim. If failure cannot be resolved by telephone, provide onsite technical support within 24 hours of warranty claim.

1.07 COORDINATION MEETINGS AND WORKSHOPS

A. Refer to Section 13300. The meetings below are in addition to the meetings specified in that section.

B. Schedule and conduct a draft graphics review meeting. The purpose of this meeting shall be to present draft graphics for the Owner's and Engineer's review and feedback prior to creating the full set of graphics for review. For repetitive graphics such as graphics for multiple process trains, include an example of the first graphic only for discussion. Include discussion of process and overview displays, examples of pop-ups, trends, and system navigation tools. Expect major comments and incorporate any changes resulting from those comments.

C. Schedule and conduct a second graphics review meeting. The purpose of this meeting is to finalize the process of building the required HMI system. This meeting will be held after return of the draft graphics submittal and incorporation of comments. At this meeting, present the actual software displays, databases, security system, reports, and the like. The Owner will make comments on the system for incorporation prior to the factory test. Bring a working system to allow for a live demonstration of the graphics.

D. Schedule and conduct a factory testing coordination meeting two weeks prior to factory testing. The purpose of this meeting is to discuss the specifics of the proposed tests and to provide a forum for coordinating the required factory testing.

E. Schedule and conduct a field-testing coordination meeting two weeks prior to field testing. The purpose of this meeting is to discuss the specifics of the proposed tests and to provide a forum for coordinating the required field-testing.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION

3.01 GENERAL

A. The system specified herein shall perform the following generalized functions:

1. The system shall allow the operator to control equipment such as pumps and valves as shown on the Drawings and as defined in Section 13305 control descriptions.

2. Perform real-time process control, including proportional integral derivative control action, sequencing, process calculations, etc.

3. Collect, calculate, and store accurate, reliable operating information for present and future uses.

4. Assist remote site operating personnel by noting and communicating off normal operating conditions and equipment failures.

5. Accumulate and store equipment running times for use in preventative maintenance.

6. Provide color graphic displays for use by the system operating and supervisory personnel.

7. Provide trending for all analog values.

8. Provide control system diagnostics.

9. All process control functions including PID, calculations, sequencing, timing, etc., shall be done in the process controller. The HMI software shall perform the real-time database, report generation, graphic screens, program development, set point modification, data archiving, etc.

10. The system shall allow the operator to manually control (by keyboard entry and mouse type pointing device) the status of pumps, valves, etc. (i.e., on off, open close, setpoint value, etc.) when viewing the appropriate graphic screen on the HMI.

3.02 CONTROLLER PROGRAMS

A. All applications programs shall be developed in a structured manner and shall follow an intuitive arrangement so that an instrumentation technician with basic programming knowledge will be able to understand. Programs shall utilize standard program templates or subroutines for repetitive logic such as equipment control, flow total calculations, equipment runtime calculations.

B. Make changes to the application programs and software configuration, based on comments during the submittals, the factory tests, the field tests, and during the commissioning process to meet the design intent, at no additional cost to the Owner.

3.03 GRAPHIC DISPLAYS - GENERAL

A. All displays shall contain and continuously update the displayed process variables, date and time of day. All process values shall be displayed in engineering units. All displays shall incorporate references to both instrumentation tag numbers and plant equipment numbers. All process variables shall be displayed on their associated display(s) with correct engineering units. Process variables shall display their associated data quality flags.

B. All operator commands related to controlling field devices or system attributes shall require multiple keystrokes or mouse actions to protect against inadvertent operations. The operator shall receive confirmation of the selected point to be controlled, at which time a cancellation of the control can be affected.

C. Process graphic displays, shall be based on the P&ID's, site plan drawings, mechanical drawings and electrical drawings included in these Contract Documents. The graphic displays shall depict process flow streams, process structures, and all major items of process equipment and control devices in a schematic format.

D. All main graphical screens shall include a title bar, main graphic area, navigational buttons, and alarm summary bar. Title bar shall be displayed on the top of each screen and include display name, description and time/date. The main graphical area shall contain primary screen data in

graphical format. Navigational buttons shall include a minimum of main menu, trends, main alarm summary, and security log in. The alarm summary bar shall display the last three valid alarms on the bottom of each screen.

E. Animation shall be provided to mimic level changes in tanks or vessels, and to mimic rotation of rotating equipment when running. Valve colors shall change when opened and closed.

F. Unless specifically noted, all timers, setpoints, alarm actuation levels, etc., shall be adjustable from the operator interface.

G. The system shall show field conditions with text that can alternate (i.e., OPEN/CLOSE, START/STOP, HIGH/LOW) and change color correspondingly. Field devices that are tri state must be represented in three conditions.

H. Conditions in the field designated as alarm conditions shall report to the operator workstation, actuate an audible alarm, and provide a visual blinking image on the associated graphic page. All alarms and events should be displayed on the screen and archived.

I. All interlocks that affect equipment operation shall be identified both by alarm and by HMI indication.

J. All analog inputs shall be checked for out of range (via high and low limit checks) and alarmed.

K. All process flow streams shall be labeled and color coded using the project color schedule in Division 9. All structures and equipment shall be identified by name and appropriate equipment and loop tags.

L. Color coding for equipment status and alarms shall be as per the existing standards.

M. Automatically record all alarm and events should any of the following sequences or events occur:

1. Date/Time entry
2. Limit changes
3. Any commanded or uncommanded change of any point
4. Alarm conditions
5. PLC activation or deactivation
6. Operator login or logout activity

N. There may be additional general programming requirements listed in PART 1 of the Section 13305 control descriptions section that impact the HMI configuration.

3.04 SPECIFIC GRAPHIC SCREENS

A. At a minimum, provide the following types of graphic screen indicated below.

1. Plant Overview screen shall include a site plan representation, indicating the geographic location of each process, and each building.

2. Main menu screen shall be developed to link to all screens and process areas. The screen shall be a complete and logical listing of the names and number of all screens

3. Overall plant process block flow diagram screen shall show all major processes in block form with flow arrows. Each block shall include a text description of key individual treatment processes. Navigational buttons to the individual treatment processes shall be performed by pressing on the text description.

4. Individual treatment process screens shall graphically screen key process variables and equipment. No operator entries shall be done from these screens. Individual process flow screens for each process shall include all process components, including tanks, pumps, blowers, mixers, drives, flow meters, valves, mechanical devices, as well as manual shutoff and isolation valves. These diagrams shall be generally depicted from the P&ID's and there shall be at least 1 screen per P&ID on average.

5. Individual unit process screens depicted from the P&ID's are used for control and screen of each major item of process equipment, process variables, and control devices, including pumps, blowers, valves, gates, mixers, drives etc. Navigational buttons shall consist of the P&ID's flow arrows to other individual unit processes. The unit process screens shall provide the ability for the operator to go to individual equipment popup screens. These diagrams shall be generally depicted from the P&ID's and there shall be at least 2 screens per P&ID on average.

6. Popup screens shall be provided for each piece of equipment to start/stop equipment, open / close valves, implement automatic control, adjust set points, establish and adjust tuning parameters, set alarm limits and initiate a sequence.

7. PLC system diagnostic screens, showing the operational status, and fault conditions of all PLC components, including processors, I/O modules, power supplies and UPS units.

8. Communications diagnostic screens, showing the details of network status, communications status of all major components including Operator Work Stations, peripheral devices and network components.

9. Maintenance screens shall screen the raw value for each analog and digital I/O point in the system. They shall also allow the operators/maintenance personnel to enter an override value for an analog point that is then used by the system instead of the value read from the input card / communications link.

10. Trend screens with the capability to screen up to eight, operator assigned, analog and/or digital process variables. Each analog value will be shown on a trend screen.

11. Main alarm summary screen shall screen the following information on each alarm: Time, tag name, description, alarm type, current value and status. An acknowledge alarm button shall acknowledge all new unacknowledged alarms. The acknowledged and unacknowledged alarms shall be different colors. Acknowledged alarms shall clear automatically after the condition is corrected.

12. Analog variable screens showing a tabular summary of all plant process variables, in operator assigned groupings.

3.05 SECURITY

A. The system shall be configured and implemented with security to prevent unauthorized access. The system shall allow authorized changes to system operation through defined user accounts and password verification.

B. Coordinate with Owner user account information, including login name and password for each account.

C. Security levels of "display only", "operator mode", "supervisor mode", and "engineer mode" shall be available through assignable passwords. On system startup, the "display only" security level shall automatically be entered. In the "display only" mode, information is available to be displayed on the screen but no changes may be made. In the "operator mode", changes may be made to process set points, times, etc.; however, the overall control concepts may not be modified. In the "supervisor mode", all operator functions can be modified and any special reports or critical process set points (data can be modified; however, the overall control concepts may not be modified). In the "engineer mode" level, all user modifiable parameters of the system shall be available for modification.

3.06 ALARM/EQUIPMENT STATUS REPORTING

A. The alarm log shall display all alarms as they occur. The alarm message shall include the time of occurrence, tag name, tag number, and whether it is a low, high, or failure alarm. When the point in alarm returns to normal, the time, point identification number, and return to normal shall be displayed. All reports shall include the plant equipment number of the associated device.

B. The equipment status shall be logged whenever a change in status occurs (i.e., start, stop). The equipment status log shall include the time, equipment name, tag number, and the particular change in status.

3.07 HISTORICAL DATA MANAGEMENT

A. The following features shall be provided for processing and storage of system historical data:

1. Each system point (analog or digital, real or pseudo) shall have the capability of being historically logged. A point shall have the capability of being deleted from historical log at any time. It shall be easy to add or delete system points using minimal keystrokes.

2. All process analogs and all flow totals and run time indications of all primary process equipment motors shall be sampled and stored in the historical data management system.

3. Data Processing: The real time instantaneous values shall be stored in a historical log file on the hard disk at defined sampling rates.

4. Data Correction: Historical data shall be manually modifiable by personnel with appropriate security levels. Such data shall be differentiated from actual monitored values on reports, in the database and in trends.

5. Data Quality: Data Quality flags shall propagate to the next higher level of the history based on user selectable percentage determining tolerance levels for averages and totals. If the percentage of suspect data exceeds the tolerance level, the suspect data flag propagates to the next higher level. Maximums and minimums shall be taken from good data.

6. Manual Input Data Handling: This data shall consist of additional values not obtainable by the system such as laboratory analysis for use in reports. All manually entered data shall be entered and stored in the appropriate engineering units. All data entered shall be displayed for con-firmation on the display prior to incorporation to the database.

3.08 TESTING

A. Refer to section 13301.

B. Supplement to Field Testing requirements

1. Prior to leaving the site, use the Owner's programming computer to monitor all PLC processors online, make on-line changes, upload and download the processor to ensure programming software version compatibility.

2. Loop Tuning - All PID control loops (single or cascade) shall be tuned following device installation but prior to commencement of the Functional Demonstration Test.
   a. Optimal loop tuning shall be achieved either by auto-tuning software or manually by trial and error, Ziegler-Nichols step-response method, or other documented process tuning method.
   b. Determine and configure optimal tuning parameters to assure stable, steady state operation of final control elements running under the control PID. Each control loop that includes anti-reset windup features shall be adjusted to provide optimum response following startup from an integral action saturation condition.
   c. Tune all PID control loops to eliminate excessive oscillating final control elements. Loop parameters shall be adjusted to achieve a decay ratio of 1 / 4 or better. In addition, loop steady state shall be achieved at least as fast as the loop response time associated with critical damping.
   d. Loop performance and stability shall be verified by step changes to setpoint in the field.
   e. Submit loop tuning documentation as specified in Part 1 of these Specifications.

3.09 TRAINING

A. Refer to Section 13303 for general training requirements

B. Furnish training as shown in the table below.

Description	Minimum Course Duration (hours)	Maximum Number of Trainees per Course	Number of Times Course to be Given	Intended Audience
Onsite Training				
Control System Overview Seminar	2	8	1	Management
Operator Training (Pre start-up)	2	8	1	Operations
Operator Training (Post start-up)	2	8	1	Operations
Software Maintenance	2	2	1	Maintenance
System Reports and Historian	2	2	1	Maintenance

C. Control System Overview Seminar

1. Provide Control System Overview seminar for the Owner's personnel at the Owner's facility. The objective of this seminar is to provide personnel with an overview understanding of the Control System. The seminar material shall be targeted to the Owner's management, engineering, and other non-operations personnel. The seminar shall include, but not limited to, the following:
   a. An overview of the Control system explaining how the hardware and software supplied under this Contract is used for the operation and control of the facilities.
   b. A block diagram presentation of the Control system showing how and what information flow within the system and what each functional unit does.
   c. An explanation of the operator interfaces including a demonstration of how to use an operator's workstation to monitor, control, navigate, display trends, and all other operational features of the system. Discussion of process control of individual processes shall be addressed outside of this course.
   d. A walkthrough of the installed system explaining each of the items covered in the functional units' discussion. The features and functions of operator controls and interfaces shall be discussed.

D. Operator Control System Training (pre or post start-up)

1. Operator training shall cover plant operation with the control system and use of the HMI display screens, including at a minimum all the following items:
   a. Basics of HMI control and navigation
   b. Alarming and Interlocks
   c. Auto functionality of automated processes and HMI control.
   d. Failure modes of equipment and operator responses.

2. Minimum of two operator training sessions (Pre-Startup) for operators shall be held 1 week before system startup. The pre-startup training shall make use of the Simulator specified in this project. Additional one or two operator training sessions (Post-Startup) for operators shall be held one week after system startup.

3. Operator training shall be held at the convenience of the OWNER. This training may be held during the day, late at night, or very early in the morning to accommodate the OWNER'S shift schedule.

4. Operator training shall be introductory in nature during pre-startup training and more in-depth and detailed during post-startup training.

5. At a minimum, the following teaching aids shall be available for distribution during Operator training sessions:
   a. Preliminary O&M Manuals (pre-startup); Final O&M Manuals (post-startup).
   b. P&IDs.
   c. Daily syllabus.

6. Fifty percent of all Operator training shall be "hands on" utilizing the installed Control System to the fullest extent possible. Confirm the operability of the Control System before commencing training. Training performed using a non-functioning Control System shall be rejected and repeated.

E. Software Maintenance

1. Provide training of how to back-up PLCs, HMIs and any other software in this system.

2. Provide training on all aspects covered in the O&M Software Maintenance Manuals.

3. Provide training on PLC program structure, HMI configuration structure, tips in how to edit programming code, and other items which will supplement the maintenance staff's ability to edit and maintain the programs.

F. Historian and System Reports

1. Provide training on how to manually enter data.

2. Provide training on how to execute data queries that are outside of those defined in the reports.

3. Provide training on Historian configuration, database maintenance and backup, and repair of failed reports.

END OF SECTION

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SECTION 13311
INSTRUMENTATION AND CONTROLS - PLC HARDWARE AND SOFTWARE

PART 1 GENERAL

1.01 SCOPE OF WORK

A. This Section includes Programmable logic controllers for control of process equipment, process oriented machinery, and process systems.

1.02 MEASUREMENT AND PAYMENT

A. No separate payment will be made for work performed under this Section. Include the cost for this work in the lump sum Base Bid Item in Section 00410.

1.03 RELATED WORK

A. Refer to Section 13300.

B. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

C. Section 13330 - Control Panels and Panel Equipment

D. Section 13335 - Control Panel UPS (Single Phase)

1.04 SUBMITTALS

A. Refer to Section 13300.

B. Descriptive literature, bulletins, catalog cuts and Drawings for the equipment specified herein.

C. Submit list of 3 firms that are located within 100 miles of the project site that are actively installing, programming, supporting, and maintaining the submitted PLC.

D. Complete bill of materials for the equipment.

E. Any deviation of the hardware or software systems from the preliminary submittal included in the Project Plan shall be described in detail.

F. Spare parts list.

1.05 REFERENCE STANDARDS

A. ASTM D999-91: Vibration

B. (CFR) Title 47, Part 18 (European EN 55011 (formerly CISPR 11))

C. CSA Certification Class I, Division 2, Group A, B, C, D Hazardous or non-hazardous locations

D. IEC 60068-2.1 Environmental testing – Part 2-1: Tests - Test A: Cold, 2.2 Environmental testing - Part 2: Tests. Tests B: Dry heat, 2.3, 2.6 Environmental testing - Part 2: Tests - Test Fc: Vibration (sinusoidal) and 2.27 Environmental testing. Part 2: Tests. Test Ea and guidance: Shock

E. IEC 61000 Electromagnetic compatibility (EMC) - Testing and measurement techniques

1. Part 4-2: Electrostatic discharge immunity test

2. Part 4-3: Radiated, radio-frequency, electromagnetic field immunity test

3. Part 4-4: Electrical fast transient/burst immunity test

4. Part 4-5: Surge immunity test

5. Part 4-6: Immunity to conducted disturbances, induced by radio-frequency fields

F. IEC 61131-3: Programmable controllers - Part 3: Programming languages

G. IEC 801-3: RFI Immunity

H. IEC 801-5: Ground Continuity

I. IEC 801-2: Electrostatic Discharge

J. IEEE 472-1974/ANSI C37.90/90A-1974 (Surge Withstand) IEEE Standard for Relays and Relay Systems Associated with Electric Power Apparatus

K. MIL STD 461B CS02: RFI/EMI Susceptibility

L. NEMA Pub No ICS2-230.42: Showering Arc Test

M. NSTA Project 1A

N. UL 508 and CSA Standard C22.2 No. 142 (Isolation Voltages)

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer shall be capable of providing training, parts, and coordination of emergency maintenance and repairs.

B. The programmable controller and all of the corresponding components within the family of controller products shall be manufactured by a company who regularly manufactures and services this type of equipment.

C. The manufacturer shall comply with ISO9001 standards for "Quality Systems- Model for Quality Assurance in Design/Development, Production, Installation, and Servicing".

D. The manufacturer shall provide complete technical support for all of the products. This shall include factory or on-site training, regional application centers, local or factory technical assistance, and a 24/7/365 technical support phone service.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver PLC components in packaging designed to prevent damage from static electricity and physical damage.

B. Store PLC equipment according to manufacturer requirements. At a minimum, store indoors in clean, dry space with uniform temperature to prevent condensation. Protect PLCs from exposure to dirt, fumes, water, corrosive substances, and physical damage. Also, protect the PLC from all forms of electrical and magnetic energy that could reasonably cause damage.

1.08 NOMENCLATURE AND IDENTIFICATION DEFINITIONS

A. AI: Analog Input

B. AO: Analog Output

C. Fixed I/O: A PLC style consisting of a fixed number of I/O, a processor, and a power supply all in one enclosure. Some fixed PLCs have limited expansion ability.

D. CPU: Central Processing Unit

E. DI: Discrete Input

F. Distributed I/O: Hardware specially designed to function as Remote I/O.

G. DO: Discrete Output

H. HMI: Human-Machine Interface

I. I/O Input and/or Output

J. Modular: A PLC style consisting of cards that are assembled to comprise a complete unit. All I/O, CPU, and Power Supply are dedicated cards. Typically, these cards are inserted into a chassis.

K. Master/Slave: Communication between devices in which one device, the master, controls all communications. The other devices, the slaves, respond only when queried by the master. Typically used in a Remote I/O application.

L. Peer to Peer: Communication between two or more devices, typically PLC's, in which each device can control the communication exchange.

M. PID: Control action, proportional plus integral plus derivative.

N. PLC: Programmable Logic Controller

O. Remote I/O: I/O that is located remotely from the processor. Remote I/O can communicate over a variety of communication protocols and can use standard rack based I/O, or special Remote I/O hardware referred to as Distributed I/O.

P. SCADA: Supervisory Control and Data Acquisition

1.09 SPARE I/O

A. Each I/O drop and I/O location shall include at least 20 percent (minimum of four) points of each type (AI, AO, DI, and DO) for future use, regardless of whether any of those point types are used in that drop or location or not. The spares shall be the same type of I/O modules supplied.

B. Spare output points that require the use of an external relay shall be supplied with the external relay.

C. Regardless of the spare requirement, all installed unused points on all I/O modules shall be wired to terminal blocks in the order that they occur on the I/O modules. Unwired spares shall not be acceptable.

1.10 MANUFACTURER SUPPORT

A. Provide a written proposal for a manufacturer support agreement for products specified herein for a minimum of 12 months starting at final completion of the project. The cost of this manufacturer support agreement shall not be included in the Contract Price. The support agreement shall be executed in the name of, and for the benefit of, the Owner. At a minimum, this agreement shall provide the Owner with:

1. 8 AM to 5 PM, 5 day per week manufacturer telephone support

2. Access to the manufacturer's technical support website

3. Software and firmware updates.

PART 2 PRODUCTS

2.01 GENERAL

A. Provide Programmable Logic Controller equipment with the required memory and functional capacity to perform the specified sequence of operation with the scheduled input and output points.

B. Processor Systems shall include processor, power supply, input/output modules, communication modules, redundancy modules, and remote interface modules as required to meet system requirements.

C. Furnish products listed and classified by Underwriters Laboratories (UL), CSA, or FM approval as suitable for purpose specified and indicated.

D. All equipment and devices furnished hereunder shall be designed for continuous industrial service. The system shall contain products of a single manufacturer, insofar as possible, and shall consist of equipment models that are currently in production.

E. All equipment furnished shall be designed and constructed so that in the event of power interruption the systems shall go through an orderly shutdown with no loss of memory, and resume normal operation without manually resetting when power is restored.

F. The PLCs shall communicate between the operator workstation and field-mounted transducers, switches, controllers, and process actuators. Communications protocol shall be completely transparent to process operators at the Human Machine Interface (HMI).

G. The PLC shall be capable of stand-alone operation in the event of failure of the communication link to the HMI subsystem.

H. Agency and environmental specifications:

1. Electrical supply voltage to the PLC shall be 120 Vac, plus or minus "15 percent, 48-63Hz. PLC system power supplies shall be fused for overload protection.

2. Vibration: 3.5 mm Peak-to-Peak, 5-9 Hz: 1.0G, 9-150\Hz. The method of testing is to be based upon IEC 68-2-6 and JIS C 0911 standards for vibration. The system is to be operational during and after testing. Vibration Rating of 2.0G maximum peak acceleration for 10 to 500Hz. in accordance with at least one of the following:

a. Installed rating: DIN rail mounted PLC: 10-57 Hz, amplitude 0.075 mm, acceleration 25-100 Hz, and Panel or plate mounted PLC: 2-25 Hz, amplitude 1.6mm, acceleration 25-200 Hz. In compliance with IEC 60068 and IEC 61131.

3. Shock: 15G, 11 msec. The method of testing is to be based upon IEC 68-2-27 and JIS C 0912 standards for shock. The system is to be operational during and after testing.

4. Temperature: All PLC hardware shall operate at an ambient temperature of 0 to +60 degrees C (+32 to +140 degrees F), with a storage ambient temperature rating of -25 to +70 degrees C (-40 to +185 degrees F).

5. Relative Humidity: The Programmable Controller hardware shall function continuously in the relative humidity range of 10 percent to 95 percent non-condensing.

6. Noise Immunity: The Programmable Controller system shall be designed and tested to operate in the high electrical noise environment of an industrial plant as governed by the following regulations: IEEE 472, IEC 801, MILSTD 461B, IEC 255-4, NEMA ICS 2-230.40, and ANSI/IEEE C-37.90A-1978.

7. Altitude:
   a. Operation: 0-6,500 feet

b. Storage: 0-9,800 feet

8. Degree of protection: NEMA 1 (IP20)

9. All products shall have corrosion protection.

I. All major assemblies and sub-assemblies, circuit boards, and devices shall be identified using permanent labels or markings indicating:

1. Modules product type such as analog or digital

2. Modules catalog number

3. Modules major revision number

4. Modules minor revision number

5. Module manufacturer vendor

6. Module serial number

J. All necessary cables shall be included. All cables and connectors shall be as specified by the manufacturer. Cables shall be assembled and installed per the manufacturer recommendations.

K. MANUFACTURERS

1. Provide all PLCs from a single manufacturer. If the PLC manufacturer has authorized third party vendors to provide modules that are compatible with their platforms, then products manufactured by these authorized third party vendors will be acceptable.

2. Provide the PLC system by one of the following:
a. Siemens Model S7-1516-3PN/DP with Profibus and Profinet (the latest version at the time of delivery)
b. To maintain consistency through the plant no other PLCs are approved.

L. Central Processing Unit (CPU)

1. The CPU shall be, at a minimum, a 16-bit microprocessor that provides system timing and is responsible for scheduling I/O updates, with no user programming required to ensure discrete or analog update. It shall execute user relay ladder logic programs, communicate with intelligent I/O modules, and perform on-line diagnostics. The CPU shall consist of a single module which solves application logic, stores the application program, stores numerical values related to the application processes and logic, and interfaces to the I/O.

2. The CPU shall sample all the discrete and analog inputs and outputs including internal coils and registers, and service special function modules every scan. The CPU shall process the I/O with user program(s) stored in memory, then control the outputs based on the results of the logic operation.

3. The CPU family shall allow for user program transportability from one CPU model to another.

M. Diagnostics

1. The CPU shall perform on-line diagnostics that monitor the internal operation of the PLC. If a failure is detected, the CPU shall initiate system shutdown and fail-over. The following, at a minimum, shall be monitored: Memory failure, memory battery low, and general fault, communications port failure, scan time over run, I/O failure, and analog or special function I/O module failure.

2. All diagnostic information shall be accessible to the host communications interfaces and to the PLC program.

3. The PLC shall have indicators and on board status area to indicate the following conditions:
   a. CPU run
   b. CPU error or fault
   c. I/O failure or configuration fault.
   d. Status of Battery or back-up power module
   e. Communications indicator

N. Memory

1. The user program and data shall be contained in non-volatile memory.

2. Include Simatic Memory Card, 12 MB or larger.

O. Programming Environment

1. Programming port: The PLC shall utilize an Ethernet port for programming.

2. On-Line programming: Application programs may be modified or stored while the CPU is running, with minimal impact on the scan time.

3. Online programming including runtime editing

4. IEC 61131-3 programming languages supported: Ladder logic, function block, sequential function chart, and structure text.

5. Supply Step7-Professional TIA Portal, latest version.

P. Communication Ports

1. The CPU shall be expandable and supplied with additional modules to support the required communication interfaces.

Q. Remote I/O Communications

1. The CPU shall be capable of communicating with at least 12 remote base locations via Profibus. The CPU shall automatically sample and update all local and remote I/O modules each scan cycle of the CPU.

2. Diagnostic and equipment status information shall be available from each RIO.

3. It shall be possible to communicate with remote I/O racks or other PLCs via fiber optic cable using Siemens OLMs (Optical Link Modules).

4. The remote I/O system shall have available a remote input/output arrangement capable of operation at locations physically separated from the PLC CPU by up to 5,000 feet as detailed on the Drawings.

5. Communication with the remote I/O arrangement shall be through cable as recommended by the PLC manufacturer and provided by the PLC system supplier under this Section.

2.02 POWER SUPPLIES

A. The PLC shall have a chassis mounted power supply, 8A, to power the chassis backplane, and provide power for the processor and applicable modules.

B. Power supplies shall have a clearly visible LED to indicate that the incoming power is acceptable and the output voltage is present.

2.03 DISCRETE INPUT AND OUTPUT MODULES

A. General

1. Digital input and output modules shall provide ON/OFF detection and actuation.

2. The I/O count and type shall be as required to implement the functions specified plus an allowance for active spares, as noted below.

3. Modules shall have indicators to display the status of communication, module health and input / output devices.

4. Each module shall have the following status indicators.
   a. The On/Off state of the field device.
   b. The module's communication status.

B. Module Specifications (120VAC Input Module)

1. Nominal Input Voltage of 120VACc

2. Number of Points per Card: [16]

C. Module Specification (120VAC Solid State Output Module)

1. Each triac type discrete output shall have an associated interposing relay located in the same control panel. 120 VAC power for relay outputs shall be provided from the associated motor starter control circuit (when used with motor starters) or other 120 VAC source (when I/O is not associated with a particular motor starter).

2. Number of Points per Card: [8]

2.04 ANALOG INPUT AND OUTPUT MODULES

A. General

1. Analog input modules shall convert an analog signal that is connected to the module's screw terminals into a digital value. The digital value representing the magnitude of the analog signal shall be transmitted on the backplane. Analog output modules shall convert a digital value that is delivered to the module via the backplane into an analog signal on the module's screw terminals.

2. Modules shall have indicators to display the status of communication, module health and input / output devices.

3. Each analog module shall provide both hardware and software indication when a module fault has occurred. Each module shall have an LED fault indicator and the programming software shall display the fault information.

4. Analog modules shall be software configurable through the I/O configuration portion of the programming software.

5. The following status shall be capable of being examined in ladder logic
   a. Module Fault Word – Provides fault summary reporting.
   b. Channel Fault Word – Provides under-range, over-range and communications fault reporting.
   c. Channel Status Words – Provides individual channel under-range and over-range fault reporting for process alarm, rate alarms and calibration faults.

6. The 24 VDC power for analog instrument loops shall be provided as a part of the system. The 24 VDC power supply shall be derived from the 120 VAC input power circuit to the PLC. The field side of the 24 VDC power sources(s) shall have individual or grouped (of logically associated circuits) fusing and be provided with a readily visible, labeled blown fuse indicator.

B. Differential Analog Input Module

1. Input Range of 0-20 mA

2. Number of Points per Card: [8]

3. Provide individual isolators, in addition to the surge suppression devices specified, in the control panels listed in Section 13330 for all signals that enter the panel from outside the building. Substitution of Isolated Analog cards to meet this requirement is acceptable.

C. Isolated Analog Output Current Module

1. Output Current Range of 4 to 20 mA

2. Number of Points per Card: [8]

2.05 COMMUNICATION INTERFACES

A. The PLC will be capable of the following communication protocols as shown on the drawings:

1. 10BASE-T/100BASE-TX Ethernet communication.

2. Profibus DP for up to 126 slaves

B. When required provide a Communications Interface Module mounted in the chassis or the equivalent port directly on the CPU.

2.06 PROFIBUS PA LINK

A. Provide Siemens Profibus PA Link to connect Profibus PA network(s) to Profibus-DP Master port on PLC.

1. Include one IM153-2 DP InterfaceModule for each PROFIBUS PA LINK

2. Include one IM157 DP/PA COUPLER for each Profibus PA Network

3. Include on PS307 power supply for each PROFIBUS PA LINK

2.07 OPERATOR INTERFACE TERMINALS (OIT)

A. OITs shall be mounted on control panels and shall run interface software separate from the HMI software specified in Section 13315.

B. Manufacturers

1. Provide operator interface terminals (OIT) from one of the following:
   a. Siemens SIMATIC HMI IPC series

C. Software

a. The Operator Interface Terminal shall be pre-packaged with all configuration and programming software necessary to perform functions as shown on Drawings and within the specifications.

2. The integrated OIT software shall have the following features
   a. Trending

b. Data Logging
c. Alarms
d. Graphic Symbols
e. Animations

D. I/O Ports and Devices

1. The OIT shall have a minimum of one Ethernet 10/100 Mbps for connectivity or programming.

2. The OIT shall have a minimum of one Serial RS232 port.

3. Include the following communication expansion modules in the selected OIT:

4. ControlNet, DeviceNet, RIO, DH+, DH485, Modbus Plus and PROFIBUS

5. GE Genius, DeviceNet Slave and PROFIBUS Slave

6. Compact flash ports shall be Type 2.

7. The OIT shall have a minimum of one USB port.

E. Display

1. The OIT display size shall be 20"

2. The type of display for the OIT shall be Color Active Matrix TFT.

3. The display resolution shall be a minimum of 320x240 for 4to 6" displays, 800x600 for 8" to 12" displays, 1024x768 for 15" displays, and 1280x1024 for 20" displays.

4. Display shall support touch screen input.

F. Environmental

1. Rating: OIT shall be rated to maintain the rating of the control panel it will be mounted in.

2. Temperature: Operating temperature range of the OIT shall range 0-50 degrees C.

2.08 SPARE PARTS

A. General requirements for spare parts are specified in section 13300.

B. The following PLC spare parts shall be furnished

1. Processors: Provide spare processor unit(s) for each unique processor installed.

2. Memory Cards: Provide spares for each type of card installed.

3. I/O Cards: Provide spares for each unique I/O module type installed. Provide two or 10 percent of installed quantity, whichever is greater.

4. Network interface, remote I/O, and communication modules: Provide one spare communication module for each unique communication module installed.

5. Specialty Modules: Provide as a minimum a spare of each type of module identified. Provide an additional spare for every ten modules of a specific type installed.

6. PLC Power supplies: Provide spare power supplies for each unique power supply installed.

7. Chassis: Provide spare chassis for each unique chassis installed.

8. Fixed PLCs: Provide spares for each unique type of PLC installed.

9. Miscellaneous components (including cables): Provide spares for each unique component installed.

PART 3 EXECUTION

3.01 GENERAL INSTALLATION

A. Maintain area free of dirt and dust during and after installation of programmable controller products.

B. Anchor PLCs within enclosures as recommended by the PLC manufacturer.

C. Ventilation slots shall not be blocked, or obstructed by any means.

D. Examine areas, surfaces, and substrates to receive PLCs for compliance with requirements, installation tolerances, and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

E. Install in accordance with manufacturer's instructions.

F. Unload, unpack and transport equipment to prevent damage or loss.

G. Replace damaged components as directed by Engineer.

3.02 PANEL LAYOUT

A. Coordinate size and configuration of enclosure to meet project requirements. Drawings indicate maximum dimensions for PLCs, minimum clearances between PLCs, and adjacent surfaces and other items.

B. Comply with indicated maximum dimensions and clearances, or with PLC vendors required distances if they are greater than the distances indicated.

1. Provide spacing around PLC as required by the PLC manufacturer to ensure adequate cooling. Insure that the air surrounding the PLC has been conditioned to maintain the required temperature and humidity range.

2. Wires entering and exiting PLC components shall be sized to comply with the PLC manufacturers requirements. Doors on all components shall be able to be fully closed when all the wires are installed.

3. For chassis mounted PLCs, no wiring, wire ducts, or other devices shall obstruct the removal of cards from the rack.

4. PLC lights, keys, communication ports, and memory card slots shall be accessible at all times. Lights shall be visible at all times when enclosure door is opened.

C. Control panel designer shall provide independent line fuses or circuit breakers, per the PLC manufacturer recommendation, for each power supply, input module, output module, and other modules with separately derived power requirements.

D. Control panel designer shall insure that communication signals, 4-20mA signals (including those with embedded HART), are properly conditioned for the PLC and protected from all sources of radiated energy or harmonics.

E. Each PLC (including all I/O) shall be powered from the UPS power conditioning system in Section 13335.

F. Where multiple sets of mechanical equipment are provided for process redundancy, arrange their field connections to I/O modules so that the failure of a single I/O module will not disable the redundant system. This applies to all I/O types. The acceptability of the I/O arrangement shall be at the discretion of the engineer.

G. Provide all required cables, cords, and connective devices for interface with other control system components.

END OF SECTION

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SECTION 13320
INSTRUMENTATION AND CONTROLS - CONTROL AND DATA NETWORK EQUIPMENT

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish the labor and materials required to install and bring into operation the control and data network as shown on the Drawings and specified herein.

B. The network shall be capable of supporting communications between all servers, operator workstations, PLCs, RTUs, and other communication devices as shown on the system architecture block diagram(s). Furnish all necessary cables, face plates, connectors, modems, transceivers, repeaters, modules; splice kits, etc. required for a complete and operational network. The system architecture diagram(s) are for network understanding only. Some communication devices maybe required for network operation, which may not be explicitly shown on the Drawings. The system shall be designed to accommodate an increase of 100 percent of network nodes.

C. The control and data network shall include all nodes on the network. Communication between nodes may be via Ethernet, serial, fieldbus, or other method as shown on the drawings.

1.02 MEASUREMENT AND PAYMENT

A. No separate payment will be made for work performed under this Section. Include the cost for this work in the lump sum Base Bid Item in Section 00410.

1.03 RELATED WORK

A. Refer to Division 16 Sections.

B. Refer to the E-sheets in the Drawing package.

C. Refer to Section 13300.

1.04 SUBMITTALS

A. Refer to Section 13300.

B. Descriptive literature, bulletins, catalog cuts and Drawings for the equipment specified herein.

C. Complete bill of materials for the equipment.

D. Spare parts list.

E. Complete system architecture diagram showing in schematic form, the interconnections between major hardware components including control centers, panels, power supplies, consoles, computer and peripheral devices, networking equipment, processors, I/O modules,

local operator interfaces, process equipment vendor controllers, and like equipment. The system architecture shall be complete and shall depict all required cables, media type between components, network protocol used at each network level, details on connection requirements such as cable pin-outs, port numbers, and rack slot numbers. The intent of this specification requirement is to develop a diagram that is complete in every aspect to allow purchase of all required equipment by part number, and to allow a qualified technician to interconnect all equipment without having to refer to additional manuals or literature. Sheet size shall be 11"x17" and using more than one sheet is acceptable.

F. Submit details of I/O level networks, including field instrument, valve, power monitoring, and field device digital networks. Submittal shall include details of the field device digital networks technology including type, wiring requirements, configuration details, device addressing, and interface to the process control system. Include details of the field device digital network configuration for each field level digital network and subnetwork.

1.05 REFERENCE STANDARDS

A. Refer to Section 13300.

1.06 QUALITY ASSURANCE

A. Refer to Section 13300.

1.07 SYSTEM DESCRIPTION

A. System Responsibility:

1. The Drawings and specifications depict a control and data network, which shall function as one unit. This network may be comprised of multiple communication protocols over various media

1.08 DELIVERY, STORAGE, AND HANDLING

A. Refer to Section 13300.

1.09 PROJECT/SITE REQUIREMENTS

A. Refer to Section 13300.

1.10 MAINTENANCE

A. Refer to Section 13300.

1.11 WARRANTY

A. Refer to Section 13300.

1.12 NOMENCLATURE AND IDENTIFICATION

A. Refer to Section 13300.

PART 2 PRODUCTS

2.01 RACK-MOUNTABLE MANAGED ETHERNET SWITCH

A. General

1. Provide a modular, rack-mountable, managed Ethernet switch for connection to the control network backbone as shown in the Drawings and specified herein.

B. Physical Features

1. Modular 19" rack-mountable enclosure

2. Modular construction such that additional copper and fiber ports can be added and removed

3. Minimum fiber uplinks: 4 x 100/1000 SFP ports

4. Minimum fiber Ports: Two (2) Gigabit Ethernet ports shall be hot pluggable into the SFP uplink. Ports shall be duplex LC and operate at a wavelength of 850 nm over multi-mode cable.

5. Minimum copper ports: 24 x 10/100/1000 T(X) RJ45 ports

6. Operating temperature: 0 to 130 °F

7. Power: 120VAC redundant power supplies

8. Enclosure: Metal case

9. Rating: UL Class 1, Division 2 Groups A, B, C, and D

C. Network Features

1. Fault tolerant for use in a ring topology as shown on Drawings. The switch shall be able to detect a blocked port and redirect data flow in the opposite direction within 30ms.

2. Layer 2 switching

3. Full duplex on all port

4. Auto negotiation and manual configurable speed and duplex

5. Wire speed switching fabric

6. IEEE 802.1w Rapid Spanning Tree Protocol

7. IGMP snooping

8. IGMP filtering

9. Configuration password protected

10. Configuration backup capability required

11. SNMP V3

12. Lock port function for blocking unauthorized access based on MAC address.

D. Additional Features

1. The switch shall come equipped with a dry contact rated for 120 VAC 5A that shall be used for common trouble alarm. The alarm shall be programmable. If the contact cannot use 120 VAC 5A, provide the necessary 24 VDC power from the PLC panel and provide interposing relays in the PLC panel.

E. Manufacturers

1. Hirschmann MAR1040

2. Or equal

2.02 INDUSTRIAL MANAGED ETHERNET SWITCH

A. General

1. Provide an industrial managed Ethernet switch for connection to the control network backbone as shown in the Drawings and specified herein.

B. Physical Features

1. Minimum fiber uplinks: 2 x 100/1000 SFP ports

2. Minimum fiber Ports: Two (2) Gigabit Ethernet ports shall be hot pluggable into the SFP uplink. Ports shall be duplex LCE and operate at a wavelength of 850 nm over multimolde cable.

3. Minimum copper ports: 16 x 10/100 TX RJ45 ports

4. Operating temperature: 0 to 130 °F

5. Power: 24 VDC redundant power supply inputs

6. Enclosure: Metal case, DIN-rail mountable

7. Rating: UL Class 1, Division 2 Groups A, B, C, and D

C. Network Features

1. Fault tolerant for use in a ring topology as shown on drawings. The switch shall be able to detect a blocked port and redirect data flow in the opposite direction within 30ms.

2. Layer 2 switching

3. Full duplex on all port

4. Auto negotiation and manual configurable speed and duplex

5. Wire speed switching fabric

6. IEEE 802.1w Rapid Spanning Tree Protocol

7. IGMP snooping

8. IGMP filtering

9. Configuration password protected

10. Configuration backup capability required

11. SNMP V3

12. Lock port function for blocking unauthorized access based on MAC address.

D. Additional Features

1. The switch shall come equipped with a dry contact rated for 120 VAC 5A that shall be used for common trouble alarm. The alarm shall be programmable. If the contact cannot use 120 VAC 5A, provide the necessary 24 VDC power from the PLC panel and provide interposing relays in the PLC panel.

E. Manufacturers

1. Hirschmann MAR1040

2. Or equal

2.03 ETHERNET MEDIA CONVERTER

A. General

1. Provide an Ethernet media converter required to accomplish network communication as specified herein.

B. Physical Features

1. RJ45 port: 10/100BaseTX to 100BaseTX

2. Fiber uplink: 100BaseTX to 100BaseFX (ST/SC connectors)

3. Fiber optics: Multi- or single-mode capability as shown in the Drawings

4. Operating temperature: 0 to 130 °F

5. Power: 24 VDC

6. Enclosure: DIN-rail mountable

C. Additional Features

1. The converter shall come equipped with a dry contact rated for 120 VAC 5A that shall be used for common trouble alarm. The alarm shall be programmable. If the contact cannot use 120 VAC 5A, provide the necessary 24 VDC power from the PLC panel and provide interposing relays in the PLC panel.

D. Acceptable Manufacturers

1. Siemens Scalance

2. Or Equal

2.04 ETHERNET MEDIA CONVERTER

A. General

1. Provide an Ethernet media converter required to accomplish network communication as specified herein.

2.05 WIRES AND CONNECTORS

A. Ethernet 10/100/1000 BASE-T/TX Cable.

1. The unshielded twisted pair cable shall be designed for use with a high speed (10/100/1000 Mbps) Ethernet 10/100/1000 BASE-T/TX communications network. The twisted pair cable shall have a nominal impedance 100 ohms at one MHz, a maximum attenuation of 8 dB per 1000 feet at one MHz. The twisted pair cable must have frequency tested up to 250 MHz or more. The twisted pair cable shall be plenum rated and shall have a minimum of four 23 AWG solid copper conductor pairs. All 10/100/1000 BASE-T/TX (RJ-45) terminations on the twisted pair cable shall be done in a professional and workman like manner. Terminations shall provide for proper strain relief on the cable jacket. Strain relief on the wire and/or wire insulation shall not be acceptable.

B. Fieldbus

1. PROFIBUS DP cable according to IEC 61158-2

2. PROFIBUS PA cable according to IEC 61158-2

3. PROFIBUS Optical Link Module
   a. Provide a PROFIBUS converter over Fiber Optics as required to accomplish network communication as specified herein and as shown on drawings
   b. Manufacturers
      1) Siemens
      2) Or Equal

2.06 SPARE PARTS

A. General requirements for spare parts are specified in section 13300.

B. The following Network and Communications System spare parts shall be furnished

1. One switch of each type provided.

2. One media converter of each type provided.

3. Manufacturer's cables - one of each type installed.

4. Five-10ft CAT 6 cables with connectors installed.

PART 3 EXECUTION

3.01 ESTABLISHING COMMUNICATIONS

A. The PCSS is responsible for establishing all Remote site communications, RIO communications, PLC to PLC communications, and PLC to HMI communications and all other network and communication systems shown on the Drawings. The PCSS is shall perform the following tasks in order to ensure this communications is achieved:

1. Coordinating with Contractor at beginning of project in order to determine which vendor packages are provided with PLCs. The PCSS shall submit the listing of these PLCs as part of their Hardware Submittal for review by the Engineer.

2. Identifying any additional hardware or software required to ensure communications as part of the PCSS hardware submittal.

3. During factory testing and field testing, the PCSS shall demonstrate communications to the Engineer. Burden of proof of communications is the transfer on 1 analog and 1 discrete register in both directions.

END OF SECTION

SECTION 13321
INSTRUMENTATION AND CONTROLS - FIBER OPTIC CABLING AND EQUIPMENT

PART 1 GENERAL

1.01 SCOPE OF WORK

A. The Work of this Section includes providing a fiber optic communications infrastructure including, but not limited to, fiber optic cable (FOC), patch panels, terminations, testing, and implementation.

B. The Work includes testing individual fiber cables installed under this Contract, and testing a completed fiber optic communications network.

1.02 MEASUREMENT AND PAYMENT

A. No separate payment will be made for work performed under this Section. Include the cost for this work in the lump sum Base Bid Item in Section 00410.

1.03 RELATED WORK

A. Delivery, Storage and Handling in Section 01600.

B. Process Instrumentation and Control System in Section 13300.

1.04 SUBMITTALS

A. Submit to the Engineer, in accordance with Sections 01330 and 01782, the following:

1. Catalog Data: Catalog data on fiber-optic cable, termination devices, patch panels, breakout enclosures, splice kits, pigtails, and fan-outs where applicable. Product data sheets shall include the manufacturer's name and catalog number for each item, the manufacturer's descriptive literature, catalog cuts, and any power supply requirements.

2. Certification of compliance in writing stating the fiber optic cable, anticipated layout, and components are compatible, acceptable for use, and in compliance with these specifications.

3. Detailed bill of materials for fiber-optic cable, terminations, patch panels, breakout enclosures, splice kits, connectors, pigtails, and fan-outs.

4. Drawings indicating the locations of all patch panels, termination points, or breakout enclosures.

5. Catalog data on all testing devices proposed for use plus certifications of accuracy, calibration, and traceability to standards of the National Institute for Standards and Testing.

B. Provide four samples of each type of cable, splice, and connector termination kit. Four samples of a completed example of each type of splice and connector termination shall be submitted.

C. The Fiber Optic System Supplier shall provide a fiber optic power budget for each cable run in excess of 1000 feet. The budget shall include transmitter power, receiver sensitivity, connector losses, cable losses, and a 3db-aging margin. Fiber optic transmission line shall maintain a minimum of 10db safety margin.

D. Training plan and schedule for fiber optic cable termination training.

E. Test reports.

F. O&M manuals.

1.05 REFERENCE STANDARDS

A. The optical fiber cable shall conform to the latest issue of the following standards documents, which are incorporated by reference into this Section:

1. EIA-455: Standard Fiber Optic Test Procedures (FOTPs) Devices.
2. EIA-598-A: Standard Colors for Color Identification and Coding.
3. MIL-202: Test Methods for Electronic and Electrical Component Parts.
4. MIL-454: Standard General Requirements for Electronic Equipment.
5. MIL-810: Environmental Test Methods and Engineering Guidelines.
6. EIA-568-B.3: Commercial Building Telecommunications Cabling Standard: Optical Fiber Cabling Components.
7. ICEA 5-83-696: Fiber Optic Premises Distribution Cable (Indoor/Outdoor).
8. National Electrical Code (NEC) Article 770.
9. UL 1581 VW-1 - Vertical Tray Cable Flame Test.
10. UL 1666 - UL Standard for Safety Test for Flame-Propagation Height of Electrical and Optical-Fiber Cables Installed in Vertical Shafts.
11. NFPA 262 - Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use IN Air-Handling Spaces.
12. IEEE Standard 383 - Flame Retardancy.
13. DOD-STD-1678.
14. National Electrical Manufacturers Association (NEMA).

15. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

B. All fiber optical cables shall be constructed in accordance with EIA-455, and 100 percent of all optical fibers and jacketing shall meet or exceed the requirements contained in this specification.

1.06 QUALITY ASSURANCE

A. The cable manufacturer shall be ISO9001 certified and registered.

B. The fiber optic cabling system materials furnished under this Section shall be provided by Fiber Optic Suppliers who have been providing these types of materials for the past three years. The Fiber Optic Suppliers shall provide personnel capable of providing technical assistance during installation.

C. The installation of fiber optic cabling system materials furnished under this Section shall be performed by an installation Contractor who has been installing these types of materials and systems for the past three years.

D. Supplier shall furnish five working installation references.

E. The Engineer shall determine whether a product is an equal based upon the information listed herein and the manufacturer's data sheets regarding the models specified. Alternate equipment shall meet the criteria listed herein and all additional information in the manufacturer's data sheets in order to be accepted as an equal.

1.07 SYSTEM DESCRIPTION

A. N/A

1.08 DELIVERY, STORAGE, AND HANDLING

A. The cable shall be packaged in cartons and/or wound on spools or reels. Each package shall contain only one continuous length of cable. The packaging shall be constructed so as to prevent damage to the cable during shipping and handling.

B. When the length of an order requires a large wooden reel, the cable will be covered with a three-layer laminated protective material. The outer end of the cable shall be securely fastened to the reel head so as to prevent the cable from becoming loose in transit. The inner end of the cable shall project into a slot in the side of the reel or into housing on the inner slot of the drum, in such a manner and with sufficient length to make it available for testing.

C. Test tails shall be at least two meters long. The inner end shall be fastened so as to prevent the cable from becoming loose during shipping and installation. Reels shall be permanently marked with an identification number that can be used by the manufacturer to trace the manufacturing history of the cable and fiber.

D. Wooden reels shall be plainly marked to indicate the direction in which it shall be rolled to prevent loosening of the cable on the reel.

E. All fiber optic cables shall be attenuated tested. The attenuation of each fiber shall be provided with each cable reel by the manufacturer.

F. The attenuation shall be measured at 1310 nm and 1550 nm for single-mode fibers and 850nm and 1300nm for multimode fiber cables after received on site. The manufacturer shall submit the test results prior to installation of the cable.

G. Packaging

1. The completed cable shall be packaged for shipment on non-returnable wooden reels. It is the responsibility of the Contractor to determine all required cable lengths.

2. Top and bottom ends of the cable shall be available for testing.

3. Both ends of the cable shall be sealed to prevent the ingress of moisture.

4. Each reel shall have a weatherproof reel tag attached identifying the reel and cable. The reel tag shall include the following information:
   a. Cable Number Gross Weight.
   b. Shipped Cable Length in Meters.
   c. Product Number.
   d. Date Cable was Tested.
   e. Cable Length Markings Item Number.

H. Each cable shall be accompanied by a cable data sheet.

1.09 SPARE PARTS AND TEST EQUIPMENT

A. Spare Parts

1. Provide a minimum five percent spares of ST connectors and dust covers, but not less than 10 spare ST style connectors and 20 dust covers.

2. Provide a minimum five percent spare 36" spare multimode patch cables with connectors (both ends) terminated, but not less than ten 36" spare multimode patch cables with connectors (both ends) terminated.

B. Test Equipment and Tools

1. One complete fiber optic connector termination tool kit. The kit shall be the CTS version with VFL, Model TKT-UNICAM-CTS by Corning Cable Systems, or equal.

2. Optical power source and test meter shall be a combination type unit in a single handheld device.
   a. Optical source shall provide stable transmission of plus or minus 0.1dB at 23 degrees C for eight hours with accurate wavelengths. Sources shall be 850/1300nm multimode (LED) and 1310/1550nm (multimode) or combined quad wavelength source. Provide with visual fault locator (VFL).
   b. Test meter utilizes InGaAs wide area detector calibrated for 850, 1300, 1550, and 1625nm wavelengths. Provide fiber identification by audible detection of 2 kHz tone.
   c. Provide data storage: Windows-based PC software and cabling for reports, printing, viewing, and export.
   d. Power source/meter shall include jumpers, sleeves, cleaning kit, and transit case and shall be Corning Cable Systems Express Series Model No. OTS-3MDSD-KIT, or equal.

PART 2 PRODUCTS

2.01 GENERAL MATERIALS

A. Cabinets: cabinets shall be provided as indicated on the Contract Drawings.

B. Provide tight buffered cables that are not gel filled and are suitable for indoor/outdoor applications. These cables shall be flame retardant for indoor applications and water and fungus resistant for outdoor applications.

C. Optical Fiber Characteristics

1. All fibers in the cable shall be usable fibers and meet required specifications.

2. Each optical fiber shall consist of a doped silica core surrounded by a concentric silica cladding. The fiber shall be matched clad design.

3. Multi-mode: Provide multimode, optical glass fiber compatible with LED or laser based transmission systems with the following fiber types:

D. Manufacturers

1. Corning Cable Systems Corp.

2. CommScope.

3. Belden Cable.

4. Or equal.

2.02 STANDARD 62.5/125 µM FIBER

A. The multimode fiber shall meet EIA/TIA-492AAAA-A-1997, "Detail Specification for 62.5-µm Core Diameter/125-µm Cladding Diameter Class Ia Graded-Index Multimode Optical Fibers".

1. Geometry

Core Diameter (μm)	62.5 ± 3.0
Core Non-Circularity	≤ 5 %
Cladding Diameter (μm)	125.0 ± 2.0
Cladding Non-Circularity	≤ 1.0 %
Core-to-Cladding Concentricity (μm)	≤ 1.5
Coating Diameter (μm)	245 ± 5
Colored Fiber Nominal Diameter (μm)	253 - 259

2. Optical

Cabled Fiber Attenuation (dB/km) 850 nm 1300 nm	 ≤ 3.5 ≤ 1.0
Point Discontinuity (dB) 850 nm 1300 nm	 ≤ 0.2 ≤ 0.2
Cabled Effective Modal Bandwidth[1)] (MHz•km) 850 nm	 ≥ 220
IEEE 802.3 GbE Distance (m) 1000BASE-SX Window (850 nm) 1000BASE-LX Window (1300 nm)	 up to 300 up to 550
OFL Bandwidth (MHz•km) 850 nm 1300 nm	 ≥ 200 ≥ 500
Numerical Aperture	0.275 ± 0.015

[1)]As predicted by RML BW, per TIA/EIA 455-204 and IEC 60793-1-41, for intermediate performance laser based systems (up to 1 Gb/s).

2.03 FIBER OPTIC DISTRIBUTION CABLE

A. Multi-fiber cables utilizing 900 micron tight-buffered fibers surrounded by dielectric strength members and a flame-retardant outer jacket. Cables shall meet the application requirements of the National Electric Code® (NEC®) Article 770 and shall be listed accordingly:

1. Non-Plenum Applications - Applicable Flame Tests: UL 1666. Cables shall be listed OFNR (OFCR)

2. Plenum Applications - Applicable Flame Test: NFPA 262. Cables shall be listed OFNP (OFCP)

B. Cable Specifications

1. Fiber Count: as indicated.

2. Maximum Tensile Load Short-Term: 148 lbf (660 N)

3. Maximum Tensile Load Long Term: 45 lbf (198 N)

4. Minimum Crush Resistance: 57 lbf/in (100 N/cm)

5. Operating Temperature: -20 to +70 degrees C (OFNR, OFCR) 0 to +70 degrees C (OFNP, OFCP)

2.04 FIBER OPTIC INTERCONNECT CABLE

A. Tight-Buffered fiber surrounded by aramid yarn strength members and flame-retardant jacket.

B. Cable Specifications

1. Fiber Count: Single or duplex type as required.

2. National Electric Code OFNR designation.

3. Crush Resistance: 20 lbf/in (35 N/cm)

4. Operating Temperature: -20 to +70 degrees C

C. Fiber Specification Parameters

1. Required Fiber Grade - Maximum Individual Fiber Attenuation.

2. The fiber manufacturer shall proof-test 100 percent of the optical fiber to a minimum load of 100 kpsi.

2.05 CABLE CONSTRUCTION

A. Plenum Cables

1. Plenum cables up to 24 fibers: The fibers shall be stranded around a dielectric member and surrounded by layered aramid yarns. The aramid yarns shall serve as the tensile strength member of the cable. A ripcord may be applied between the aramid yarns and the outer jacket to facilitate jacket removal. The outer jacket shall be extruded over the aramid yarns for physical and environmental protection.

B. The strength member shall be a high modulus aramid yarn. The aramid yarns shall be helically stranded around the buffered fibers. Non-toxic, non-irritant talc shall be applied to the yarn to allow the yarns to be easily separated from the fibers and the jacket.

C. Cable Jacket

1. The jacket shall be continuous, free from pinholes, splits, blisters, or other imperfections. The jacket shall have a consistent, uniform thickness; jackets extruded under high pressure are not acceptable. The jacket shall be smooth, as is consistent with the best commercial

practice. The jacket shall provide the cable with a tough, flexible, protective coating, able to withstand the stresses expected in normal installation and service.

2. The cable and subunit jacket color shall be orange for cables containing multimode fibers.

3. For cables with more than two fibers, the cable jacket shall be designed for easy removal without damage to the optical fibers by incorporating a ripcord under each cable jacket. Non-toxic, non-irritant talc shall be applied to the aramid yarns to allow the yarns to be easily separated from the fibers and the jacket.

4. The nominal thickness of the cable outer jacket shall be sufficient to provide adequate cable protection while meeting the mechanical, flammability, low smoke, and environmental test requirements of this document over the life of the cable.

D. The cable shall be all-dielectric.

2.06 CABLE IDENTIFICATION

A. The individual fibers shall be color coded for identification. The optical fiber color coding shall be in accordance with EIA/TIA-598, "Color Coding of Fiber Optic Cables." The coloring material shall be stable over the temperature range of the cable, shall not be susceptible to migration, and shall not affect the transmission characteristics of the optical fibers. Color coded buffered fibers shall not adhere to one another. When fibers are grouped into individual units, each unit shall be numbered in the unit jacket for identification. The number shall be repeated at regular intervals.

B. The outer cable jacket shall be marked with the manufacturer's name or UL file number, date of manufacture, fiber type, flame rating, UL symbol, and sequential length markings every two feet. The markings shall be in contrasting color to the cable jacket.

2.07 CABLE TESTING REQUIREMENTS

A. Fiber cables shall be tested in accordance with the following industry standard (EIA-455) tests:

1. FOTP-41, Compressive Loading Resistance Test.

2. FOTP-104, Fiber Optic Cable Cyclic Flexing Test.

3. FOTP-25, Repeated Impact Testing.

4. FOTP-33, Fiber Optic Cable Tensile Loading and Bending Test.

5. FOTP-85, Fiber Optic Cable Twist Test.

6. FOTP-181, Lightning Damage Susceptibility Test.

7. FOTP-3, Procedure to Measure Temperature Cycling Effects on Optical Fibers, Cables, and other Passive Fiber Optic Components.

8. FOTP-82, Fluid Penetration Test for Fluid-Blocked Fiber Optic Cable.

9. FOTP-37, Low or High Temperature Bend Test for Fiber Optic Cable.

10. FOTP-98, External Freezing Test.

11. FOTP-27, Fiber Diameter Measurements.

12. FOTP-28, Measurement of Dynamic Tensile Strength.

13. FOTP-34, Interconnection Device Insertion Loss Test.

14. FOTP-89, Cable Jacket Elongation and Tensile Strength Test.

B. The Contractor shall submit laboratory test reports on representative samples of similar cable design to demonstrate compliance prior to cable installation.

2.08 FIBER CABLE TERMINATIONS, CONNECTORS, AND CABLE ASSEMBLIES

A. Pigtail Splicing

1. For termination of fiber cables at a termination or connector panel (patch panel), with one end of a piece of cable pre-connected and the other end unterminated for splicing to the cable that needs to be terminated. Splicing and connectors shall meet the requirements listed in this Section.

2. A splice/termination tray shall house the splices and serve to fully protect excess lengths of loose tube fibers from exposure. Splice tray shall be compatible with the selected patch panel and installed for easy access to the spliced cable sections.

3. Pigtail assemblies shall match fiber cable type and model and shall be as manufactured by Corning Cable Systems or equal.

B. Buffer Tube Fan-Out Kits

1. Individual fibers within a loose tube cable with 250 µm coated fibers shall use a fan-out kit to maintain flexibility and ease of handling fibers within a termination cabinet. Fan-out kits shall be installed in the patch panel enclosures to transition the loose tube fibers to ruggedized tight-buffered fiber pigtail cables. Optical fusion splices shall connect the loose tube fibers to the tight-buffered pigtail cables. The optical splice loss shall comply with the specifications for optical splices. Splice protection sleeves shall be employed on all splices to protect the splices.

2. The tight-buffered pigtails shall be factory pre-connected with STTM connectors as specified.

C. Connectors (Cable Assemblies)

1. The fiber optic communications system shall utilize stainless steel ST style connectors for all fiber optic connections. SC style connectors will be acceptable only if ST style connectors are not compatible with the equipment being provided. The connectors shall be designed for use with 50/62.5/125/250 micron cable. Each connector shall cause a maximum signal attenuation of 1.6 dB.

2. [Factory-Installed Connectors: All cable assemblies shall have connectors installed at the factory. The connectors shall provide tight-fitting termination to the cladding and buffer coating. Epoxy-based or "hot melt "adhesives shall be used to bond the fiber and buffer to the connector ferrule and body prior to polishing the end face.]

3. After termination with connectors, the fiber ends shall be visually inspected at a magnification of not less than 100 power for multimode and 200x for single mode to check for cracks or pits in the endface of the fiber.

4. Connectors shall have a maximum allowable connection loss of 0.3 dB per mated pair, as measured per EIA-455-34. No index-matching gel is to be used; dry interfaces only.

5. Each connector shall be of the industry standard ST type compatible; designed for single-mode and multimode tolerances; shall meet or exceed the applicable provisions of EIA-455-5, 455-2A, and 455-34; and shall be capable of 100 repeated ratings with a maximum loss increase of 0.1 dB. Connectors shall incorporate a key-way design and shall have a Zirconia ceramic ferrule. Connector bodies and couplings shall be made of corrosion-resistant and oxidation-resistant materials such as nickel-plated zinc, designed to operate in humid environments without degradation of surface finishes. Connectors shall be capable of operating in a range of -40 to 80 degrees C.

6. Manufacturers
   a. Corning Cable Systems, Hickory, NC
   b. AMP, Inc., Harrisburg, PA
   c. 3M Telecom Systems Group, Austin, TX or equal.

D. Fiber Optic Patch Cables

1. Fiber optic patch cable shall be two-fiber zipcord 50/62.5/125 core/clad micron multimode riser rated cable.

2. Installation of patch cables shall include all spares and observe the minimum fiber bend radius and strain relief.

2.09 FIBER OPTIC TERMINATION PATCH PANELS

A. General

1. Patch panels shall be suitable for wall mounting, comprised of internal mounting plate, cable holders, slack cable take up/organizer blocks, patch block with connectors, and

ground lugs as indicated. Panels shall be NEMA 4X, Type 316 stainless steel construction for outdoors; and NEMA 12, Type 316 stainless steel or fiberglass for indoor use. Patch panels shall be suitable for multimode system operation at 800 and 1300 nanometers. Patch panels shall be suitable for ST or LC connectors. The patch panels shall be sized to handle the number of fibers as required. All fibers shall be terminated in the patch panel.

2. Where shown on the plans or in the related specification Sections, the fiber optic cable shall terminate inside a communications cabinet on a termination patch panel. All fiber sub-cables within the exposed buffer tube shall be terminated with fan-out kits with pre-connected pigtails. The patch panel shall have a fiber capacity equal to the total number of fibers (connected and spare) for all cables to be connected.

3. Unused buffer tubes shall be uncut and looped within the patch panel for continuous routing of the fiber buffer tube within the cable assembly.

4. Patch panels shall be designed for either rack mounting on a standard equipment rack or housed in an enclosure for direct wall mounting. The patch panel shall contain "ST" type bayonet or LC couplings. All unused couplings shall have protective dust covers. All panels shall be furnished with locking doors.

5. Factory-terminated, tight-buffered, aramid-reinforced fiber optic jumper assemblies or interconnect cables, standard 3.0-mm O.D., shall connect the optical cable terminations to the patch panel couplings.

6. The termination patch panel shall be equipped with a suitable means for routing and securing of cables, and shall provide a suitable means of protection for the mounted fiber connectors to prevent damage to fibers and connectors during all regular operation and maintenance functions. All cables shall be provided with strain relief. Bend diameters on cable fibers and jumpers must be greater than four inches at all times to ensure optical and mechanical integrity of the optical fibers.

7. Termination panels shall be equipped with splice trays (where applicable) and holders for pigtail and through fiber splicing.

8. Termination panels shall be provided with all hardware, options, and accessories to provide for a complete installation of the fiber optic system.

9. Panels shall be as manufactured by Corning Cable Systems LANscape or equal.

B. Rack Mount Fiber Distribution Center (FDC) Splice Housing

1. A rack-mountable Fiber Distribution Center splice housing shall be provided for pigtail splicing and through fiber splicing equipment.

2. The splice housing shall be compatible with the FDC for interconnection of the splicing equipment with the fiber cable management, termination, and distribution rack equipment.

3. Splice trays shall be provided for pigtail splicing.

4. The splice housing shall be sized and equipped with sufficient capacity to terminate and feed through all required fiber cable, plus an additional 20 percent.

5. Provide one spare splice tray.

6. Splice housing shall be Corning Cable Systems LANscape CSH series.

C. Wall/Panel Mount Fiber Distribution Center (WDC)

1. The field-mounted fiber termination enclosures shall be supplied with a Wall Mount Fiber Distribution Center (WDC) capable of 48 ST fiber termination points. The distribution center shall be panel-mounted and provide for internal fan-out, splicing, and connection of the fiber optic cable to the patch panel assemblies.

2. Splice trays shall be provided for pigtail splicing. The WDC shall be provided with pass-thru splice trays for continuation of the fiber cable system to additional sites.

3. Provide one spare splice tray.

4. The WDC shall provide space and support the addition of future fiber cable splice trays.

5. The Wall Mount Fiber Distribution Center shall be Corning Cable Systems LANscape (WCH) series.

PART 3 EXECUTION

3.01 GENERAL

A. Provide all material, equipment, and labor to test and integrate the fiber optic system as indicated and as specified.

B. Installation shall comply with EIA/TIA Standards 568 and 569.

C. Fiber optic cables shall be continuous from component to component. Intermediate fiber splices shall not be allowed.

D. Provide delivery, storage, and handling of materials and equipment in accordance with Section 01600.

3.02 IDENTIFICATION

A. Label each termination point.

B. Label each cable, buffer tube, and fiber with permanent waterproof typewritten tags.

3.03 PHYSICAL CHECKOUT

A. General Procedures

1. Conduct physical checkout of the fiber optic data highway network.

2. Physical checkout shall be performed prior to functional testing.

B. Check Procedures

1. Verify that fiber optic cable reels have been off-loaded from truck carefully and not damaged.

2. Submit to the Engineer all test data provided by the fiber manufacturer.

3. Verify that the optical fibers of the cable assembly are the type and quantity as specified and as recommended by the Instrumentation System Supplier.

4. Verify that cable construction is the type specified.

5. Verify that fiber optic patch panels have been installed plumb and level at locations indicated.

6. Verify that optical fiber connections or terminations within patch panels and splice closures are in accordance with cable manufacturer's recommendations.

3.04 FIBER OPTIC CABLE TESTING

A. General: The Contractor shall perform pre-installation and post-installation FOC tests. The Engineer shall be notified a minimum of 10 days in advance so that these tests are witnessed. All test equipment shall be traceable to NIST standards.

B. Test equipment: The Contractor shall use the following to perform pre-installation and post-installation FOC tests:

1. Optical time domain reflectometer (OTDR). The OTDR shall be laser precision, and be able to test single mode or multimode systems with a visual fault locator. The OTDR shall be as manufactured by Corning, Agilent Technologies, Fluke Networks, or equal.

C. Pre-installation Tests

1. The purpose of these tests is to perform acceptance tests on the cable prior to installation to verify that the cable conforms to the manufacturer's specifications; is free of defects, breaks, and damages by transportation and manufacturing processes; and to provide baseline readings in dB.

2. Prior to removal of each cable from the delivery reel, all optical fibers within the cables shall be tested by the Contractor using an OTDR. The OTDR tests shall consist of end-to-

end length and fiber attenuation (dB/km) measurements to ensure proper performance of the fiber optic cable. The tests shall be performed from both ends of each fiber to ensure complete fiber continuity within the cable structure.

3. Pre-installation, "on-reel" test results shall be compared with the manufacturer's test report delivered with the cable. Gross dissimilarities shall be noted and remedied between the Contractor and manufacturer. In all cases, all fibers shall meet the optical attenuation specifications prior to cable installation.

4. The Contractor shall perform tests on all reels of cable. The Engineer shall be notified a minimum of 15 days prior to any test.

5. The Contractor shall document each test and submit the report to the Engineer for review. Documentation shall consist of both hard copy and 3.5 inch electronic disk complete with all application software.

6. Cable shall not be installed until the Engineer has reviewed the test report.

D. Post-installation tests: After FOC has been installed and connected, the following tests shall be performed:

1. Visually inspect terminal connectors for out-of-round condition and surface defects such as micro-chips and cracks using a 200X (minimum) inspection microscope.

2. A recording OTDR shall be used to test for end-to-end continuity and attenuation of each optical fiber. The OTDR shall have an X-Y plotter to provide a hard copy record of each trace of each fiber. The OTDR shall be equipped with sufficient internal masking to allow the entire cable section to be tested. This may be achieved by using an optical fiber pigtail of 30 feet or more to display the required cable section.

3. The OTDR shall be calibrated for the correct index of refraction to provide proper length measurement for the known length of reference fiber.

4. A transmission test shall be performed with the use of a 1310 and 1550 nm stabilized light sources and 1310 nm/1550 nm power meters for SMF. This test shall be conducted in both directions on each fiber of each cable.

5. Hard and electronic copies of test documentation shall be submitted to the Engineer. The documentation shall include:
   a. The trace plot.
   b. Index.
   c. dB/km loss.
   d. Cable length.
   e. Date and time of test.
   f. Wavelength.
   g. Pulse width.
   h. The test site.
   i. Cable ID.

j. Fiber number and type.
k. Operator's initials.
l. The Contractor shall compare the pre-installation test results to the post-installation results. If a deviation of greater than one dB occurs, the Engineer shall be notified in writing by the Contractor, and the cable shall be removed and replaced at no additional cost to the Owner.

6. Upon completion of the previous tests, all FOC coils shall be secured with ends capped to prevent intrusion of dirt and water.

E. Certification of completion of pre- and post-fiber installation testing including test results shall be provided to the Engineer. Test results shall be submitted on paper in a binder, including results indicated in tables or a spreadsheet. Test results that exceed specification limits shall be noted. The electronic copy shall be included in the binder.

F. Required OTDR Trace Information

1. All traces shall display the entire length of cable under test, highlighting any localized loss discontinuities (installation-induced losses and/or connector losses). The trace shall display fiber length (in kilofeet), fiber loss (dB), and average fiber attenuation (in dB/km), as measured between two markers placed as near to the opposite ends of the fiber under test as is possible while still allowing an accurate reading. Care shall be taken to ensure that the markers are placed in the linear region of the trace, away from the front-end response and far-end Fresnel reflection spike. Time averaging shall be used to improve the display signal to noise ratio. The pulse width of the OTDR shall be set to a sufficient width to provide adequate injected power to measure the entire length the fiber under test.

2. If connectors exist in the cable under test, then two traces shall be recorded. One trace shall record the fiber loss (dB) and average attenuation (dB/km) of the entire cable segment under test, including connectors. The second trace shall display a magnified view of the connector regions, revealing the connector losses (dB). All connector losses shall be measured using the five-point splice loss measurement technique.

3. The OTDR trace shall also include the following information:
a. The date and time of the test.
b. The cable ID number.
c. The cable segment ID number.
d. The fiber color or sub-cable number.
e. Launch point connector number.
f. The optical wavelength used for the test.
g. The refractive index setting of the OTDR.
h. The pulse width setting of the OTDR.
i. The averaging interval of the test.

3.05 TRAINING

A. Provide one half-day training on termination techniques and testing for up to three students prior to installation.

B. Provide training as soon as possible following submittal of proposed fiber optic cable.

3.06 WARRANTY

A. Refer to Section 13300.

B. The Contractor shall provide an unconditional warranty on all installed cable for a minimum period of 20 years, commencing at the time of final acceptance by the Owner.

C. This Section describes the material and installation requirement for the fiber optic cabling system and associated equipment.

END OF SECTION

SECTION 13330
INSTRUMENTATION AND CONTROLS - CONTROL PANELS AND PANEL MOUNTED EQUIPMENT

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Refer to Section 13300.

B. Furnish and install control panels and panel mounted equipment as specified herein and shown on the Drawings.

C. All new panels and panel components shall match existing equipment makes and models wherever possible, so that system additions can be most easily integrated with respect to operation and maintenance training, spare parts inventory, and service contracts. Even when exact matches are not possible, equipment furnished must be fully compatible with the existing system. Color, size, and material of new panels should conform to that of existing panels.

D. Each panel shall be supplied with full sub-panels with the minimum specified dimensions regardless of the quantity of mounted components inside the panel. All panel mounted components shall be mounted on the single rear-of-panel sub-panel unless the density of devices exceeds the panel mounting space permitted by the minimum panel dimensions specified. Side panel mounted components shall only be permitted after review and approval of the Engineer.

E. Furnish the following panels [and consoles].

PANEL SCHEDULE

Panel Designation	Minimum Panel Size	Maximum Space Available	Enclosure Rating & Type
PLC-3 enclosure in New Electrical Building	90-inch high by 72-inch wide by 24-inch deep	120-inch high by 80-inch wide by 24-inch deep	NEMA Type 12, 2-door, steel construction, free standing. Front Access Only

1.02 MEASUREMENT AND PAYMENT

A. No separate payment will be made for work performed under this Section. Include the cost for this work in the lump sum Base Bid Item in Section 00410.

1.03 RELATED WORK

A. Refer to Section 13300.

1.04 SUBMITTALS

A. Refer to Section 13300.

B. Descriptive literature, bulletins, catalog cuts and Drawings for the equipment specified herein.

C. Complete bill of materials for the equipment.

D. Spare parts list.

E. Panel Layout Drawings and Wiring Diagrams Submittal

1. Where direct hardwired interfaces exist between the PCSS control panels and vendor provided control panels furnished under other Divisions, the Contractor shall provide to the PCSS the approved submittals in order for the PCSS to provide complete wiring diagrams showing all wiring connections in the I/O system. This includes but is not limited to terminal block numbering, relay contact information, instruments, equipment, and control panel names. These drawings shall be included in the Final O&M submittal. Leaving this information blank on the Final Documentation drawings is not acceptable.

2. Panel Layout Drawings: Drawings shall be furnished for all panels, consoles, and equipment enclosures specified. Panel assembly and elevation drawings shall be drawn to scale and detail all equipment in or on the panel. Panel drawings shall be 11"x17" in size. At a minimum, the panel drawings shall include the following:
   a. Interior and exterior panel elevation drawings to scale.
   b. Nameplate schedule.
   c. Conduit access locations.
   d. Panel construction details.
   e. Cabinet assembly and layout drawings to scale. The assembly drawing shall include a bill of material on the drawing with each panel component clearly defined. The bill of material shall be cross-referenced to the assembly drawing so that a non-technical person can readily identify all components of the assembly by manufacturer and model number.
   f. Fabrication and painting specifications including color (or color samples).
   g. Construction details, NEMA ratings, intrinsically safe barrier information, gas sealing recommendations, purging system details, etc. for panels located in hazardous locations or interfacing to equipment located in hazardous areas.
   h. For every control panel, heating and cooling calculations for each panel supplied indicating conformance with cooling requirements of the supplied equipment and environmental conditions. Calculations shall include the recommended type of equipment required for both heating and cooling.
   i. Submit evidence that all control panels shall be constructed in conformance with UL 508 and bear the UL seal confirming the construction. Specify if UL compliance and seal application shall be accomplished at the fabrication location or by field inspection by UL inspectors. All costs associated with obtaining the UL seal and any inspections shall be borne by the Contractor.

3. Panel Wiring Diagrams: Panel wiring diagrams depicting wiring within and on the panel as well as connections to external devices. If ISA Loop Wiring Diagrams are specified below, equipment external to the control panel and related external connections do not need to be shown on the Panel Wiring Diagrams. Panel wiring diagrams shall include power and signal connections, UPS and normal power sources, all panel ancillary equipment,

protective devices, wiring and wire numbers, and terminal blocks and numbering. Field device wiring shall include the device ISA-tag and a unique numeric identifier. The diagrams shall identify all device terminal points that the system connects to, including terminal points where I/O wiring lands on equipment not supplied by the PCSS. Wiring labeling used on the drawings shall match that shown on the Contract Documents or as developed by the PCSS and approved by the Engineer. I/O wiring shall be numbered with rack number, slot number, and point number. Two-wire and four-wire equipment shall be clearly identified and power sources noted. Submit final wire numbering scheme. Panel drawings shall be 11" x17" in size.

4. ISA Loop Wiring Diagrams: Not required

1.05 COORDINATION MEETINGS

A. Refer to Section 13300.

1.06 REFERENCE STANDARDS

A. Refer to Section 13300.

1.07 QUALITY ASSURANCE

A. Refer to Section 13300.

1.08 DELIVERY, STORAGE AND HANDLING

A. Refer to Section 13300.

1.09 NOMENCLATURE AND IDENTIFICATION

A. Refer to Section 13300.

1.10 MAINTENANCE

A. Refer to Section 13300.

B. Test Equipment:

1. Refer to Section 13300.

1.11 WARRANTY

A. Refer to Section 13300.

PART 2 PRODUCTS

2.01 GENERAL

A. Refer to Section 13300

2.02 LIGHTNING/SURGE PROTECTION

A. Refer to Section 13300

2.03 CONTROL PANEL GENERAL REQUIREMENTS

A. The dimensions within this Section and on the Contract Drawings are for general reference only. Ensure that final enclosure sizing and panel arrangements accommodate all required equipment for a fully integrated and operational system as specified herein and in the Contract Documents.

B. Each control panel and terminal cabinet shall bear the UL label. The UL label shall apply to the enclosure, the specific equipment supplied with the enclosure, and the installation and wiring of the equipment within and on the enclosure. If required for UL labeling, provide ground fault protective devices, isolation transformers, fuses and any other equipment necessary to achieve compliance with UL 508 requirement. The Drawings do not detail all UL 508 requirements.

C. All panel doors shall have a lock installed in the door handle, or a hasp and staple for padlocking. Locks for all panels provided under this Contract shall be keyed alike.

D. The devices designated for rear-of-panel mounting shall be arranged within the panel according to respective panel drawings and in a manner to allow for ease of maintenance and adjustment. Heat generating devices such as power supplies shall be located at or near the top of the panel.

E. The panels shall be completely fabricated, instruments and devices installed and wired at the PCSS's facility.

F. All components shall be mounted in a manner that shall permit servicing, adjustment, testing, and removal without disconnecting, moving, or removing any other component. Components mounted on the inside of panels shall be mounted on removable plates and not directly to the enclosure. Mounting shall be rigid and stable unless shock mounting is required otherwise by the manufacturer to protect equipment from vibration. Component mounting shall be oriented in accordance with manufacturer's recommendations. The internal components shall be identified with suitable plastic or metal engraved nametags mounted adjacent to (not on) each component identifying the component in accordance with the drawing, specifications, and PCSS's data.

G. All exterior panel mounted equipment shall be installed with suitable gaskets, faceplates, etc. required to maintain the NEMA rating of the panel.

H. Nameplates

1. All panels and panel devices shall be supplied with suitable nameplates, which identify the panel and individual devices as required. Unless otherwise indicated, each device nameplate shall include up to three lines with the first line containing the device tag number as shown on the drawings, the second line containing a functional description (e.g., Recirculation Pump No. 1), and the third line containing a functional control description (e.g., Start).

2. Unless escutcheon plates are specified or unless otherwise noted on the Drawings, nameplates shall be 3/32-inch thick, black and white, Lamicoid with engraved inscriptions. The letters shall be Black [White] against a White [Black] background unless otherwise noted. Edges of the nameplates shall be beveled and smooth. Nameplates with chipped or rough edges will not be acceptable.

3. Nameplate fasteners and mounting shall be epoxy adhesive or stainless steel screws for cabinet mounted nameplates

4. For every panel, provide a panel nameplate with a minimum of 1-in high letters. Provide legend plates or 1-in by 3-in engraved nameplates with 1/4-in lettering for identification of door mounted control devices, pilot lights, and meters.

5. Single lamicoid nameplates with multiple legends shall be used for grouping of devices such as selector switches and pilot lights that relate to one function.

I. Mounting Elevations

1. ISA Recommended Practice RP60.3 shall be used as a guide in layout and arrangement of panels and panel mounted components. Dimensions shall account for all housekeeping pads that panels will sit on once they are installed.

2. Centerline of indicators and controllers shall be located no lower than 48-inches or higher than 66-inches above the floor on a panel face.

3. Centerline of lights, selector switches, and pushbuttons shall be located no lower than 32-inches or higher than 70-inches above the floor on a panel face.

4. Tops of annunciators shall be located no higher than 86-inches above the floor on a panel face.

5. Installation of panel components shall conform to component manufacturers' guidelines.

2.04 PANEL MATERIALS AND CONSTRUCTION

A. Structure and Enclosure

1. Panels shall be of continuous welded-steel or FRP construction as shown on the Panel Schedule. Provide angle stiffeners as required on the back of the panel face to prevent panel deflection under instrument loading or operation. Internally the panels shall be supplied with a structural framework for instrument support purposes and panel bracing. The internal framework shall permit panel lifting without racking or distortion. Provide removable lifting rings designed to facilitate simple, safe rigging, and lifting of the control panels during installation.

2. Each panel shall be provided with full height, fully gasketed access doors where shown. Doors shall be provided with a three-point stainless steel latch (except for NEMA 4X panels) and heavy duty stainless steel locking handle. Rear access doors (if included) shall

be conveniently arranged and sized such that they extend no further than 24-inches beyond the panel when opened to the 90-degree position. Front and side access doors shall be as shown. Panel access doors shall be provided with full length, continuous, piano type stainless steel hinges with stainless steel pins. Front access doors with mounted instruments or control devices shall be of sufficient width to permit door opening without interference from flush mounted instruments.

3. The panels, including component parts, shall be free from sharp edges and welding flaws. Wiring shall be free from kinks and sharp bends and shall be routed for easy access to other components for maintenance and inspection purposes.

4. The panel shall be suitable for top and bottom conduit entry as required by the Electrical Drawings. For top mounted conduit entry, the panel top shall be provided with nominal one-foot square removable access plates, which may be drilled to accommodate conduit and cable penetrations. All conduit and cable penetrations shall be provided with ground bushings, hubs, gasketed locknuts, and other accessories as required to maintain the NEMA rating of the panel and electrical rating of the conduit system.

5. All panels in indoor, dry, non-corrosive environments shall be NEMA 12 unless otherwise noted. All panels in outdoor, wet, and non-chemically corrosive environments shall be NEMA 4 unless otherwise noted. Panels in chemically corrosive environments shall be NEMA 4X unless otherwise noted. All panels located in a hazardous location shall be rated for the type of hazard (e.g., NEMA 7 for Class 1, Division 1).

B. Freestanding and Floor-Mounted Vertical Panels

1. Freestanding and floor-mounted vertical panels shall meet the NEMA classification as shown on the drawings or specified herein. The panels shall be constructed of 12 gauge sheet steel, suitably braced internally for structural rigidity and strength. All NEMA 4X rated panels shall be constructed of Type 316 stainless steel, unless FRP is specifically indicated to be provided. Front panels or panels containing instruments shall be not less than 10 gauge stretcher leveled sheet steel, reinforced to prevent warping or distortion.

C. Wall and Unistrut Mounted Panels

1. All wall and Unistrut mounted panels shall meet the NEMA classification as shown on the drawings or specified herein. The panels shall be constructed of not less than USS 14 gauge steel, suitably braced internally for structural rigidity and strength. All NEMA 4X rated wall mounted panels shall be constructed of Type 316 stainless steel, unless FRP is specifically indicated. FRP panels shall be used in chlorine areas. All FRP panels located in direct sunlight shall be provided with a protective coating and sun shield to prevent discoloration and cracking.

D. Finish Requirements

1. All sections shall be descaled, degreased, filled, ground and finished. The enclosure when fabricated of steel shall be finished with two rust resistant phosphate prime coats and two coats of enamel, polyurethane, or lacquer finish which shall be applied by either the hot air

spray or conventional cold spray methods. Brushed anodized aluminum, stainless steel, and FRP panels will not require a paint finish.

2. The panels shall have edges ground smooth and shall be sandblasted and then cleaned with a solvent. Surface voids shall be filled and ground smooth.

3. Immediately after cleaning, one coat of a rust-inhibiting primer shall be applied inside and outside, followed by an exterior intermediate and top coat of a two-component type epoxy enamel. A final sand-ing shall be applied to the intermediate exterior coat before top coating.

4. Apply a minimum of two coats of manufacturer's standard, flat light-colored lacquer, on the panel interior after priming.

5. Unless otherwise noted, the finish exterior colors shall be ANSI 61 gray with a textured finish.

E. Print storage pockets shall be provided on the inside of each panel. The storage pockets shall be steel, welded on to the door, and finished to match the interior panel color. The storage pocket shall be sufficient to hold all of the prints required to service the equipment, and to accommodate 8.5 inch by 11 inch documents without folding.

F. Where specified on the Panel Schedule, a folding shelf shall be provided on the inside of the door on all free-standing and floor-mounted panels. The shelf shall be suitable for a laptop computer and shall be placed such that an open laptop computer does not interfere with any door-mounted devices. The folded shelf shall not interfere with any internal panel components when the door is closed. The folding shelf shall automatically lock in the horizontal position when raised. The folding shelf shall be approximately 18 inches wide by 12 inches deep and shall have a minimum distributed load rating of 100 pounds. All parts shall be made of heavy gauge steel and shall be painted white or finished to match the interior panel color.

2.05 ENVIRONMENTAL CONTROL

A. All panels shall be provided with louvers, sun shields, heat sinks, forced air ventilation, or air conditioning units as required to prevent temperature buildup inside of panel. The internal temperature of all panels shall be regulated to a range of 45 Deg F to 104 Deg F under all conditions. Under no circumstances shall the panel cooling or heating equipment compromise the NEMA rating of the panel.

B. Except for panels mounted with their backs directly adjacent to a wall, louvers shall be in the rear of the panels, top and bottom, and shall be stamped sheet metal construction.

C. For panels mounted with their backs directly adjacent to a wall, louvers shall be on the sides.

D. Forced air ventilation fans, where used, shall provide a positive internal pressure within the panel, and shall be provided with washable or replaceable filters. Fan motors shall operate on 120-volt, 60-Hz power.

E. For panels with internal heat that cannot be adequately dissipated with natural convection and heat sinks, or forced air ventilation, an air conditioner shall be provided.

F. Provide custom fabricated sun shields for all outdoor panels in accordance with the following requirements:

1. Sun shields shall be fabricated from minimum 12 gauge Type 316 stainless steel. Units shall be designed, fabricated, installed, and supported to fully cover and shade the top, sides and back of the enclosure, and to partially shade the front panel of the enclosure, from direct exposure to sunlight from sunrise to sunset.

2. Depending on overall size, sun shields may be fabricated in single or multiple segments for attachment to the enclosure support framing or to separate free standing framing around the enclosure.

3. Sun shields shall not be attached directly to the enclosure by drilling holes through, or welding studs to, the enclosure surfaces, and shall be designed and mounted to provide a minimum 3-inch air gap all around the enclosure for air circulation and heat dissipation.

4. The top section of all sun shields shall be sloped at a minimum angle of 5 degrees from horizontal. For wall mounted enclosures, the top section shall slope downward away from the wall and towards the front of the enclosure. For free standing, floor mounted and frame mounted enclosures the top section shall slope downward towards the back side of the enclosure.

5. The front edge of the top section of all sun shields shall incorporate a narrow and more steeply sloped drip shield segment which sheds water away from the front of the enclosure and prevents it from dripping or running directly onto the front panel of the enclosure.

6. All seam welds used in sun shield fabrication shall be continuous and shall be ground smooth.

7. All exposed corners, edges and projections shall be smooth rounded or chamfered to prevent injury.

2.06 CORROSION CONTROL

A. Panels shall be protected from internal corrosion by the use of corrosion-inhibiting vapor capsules as manufactured by Northern Technologies International Corporation, Model Zerust VC; Hoffman Model AHCI; or equal.

2.07 CONTROL PANEL - INTERNAL CONSTRUCTION

A. Internal Electrical Wiring

1. All interconnecting wiring shall be stranded, type MTW, and shall have 600 volt insulation and be rated for not less than 90 degrees Celsius. Wiring for systems operating at voltages in excess of 120 VAC shall be segregated from other panel wiring either in a separate

section of a multi-section panel or behind a removable Plexiglas or similar dielectric barrier. Panel layout shall be developed such that technicians shall have complete access to 120 VAC and lower voltage wiring systems without direct exposure to higher voltages.

2. Power distribution wiring on the line side of fuses or breakers shall be 12 AWG minimum. Control wiring on the secondary side of fuses shall be 16 AWG minimum. Electronic analog circuits shall utilize 18 AWG shielded, twisted pair, cable insulated for not less than 600 volts.

3. Power and low voltage DC wiring systems shall be routed in separate wireways. Crossing of different system wires shall be at right angles. Different system wires routed parallel to each other shall be separated by at least 6-inches. Different wiring systems shall terminate on separate terminal blocks. Wiring troughs shall not be filled to more than 60 percent visible fill.

4. Terminations
   a. All wiring shall terminate onto single tier terminal blocks, where each terminal is uniquely and sequentially numbered. Direct wiring between field equipment and panel components is not acceptable.
   b. Multi-level terminal blocks or strips are not acceptable unless they are approved by the Engineer in advance of panel wiring diagrams. If approved, they shall be mounted on angled din rail elevated from the back panel.
   c. Terminal blocks shall be arranged in vertical rows and separated into groups (power, AC control, DC signal). Each group of terminal blocks shall have a minimum of 25 percent spares.
   d. Terminal blocks shall be the compression type, fused, unfused, or switched as shown on the Contract Drawings or specified elsewhere in Division 13.
   e. Discrete inputs and outputs (DI and DO) shall have two terminals per point with adjacent terminal assignments. All active and spare PLC and controller points shall be wired to terminal blocks.
   f. Analog inputs and outputs (AI and AO) shall have three terminals per shielded pair connection with adjacent terminal assignments for each point. The third terminal is for shielded ground connection for cable pairs. Ground the shielded signal cable at the PLC cabinet. All active and spare PLC and controller points shall be wired to terminal blocks.
   g. Wire and tube markers shall be the sleeve type with heat impressed letters and numbers.
   h. Only one side of a terminal block row shall be used for internal wiring. The field wiring side of the terminal shall not be within 6-inches of the side panel or adjacent terminal or within 8-inches of the bottom of free standing panels, or within 3-inches of stanchion mounted panels, or 3-inches of adjacent wireway.
   i. Circuit power from the SCADA cabinet out to field devices (switches, dry contacts etc.) that are used as discrete inputs to the PLC input cards shall be isolated with an isolating switch terminal block with flip cover that is supplied with a dummy fuse. Isolation switch block shall be an Allen Bradley Model 1492-H7 or equal. One isolating switch terminal block per loop numbered piece of equipment and one per spare I/O point is acceptable.

j. All PLC discrete outputs to the field shall be isolated with an isolating fuse switch terminal block with a flip cover and a neon blown fuse indicator. The single circuit fusible terminal block shall be an Allen Bradley 1492-H4 or equal.

5. All wiring to hand switches and other devices, which are live circuits independent of the panel's normal circuit breaker protection, shall be clearly identified as such.

6. All wiring shall be clearly tagged and color coded. All tag numbers and color coding shall correspond to the panel wiring diagrams and loop drawings prepared by the PCSS. All power wiring, control wiring, grounding, and DC wiring shall utilize different color insulation for each wiring system used. The color coding scheme shall be:
   a. Incoming 120 VAC Hot - Black
   b. 120 VAC Hot wiring downstream of panel circuit breaker – Red
   c. 120 VAC Hot wiring derived from a UPS system – Red with Black stripe
   d. Three phase power – Brown, Orange, Yellow, and Green ground or as specified in Division 16.
   e. 120 VAC neutral - White
   f. Ground - Green
   g. DC power or control wiring – Blue
   h. DC analog signal wiring – Black (+), White (-)
   i. Foreign voltage – Yellow

7. Provide surge protectors on all incoming power supply lines at each panel per the requirements of Section 13300.

8. Each field instrument furnished under Division 13 and shown on the Drawings as deriving input power from the control panel(s) shall have a separate power distribution circuit with a circuit breaker or fuse and blown fuse indication. All instruments requiring 120VAC power shall be powered from the UPS source in the panel where the instrument signals lands.

9. Provide redundant 24 VDC power supplies to power field instruments and panel devices. Twenty-four VDC power supplies shall be as specified in this Section.

10. Wiring trough for supporting internal wiring shall be plastic type with snap-on covers. The side walls shall be open top type to permit wire changing without disconnecting. Trough shall be supported to the subpanel by stainless steel screws. Trough shall not be bonded to the panel with glue or adhesives.

11. Each panel shall have a single tube, fluorescent light fixture, 20 Watt in size, mounted internally to the ceiling of the panel. Light fixture shall be switched and shall be complete with the lamp.

12. Each panel shall have a specification grade duplex convenience receptacle with ground fault interrupter, mounted internally within a stamped steel device box with appropriate cover. Convenience receptacle shall not be powered from a UPS and shall be protected by a dedicated fuse or circuit breaker.

13. Each panel shall be provided with an isolated copper grounding bus for all signal and shield ground connections. Shield grounding shall be in accordance with the instrumentation manufacturer's recommendations.

14. Each panel shall be provided with a separate copper power grounding bus (safety) in accordance with the requirements of the National Electrical Code.

15. Each panel shall have control, signal, and communication line surge suppression in accordance with Section 13300.

16. All microprocessor-based electronic devices in the panel that are powered by 120VAC shall be powered by the UPS (refer to appropriate Section in Division 13.

17. Each panel shall be provided with a circuit breaker to interrupt incoming power.

18. Additional electrical components including transformers, motor starters, switches, circuit breakers, etc. shall be in compliance with the requirements of Division16.

B. Pneumatic Tubing

1. Refer to Section 13300.

2. Pneumatic tubing shall be a minimum of 1/4-inch O.D. Type 316 stainless steel with compression fittings. All tubing shall be rigidly supported and run in horizontal or vertical planes.

3. All pneumatic equipment shall be provided with separate shut-off valves. Flexible polyethylene tubing shall be used on all devices mounted on hinged doors, etc.

4. A screened vent shall be provided on all enclosures using pneumatic instruments.

5. All pneumatic tubing shall be routed in separate bundles or wireways, and shall be separated from all electrical wiring by a minimum of 3-inches.

C. Relays not provided under Division 16 and required for properly completing the control function specified in Division 13, Division 16, or shown on the Drawings shall be provided under this Section.

D. The orientation of all devices including PLC and I/O when installed shall be per the manufacturer's recommendations. No vertical orientation of PLC racks shall be allowed unless specifically indicated by the manufacturer as an acceptable mounting alternative and also approved by the engineer.

2.08 ELECTRICAL COMPONENTS

A. The main circuit breaker shall be a thermal-magnetic molded case breaker, by Square D Company, or equal. Provide a flange mounted main power disconnect operating handle with

mechanical interlock having a bypass that will allow the panel door to open only when the switch is in the OFF position.

B. A mechanical disconnect mechanism, with bypass, shall be installed on each motor circuit protector, capable of being locked in the "OFF" position to provide a means of disconnecting power to the motor.

C. Auxiliary contacts shall be provided for remote run indication and indication of each status and alarm condition. Additional controls shall be provided as specified herein and as required by the detailed mechanical equipment requirements, the P&IDs (Division 13, the Control Wiring Diagrams (Division 16) and as shown on the Drawings.

D. All operating control devices and instruments shall be securely mounted on the exterior door. All controls shall be clearly labeled to indicate function and shall be in accordance with the electrical area classification indicated on the Electrical Contract Drawings.

E. A six digit, non-resettable quartz time base elapsed time meter shall be connected to each motor starter. Meter shall be Hobbs 98000 Series, Redington Model 722, Cramer Model ETI-635 G, or equal.

F. The control panel shall be provided with a lightning and surge protection unit on the line side of the main circuit breaker. Unit shall be 600 Volt, 3 Phase, General Electric "Tranquell" Series, or equal.

G. Where required by Specifications, an alternator shall be provided to sequence motors. Alternator shall be Catalog No. 008-120-13SP or 009-120-23AP by Stacon; Square D, Class 9039, Type HG-21 or equal.

H. Panel mounted timers shall be flush mounted, plug-in type, Eagle Signal Bulletin 125 cycle-flex, Idec SR6P-MO8G or equal, with ranges as shown on the Drawings, or as required by the detailed mechanical equipment specifications.

I. Specific control devices, control descriptions and other data are specified under the detailed specification for the mechanical equipment with which the control panel is supplied.

2.09 PILOT TYPE INDICATING LIGHTS

A. Type: Energy efficient Solid State LED Lamps.

B. Functional:

1. Units shall be provided with low voltage LED lamps suitable for the voltage supplied.

2. Lights supplied with 120V AC power shall have integral reduced voltage transformers.

3. Lamps shall be replaceable from the front of the unit.

C. Physical:

1. Lens color:
   a. Stopped, off, closed – Red.
   b. Running, on, open – Green.
   c. Alarm – Amber.
   d. White - Power on
   e. Blue - All other status indications not covered by the above
   f. Lens caps shall be approximately .46 inch diameter. Provide legend faceplates engraved to indicate the required function of each device; NEMA rating - 4X.

D. Manufacturer(s):

1. Cutler-Hammer.

2. Allen Bradley.

3. General Electric.

4. Square D.

5. Crouse Hinds (NEMA 7).

6. Equal.

2.10 SELECTOR SWITCHES AND PUSHBUTTONS

A. Type:

1. Control devices shall be heavy-duty oil tight type with stackable contact blocks.

B. Functional:

1. Provide contact arrangement and switching action as required for the control system specified.

C. Physical:

1. For 120 VAC service provide contacts rated 10 amps at 120 VAC, for 24 VDC service provide silver sliding contacts rated 5 amps at 125 VDC, for electronic (millivolt/ milliamp) switching provide contacts rated lamp at 28 VDC.

2. Pushbuttons shall have flush type operators.

3. Selector switches shall have knob or wing lever operators; NEMA rating - 4X; Provide legend plates denoting switch/pushbutton position/ function.

D. Manufacturer(s):

1. Cutler-Hammer.
2. Allen Bradley.
3. General Electric.
4. Square D.
5. Crouse Hinds (NEMA 7).
6. Equal.

2.11 POTENTIOMETER

A. Type:

1. Device shall be heavy-duty 30 mm oil tight type.

B. Functional:

1. 270 degree dial
2. Rated for 1,000 ohms.

C. Physical:

1. Mounting: Suitable for panel mounting
2. NEMA 4X rating; escutcheon plates scaled in engineering units.

D. Manufacturer(s):

1. Allen Bradley Co.
2. Cutler-Hammer.
3. Square D.
4. Equal.

2.12 GENERAL PURPOSE RELAYS AND TIME DELAYS

A. Type:

1. General purpose plug-in type.

B. Functional:

1. Contact arrangement/function shall be as required to meet the specified control function; Mechanical life expectancy shall be in excess of 10 million.

2. Duty cycle shall be rated for continuous operation; Units shall be provided with integral indicating light to indicate if relay is energized.

3. Solid state time delays shall be provided with polarity protection (DC units) and transient protection.

4. Time delay units shall be adjustable and available in ranges from .1 second to 4.5 hours.

C. Physical:

1. For 120 VAC service provide contacts rated 10 amps at 120 VAC, for 24 VDC service provide contacts rated 5 amps at 28 VDC, for electronic (milliamp/millivolt) switching applicator provide gold plated contacts rated for electronic service; relays shall be provided with dust and moisture resistant covers.

D. Options/Accessories Required:

1. Provide mounting sockets with pressure type terminal blocks rated 300 volt and 10 amps.

2. Provide mounting rails/holders as required.

E. Manufacturer(s):

1. Allen Bradley.

2. Potter & Brumfield.

3. Equal.

2.13 SIGNAL RELAY SWITCHES (CURRENT TRIPS)

A. Type:

1. Solid state, ASIC technology, electronic type.

B. Functional:

1. Input: 4-20 mA.

2. Output: Isolated contact output, double pole double throw, rated 5 amps at 120 VAC.

3. Accuracy: 0.1 percent.

4. Protection: Provide RFI protection.

5. Deadband: Adjustable between 0.1 and 5.0 percent of span.

6. Set point Adjustment: Single Point alarms shall be adjustable to trip on rising or falling input signal, dual point alarms shall be adjustable to trip on rising and falling input signals.

7. Repeatability: Trip point repeatability shall be at least 0.1 percent of span.

C. Physical:

1. Mounting: DIN rail.

D. Manufacturer(s):

1. Action Instruments Slim Pak.

2. Acromag.

3. Equal.

2.14 SIGNAL ISOLATORS/BOOSTERS/CONVERTERS

A. Type:

1. Solid state, ASIC technology; electronic type.

B. Functional:

1. Accuracy: 0.15 percent.

2. Inputs: Current, voltage, frequency, temperature, or resistance as required.

3. Outputs: Current or voltage as required.

4. Isolation: There shall be complete isolation between input circuitry, output circuitry, and the power supply.

5. Adjustments: Zero and span adjustment shall be provided.

6. Protection: Provide RFI protection.

C. Physical:

1. Mounting: DIN Rail.

D. Manufacturer(s):

1. Action Instruments Slim Pak.

2. Acromag.

3. Equal.

2.15 SIGNAL SELECTORS, COMPUTATION, AND CONDITIONING RELAYS

A. Type:

1. Solid state, ASIC technology, electronic type.

B. Functional:

1. Inputs: 4-20 mA.

2. Outputs: 4-20 mA.

3. Protection: Provide RFI protection.

4. Operation: The relay shall multiply, add, subtract, select, extract the square root, or perform the specified conditioning/ computation function required. All inputs shall be able to be individually rescaled and biased as required.

5. Isolation: All inputs, outputs, and power supplies shall be completely isolated.

6. Accuracy: 0.35 percent of span.

7. Adjustments: Multi turn potentiometer for zero, span, scaling, and biasing.

C. Physical:

1. Mounting: DIN rail.

D. Manufacturer(s):

1. Action Instruments Slim Pak.

2. Acromag.

3. Equal.

2.16 INTRINSIC SAFETY BARRIERS

A. Type:

1. Barriers shall be of the solid state electronic type in which the energy level of the sensing or actuation circuit is low enough to allow safe usage in hazardous areas.

2. Provide a barrier for instrumentation and equipment transmitting analog or digital signals that originate in a hazardous area as indicated in the design documents.

B. Options Required:

1. Barriers shall match power supply provided.

2. Barriers shall be located in non-hazardous areas.

C. Manufacturer(s):

1. Siemens Water Technologies – IS1 (4-20mA) and IS6 (dry contacts)

2. Gems – 54800 (4-20mA) and 65800 (dry contacts)

3. R. Stahl - Intrinspak

4. Equal.

2.17 INTRINSIC SAFETY BARRIERS (FOR 2-WIRE TRANSMITTER SYSTEMS)

A. Intrinsic safety barriers shall be passive devices requiring no external voltage supply and supplied with series resistors, series fuse and shunt zener diodes to limit the transfer of energy to levels required by intrinsically safe protection between safe and hazardous locations.

B. Unit shall be Factory Mutual approved and certified for use in accordance with National Fire Protection Association (NFPA 493).

C. Manufacturer(s):

1. P&F.

2. Gems.

3. Unitech.

4. Equal.

2.18 24 VDC POWER SUPPLIES

A. Provide a 24 VDC power supply in the control panel to power field instruments, panel devices, etc., as required. Equip the power supply with a power on/off circuit breaker.

B. The 24 VDC power supply shall meet the following requirements:

1. Input power: 115 VAC, plus or minus 10 percent, 60 Hz.

2. Output voltage: 24 VDC.

3. Output voltage adjustment: 5 percent.

4. Line regulation: 0.05 percent for 10 volt line change.

5. Load regulation: 0.15 percent no load to full load.

6. Ripple: 3 mV RMS.

7. Operating temperature: 32 to 140 degrees Fahrenheit.

C. Size the 24 VDC power supply to accommodate the design load plus a minimum 25 percent spare capacity.

D. If power supply on/off status signal is shown, provide a relay contact (internal to the power supply or external if the power supply is not so equipped) to indicate on/off status of the power supply.

E. Provide output overvoltage and overcurrent protective devices with the power supply to protect instruments from damage due to power supply failure and to protect the power supply from damage due to external failure.

F. Mount the 24 VDC power supply such that dissipated heat does not adversely affect other panel components.

G. Manufacturer(s):

1. Acopian.

2. Lambda.

3. Equal.

2.19 DIGITAL PANEL METER

A. Type:

1. Electronic, 3.5 digit, 0.56 inch high efficiency LED display.

B. Operation:

1. To accept 4-20 mA DC input signal and provide indication in Engineering Units of measured variable.

C. Functional:

1. Power supply: 115 VAC, plus or minus 10 percent, 50/60 Hz, 10 VA.

2. Input: 4-20 mA DC into 100 ohms.

3. Indication: 0.56 inch LED display.

D. Physical:

1. Case size nominal 2.5 inch high by 5 inch wide by 6 inch deep.

2. Case type: watertight and dust-tight (NEMA 4X).

3. Mounting: flush panel suitable for high density mounting arrangements.

E. Performance: Linear input accuracy plus or minus 0.05 percent of calibrated span, plus or minus 1 count.

F. Manufacturer(s):

1. Precision Digital.

2. Red Lion.

3. Equal.

2.20 SPARE PARTS

A. General requirements for spare parts are specified in section 13300.

B. The following control panel spare parts shall be furnished:

1. Timers and sockets - Two of each type installed.

2. Relays and sockets - Two of each type installed.

3. Fuses and circuit breakers - 10% (minimum of 10 fuses and 2 circuit breakers) of each type and size installed.

4. Light bulbs - 10% (minimum of 10) of each type installed. For LED type lights, 5% (minimum of 3) of each color installed.

5. Panel Mounted power supplies - one of each type installed.

6. Selector switches/pushbuttons - Two of each type installed including contact blocks.

7. Provide touch-up paint, of each type and color used for all cabinets, panels, and consoles supplied.

PART 3 EXECUTION

3.01 INSTALLATION

A. The panels shall be installed at locations as shown on the Contract Drawings.

B. Refer to Section 13300.

3.02 TESTS

A. Refer to Section 13300.

END OF SECTION

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SECTION 13335
INSTRUMENTATION AND CONTROLS - CONTROL PANEL UNINTERRUPTIBLE POWER SUPPLY (SINGLE-PHASE)

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Labor, equipment, supervision and materials for the installation, testing, startup, and training for the uninterruptible power supply (UPS) as shown on the Drawings and as specified herein.

1.02 MEASUREMENT AND PAYMENT

A. No separate payment will be made for work performed under this Section. Include the cost for this work in the lump sum Base Bid Item in Section 00410.

1.03 RELATED WORK

A. Section 16010– Electrical – General Provisions.

B. Section 16140– Wiring Devices.

1.04 SUBMITTALS

A. Submittals shall be in accordance with Sections 01330 and 13300. Submittals shall include shop drawings and product data, for the following:

1. Product brochure.

2. Bill of materials listing all components provided.

3. Deviation list indicating all proposed exceptions.

4. Power single line and control schematics drawings. All external connection details and their terminal block locations shall be fully detailed. All internal wiring shall include terminal numbers and color coding.

5. UPS performance specifications:
   a. kVA rating.
   b. Input and output voltage and phase.
   c. Run time at full and half load.
   d. Voltage (output regulation, input tolerance, unbalance, transfer/retransfer voltage, etc.).
   e. Heat rejection.

6. Operating Instruction manuals and recommended replacement parts.

7. Name, address, and telephone number of the nearest service facility.

8. Training agenda and information per Section 01758. (not in spec book)

9. Battery specifications and warranty.

10. UPS Loading and battery sizing calculations to support runtimes as specified herein.

1.05 REFERENCE STANDARDS

A. ANSI C62.41/IEEE 587 - Standards for Surge Withstandability.

B. FCC (Federal Communications Commission) Rules and Regulations, Part 15, Subpart B, Class A certified compliance.

C. UL (Underwriters Laboratories) 1778 Listed (Rev. Jan 5, 2000), UL497A

D. CSA 22.2, No. 107.1 M95 AND 107.2.

E. IEC 62040-2 Emission and Immunity.

F. IEC 62040-3 (Uninterruptible Power Systems, Part 3).

G. EN 60529 Equipment Protection.

H. National Electric Code (NFPA-70).

I. ISO 9001.

1.06 DELIVERY, STORAGE AND HANDLING

A. Provide delivery, storage and handling in accordance with Section 01600 and per the following:

1. Store the equipment indoors in a clean, dry, heated storage facility until ready for installation. Do not install the equipment in its final location until the facilities are permanently weather tight. Furnish, install and wire temporary electric space heaters in the equipment until the permanent heating equipment is operational. Protect the equipment at all times from exposure to moisture and chemicals.

1.07 QUALITY ASSURANCE

A. UPS systems shall utilize a field proven design. The UPS manufacturer shall demonstrate at least ten years of continuous field operating experience with equipment of similar size and design.

B. A factory authorized service and parts organization shall be located within 100 miles of the project location. Submit the name and address of the factory authorized service and parts organization. The manufacturer shall have a complete selection of service options that may

include onsite service by factory-employed service engineers and factory depot quick-return service plan options.

C. Equipment shall be UL or ETL labeled.

D. The UPS manufacturer shall have ISO 9001 certification.

E. The UPS system shall meet or exceed the theoretical Mean-Time-Between-Failures (MTBF) for a Single module UPS operation (represents UPS module operation only) of 140,000 MTBF hours.

1.08 WARRANTY

A. Refer to Section 01740.

B. UPS: In addition to the basic warranty, the UPS manufacturer shall provide a standard warranty for the UPS for a period of one year from the date of purchase. The Contractor shall provide an additional one year extended warranty to cover delays associated with equipment startup or date of receipt by end user, whichever occurs first.

C. Battery: In addition to the basic warranty, the UPS manufacturer shall provide a standard warranty for the batteries for a period of one year from the date of purchase. The Contractor shall provide an additional one year extended warranty to cover delays associated with equipment startup or date of receipt by end user, whichever occurs first.

PART 2 PRODUCTS

2.01 SINGLE-PHASE UPS - EXTERNAL TO CONTROL PANEL

A. SYSTEM DESCRIPTION

1. Provide a continuous-duty, on-line, solid state, dual conversion, single-phase input (using input voltage as shown on the Drawings), single-phase 120VAC true sinewave output uninterruptible power system.

2. The UPS shall provide power conditioning and power backup for computer, communication, and other critical electronic loads as indicated on the Drawings.

3. The UPS system shall consist of the following major components:
   a. Rectifier and battery charger.
   b. Inverter.
   c. Batteries and battery disconnect switch.
   d. Automatic static bypass switch.
   e. External maintenance bypass switch.
   f. Integral control and monitoring panel.
   g. Other features as described in this Section and as indicated on the Drawings.

4. The UPS shall be manufactured by one of the following:
   a. Liebert GXT2 Series.
   b. Eaton Powerware.
   c. Schneider Electric APC Smart-UPS.
   d. Ametek Solid State Controls
   e. Tripp Lite
   f. Or equal.

B. General Requirements

1. External Battery Enclosure: A separate enclosure shall be provided for housing additional batteries if required to provide the minimum run time as specified herein. The battery enclosure shall match the main UPS enclosure in style and color.

2. All cabling required to interconnect all components of the UPS system shall be provided by the UPS manufacturer.

3. Battery protection shall be provided an internal circuit breaker disconnect. Battery cabinets shall be protected by an internal circuit breaker.

4. Current limiting circuitry shall protect the inverter output under any load condition. High speed semiconductor fusing shall protect the static bypass in the event of an output short circuit.

5. The AC output neutral shall be electrically isolated from the UPS chassis. The UPS chassis shall have an equipment ground terminal. Provisions for installation of a bonding connector shall be provided.

6. The UPS shall be suitable for installation at the location as shown on the Drawings.

C. Performance Requirements - Ratings

1. Battery runtime: Provide batteries to support 125% of calculated load for 20 minutes. Provide additional batteries in separate enclosure as required to meet the runtime requirement.

2. Output power: Provide the minimum recommended kVA ratings for the following UPSs in order to supply the control panels and ancillary equipment shown on the Control System Architecture Diagram and the P&IDs. Confirm UPS ratings below. Rating shall be per UPS submitted load calculations, spare capacity, and runtime requirements as specified herein.

D. Performance Requirements -Environment:

1. Ambient temperature: 0 to 40 degrees C.

2. Elevation: Project site elevation

3. Relative humidity: 0 to 95 percent non-condensing

E. Electrical Requirements:

1. System Input – Primary source:
   a. Single input: Nominal Input Voltage: As shown in the Drawings.
   b. Frequency: 60 Hertz plus or minus five percent.
   c. Input Power Factor: 0.96 lag minimum, 50 to 100 percent load.
   d. Input Current Total Harmonic Distortion (THD): <33 percent.
   e. Input Surge Withstandability: Per IEEE 587/ANSI C62.41. Category A and B, (6 kV).
   f. Input Connection: Coordinate with electrical contractor.

2. System Output:
   a. Nominal Output Voltage: As indicated herein and as shown on the Drawings.
   b. Frequency: 60 Hertz plus or minus 3 Hertz.
   c. 100 percent load with 3:1 Crest Ratio
   d. Frequency Slew Rate: 1 Hz/second. (Adjustable at startup)
   e. Output Connections: (six) NEMA 5-15R receptacles.

3. AC to AC Efficiency: (100 percent load @ rated PF): 91 percent

4. Acoustical Noise: Noise generated by the UPS under normal operation shall not exceed 65 dBA (60 dBA typical) at one meter from any surface, measured at 25 degrees C (77 degrees F) and full load.

5. EMI Suppression: The UPS shall meet FCC Rules and Regulation 47, Part 15, Subpart B, for Class A devices.

F. Modes of Operation

1. Normal Mode: The UPS shall be a continuous online unit. Power to the critical loads shall be continuously generated by the inverter during normal AC line power. In the event of AC line power failure, power to inverter is supplied by the batteries. Under normal operation, the batteries shall be charged in a manner that optimizes battery life. Simple "trickle charge" of the batteries shall not be acceptable.

2. Bypass Mode: The automatic bypass shall transfer the critical load to the commercial AC source, bypassing the UPS' inverter/rectifier, in the case of an overload, load fault, or internal failure.

3. Maintenance Mode: If a Maintenance Bypass switch is provided, the external manual bypass switch shall be operated to transfer the load to the alternate source when the UPS is taken out of service for maintenance or repair. This transfer shall occur without interruption.

G. Controls

1. Microprocessor-controlled circuitry: Fully automatic operation of the UPS shall be provided through the use of a microprocessor-based controller. All operating and protection parameters shall be firmware-controlled. The logic shall include system test capability to facilitate maintenance and troubleshooting. Startup, battery charging, and transfers shall be automatic functions.

2. Graphical Display: The UPS control panel shall utilize an LED graphical display for all UPS control, monitoring, alarming, configuration and diagnostic functions. The following operational controls and indicators shall be provided on the UPS control panel per the following KVA ranges:

3. 3 to 6 KVA Indicators:
   a. Battery in operation status
   b. Load on Inverter status
   c. Load on By-Pass status
   d. AC input status
   e. UPS malfunction alarm
   f. LED AC Input Meter
   g. LED Battery Meter
   h. AC input voltage (line to line)
   i. AC input current (each phase)
   j. AC input power (kW, KVA and power factor)
   k. DC battery voltage
   l. Battery current (charge and discharge)
   m. AC output voltage (line to line and line to neutral)
   n. AC output current (each phase)
   o. AC output frequency
   p. AC output power (kW, KVA and power factor)
   q. Diagnostic Alarms: Specific details for all UPS alarms and status parameters shall be indicated on the graphical panel for diagnosis.

H. Remote alarm and status indication: Isolated SPDT Form C dry contacts shall be provided to indicate UPS status for remote monitoring. Contacts shall be rated for 250VAC @ 5A or 30VDC @ 5A. Individual contacts shall be provided for separate annunciation of the following alarm and status conditions:

1. UPS Normal (UPS is using utility power to power the load and detects no faults)

2. UPS in Static bypass mode

3. UPS using battery to power the load

4. UPS on battery and battery low

5. If a maintenance bypass switch is provided, provide a contact from that switch to indicate UPS in Maintenance Bypass mode.

I. ENCLOSURES

1. All UPS equipment shall be housed in a free standing NEMA 1 enclosure(s). The enclosures shall line up and match in style and appearance.

2.02 SINGLE PHASE UPS - INTERNAL TO CONTROL PANELS

A. SYSTEM DESCRIPTION

1. Provide an industrially rated continuous-duty, on-line, solid state, line interactive, single-phase uninterruptible power system.

2. The UPS shall provide power conditioning and power backup for PLC, communications hardware, and other critical electronic loads as indicated on the Drawings.

3. The UPS shall be
   a. Allen Bradley 1609-U UPS
   b. Sola Hevi Duty SDU UPS
   c. Or equal

B. GENERAL REQUIREMENTS

1. Battery protection shall be provided an internal circuit breaker disconnect.

2. Current limiting circuitry shall protect the inverter output under any load condition.

3. The AC output neutral shall be electrically isolated from the UPS chassis. The UPS chassis shall have an equipment ground terminal. Provisions for installation of a bonding connector shall be provided.

4. The UPS shall be suitable for installation in a UL508A listed panel.

5. The UPS shall be DIN rail mountable.

6. UL recognized components for industrial applications in accordance with UL508 without derating.

C. PERFORMANCE REQUIREMENTS

1. Ratings
   a. Output power: 350VA – 800VA
   b. Battery runtime: 14 minutes at full-load, 34 minutes at half-load

2. Environment:
   a. Ambient temperature: 0 to 40 degrees C.
   b. Elevation: Up to 500-ft above mean sea level
   c. Relative humidity: 1 to 95 percent non-condensing

3. System Input – Primary source:
   a. Single input: Nominal Input Voltage: 120 VAC
   b. Frequency: 45 to 65 Hz.
   c. Input Power Factor: 0.95 lag minimum, 50 to 100 percent load.
   d. Input Surge Withstandability: Per IEEE 587/ANSI C62.41. Category A and B, (6 kV).

4. System Output:
   a. Nominal Output Voltage:120 VAC
   b. Frequency: 60 Hertz plus or minus 3 Hertz.
   c. 100 percent load with 3:1 Crest Ratio
   d. Frequency Slew Rate: 1 Hz/second. (Adjustable at startup)

5. AC to AC Efficiency: (100 percent load @ rated PF): 88 percent online, 86 percent on battery.

6. Acoustical Noise: Noise generated by the UPS under normal operation shall not exceed 65 dBA (60 dBA typical) at one meter from any surface, measured at 25 degrees C (77 degrees F) and full load.

7. EMI Suppression: The UPS shall meet FCC Rules and Regulation 47, Part 15, Subpart J, for Class A devices.

D. MODES OF OPERATION

1. The UPS shall operate as a line interactive on-line, fully automatic system in the following modes:
   a. Normal: The critical load shall be continuously supplied with filtered and regulated AC power by the inverter. The rectifier/battery chargers shall derive power from the preferred AC source and supply DC power to the inverter while simultaneously floats charging the batteries.
   b. Emergency: Upon failure of the preferred ac power source, the critical load shall continue to be supplied by the inverter. Inverter power shall be supplied without switching from the storage battery. There shall be no interruption to the critical load upon failure or restoration of the preferred ac sources. If the AC source cannot be restored before the battery discharges to its low voltage dropout value, the UPS shall automatically shut itself down in an orderly manner.
   c. Recharge: Upon restoration of the AC source, the rectifier/battery charger shall power the inverter and simultaneously recharges the batteries. This shall be an automatic function causing no interruption to the critical load.

E. RECTIFIER/CHARGER

1. The term rectifier/charger shall denote the solid-state equipment and controls necessary to convert incoming AC power to regulated DC power for input to the inverter and for battery charging. The rectifier/charger shall be a solid-state SCR/IGBT power transistor type with constant voltage/current limiting control circuitry.

F. INVERTER

1. The inverter shall include all solid-state equipment and controls to convert DC power from the rectifier/charger or battery to a regulated AC power for powering the critical load. The inverter shall use Insulated Gate Bipolar Transistors (IGBTs) in a phase-controlled, pulse width modulated (PWM) design capable of providing the specified AC output.

2. The inverter shall be capable of supplying current and voltage for overloads exceeding 100 percent. The inverter is to provide 150 percent of full load for 30 seconds and 125 percent of full load for 2 minutes. A status indicator and audible alarm shall indicate overload operation.

3. The output voltage shall be maintained to within plus or minus 5 percent.

4. The output voltage total harmonic distortion (THD) shall not be greater than 5 percent at full load.

G. CONTROLS AND MONITORING

1. Microprocessor-controlled circuitry: Fully automatic operation of the UPS shall be provided through the use of a microprocessor-based controller. All operating and protection parameters shall be firmware-controlled. The logic shall include system test capability to facilitate maintenance and troubleshooting. Startup, battery charging, and transfers shall be automatic functions.

2. Front Indicators: As a minimum, the following indicators shall be provided on the UPS control panel:
   a. On-line (UPS is using utility power to power the load)
   b. In bypass mode
   c. On battery
   d. Overload
   e. Replace battery / battery disconnected
   f. Fault
   g. Bar graph for utility voltage
   h. Bar graph for battery

3. Front Panel Controls: As a minimum, the following controls shall be provided on the UPS control panel
   a. Power On/Off
   b. Self-test
   c. Alarm silence
   d. Cold start
   e. Load off

2.03 24VDC UNINTERRUPTIBLE POWER SUPPLY

A. Type:

1. 24 VDC uninterruptible primary switched mode power supply unit.

B. Operation:

1. To provide uninterrupted 24VDC power to the output upon loss of input power.

2. When the 24 V supply voltage is applied, the connected battery module is charged.

3. In the event of a supply voltage failure, the battery module is connected to the output, and the stored power ensures that all connected devices continue to operate without interruption. The UPS supplies a 24V DC voltage with a load current up to 10 A.

C. Functional:

1. Input voltage range: 22.5-30 VDC

2. Nominal Output Voltage: 24VDC

3. Output Current: 10A

D. CONTROLS

1. Dry contacts shall be provided for remote monitoring of UPS conditions:
   a. UPS on battery
   b. Fault

E. Physical:

1. Mounting: horizontal DIN rail mounting

2. Operating temperature range: 0-50 C

3. Degree of protection: IP20

F. Performance: The UPS shall provide a minimum of 15 minutes of run time for the calculated full load. The unit may have either internal or external batteries as necessary to support the runtime requirements.

G. Manufacturer(s):

1. Phoenix Contact Quint Series

2. Siemens SITOP Series with signaling contact module

3. Sola HD Series

4. Or equal

PART 3 EXECUTION

3.01 INSTALLATION

A. Install and connect the equipment in accordance with the manufacturer's instructions.

B. Remove temporary lifting angles, lugs and shipping braces.

C. Touch up damaged paint finishes.

3.02 FACTORY TESTING

A. Prior to shipment, the complete UPS system shall undergo the manufacturer's standard factory test.

3.03 FIELD TESTING

A. Perform the following minimum test and checks:

1. Verify that all connections are completed in accordance with shop drawings.

2. Verify supply voltage and phase sequence are correct.

3. Check mechanical interlocks for proper operation.

4. Test ground connections for continuity and resistance.

5. Check control circuit interlocking and continuity.

B. Submit the test plan for review and approval.

C. For UPSs rated 3-6kVA, the manufacturer's field service technician shall perform startup and adjustment of the UPS in accordance with the manufacturer's written instructions. Submit a copy of the field report containing verification of all startup tests and adjustments performed.

D. The Contractor shall include testing of battery runtime under full load with loss of AC power.

E. Perform all additional tests required by Section 16950 Electrical Acceptance Testing.

F. In the event of an equipment fault, notify the Engineer immediately. After the cause of the fault has been identified and corrected, a joint inspection of the equipment shall be conducted by the Contractor, the Engineer and the equipment manufacturer's factory service technician. Repair or replace the equipment as directed by the Engineer.

3.04 ADJUSTMENT

A. Make all UPS adjustments necessary for manual and automatic operation of the entire system.

3.05 CLEANING

A. Remove all rubbish and debris from inside and around the equipment. Remove dirt, dust, or concrete spatter from the interior and exterior of the equipment using brushes, vacuum cleaner, or clean, lint free rags. Do not use compressed air.

3.06 TRAINING

A. Provide training of staff in accordance with Section 01755 and Section 13303.

END OF SECTION

SECTION 13340
INSTRUMENTATION AND CONTROLS – INSTRUMENTS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. This section covers the furnishing, installation, and services for instruments.

B. Refer to Section 13300.

1.02 MEASUREMENT AND PAYMENT

A. No separate payment will be made for work performed under this Section. Include the cost for this work in the lump sum Base Bid Item in Section 00410.

1.03 RELATED WORK

A. Refer to Section 13300.

B. Section 13341 through Section 13346.

1.04 SUBMITTALS

A. Submit complete documentation of all field instruments using ISA-TR20.00.01-2001 (updated in 2004-2006) data sheet formats. Submit a complete Bill of Materials (BOM) or Index that lists all instrumentation equipment. The list shall be sorted by Loop Number.

B. Submit separate data sheets for each instrument including:

1. Plant Equipment Number and ISA tag number per the Drawings.
2. Product (item) name used herein and on the Drawings.
3. Manufacturer's complete model number.
4. Location of the device.
5. Input - output characteristics.
6. Range, size, and graduations in engineering units.
7. Physical size with dimensions, enclosure NEMA classification and mounting details in sufficient detail to determine compliance with requirements.
8. Materials of construction for enclosure and wetted parts.
9. Instrument or control device sizing calculations where applicable.

10. Certified calibration data for all flow metering devices.

11. Two-wire or four-wire device type as applicable.

C. Submit catalog cuts for all instruments. Submit descriptive literature for each hardware component, which fully describes the units being provided.

D. Submit index and data sheets in electronic format as well as hard copies on 8-1/2" x 11" formats. Electronic format shall be in Microsoft Excel or Word. Submit electronic copy on CD-ROM or DVD disk.

1.05 MAINTENANCE

A. Refer to Section 13300.

B. Test equipment.

1.06 INSTRUMENT TAGS

A. A permanent stainless steel or other non-corrosive material tag firmly attached and permanently and indelibly marked with the instrument tag number, as indicated in the Drawings, shall be provided on each piece of equipment supplied under this Section and related sections. Equipment shall be tagged before shipping to the site.

B. Provide 1/8-in by 3/8-in, Type 316 stainless steel button head machine screws.

C. All supplied instrument transmitters and instrument transmitter elements shall have a stainless steel identification tag attached to each transmitter and element prior to shipment. Tag shall be attached via stainless steel chain or stainless steel wire (24 gauge min) to a non-removable part of the device. The tag size shall be a minimum of 1.5 square inches. Tag shall include the ISA alphanumeric instrument number as indicated in the P&ID, loop, and detail drawings. The alphanumeric instrument number shall be stamped into the tag and shall have a minimum of 3/16-in high alphanumeric characters.

1.07 APPROVALS/CERTIFICATIONS

A. Instruments for hazardous locations shall have Factory Mutual (FM), Canadian Standards Association (CSA), and CENELEC approvals and certifications as specified herein and as indicated on the Drawings or in the Instrument Device Schedule. The instrument specifications in Part 2 state the Class, Division, and gas groups for FM/CSA approval, followed in parenthesis by the CENELEC certification; however, instruments provided are only required to have the approval/certification stated above. The instrument shall have a stainless steel tag identifying the relevant approval or certification.

1.08 MANUFACTURERS' START-UP AND TRAINING SERVICES

A. If indicated in the individual instrumentation paragraphs, the instrument manufacturer or manufacturer's certified service representative shall provide start-up and training services. This work shall not be done by the PCSS or AESS contractor.

B. The start-up services shall be to calibrate, oversee the installations of the sensor, and start-up the sensor/transmitter in order to provide reliable measurement at the instrument and to a remote system. The vendor shall work with the PCSS and AESS to verify the transmitter sends correct information to the remote system (i.e., that the scaling and units are the same at the instrument and on the remote operator interface).

C. While the instrument manufacturer or manufacturer's certified service representative is starting up the instrumentation, training shall be provided to the Owner's instrumentation technicians. The training shall be in how to calibrate, install, troubleshoot, read the diagnostics, and maintain the sensor and transmitter.

PART 2 PRODUCTS

2.01 MAGNETIC FLOWMETER

A. Flow Element

1. Type:
   a. Flow meter shall provide a signal which is linear to the liquid flow rate.

2. Function/Performance:
   a. Power requirements: Match to converter/ transmitter.
   b. Accuracy: Plus or minus 0.5 percent of rate (including converter/transmitter).
   c. Temperature rating: Suitable for process liquid temperature up to 70 degrees C and an ambient of 65 degrees C.
   d. RFI protection: Provide RFI protection.
   e. Pressure rating: 240 psig if 150 lb flanges are used, 700 psig if 300 lb flanges are used.
   f. Additional: Meter shall be capable of running empty indefinitely without damage to any component.

3. Physical:
   a. Metering Tube: Type 304 stainless steel or equivalent.
   b. Flanges: ANSI 150 lb. or DIN PN 16 carbon steel, as required by the piping system, unless otherwise indicated. ANSI 150 lb. or DIN PN 16 stainless steel flanges shall be used on all SS process pipes.
   c. Liner: Polyurethane or composite elastomer unless otherwise indicated on the Drawings or in the Instrument Device Schedule.
   d. Electrodes: Type 316 stainless steel standard minimum requirements. All electrodes to be compatible with process fluid as indicated on the Drawings or electrodes to be supplied as listed in the Instrument Device Schedule.

e. Housing: For meters with remote mounted transmitters, meters below grade shall be suitable for submergence for up to 48 hours to a depth of 30 ft (9m). Meters above grade shall be NEMA 4X (IP65). Where hazardous areas are indicated on the Drawings, the equipment shall be rated for that area.
f. Finish: All external surfaces shall have a chemical and corrosion resistant finish.

4. Power Requirements:
   a. Meter shall be 24 VDC powered instrument, receiving its power from transmitter.

5. Accessories/Documentation Required:
   a. Factory calibration: All meters shall be factory calibrated. A copy of the calibration report shall be included in the O&M manual.
   b. Grounding: Meter shall be grounded in accordance with the manufacturer's recommendation. Provide ground ring, ground wires, gaskets, etc., as required. All materials shall be suitable for the liquid being measured and must be compatible with process fluid and with the process pipe.
   c. For meters with remote mounted transmitters, signal cable for installation between the flow tube and the transmitter. Length shall be as required by installation as indicated on the Drawings.

B. Flow Converter/Transmitter

1. Type:
   a. Micro-processor based, intelligent transmitter compatible with flow tube provided.
   b. Integral mount or mounted remote from the flow tube as shown on the drawings or as required by the physical location.

2. Functional/Performance:
   a. Accuracy (including flow tube): Plus/minus 0.5 percent of flow rate or better.
   b. Operating Temperature: –20 to 140 degrees F.
   c. Output: Isolated 4-20 mA with HART protocol. Current output adjustable over the full range of the instrument. Provide a dry contact to indicate reverse flow.
   d. Diagnostics: Self diagnostics with on screen display of faults.
   e. Display: Digital indicator displaying flow in engineering units indicated in the Instrument Device Schedule.
   f. Totalizer: A fully configurable totalizer integral to the transmitter. Totalized flow shall be displayed.
   g. Empty Tube Zero: The transmitter shall include a feature that will lock the output at zero when no flow is detected. The empty tube zero feature shall be enabled automatically when the transmitter detects no flow or manually through a contact input.
   h. Provide electrode cleaning unit to match flow element requirements.

3. Physical:
   a. Transmitter shall be suitable for surface or pipe stand mounting.
   b. Enclosure shall be NEMA 4X (IP65).

4. Power Requirements:
   a. The transmitter shall be 120 VAC powered instrument.

5. Accessories/ Required:
   a. Keypad where required for transmitter configuration.

C. Manufacturer:

1. Rosemount.

2. Siemens.

3. Endress+Hauser

2.02 ULTRASONIC FLOW METER

A. Flow Element: Ultrasonic flow meters will be installed on the 30-inch temporary bypass pipes and used to monitor filter backwash water flow during the time period when the existing filter backwash pipe and flow meter are bypassed for removal of pipe couplings.

1. Type:
   a. Transit-time ultrasonic microprocessor-based flow/velocity meter.

2. Fuction/Performance
   a. Accuracy: +/- 10.0%
   b. Linearity: +/- 0.25%
   c. Repeatability: 0.25%
   d. Range: 40 to 0.1 ft./sec.
   e. Turndown: 400:1
   f. The sensors shall be designed for use in Class I, Division I, Groups A, B, C, & D hazardous areas.

3. Physical:
   a. Strap on sensor with mounting rails.
   b. Sensors: Anodized Alum./Ultem®/PVC
   c. Strap-on hardware Anodized Aluminum
   d. Pipe Diameter 1" to 120"
   e. The sensors shall be corrosion resistant and be supplied with 50 ft. of cable.
   f. All mounting hardware for the sensors shall be provided.

4. Power Requirements:
   a. Meter shall be 24 VDC powered instrument, receiving its power from transmitter.

B. Flow Converter/Transmitter

1. Type:
   a. Transit-time ultrasonic microprocessor-based flow/velocity meter

2. Functional/Performance:
   a. Accuracy: +/- 10.0%
   b. Linearity: +/- 0.25%
   c. Repeatability: 0.25%
   d. Range: 40 to 0.1 ft./sec.
   e. Turndown: 400:1
   f. Temperature: -4° F to 158° F (-20° C to 70° C)
   g. Outputs: 4-20 mA One analog isolated into 800 ohms max, monitored to detect open circuits. RFI and gas discharge surge protection and two fuses.
   h. Relay Alarms 1 standard, SPDT relay (plug-in) 0.25A @ 120 VAC or 0.50A @ 24 VDC
   i. RS-232 Serial Port 1200-38400 Baud, Modbus RTU protocol

3. Physical:
   a. Enclosure: Nema, 4, 4X polycarbonate (9.25" x 8.87" x 5.38")

4. Power Requirements:
   a. Power: 90 to 240 VAC, 50/60 Hz

C. Manufacturer:

1. Eastech Flow Controls Model 4400-AS1. No approved equal.

2. Contact for supply and installation support:
   a. Frank Clark
      Frank Clark & Associates, Inc.
      6080 South Hulen Street
      Suite 360, PM 390
      Fort Worth, TX 76132
      Phone: 817-307-8730
      Fax: 817-394-2343
      Email: frankc@sbcglobal.net

2.03 PRESSURE INDICATING TRANSMITTER

A. Type

1. Loop powered 2-wire, 24 volts direct current.

2. Process Pressure Indicating Transmitters: Provided with microprocessor electronic circuitry and process suitable wetted parts.

B. Function/Performance:

1. Accuracy: Within 0.10 percent of calibrated span including combined effects of linearity, hysteresis, and repeatability.

2. Rangeability: 10 to 1 with negligible effect on accuracy from static atmospheric pressure changes and 0 to 100 degrees Centigrade.

3. Transmitter Output: 4-20 milliampere direct current into 650 ohm load without need for external load adjustments.

4. Overrange Protection: To maximum process line pressure.

5. Adjustments: Electronic zero and span, and elevated or suppressed zero as required by application.

C. Physical:

1. Housing: NEMA 4X, weatherproof corrosion-resistant with operating temperature from 0 to 220 degrees Fahrenheit and relative humidity of 0 to 100 percent.

2. Local Indicators: Scaled in Engineering units, calibrated to required range.

D. Manufacturers:

1. Rosemount.

2. Endress+Hauser

3. Siemens

2.04 PRESSURE SWITCH

A. Type:

1. Diaphragm actuated.

B. Function/Performance:

1. Repeatability: Better than 1 percent of full scale.

2. Setpoint: Field adjustable and set between 30 and 70 percent of the adjustable range.

3. Dead Band: Fixed unless adjustable dead band requirement is noted in the Instrument Device Schedule.

4. Reset: Unit shall be of the automatic reset type unless noted otherwise in the Instrument Device Schedule.

5. Over Range Protection: Over range protection to 150 percent of the maximum process line pressure.

6. Output: Single pole double throw (SPDT) unless requirement for double pole double throw (DPDT) switch is shown on the instrument device schedule. Switch rating shall be 10 A at 230 VAC.

C. Physical:

1. Housing: NEMA 4X (IP65) for non-hazardous areas. For installation in hazardous areas, housing shall be explosion proof approved for Class 1, Division 1, Groups C and D (EEx d IIB).

2. Switch Assemblies: Hermetically sealed switches.

3. Wetted Parts: Type 316L stainless steel diaphragm, viton seals, Type 316 stainless steel connection port.

D. Accessories/Options Required:

1. Shutoff Valve: Provide a Type 316 stainless steel shutoff valve. Valve shall be by D/A Manufacturing, Anderson Greenwood, or Equal.

2. Where indicate on the instrument device schedule, provide a Type 316 stainless steel snubber for pulsation dampening.

E. Manufacturer(s):

1. Ashcroft.

2. Rosemount.

3. Endress+Hauser

4. Siemens

2.05 PRESSURE GAUGE

A. Type:

1. Bourdon tube actuated dial face pressure gauge.

B. Function/Performance:

1. Accuracy: Plus or minus 1.0 percent of span or better.

C. Physical:

1. Case: Phenolic shock resistant or Type 316 stainless steel for surface/stem mounting with a pressure relieving back. The case shall be vented for temperature/atmospheric compensation. Gauge shall be callable of being liquid filled in the field or at the factory.

2. Window: Clear acrylic or shatter proof glass.

3. Bourdon tube: Stainless steel.

4. Connection: 1/2 in. NPT.

5. Gauge size: Minimum 4-in. viewable.

6. Pointer travel: Not less than 200 degrees not more than 270-degree arc.

7. Range: As indicated in the instrument device schedule. Range may include inches of water vacuum.

D. Accessories/Options Required:

1. Shutoff valve: Each gauge shall have a process shutoff valve that can also be used as an adjustable pressure snubber.

2. Special scales: Engineer reserves the right to require special scales and/or calibration if the manufacturer's standard is not suitable for the application.

3. Gauges listed as liquid filled in the instrument device schedule shall be liquid filled at the factory.

E. Manufacturer(s):

1. Ashcroft.

2. Ametek US Gauge.

2.06 CHLORINE RESIDUAL ANALYZER

A. Type:

1. Microprocessor based electronic transmitter/converter with a submersible membrane type sensor.

B. Function/Performance:

1. Power Requirements: 115 V, 60 Hz supply.

2. Operating Range: Selectable 0 to 1; 0 to 5; 0 to 10 ppm chlorine. Internal battery will maintain sensor polarization in the case of power failure.

3. Signal Output: Isolated 4-20 mA

4. Accuracy: Plus/minus 3 percent full scale.

5. Alarms: Two adjustable Form C contact closure alarms rated 5 amps at 24V DC/250V AC.

6. Response: 90 percent in 20 seconds.

7. Repeatability: 0.05 ppm CL.

8. Diagnostics: Shall have built-in self diagnostics and display operational errors and equipment malfunctions.

C. Physical:

1. Transmitter/Converter Enclosure: NEMA 4X.

2. Display: LCD with .7-in high characters.

3. Sensor Material: PVC body, gold cathode, silver anode, or other noble metal electrodes and chlorine permeable membrane.

4. Mounting: Sensor shall be installed for pipe or handrail mounting, or installed for flow through tee applications as indicated on the instrument device schedule. Electronics case shall be suitable for pipe, unistrut, or wall mounting as required.

5. Options/Accessories Required:
   a. Provide a complete handrail mounting system or flow through tee mounting system as required by the instrument device schedule to meet the application. The handrail mounting system shall include PVC mounting pipe (length as required) and stainless steel mounting hardware. The flow through tee mounting system shall include all flow regulators, pressure regulators, shutoff valves, sample pumps, etc, as detailed or required for complete operational system.
   b. Provide sensor cable of sufficient length for installation without splices between the sensor and transmitter.
   c. Where the Drawings, instrument device schedule, or manufacturer indicate that the sensor will be subject to both free chlorine and combined chlorine in the water/wastewater being measured, the Contractor shall supply the necessary sample conditioning required to monitor total chlorine residual.
   d. Provide one full year spare supply of any expendable items such as reagents, chemicals, membranes, etc, as required for the analyzer furnished.

6. Manufacturer(s):
   a. Hach Model CL 17

2.07 SPARE PARTS AND ACCESSORIES

A. General requirements for spare parts are specified in Section 13300.

B. The following field Instrument related Spare Parts shall be furnished:

1. One Hach Datalogger - sc200 Universal Controller: 100-240 V AC with two digital sensor inputs and two 4-20 mA outputs

2. One flow indicating transmitter for each type of flow element provided.

3. One temperature transmitter for each type provided.

4. One pressure transmitter for each type provided.

5. One spare ultrasonic level switch for each type provided.

6. One spare float type level switch for each type provided.

7. Miscellaneous: One year supply of items recommended by the manufacturer of the equipment including all reagents, pH probes, batteries, chart paper, calibration standards as needed to operate and maintain the furnished equipment.

C. The following accessories shall be furnished:

1. All mounting hardware required for pipe stand, surface, or other mounting shall be provided.

2. Each instrument shall be provided with a manufacturer installed stainless steel tag identifying the instrument tag number.

PART 3 EXECUTION

3.01 GENERAL

A. See execution requirements in Section 13300.

B. Unless specifically indicated, direct reading or electrical transmitting instrumentation shall not be mounted on process piping. Instrumentation shall be mounted on instrument racks or stands. All instrumentation connections shall be provided with shutoff and drain valves. For differential pressure transmitters, 5-valve manifolds for calibration, testing and blow down service shall also be provided. For chemical or corrosive fluids, diaphragm seals with flushing connections shall be provided.

END OF SECTION

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SECTION 13900
PUMP OPERATION AND OPTIMIZATION SOFTWARE

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, equipment, materials, and appurtenances required to deliver and install equipment and services to perform automated pump asset management and optimization for the existing High Service Pump Station at the NEWPP. The asset management function shall enable routine, automated pump testing to track high service pump condition over time for enhanced maintenance scheduling and decision-making. The optimization function shall continually compute the most efficient combinations of the high service pumps and speeds to maximize energy efficiency while meeting flow and pressure demands. The optimization function shall ensure that all the high service pumps are operated within their Preferred Operating Range (POR) to extend pump life.

1.02 MEASUREMENT AND PAYMENT

A. No separate payment will be made for work performed under this Section. Include the cost for this work in the lump sum Base Bid Item in Section 00410.

1.03 RELATED WORK

A. Instrumentation and control work, and system architecture, except as specified herein, is included in Division 13 and further defined in the Instrumentation Drawings.

B. Instrumentation and Controls Testing is included in Section 13301.

C. Application Engineering Services are included in Section 13306.

D. Electrical work is included in Division 16.

1.04 SUBMITTALS

A. Submit to the Engineer shop drawings of all items and accessories in accordance with the requirements of Section 01330.

B. Submittals shall include:

1. Product Data
   a. Submit manufacturer's product data

2. Record Documents:
   a. Shop Drawings are required, with the following:
      1) Control Panel Elevation drawings showing dimensional information.
      2) Structural descriptions showing:
         a) Enclosure ratings

b) Other information as required for approval
3) Power and control connection diagram(s) including conduit locations
4) Schematic wiring diagrams

1.05 REFERENCE STANDARDS

A. The latest published edition of a reference shall be applicable unless identified by a specific edition date.

B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.

C. All materials, installation, and workmanship shall comply with the applicable requirements and standards addressed within the following references:

1. ANSI/NEMA ICS 6 – Enclosures for Industrial Controls and Systems

2. NEMA 250 – Enclosures for Electrical Equipment

3. NEMA ICS 2 – Industrial Control Devices, Controllers, and Assemblies

4. NFPA 70 – National Electrical Code

1.06 VENDOR QUALIFICATION

A. Vendor Qualifications: All primary equipment and services specified in this section shall be supplied by a single vendor with a minimum of four (4) years' experience in pump optimization and asset management for water pump stations. When requested by the engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.

1.07 DEFINITION

A. Commission – To verify that the equipment is installed correctly and able to perform the desired functions.

B. Specific Energy – A metric defined as the ratio of the units of energy required by a process to the amount of work performed by the process or the amount of product that the process produces. For water systems, it is convenient to use units of kilowatt-hours per million gallons of water (kWh/MG).

C. Programmable Logic Controller (PLC) – A computer that may be programmed to automate electromechanical processes. A PLC may be used at a pump station to start and stop pumps based on station conditions.

D. Adjustable Speed Drive (ASD) – Electrical power equipment that may be used to drive the motor of a pump. An ASD can vary the frequency of power provided to a pump's motor to vary the pump's speed.

1.08 WARRANTY

A. Vendor shall replace, at no cost to owner, any physical equipment or components that fail during first 24 months of licensed service from date of Substantial Completion.

PART 2 PRODUCTS

2.01 VENDORS

A. The asset management and optimization equipment and services, as specified in this section, shall be the Dynamic Pump Optimizer (DPO) hardware, and Asset Management Suite and Optimization Suite software as supplied by Specific Energy, Inc. (specificenergy.com; contact Perry Steger or Dave Pierce at 512-930-9415), Georgetown, Texas, or Engineer approved equal.

2.02 GENERAL

A. The equipment shall perform asset management and pump optimization functions.

1. The asset management function shall enable routine automated pump testing to track the plant high service pump condition over time for enhanced maintenance scheduling and decision-making.

2. The optimization function shall continually compute the most efficient combinations of the plant high service pumps and speeds to maximize energy efficiency while meeting flow and pressure demands. The optimization function shall ensure that all pumps are operated within their Preferred Operating Range (POR) to extend pump life.

B. Results from asset management and optimization functions shall be presented via a graphical operator interface that is independent of plant's SCADA system.

2.03 ASSET MANAGEMENT FUNCTIONS

A. Pump Monitoring

1. The graphical operator interface shall display each pump's real time flow, head, and power consumption on its tested pump curves.

2. The graphical operator interface shall display real-time operating data for each pump in the station. The real-time operating data shall include, but is not limited to the following:
   a. Shaft Power
   b. Motor Voltage
   c. Motor Current
   d. Adjustable Speed Drive (ASD) Speed
   e. Flow
   f. Head
   g. Pump Efficiency

B. Data Storage

1. The equipment shall transmit operating data to a remote, secure server in a HIPAA-compliant colocation facility to be stored in a historical database.

2. In the case that a connection is lost to the database, the equipment shall store data locally until the connection is reestablished and the data can be resynchronized.

3. The stored data shall be available to view on the graphical operator interface.

4. The stored data shall be available to download as a comma-separated values (CSV) file.

C. Reporting

1. The equipment shall produce and deliver monthly reports by email to a list of email addresses provided by the City.

2. The reports shall include each pump's tested pump curves, financial asset management analysis, and operational data.

2.04 OPTIMIZATION FUNCTIONS

A. Efficiency Optimization

1. The equipment shall calculate predicted flow, discharge pressure, specific energy, and power consumption for each combination of pumps over a range of operating speeds.

2. The graphical operator interface shall display the calculated flow, discharge pressure, specific energy, and power data.

3. The equipment shall determine the set of pumps and speeds that will operate the pump station at minimal specific energy while satisfying operational constraints.
   a. The equipment shall provide the High Service Pump Station PLC3 with recommended set of pumps and speeds that will operate the pump station at minimal specific energy for the current set of operational constraints.
   b. The equipment shall display the pumps and speeds that will operate the pump station at minimal specific energy for the current set of operational constraints on the graphical operator interface.

4. The equipment shall determine if a combination of pumps and speeds will operate one or more pumps in the pump station outside of their Preferred Operating Range (POR).
   a. The equipment shall display the sets of pumps and speeds that cause one or more pumps to operate outside of their Preferred Operating Range on the graphical operator interface.
   b. The equipment shall recommend pump combinations and speeds that do not cause one or more pumps to operate outside of their Preferred Operating Range.

2.05 EQUIPMENT

A. Furnish a controller with pre-programmed asset management software and optimization software installed.

B. Furnish a NEMA 12 enclosure complete with required power, computation, and communication devices preconfigured on the interior panel. This enclosure shall contain a power supply, uninterruptible power supply (UPS), industrial-rated computer, and cellular modem.

C. Furnish a communication antenna with suitable cables and connectors that will be installed by the Contractor.

2.06 SECURITY

A. The equipment shall include access control policies and procedures, including:

1. Unique user ID for each user

2. Password for each user with a system to ensure password strength

3. Certificate based authentication

B. The equipment shall encrypt all communication that extends beyond the City's local network.

PART 3 EXECUTION

3.01 INSTALLATION

A. Prior to providing equipment to Contractor, Vendor shall individually test each piece of equipment.

B. Contractor shall mount the Vendor's NEMA 12 enclosure inside the new High Service Electrical Building at the location as shown on the Drawings.

C. Contractor shall furnish and install power and communication wiring between the Vendor's enclosure and the High Service Pump Station PLC3 cabinet.

D. Contractor shall furnish and install separate power and communication conduits connecting Vendor's enclosure to the High Service Pump Station PLC3 cabinet.

E. Contractor shall furnish and install a Siemens Scalance S612 Industrial Ethernet Security Module 6GK5-612-0BA10-2AA3 with all necessary wiring or Engineer approved equal.

F. Contractor shall furnish and install a dedicated 15A circuit breaker wired from or through the PLC3 cabinet to supply power to the Vendor's equipment.

G. Contractor shall install a conduit with CAT5e Ethernet cable between the Vendor enclosure and the PLC3 cabinet. Contractor shall use this cable to connect the Ethernet Security Module's

Wide Area Network in the PLC3 cabinet to the controller in the Vendor's enclosure in accordance with the Vendor's installation instructions.

H. Contractor shall install a conduit with three 12 AWG conductors between the Vendor enclosure and the PLC3 cabinet. Contractor shall connect these to a dedicated 120V AC, 15A circuit breaker and terminate them at the Vendor's equipment in accordance with the Vendor's installation instructions. Conductors shall be colored as follows:

1. Black – 120V AC Line
2. White – 120V AC Neutral
3. Green – 120V AC Ground

I. The Contractor shall mount the Vendor's cellular antenna on the exterior of the building as shown on the Drawings, making the connection using antenna cable and connectors provided by the Vendor.

J. Contractor shall install the Ethernet Security Module in the PLC3 cabinet. Contractor shall connect power to the device and connect the module's Local Area Network to an Ethernet switch in the PLC3 cabinet.

3.02 COMMUNICATION

A. Vendor shall configure the Ethernet Security Module. The module shall be configured to allow no incoming connections from the Wide Area Network and shall have no configured VPN. There shall be a single permitted connection from the Local Area Network that allows the PLC's IP address on a specific port to connect to the Vendor's equipment's IP address on a specific port.

B. The equipment shall communicate with the High Service Pump Station PLC3 that is located inside the new High Service Electrical Building to receive real-time flow, pressure, power, and pump operation commands and speeds. Contractor's AE or AESS shall configure the PLC3 to establish a TCP (Transmission Control Protocol) connection to the Vendor's equipment through the Ethernet Security Module.

C. Contractor's AE or AESS shall configure the PLC3 to write the following values to the Vendor's equipment at least once per second:

1. Ground Storage Tank levels including GST 1 and GST 2
2. High Service Pump Station Suction Pressure measured by a pressure transmitter on the common high service pump suction header
3. Station Discharge Pressure measured by a pressure transmitter on the high service pump discharge header
4. Station Flow measured by a flow transmitters on the high service pump discharge headers

5. Running status for each pump
6. Motor Power for each pump
7. Motor Voltage for each pump
8. Motor Current for each pump
9. For each pump with an ASD, ASD Input power
10. For each pump with an ASD, ASD Actual Speed
11. For each pump with an ASD, ASD At Speed Status
12. For each pump with an ASD, ASD Fault status
13. Discharge Pressure setpoint

D. Contractor's AE or AESS shall configure the PLC to read the following values from the Vendor's equipment at least once a second:

1. Start request for each pump
2. For each pump with an ASD, ASD Requested Speed
3. Current Station Specific Energy Consumption
4. Percent of Optimal Specific Energy Consumption
5. Specific Energy Deviation Cost in Dollars Per Year

E. Prior to PLC configuration, the Contractor's AE and Vendor shall conduct a workshop to coordinate data transfer and register between the PLC3 and Vendor's equipment:

3.03 SCADA MODIFICATIONS

A. Contractor's AE or AESS shall modify plant's SCADA system HMI to display a modifiable Discharge Pressure setpoint. When changed, this value will update the value written to the Vendor's equipment through TCP communication with the PLC.

B. Contractor's AE or AESS shall modify City's SCADA system HMI to display next to owner's pump controls the start and speed requests read from the Vendor's equipment.

C. Contractor's AE or AESS shall modify City's SCADA system HMI to display near the pump controls the Specific Energy Consumption, Percent of Optimal Specific Energy Consumption, and Specific Energy Deviation Cost metrics read from the Vendor's equipment.

3.04 PUMP TESTING

A. Upon completion of new pump control valves, ASDs, pump discharge piping modifications and associated improvement works, and successful demonstration of a functional high service pump and valve system, pump testing shall be conducted.

B. Vendor shall conduct initial pump testing to acquire pump test curves for each high service pump after completion of the installation. Vendor will coordinate with the City CM and DWOs to generate test data suitable for calculating initial pump test curves while satisfying the station's pressure constraints.

1. Vendor will coordinate with the City CM and DWOs to run each ASD pump against every other pump at three different speeds in remote manual mode. Each speed must differ by at least 5 Hz from the previous speeds.

2. The pump testing shall consist of operating a given pump at a range of operating points on its pump curve while collecting total pump station flow, suction header pressure, discharge header pressure, and per-pump power data at each operating point. The collected data shall be used to form head versus flow and efficiency versus flow curves for each pump.

3. Subsequent to pump testing, the Vendor's graphical operator interface shall display results of pump tests for each pump in the pump station.

C. Pump test curves shall be automatically recomputed every 90 days using the system operation data. If needed, the Vendor may periodically coordinate with the City to collect additional test data to calculate updated pump curves.

3.05 SUPPORT

A. Vendor shall supervise equipment installation and provide on-site support services up to four (4) trips for the duration of licensed service.

B. Vendor shall provide software updates to improve asset management and optimization functions and add new features for the duration of licensed service.

C. Vendor shall provide an operator training session for a duration of 8 hours after completion of the installation.

D. The first 24 months of maintenance and support shall be included with the original installation.

E. Subsequent support and maintenance shall be provided by Vendor under a separate agreement with the City if desired by the City.

3.06 EQUIPMENT AND SERVICE COMMISSIONING

A. Vendor shall provide qualified and trained personnel to inspect the installed equipment, conduit and conductors to ensure the equipment has been installed properly and in accordance with Vendor's recommendations.

B. Subsequent to a satisfactory installation, Vendor shall demonstrate the following before commissioning the equipment and beginning service.

1. Confirmation of correct values displayed on the City's SCADA HMI for each of the points as specified herein (read by PLC from DPO).

2. Confirmation of correct signal values displayed on the Vendor's HMI (accessible via a secure connection from a web browser) for each of the IO points as specified herein (written by PLC to from pump operation and optimization software).

3. Demonstration of the logging and displaying of historical data (flow, pressures, pump status and speeds, pump powers).

4. Demonstration that the factory pump head and power curves have been correctly entered in the DPO.

5. Demonstration that the DPO has acquired field-tested pump head and power curves.

C. If the system fails to fulfill the performance required by the requirements specified, corrective measures shall be taken and retested to assure full compliance with this Section. All costs associated with any required corrective action, shall be borne by the CONTRACTOR.

END OF SECTION

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SECTION 15051
PIPING - GENERAL REQUIREMENTS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. This Section specifies the basic administrative and testing requirements for piping. Specific piping materials, systems and related installation and testing requirements are specified in other Sections of Division 2 and 15.

1.02 MEASUREMENT AND PAYMENT

A. No separate payment will be made for work performed under this Section. Include the cost for this work in the lump sum Base Bid.

1.03 RELATED WORK

A. Piping materials and systems are included in other Sections of Division 2 and 15.

B. Valves are included in Section 15100.

1.04 SUBMITTALS

A. Submit, in accordance with Section 01330, general submittals for piping and piping systems are listed below. It is not intended that all submittals listed below be provided for all piping materials and systems. Refer to individual System or Piping Sections for specific submittals.

B. Shop Drawings and Product Data

1. Piping layouts in full detail.

2. Location of pipe hangers and supports.

3. Location and type of backup block or device to prevent joint separation.

4. Large scale details of wall penetrations and fabricated fittings.

5. Schedules of all pipe, fittings, special castings, couplings, expansion joints and other appurtenances.

6. Catalog cuts of joints, couplings, harnesses, expansion joints, gaskets, fasteners and other accessories.

7. Brochures and technical data on coatings and linings and proposed method for application and repair.

C. Samples

D. Design Data

E. Test Reports

1. Copies of certified shop tests showing compliance with appropriate standard.

2. Copies of all field test reports, signed by Contractor and Engineer or City Representative.

F. Certificates

1. Copies of certification for all welders performing work in accordance with ANSI B31.1.

G. Manufacturer's Installation (or application) instructions.

H. Statement of Qualifications

I. Manufacturers Field Report

J. Project Record Document

K. Operation and Maintenance Data in accordance with Section 01730.

L. Warranties

1.05 REFERENCE STANDARDS

A. American Society for Testing and Materials (ASTM)

1. ASTM A307 - Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength

B. American National Standards Institute (ANSI)

1. ANSI B16.5 - Pipe Flanges and Flanged Fittings

2. ANSI B31.1 - Power Piping

C. American Welding Society (AWS)

1. AWS B2.1 - Specification for Welding Procedure and Performance Qualifications

D. American Water Works Association (AWWA)

1. AWWA Manual M11 - Steel Pipe - A Guide for Design and Installation

E. American Society of Mechanical Engineers (ASME)

F. Underwriters Laboratories (UL)

G. Factory Mutual (FM)

H. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.06 QUALITY ASSURANCE

A. All materials shall be new and unused.

B. Install piping to meet requirements of local codes.

C. Provide manufacturer's certification that materials meet or exceed minimum requirements as specified. Reference to standards such as ASTM and ANSI shall apply to those versions in effect at the time of bid opening.

D. Coordinate dimensions and drilling of flanges with flanges for valves, pumps and other equipment to be installed in piping systems. Bolt holes in flanges to straddle vertical centerline.

E. Reject materials contaminated with gasoline, lubricating oil, liquid or gaseous fuel, aromatic compounds, paint solvent, paint thinner and acid solder.

F. Pipe joint compound, for pipe carrying flammable or toxic gas, must bear approval of UL or FM.

G. Unless otherwise specified, pressures referred to in all Piping Sections are expressed in pounds per square in gauge above atmospheric pressure, psig and all temperature are expressed in degrees Fahrenheit (F).

1.07 DELIVERY, STORAGE AND HANDLING

A. During loading, transportation and unloading take care to prevent damage to pipes and coating. Carefully load and unload each pipe under control at all times. Place skids or blocks under each pipe in the shop and securely wedge pipe during transportation to ensure no injury to pipe and lining.

PART 2 PRODUCTS

2.01 MATERIALS

A. Specific piping materials and appurtenances are specified in the respective Piping or System Sections.

B. General installation materials shall be as specified below.

1. Unions shall be brass or bronze unions for joining nonferrous pipe; malleable brass or bronze seated iron or steel unions for joining ferrous pipe; PVC unions for joining PVC pipe; CPVC unions for joining CPVC pipe.

2. Flanged Joints. Bolt and nuts, Grade B, ASTM A307 Type 304 stainless steel, bolt number and size same as flange standard; studs - same quality as machine bolts; 1/16-in thick rubber gaskets with cloth insertions; rust resistant coatings. Refer to individual pipe specifications for additional details.

3. Temporary Plugs shall be standard plugs or caps which are suitable for permanent service.

4. Wall Sleeve Seals shall be a specified in Section 01172.

5. Flexible Connections shall be flanged spool type, 180 degree F maximum service, single filled arch with synthetic rubber tube and cover, steel ring reinforced synthetic fiber carcass, with flanges drilled to 150 lb ANSI B16.5. Steel retaining rings, control rods and compression sleeves shall be provided where shown and as required for the working pressure of the system in which the joint is installed. All flexible joints shall be rated for the working pressure of the system in which they are installed. Refer to individual pipe specifications for additional details.

PART 3 EXECUTION

3.01 GENERAL

A. All dirt, scale, weld splatter, water and other foreign matter shall be removed from the inside and outside of all pipe and subassemblies prior to installing. Repair all coatings if damaged.

B. All pipe joints and connections to equipment shall be made in such a manner as to produce a minimum of strain at the joint.

C. Install piping in a neat manner with lines straight and parallel or at right angles to walls or column lines and with risers plumb. Run piping so as to avoid passing through ductwork or directly under electric light outlets and/or interference with other lines or extending beyond furring lines as determined by Architectural Drawings. All work shall be accomplished using recognized methods and procedures of pipe fabrication and in accordance with the latest revision of applicable ANSI Standards, ASME Codes and Pipe Fabrication Institute Standards.

1. Use full length of pipe except where cut lengths are necessary. Do not spring or deform piping to make up joints.

2. Pipe shall be cut square, not upset, under-size or out of round. Ends shall be carefully reamed and cleaned before being installed.
   a. Bending of pipe is not permitted. Use fittings for all changes in direction.

3. Do not use bushings except where specifically approved by the Owner's Representative. Reducers shall be eccentric to provide for drainage from all liquid bearing lines and facilitate air removal from water lines.

4. Verify the locations and elevations of any existing piping and manholes before proceeding with work on any system. Any discrepancies between the information shown on the Drawings and the actual conditions found in the field shall be reported at once to the

Owner's Representative. No claim for extra payment will be considered if the above provision has not been complied with.

5. Where lines of lower service rating tie into services or equipment of higher service rating the isolation valve between the two shall conform to the higher rating.

6. Mitering of pipe to form elbow is not permitted.

7. All piping interiors shall be thoroughly cleaned after installation and kept clean by approved temporary closures on all openings until the system is put in service. Closures should be suitable to withstand the hydrostatic test.

8. End caps on pre cleaned pipe shall not be removed until immediately before assembly. All open ends shall be capped immediately after completion of installation.

D. Test Connections

1. Provide 1/2-in female NPT test connection equipped with 1/2-in brass plug on all pump suction and discharge lines. Where indicated on the Drawings, test connections should be equipped with bar stock valve and gauge. Provide test connections at all steam traps. The connection shall be located on the discharge side of the trap between the trap and the first valve. It shall consist of a 1/2-in branch connection terminated with a gate valve.

E. Unions

1. Unions screwed or flanged shall be provided where indicated and in the following locations even if not indicated.
   a. In long runs of piping to permit convenient disassembly for alterations or repairs.
   b. In by passes around equipment.
   c. In connections to tanks, pumps and other equipment between the shut off valve and the equipment.
   d. In connections on both sides of traps, controls and automatic control valves.

F. Vents and Drains

1. Provide vents and drains in the following places:
   a. Water Lines - Vents at high points and drains at low points.
   b. Air Lines - Drains at low points.

3.02 UNIONS

A. Use unions to allow dismantling of pipe, valves and equipment.

3.03 WELDING

A. Welding in accordance with ANSI B31 and AWS B3.0.

B. Install welding fittings on all welded lines. Make changes in direction and intersection of lines with welding fittings. Do not miter pipes to form elbows or notching of straight runs to form tees, or any similar construction. Do not employ welder who has not been fully qualified in above specified procedure and so certified by approved welding bureau or similar locally recognized testing authority.

3.04 FLANGED JOINTS

A. Make flanged joints with bolts; bolt studs with nut on each end; or studs with nuts where one flange is tapped. Use number and size of bolts conforming to same ANSI Standard as flanges. Before flanges pieces are assembled, remove rust resistant coating from machined surfaces, clean gaskets and smooth all burrs and other defects. Make up flanged joints tight, care being taken to prevent undue strain upon valves or other pieces of equipment.

3.05 SLEEVE COUPLINGS

A. Install tierods, pipe clamps or bridles when sleeve type couplings or fittings are used in piping system where indicated, and at changes in direction or other places as necessary, to prevent joints from pulling apart under pressure. Use bridles and tierods at least 3/4-in in diameter, except where tierods replace flange bolts of smaller size, in which case fit with nut on each side of pair of flanges. Joint harnessing shall conform, as a minimum, to the requirements for the bolts and tie bolt lugs as set forth in AWWA Manual M11.

3.06 WALL SLEEVE SEALS

A. Use expandable rubber segmented sealing device with corrosion resistant fasteners to make watertight the annular space between pipe and sleeve. Determined the required inside diameter of each individual wall opening or sleeve to fit the pipe and seal it to assure a watertight joint as recommended by the manufacturer, before ordering, fabricating or installing. Install pipe concentrically through wall sleeve. Install and tighten seal per manufacturer's instructions.

3.07 TESTING

A. Test all pipelines for water/gas tightness as specified in the Piping or System sections. Furnish all labor, testing plugs or caps, pressure pumps, pipe connections, gauges and all other equipment required. Testing shall be performed in accordance with one or more of the testing procedures appended to this Section as specified in each Piping or System Section. All testing shall be performed in the presence of the owner's representative.

B. Repair faulty joints or remove defective pipe and fittings and replace as approved by the Engineer. Retest.

3.08 DISINFECTION

A. After satisfactory testing, all potable, and plant water collection and distributed systems downstream of the filters shall be thoroughly disinfected per Section 02514 as applicable.

END OF SECTION

HYDROSTATIC TEST

SCOPE: This test shall be used to hydrostatically test piping systems for structural integrity and leaks. The test shall be performed at ambient temperature unless otherwise specified. Refer to City of Houston Standard Specification 02515 for additional requirements related to Hydrostatic Testing of Pipelines.

1.0 TEST FLUID

1.1 Water should be used as the test fluid whenever possible. In those systems where water cannot be used the test fluid may be either the one to be used in the system or the one agreed upon by the Engineer and the Contractor.

2.0 TEST EQUIPMENT

2.1 Water - Of sufficient capacity to deliver the required test pressure.

2.2 Strainer - On inlet side of the pump to prevent foreign matter from entering the system.

2.3 Valves - Shall be provided on the suction and discharge side of the pump.

2.4 Heater - To allow heating of the test fluid when elevated temperatures are required for test.

2.5 Relief Valve - Set at a pressure to relieve at 20 to 25 percent above the required test pressure.

2.6 Pressure Gauge(s) - Capable of reaching 50 percent over the test pressure. These should be located at the pump discharge and any other place deemed convenient by the Contractor.

2.7 Pressure gauges and relief valves shall be checked for accuracy before use in test procedures.

3.0 PREPARATION FOR TEST

3.1 Prior to the start of the hydrostatic test, all water system pipelines shall be disinfected per Section 02514.

3.2 Determine the fluid to be used for the test, and, if other than ambient temperature is required, what the test temperature will be.

3.3 When a fluid other than water is used for a test, the equipment used for the test shall be of a material compatible with the test fluid. Normally this would be equal to the piping material.

3.4 Vents shall be provided at the high points of the system and drains provided where means of venting or draining do not exist.

3.5 Remove or block off, all relief valves, rupture discs, alarms, control instruments, etc, that shall not be subjected to the test pressure.

3.6 All discs, balls, or pistons from check valves shall be removed if they interfere with filling of the system. Open all valves between inlet and outlet of the section to be tested.

3.7 Connect pump and provide temporary closures for all of the external openings in the system. Use caution to ensure that the closures are properly designed and strong enough to withstand the test pressure.

3.8 All joints, including welds, are to be left uninsulated and exposed for examination during test.

3.9 A joint previously tested in accordance with this Section may be covered or insulated.

3.10 Piping designed for vapor or gas shall be provided with additional temporary supports, if necessary, to support the weight of the test liquid.

3.11 Expansion joints shall be provided with temporary restraint for additional pressure under test or shall be isolated from the test.

3.12 Flanged joints, where blanks are inserted to isolate equipment during the test, need not be tested.

3.13 Water for testing will be obtained from the plant utility water loop. Prior to hydrostatic testing, Contractor shall furnish and install a reduced pressure backflow preventer and a transient meter at the take-off location.

3.14 Test pipelines with maximum lengths between valves or plugs of 2,000 linear feet for pipe diameters 20-inches or smaller and 4,000 linear feet for pipe diameters 24-inches or larger.

4.0 TEST PRESSURE

4.1 The hydrostatic test pressure shall be 1-1/2 times the design pressure unless otherwise specified in the System Section.

5.0 TEST PROCEDURE

5.1 Allow the test fluid to enter the system. Open vents to allow displacement of all entrapped air. For all pipelines exceeding 500-ft in length, the maximum rate of filling shall be limited to that which produces a maximum nominal flow velocity of one foot per second in the pipe to be tested.

5.2 Close vents and restrict personnel in the test area to those involved in the test.

5.3 Raise the pressure slowly with the pump until the predetermined test pressure is reached. Maintain pressure for duration of time specified in System Section, keeping personnel at a safe distance.

5.4 Reduce the pressure about 20 percent and hold it at that point while the entire system is carefully inspected for leaks, cracks, or other signs of defects.

5.5 If defects are found, the pressure shall be released, the system drained, the defects corrected and the test repeated.

5.6 After a satisfactory test has been completed, the line shall be drained.

6.0 FLUSHING

6.1 Lines tested with water shall be completely drained.

6.2 Lines shall be flushed, after test.

7.0 TEST RECORDS

7.1 Records shall be maintained of all tests performed.

7.2 Test records shall include:

A. Date of Testing

B. Identification of Piping Tested

C. Test Fluid

D. Test Pressure

E. Signatures of Contractor and Owner's representative

7.3 If leaks are found, they shall be noted, on the record. After correction, retesting as specified for original test.

7.4 Records of test shall be maintained by the Contractor and copies furnished to the Engineer in accordance with Section 01330.

SERVICE PRESSURE TEST

SCOPE: This test shall be used to test piping systems using service pressure and the fluid for which the system is used.

It shall not be used to test piping systems conveying combustible or flammable liquids or systems that comply with ANSI B31 codes.

1.0 TEST FLUID

1.1 The fluid for which the system is designed shall be the test fluid.

2.0 TEST EQUIPMENT

2.1 A pressure gauge capable of registering 25 psi over the design pressure shall be installed down-stream from the supply shut-off valve if one is not included in the system.

3.0 PREPARATION FOR TEST

3.1 Insulated lines shall have all joints left exposed until completion of the test.

4.0 TEST PRESSURE

4.1 The test pressure shall be equal to the maximum pressure that the line will be subjected to under normal operating conditions as determined by the Engineer.

5.0 TEST PROCEDURE

5.1 Liquids

5.1.1 See that all personnel not involved in the test vacate the area.

5.1.2 Allow the system fluid to enter the system slowly while venting the air at the extreme far and uppermost points. For all pipelines exceeding 500-ft in length, the maximum rate of filling shall be limited to that which produces a maximum nominal flow velocity of one foot per second in the pipe to be tested.

5.1.3 When the system is full and all air is vented, close the vents.

5.1.4 Allow the pressure in the system to build up to the full line pressure.

5.1.5 Inspect entire system for leaks.

5.2 Gas or Vapor (Including Compressed Air and Steam)

5.2.1 See that all personnel not involved in the test vacate the area.

5.2.2 In systems that do not have a pressure gauge near the main shut-off valve, a gauge shall be installed.

5.2.3 Allow the system fluid to enter the system slowly until the full operating pressure is reached.

5.2.4 Shut off main supply valve. Observe the gauge for 15 minutes. The pressure gauge shall not drop during this time.

5.2.5 If the gauge drops, indicating the presence of leaks, the systems shall be inspected visually and, if necessary, with soap suds or commercially available leak detectors to locate the leak(s).

5.3 If leaks are found, the lines shall be relieved of pressure, purged if necessary, and repaired. Tests shall be repeated for repaired sections.

6.0 TEST RECORDS

6.1 Records shall be maintained of all tests performed.

6.2 Test records shall include:

A. Date of Testing

B. Identification of Piping Tested

C. Test Fluid

D. Test Pressure

E. Signatures of Contractor and Owner's representative.

6.3 If leaks are found, they shall be noted on the record. After correction, retesting is required.

6.4 Test records shall be maintained by the Contractor and copies furnished to the Engineer in accordance with Section 01330.

PNEUMATIC TEST

SCOPE: This procedure for a pneumatic test of piping systems shall be used when water, or other liquid, cannot be introduced into the line, or as a supplement to a hydrostatic test.

IT SHALL NOT BE USED TO TEST NON-METALLIC (PLASTIC) PIPE.

1.0 GENERAL

1.1 There is a hazard in using gases for test fluids because of their compressibility.

1.2 Gases shall never be used unless there is ample justification and always in a safe manner. See Paragraph 3.0.

2.0 TEST GASES & PRESSURES

2.1 Compressed air shall normally be used. Other gases may be used when specified or directed by the Engineer.

2.2 Test pressures shall be 110 percent of the anticipated maximum operating pressure, but not exceeding 100 psig and not less than 5 psig at the highest point in the system.

3.0 SAFETY

3.1 All pneumatic tests shall be done under the supervision of Contractor and in the presence of the Engineer.

3.2 New Construction: The Engineer's permission shall be secured before testing.

3.3 Renovation Projects: The Owner representative and the Engineer must be informed and their permission secured before testing.

3.4 Only those people actively participating in the test shall be allowed in the test area.

3.5 Safety glasses and hard-hats must be worn.

4.0 EQUIPMENT

4.1 Building supply air to deliver the required test pressure if available, or Contractor shall provide a compressor capable of the required test pressure.

4.2 Valves shall be provided on the discharge side of the pump.

4.3 Relief valve to relieve at 10 to 15 percent over the test pressure.

4.4 Pressure Gauge(s) capable of reaching 50 percent over the test pressure. A gauge shall be located on the pump discharge and other location as required.

5.0 TEST PROCEDURE

5.1 Increase the pressure in the line gradually, in steps, to the specified pressure. Checks shall be made at 25 psig and at 10 psig intervals until the test pressure is reached using sound, soap solution or a drop in indicated pressure.

5.2 When the specified pressure for the test is reached, shut off the valve in the supply line from the pump.

5.3 Maintain the test pressure long enough to visually inspect all joints or a minimum of 10 minutes. There shall be no drop in the test pressure in this time.

5.4 Leaks shall be repaired and the line retested. All leaks shall be noted on the Test Record form.

5.5 After satisfactory completion of the test, vent the line and allow it to return to atmospheric pressure. Connection can then be made to the supply line.

6.0 TEST RECORDS

6.1 Records shall be maintained of all tests performed.

6.2 Test records shall include:

A. Date of Testing

B. Identification of Piping Tested

C. Test Fluid

D. Test Pressure

E. Signatures of Contractor and Owner's Representative

6.3 If leaks are found, they shall be noted on the record. After correction, retesting is required.

6.4 Test records shall be maintained by the Contractor and copies furnished to the Engineer per 01330.

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SECTION 15061
STEEL PIPE AND FITTINGS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals required to install test, and clean all steel pipe and fittings of 6 inches and smaller; black or galvanized, for services as shown on the Drawings and as specified herein.

1.02 MEASUREMENT AND PAYMENT

A. No separate payment will be made for work performed under this Section. Include the cost for this work in the lump sum Base Bid Item.

B. Payment for extra unit price work shall be as defined in the extra unit price schedule.

1.03 RELATED WORK

A. Valves and appurtenances are included in Section 15100.

B. Piping Specialties are included in Section 15120.

C. Pipe hangers and supports are included in Section 15140.

1.04 SUBMITTALS

A. Furnish shop drawings, product data, design calculations, and test reports as described below and in accordance with Section 01330.

1. Certified copies of mill tests confirm the type of materials used in steel plates, mill pipe flanges, and bolts and nuts to show compliance with the requirements of the applicable standards.

2. Large-scale complete and dimensional working AutoCAD drawings of all pipe layouts. Shop drawings shall include the grade of material, size, wall thickness of the pipe and fittings, type and locations of fittings, and the type and limits of the lining and coating systems of the pipe and fittings. Submit cleaning and testing procedures to be used and photocopy excerpts from referenced standards.

3. Product data to show compliance of all couplings, supports, fittings, coatings, and related items.

4. Fabrication dimensions and accuracy of fabrication are Contractor's responsibility.

1.05 REFERENCE STANDARDS

A. Specifications of the American Society for Testing and Materials (ASTM) listed below shall apply to this Section.

1. A53 – Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless, 1997.

2. A105 – Carbon Steel Forgings for Piping Applications, 1997.

3. A106 – Seamless Carbon Steel Pipe for High-Temperature Service, 1997.

4. A120 – Pipe, Steel, Black, and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless, for Ordinary Uses, 1997.

5. A181 – Carbon Steel Forgings for General Purpose Piping, 1995.

6. A182 – Forged or Rolled Alloy-Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service, 1997.

7. A193 – Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service, 1997.

8. A194 – Carbon and Alloy-Steel Nuts for Bolts for High Pressure and High-Temperature Service, 1997.

9. A216 – Steel Castings, Carbon, Suitable for Fusion Welding for High-Temperature Service, 1993.

10. A234 – Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures, 1997.

11. A320 – Alloys Steel Bolting Materials for Low-Temperature Service, 1995.

12. A333 – Seamless and Welded Steel Pipe for Low-Temperature Service, 1994.

13. A351 – Castings, Austenitic, Austentic-Ferritic (Duplex) for Pressure Containing Ports, 1994.

14. A352 – Steel Castings, Ferritic and Martensitic, for Pressure Containing Parts, Suitable for Low-Temperature Service, 1993.

15. A420 – Piping Fittings of Wrought Carbon Steel and Alloy Steel for Low-Temperature Service, 1996.

B. Specifications of the American National Standards Institute (ANSI) listed below shall apply to this Section.

1. B1.1 – Unified Inch Screw Threads (UN and UNR Thread Form) 1989.

2. B16.5 – Pipe Flanges and Flanged Fittings, 1996.

3. B16.9 – Factory-Made Wrought Steel Buttwelding Fittings, 1998.

4. B16.11 – Forged Steel Fittings, Socket-Welding and Threaded, 1996.

5. B16.34 – Valves - Flanged, Threaded and Welding End, 1996.

6. B18.2.1 – Square and Hex Bolts and Screws (Inch Series), 1996.

7. B18.2.2 – Square and Hex Nuts (Inch Series), 1987.

8. B31.3 – Process Piping, ANSI/ASME Code for Pressure Piping, 1996.

9. B36.10 – Welded and Seamless Wrought Steel Pipe, 1996.

10. BPV-IX – Welding and Brazing Qualifications, Section IX, ASME Boiler and Pressure Vessel Code, 1998.

1.06 QUALITY ASSURANCE

A. All steel pipe and fittings shall be furnished by manufacturers who are fully experienced, reputable and qualified in the manufacture of the items to be furnished. The equipment shall be designed, constructed, and installed in accordance with the best practices and methods and shall comply with this Section as applicable.

B. Steel pipe and fittings shall conform to all applicable standards of ASTM or ANSI.

C. Welding of pipe must be performed by qualified individuals currently experienced in the specific metallurgy. Procedures and welder qualifications must be in accordance with ANSI/ASME BPV-IX (13.2.10) and ASME B31.3 (13.2.8). Care must be taken to insure the use of proper welding procedures, correct filler metal and adequate preheat or post heat treatment especially where allow steel piping is used.

1.07 SYSTEM DESCRIPTION

A. Refer to Drawings for location of specific systems.

PART 2 PRODUCTS

2.01 MATERIALS

A. Description. Pipe shall comply with the applicable standard depending on the proposed piping system as designated by the pipeline sizes shown on the Drawings.

B. Specific components (e.g., piping, fittings, gaskets, nuts and bolts, valves, etc.) Have been organized into service classes according to the operating pressure and temperature of the chlorine gas and liquid. These service classes are as follows:

C. Method of Manufacture

1. Black or galvanized steel pipe may be seamless, electro-resistance welded or furnace-welded.

D. Weight or Wall Thickness

1. Black or galvanized steel pipe shall be standard weight (Schedule 40) or extra heavy weight (Schedule 80) depending on service.

E. Diameter. Nominal pipe diameter shall be as shown on the Drawings. Unless otherwise specified, the diameter shall be as follows:

1. Black or galvanized steel pipe – diameter shall be per ASTM A120.

F. All steel pipe and fittings shall be manufactured domestically.

2.02 FITTINGS

A. Threaded

1. Malleable iron fittings shall comply with FS WW-P-521, Type 1 for use with black steel pipe and Type 2 for use with galvanized steel pipe.

2. Forged steel fittings shall comply with ANSI B16.11 for extra heavy weight piping.

B. Welded

1. Forged steel fittings shall comply with ANSI B16.11.

2. Butt-welded fittings shall comply with ANSI B16.9.

2.03 FLANGES

A. Flanges shall comply with the requirements of ANSI B16.1, Class 125.

B. Gaskets for other than air service shall be cloth-inserted rubber, 1/8-inch thick. Gaskets shall be full face. Gaskets for air service shall be 1/8-inch thick, constructed of elastomers suitable for temperatures to 250°F. Gaskets shall be full face.

C. Flanges shall be flat faced with a serrated finish.

2.04 COUPLINGS

A. Grooved or Shouldered Type Coupling (Split Coupling) for galvanized piping system only.

1. Grooved or shouldered couplings may be used as an alternate to flanged couplings with the Engineer's approval.

2. Couplings shall be Victaulic Style 77 or 41. Joints shall be flexible unless otherwise shown to be rigid.

3. Gaskets for couplings on air service piping shall be suitable for use up to 250°F.

2.05 UNIONS

A. Unions shall be malleable iron complying to FS WW-U-531, Class 1, Type A for use with black steel pipe and Type B for use with galvanized steel pipe. Use dielectric union where specified.

2.06 FLANGE BOLTS AND NUTS

A. Use Type 316 stainless steel when required by Drawings or buried service, otherwise use ASTM A307, Grade B, ANSI B18.2.1. Bolts to extend past nut at least 3 threads but not more than 5 threads maximum.

PART 3 EXECUTION

3.01 PIPE JOINTS

A. Threaded

1. Comply with ANSI B2.1, NPT. For chlorine service, comply with the recommendations of the Chlorine Institute.

2. Cut threads full and clean with sharp dies, with not more than three threads exposed at each connection.

3. Ream ends of pipe after threading and before assembly to remove burrs.

4. Use joint compound or thread tape on male threads only. After having been set up, a joint must not be backed off unless the joint is completely broken, the threads cleaned, and new compound applied.

B. Welded

1. All welds shall be sound and free from embedded scale or slag, shall have tensile strength across the weld not less than that of the thinner of the connected sections, and shall be watertight.

C. Flanged

1. Tighten flange bolts so gasket is uniformly compressed and sealed.

2. Do not distort flanges.

3. Flange bolts shall be coated with anti-seize compound.

D. Grooved or Shouldered Type Couplings (Split Couplings) for galvanized pipe system only.

1. Cut grooves clean and sharp without burrs or chuck marks.

2. Ream end of pipe after grooving and before assembly to remove burrs.

3. Pipe shall be free of indentations, projections, or roll marks from the end of pipe to the groove to provide a leak-tight seat for the gasket.

4. Lubricate gasket with manufacturer's furnished lubricant prior to assembly.

5. Split couplings used in lieu of flanges shall be of the rigid type.

3.02 INSTALLATION

A. Piping Exposed, 3 Inches and Smaller

1. Piping Layout
   a. Make provisions for expansion and contraction during normal operations.
   b. Provide unions to permit removal of equipment and valves.
   c. Provide dielectric unions for connection of copper piping.

2. Cut pipe from measurements taken at the site, using Drawings as guide.

3. Water Piping: Arrange so system can be completely drained.

4. Air Piping: Grade to points of drainage collection.

3.03 PIPE SUPPORTS

A. Provide supports as shown on the Drawings and as specified in Section 15140.

B. Provide additional supports as required to support piping such that its weight is not supported by the equipment.

3.04 PROTECTIVE COATING

A. Exterior Surfaces. See specification Sections 09901 and 09915.

B. Internal Lining Systems: Supply steel pipe with either epoxy lining or cement-mortar lining.

1. Where specified, the interior of the pipe shall be coated with an NSF 61-approved epoxy lining, in accordance with AWWA C210. The lining shall be applied in two coats achieving a minimum dry film thickness of 16 mils. The epoxy-lining shall be Tnemec Series 22 or; FC-22 or equal.

2. Where specified, the interior of the pipe shall be cement mortar lined in accordance with AWWA C205, shop applied. Field repair of cement mortar lining after field cutting or welding shall be in accordance with AWWA C602. Fabricated pipe and fittings shall be

cement mortar lined after fabrication. Apply a seal coat of asphaltic material in conformance with AWWA C203 over the cement mortar lining. Seal coat for potable water piping shall be NSF61 approved.

3.05 CLEANING

A. Keep inside of all pipe, fittings, and valves clean and free from dirt and debris.

B. Thoroughly blow all lines before cleaning.

3.06 TESTING

A. Furnish all necessary equipment and labor for carrying out a pressure test on the pipelines. The procedures and method for carrying out the pressure tests shall be approved by the Engineer. The test gauge shall have minor graduations no greater than one percent of the specified test pressure.

B. Make any taps and furnish all necessary caps, plugs, etc., as required in conjunction with testing a portion of the pipe between valves. Furnish a test pump, gauges, and any other equipment required in conjunction with carrying out the tests.

C. Contractor to remove items such as rupture discs, pressure gauges, and other items that may be damaged during testing.

D. All galvanized steel pipe shall be hydrostatically tested. Testing shall take place in the presence of the Engineer. If leaks are discovered, they shall be repaired at no additional cost to the Owner and approved by the Engineer.

E. Pneumatic testing involves the hazard of released energy stored in compressed gas. The test pressure shall be 110% of design pressure. The pressure shall be increased until a gage pressure that is the lesser of one half the test pressure or 25 psig is attained, at which time a preliminary check shall be made. The pressure should be gradually increased and leak check made at intermediate pressures.

3.07 LABELING

A. Labeling of pipe shall be in accordance with Section 15120.

END OF SECTION

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SECTION 15064
PVC & CPVC PIPE AND FITTINGS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals required and install 1/8 inch to 6 inch PVC and CPVC piping and appurtenances as shown on the Drawings and as specified herein.

1.02 MEASUREMENT AND PAYMENT

A. No separate payment will be made for work performed under this Section. Include the cost for this work in the lump sum Base Bid Item.

1.03 RELATED WORK

A. Buried piping is included under Division 2.

B. Concrete work is included in Division 3.

C. Valves and appurtenances are included in Section 15100.

D. Piping Specialties are included in Section 15120.

E. Pipe hangers and supports are included in Section 15140.

1.04 SUBMITTALS

A. Shop drawings and product data, in accordance with Section 01330, shall include the following:

1. Shop drawings including piping layouts in AutoCAD 2012 and schedules shall be submitted to the Engineer and shall include dimensioning, fittings, locations of valves and appurtenances, joint details, methods and locations of supports, location of expansion joints and/or loops, and all other pertinent technical specifications for all piping to be furnished. Contractor shall coordinate with the piping supplier and engage a service to perform an analysis of the proposed piping system to determine expected thermal movements and recommend number and location of expansion joints.

2. Shop drawing submittals for piping under this Section shall include all data and information required for the complete piping systems. All dimensions shall be based on the actual equipment to be furnished. Types and locations of pipe hangers and/or supports shall be shown on the piping layout for each piping submittal.

1.05 REFERENCE STANDARDS

A. American Society for Testing and Materials (ASTM)

1. ASTM D1784 – Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.

2. ASTM D1785 – Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80 and 120.

3. ASTM D2464 – Standard Specification for Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.

4. ASTM D2466 – Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.

5. ASTM D2467 – Standard Specification for Socket Type Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.

6. ASTM D2564 – Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Pipe and Fittings.

7. ASTM D2665 – Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste and Vent Pipe and Fittings.

8. ASTM D2774 – Standard Practice for Underground Installation of Thermoplastic Pressure Piping

9. ASTM D2855 – Standard Practice for Making Solvent Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings.

10. ASTM D3311 – Standard Specification for Drain, Waste and Vent Plastic Fittings Patterns.

11. ASTM F437 – Standard Specification for Threaded Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80.

12. ASTM F438 – Standard Specification for Socket Type Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 40.

13. ASTM F439 – Standard Specification for Socket Type Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80.

14. ASTM F441 – Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80.

15. ASTM F493 – Standard Specification for Solvent Cements for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe and Fittings.

16. ASTM F593 – Standard Specification for Stainless Steel Bolts, Hex Cap Screws and Studs.

17. ASTM F594 – Standard Specification for Stainless Steel Nuts.

B. Plastic Pipe Institute (PPI)

1. PPI TR31 – Underground Installation of Polyolefin Piping.

C. American National Standard Institute

1. ANSI B16.5 – Pipe Flanges and Flanged Fittings.

D. Where reference is made to one of the above standards, the revisions in effect at the time of bid opening shall apply.

1.06 QUALITY ASSURANCE

A. **A letter stating that all components used on the piping system are fully compatible with the service and chemicals specified in this specification. The letter shall state that the piping system supplier has reviewed the MSDS sheets of all the chemicals being conveyed in the piping system including the summary of hazards, and physical and chemical data.**

B. All plastic pipe and fittings of each type shall be furnished by a single manufacturer who is experienced in the manufacture of the items to be furnished; however, it shall not be a requirement that the pipe and fittings be manufactured by the same manufacturer, provided that the pipe and fittings are compatible in both compounding and size. The pipe and fittings shall be designed, constructed and installed in accordance with the best practices and methods and shall be suitable for the intended service.

C. When CPVC is used, all installers must be trained by Corzan representatives as provided by Noveon (www.corzancpvc.com) or by licensed manufacturer of FlowGuard Gold or Corzan material.

1.07 SYSTEM DESCRIPTION

A. Piping shall be installed in those locations as shown on the Drawings.

B. The equipment and materials specified herein are intended to be standard types of plastic pipe and fittings for use in transporting water and chemicals.

C. The piping system shall be designed to handle several different types of chemicals. The piping shall be designed to be compatible with the following chemicals:

1. Hydrofluosilicic Acid (23%); also known as fluoride

2. Sodium Hydroxide (25%); also known as caustic soda

3. Liquid Ammonium Sulfate (40%); also known as LAS

4. Sodium Hypochlorite (12.5%)

D. MSDS sheets of the all chemicals shall be requested from the City by the successful Bidder.

E. The piping system shall be designed to handle a fluid temperature of 40°F to 110°F, and an outside air temperature of 20°F to 110°F.

F. Other uses of PVC and CPVC include the following:

1. Other process piping as shown on the Drawings.

2. Potable water (PW).

3. Plant process water (PPW, potable water protected by RPZBP).

4. Drain piping.

5. Sample piping from various treatment steps in conventional surface water treatment plant.

6. Sanitary sewer.

PART 2 PRODUCTS

2.01 MATERIALS

A. Poly(Vinyl Chloride) Pipe and Fittings – PVC

1. Pipe shall be manufactured from PVC compounds meeting ASTM D1784, Class 12454 B in accordance with ASTM D1785, PVC 1120. The pipe shall have a minimum hydrostatic design stress of 2,000 psi at 73EF and shall be suitable for field cutting and solvent welding. Pipe shall be of the sizes as shown on the Drawings and shall be Schedule 80 unless otherwise shown.

2. Fittings shall be the socket type for solvent welded joints conforming to ASTM D2467 or ASTM D2466 where Schedule 40 pipe is shown on the Drawings. Fittings shall be manufactured from PVC compound meeting ASTM D1784, Class 12454 B. Solvent cement shall be as specified in ASTM D2564. Solvent cement for sodium hypochlorite service piping shall be Weld-On CPVC 724 by IPS Corp. or Oatey Industrial Grade Low Voc Heavy Duty Gray.

3. Pipe, fittings and solvent for use with potable water shall be certified by NSF in accordance with NSF standard No. 14 and the seal shall be included on the pipe.

B. Poly(Vinyl Chloride) Pipe and Fittings for Drain, Waste and Vent Services

1. Pipe shall be manufactured from PVC compounds meeting ASTM D1784, Class 12454 B in accordance with ASTM D2665. The patterns, dimensions and laying lengths of fittings

including adapters shall meet the requirements of ASTM D3311. Solvent cement for joining pipe and fittings shall be as specified in ASTM D2564.

C. Chlorinated Poly (Vinyl Chloride) Pipe and Fittings – CPVC

1. Pipe shall be manufactured in accordance with ASTM F441 Schedule 80. The Corzan® CPVC pipe compound used for pipe up to 8" in diameter shall meet cell class 24448 as defined by ASTM D1784. Corzan CPVC pipe 8" in diameter and larger shall meet cell class 23447.

2. Fittings shall be socket type for solvent weld joints conforming to ASTM F439 or ASTM F438 where Schedule 40 pipe is shown on the Drawings. Fittings shall be manufactured from Corzan® CPVC compound meeting ASTM D1784, Class 23447. Fitting compound shall be pressure rated in accordance with ASTM D-2837 and PPI TR-3 having Hydrostatic Design Basis (HDB) of 4000 psi at 72oF and 1000 psi at 180oF as listed in PPI TR-4.

3. All socket type joints shall be made employing solvent cements that meet or exceed the requirements ASTM F493 and primers that meet or exceed the requirements of ASTM F656. IPS Weld-On CPVC 724 heavy bodied, medium setting, CPVC cement shall be used for all caustics including hypochlorite solutions.

D. Threaded joints shall be as specified under the applicable ASTM standard for the pipe and fittings being used. Thread sealer shall be thread tape which shall be standard industrial quality Teflon, Type 1. Where this material is not compatible with intended service, pipe manufacturer shall offer an alternate "A-grade" material. Where threads are necessary on CPVC piping systems, it is recommended that threaded male adapters be utilized. Do not thread the CPVC pipe.

E. Flanged Joints

1. Where flanged joints are shown on the Drawings, they shall be supplied with 1/8 inch thick full faced gaskets compatible with intended service. Provide Telflon or other "A-grade" material compatible with intended service.

2. Flange bolt spacing, number and dimensions shall conform to the requirements of ANSI B16.5. CPVC and PVC flanges shall be single piece, suitable for solvent cementing to the pipe and shall be suitable for a minimum pressure of 150 psi. Two piece sleeved flanges (Van Stone type) shall not be acceptable.

3. Bolts, nuts and washers for flanged joints shall be for corrosive service conditions and shall be ASTM F593 and F594, Type 316 stainless steel. Antisieze compound for stainless steel bolts and nuts shall be of a molybdenum disulfide base such as Molycoat G or equal. Confirm compatibility with CPVC prior to use (www.corzancpvc.com).

F. Fittings, specials, unions and flanges shall be of the same schedule number and manufactured of the same materials as the pipe. Whenever unions are called out on the Drawings, flanged

connections may be substituted, provided that dimensional controls do not preclude use of flanges.

G. Sleeves for plastic pipe shall be as specified in Section 01172.

1. Expansion joints for PVC and CPVC sizes 1/2– inch to 6 inches shall be telescoping type as manufactured by IPEX, Plastinetics, Inc.; ASAHI/America or equal. Expansion in pipes smaller than 1/2– inch shall be accommodated with expansion loops.

PART 3 EXECUTION

3.01 INSTALLATION

A. **No PVC piping will be installed on project until manufacturer has submitted certification of materials compatibility of pipe and gaskets with intended service. Should piping and/or gaskets be installed without this certification Contractor is liable for replacement of piping system and or gaskets at his expense.**

B. The installation of plastic pipe shall be strictly in accordance with the manufacturer's technical data and printed instructions. Cut and fit pipe accurately to measurements established at the site. Use methods of cutting, welding, and threading as recommended in instruction manuals published by the manufacturer of the materials being used. Use only strap wrenches for tightening threaded joints. Do not spring or force pipe in place.

C. Joints for PVC and CPVC pipe shall be solvent cemented unless threaded are otherwise shown on the Drawings or are specified as other types herein. In making solvent cemented connections, clean dirt and moisture from pipe and fittings. A slight chamfer (bevel) of 15 degrees should be incorporated to the end of the pipe to permit easier insertion of the pipe into the fitting. Remove any burrs from cutting of the pipe. Solvent cement joints shall be made in accordance with ASTM D2855, except that solvent cement formulated especially for and as specified above shall be used for joining CPVC pipe and fittings. Primer shall be used whenever recommended by the pipe, fitting, or cement manufacturer and in all cases for joints on pipe systems four inches in diameter or larger. Making solvent cement joints shall not be performed and the work shall stop when the temperature, measured in the shade, is 40°F and falling.

D. Installation of valves and fittings shall be in accordance with manufacturer's instructions. Particular care shall be taken not to overstress threaded connections. In making solvent cement connections, the solvent cement or primer shall not be spilled on valves. Any cement allowed to run from joints shall be cleaned from the pipe and fittings immediately.

E. **All piping shall have a sufficient number of unions to allow convenient removal of piping and shall be as approved by the Engineer. PVC and CPVC pipe shall be installed with expansion joints to accommodate thermal expansion and contraction. Contractor to coordinate with piping supplier to determine number and location of expansion joints.**

F. Where plastic pipe passes through wall sleeves, the space between the pipe and sleeve shall be sealed with a mechanical sealing element as specified in Section 01172.

G. All plastic pipe to metal pipe connections shall be made using flanged connections. Metal piping shall not be threaded into plastic fittings, valves, or couplings nor shall plastic piping be threaded into metal valves, fittings or couplings. Only socket to thread adaptors (Male Adapters) shall be used for threaded plastic pipe connections to other threaded devices.

H. Concrete inserts for hangers and supports shall be furnished and installed in the concrete as it is placed. The inserts shall be set in accordance with the requirements of the piping layout and the Contractor shall verify these locations from approved piping layout drawings and the structural drawings. Pipe hangers and supports are specified in Section 15140.

I. Where practical, pitch all horizontal runs of piping to drain.

J. Use spring hangers on vertical runs of piping when necessary to provide for expansion.

K. Use roller and sliding, guiding supports on horizontal runs of piping when necessary to provide for expansion.

L. Anchor and brace pipe at expansion joints to force expansion and contraction within joint without buckling. Follow manufacturer's published instructions.

M. Minimum span to be shown on the Drawings or as recommended in the published manuals of the pipe manufacturer for the sizes and weights being used. Use 100°F for inside piping and 120°F for outside piping when selecting span dimensions. Span to be the shortest required or recommended in any case of conflict between Drawings and published data.

3.02 FIELD TESTING

A. Hydrostatic Pressure Test. This procedure applies to all exposed plastic piping systems except for gas vacuum lines.

1. All pipelines shall remain undisturbed for the minimum curing or cooling time specified for each type of pipe material but no less than 8 hours to develop full curing and complete strength at all joints. All pipe systems shall be flushed clean and then subjected to a hydrostatic pressure test for 8 hours at a test pressure and temperature specified below. Should the temperature not be attainable under hydrostatic conditions, then the test may be performed under hydro-dynamic conditions, provided that accurate measurements for loss of the test fluid can be made, or the pressure shall be proportionally increased to simulate the stresses of the higher temperature in relation to the lowest system temperature that is expected during the duration of the test. The proportionally higher test pressures shall be determined in accordance with the accepted temperature versus strength properties as published by the pipe manufacturer, Plastic Pipe Institute or other pipe material standards organization.

2. The test pressures shall be in accordance with the schedule as shown on the Drawings. In the absence of a test pressure for any line designation use 150 psig as a test pressure.

3. The test shall be performed by slowly filling the piping system, expelling entrapped air from all high points. The fill rate shall be controlled so that the fluid velocity within the

pipe system is less than two fps. Upon completion of the filling process, the system shall be brought up to the specified test temperature as applicable, holding the system pressure to less than ten percent of the test pressure. Once the system has been stabilized at the specified test temperature, the pipe should be slowly brought up to the test pressure in such a manner so as to not create shock, surge or water hammer in the pipe system. The test duration time limit shall not begin until the full pressure specified above has been reached and the system has been stabilized to within five percent of the test temperature. The system pressure and temperature shall be maintained to within one half percent but no more than five percent of the specified value for the temperature and within five psi of the specified value for the pressure. These tolerances shall be held for the entire duration of the test. Upon completion of the test, the pressure shall be slowly removed by opening a valve or other pressure relieving device at a location remote to the location of the pressure/temperature monitoring equipment.

4. The pressure test shall be monitored by a recording type pressure gage for tests not requiring temperature control or a dual pen pressure/temperature recording gage when temperature control is required. The entire test process shall be recorded, including the initial temperature stabilization and pressurization of the piping system. The record shall be continuous through the system test and shall show the final de pressurization of the pipe system.

5. All visible leaks detected during the pressure test shall be repaired and the pressure/temperature test rerun. A successful test shall be a test in which no visible leaks are detected and the pipe system pressure can be maintained within one half percent but no more than five psi of the specified value.

6. Prior to testing, the pipelines shall be supported in an approved manner to prevent movement during the tests.

B. Testing for all gas vacuum lines shall be performed prior to installing mechanical equipment by placing the pipe system under 10 psi vacuum for 8 hours duration. No water or other fluids shall be introduced into gas vacuum lines. Pipe support system shall be installed before testing. Pipe system shall be temporarily capped and isolated during the test, and once the initial vacuum is achieved, no further pumping or evacuation shall be performed during the test. A vacuum gauge with minimum 0 to 15 psi range and at least 0.1 psi resolution shall be installed, and the pipe shall be slowly evacuated to achieve the test vacuum, then isolated. Testing shall be continuously monitored and recorded as described for pressure testing. A successful test shall indicate no loss of vacuum over 12 hours, other than any decrease due to documented change in ambient temperature. Any defects shall be repaired and the vacuum test rerun. Relieve vacuum slowly when test is completed.

3.03 CLEANING AND DISINFECTION

A. Keep inside of all pipes, fittings and valves clean and free from dirt and debris.

B. Thoroughly blow all lines with high pressure air before connecting mechanical equipment, testing, or placing in service.

3.04 PAINTING AND INSULATION

A. All PVC and CPVC pipe and fittings exposed to the direct sunlight and not insulated shall be field painted with a latex based paint system, to provide additional UV protection. This painting shall be required whether or not marking is required and shall be in accordance with Section 09901. If required by Drawings, and/or specification section, provide aluminum jacketed insulation in lieu of pipe painting.

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SECTION 15100
VALVES

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals required and install complete and ready for operation and test all non-buried valves as shown on the Drawings and as specified herein.

B. The equipment shall include, but not be limited to, the following. However not all items specified herein may be included in this project.

1. General Requirements
2. Valve Actuators – Manual
3. Valve Actuators – Powered
4. Butterfly Valves
5. Gate Valves
6. Ball Valves
7. Corporation Stops
8. Air Release and Vacuum Relief Valves

1.02 MEASUREMENT AND PAYMENT

A. No separate payment will be made for work performed under this Section. Include the cost for this work in the lump sum Base Bid Price.

B. Payment for extra unit price work shall be as defined in the extra unit price schedule.

1.03 RELATED WORK

A. Buried valves and appurtenances are included in Division 2.

B. Piping and disinfection for potable water systems is included in the respective Sections of Divisions 2.

C. Shop and Finish painting is included in Sections 09915 and 09901.

D. Instrumentation, not specified herein, is included in Division 13.

E. Valves on all HVAC and plumbing systems are included in their respective sections of Division 15.

F. Piping Specialties are included in section 15120.

G. Pump Control Valves are included in Sections 15953 and 15954.

H. Electrical work is included in Division 16.

I. Certain items similar to those specified in this Section may be specified to be furnished and installed with individual equipment or systems. In case of a conflict, those individual equipment or system requirements shall govern.

J. Electric valve operators of all types, rate of flow controllers (including modulating valves and operators) and other types of valves which are part of the automated instrumentation (such as some solenoid valves) if not included herein are included in Division 13. Valve operators shall, however, be mounted at the factory on the valves as specified herein, as part of the work of this Section.

K. Certain items similar to those specified in this Section may be specified to be furnished and installed with individual equipment or systems. In case of a conflict, those individual equipment or system requirements shall govern.

1.04 SUBMITTALS

A. Submit to the Engineer, in accordance with Section 01330, materials required to establish compliance with this Section. The first submittal shall be the valve schedule described in Paragraph 1.09. Approval of the valve schedule submittal is required prior to Contractor submitting any of the equipment in this specification. Subsequent Equipment Submittals shall include at least the following:

1. Valve tag number and location within plant.

2. The manufacturer and supplier.

3. The address at which equipment will be fabricated or assembled.

4. Shop drawings showing assembly details, materials of construction (by common name and ASTM number), and dimensions.

5. Provide hydraulic characteristics of valves being provided.

6. Descriptive literature, bulletins and/or catalogs of the equipment.

7. The total weight of each item.

8. A complete bill of materials.

9. Additional submittal data, where noted with individual pieces of equipment.

10. Individual electrical/pneumatic/hydraulic control schematics and wiring diagrams for each valve operator with all external interfaces, identified exactly as detailed on the Electrical

and Instrumentation Drawings. Standard catalogue cut sheets that show typical wiring diagrams only are not acceptable. Valve actuators shall be coordinated with electrical requirements shown on the Drawings and valves as specified herein.

B. Test Reports

1. Provide certified hydrostatic test data, per manufacturer's standard procedure or MSS SP 61 for all valves.

C. Certificates

1. For each valve specified to be manufactured, tested and/or installed in accordance with AWWA and other standards, submit an affidavit of compliance with the appropriate standards, including certified results of required tests and certification of proper installation.

D. Manufacturer's Installation and Application Data

E. Operating and Maintenance Data

1. Operating and maintenance instructions shall be furnished to the Engineer as provided in Section 01782. The instructions shall be prepared specifically for this installation and shall include all required cuts, drawings, equipment lists, descriptions and other information required to instruct operating and maintenance personnel unfamiliar with such equipment.

1.05 REFERENCE STANDARDS

A. American Society for Testing and Materials (ASTM)

1. ASTM A48 - Standard Specification for Gray Iron Castings.

2. ASTM A126 - Standard Specification for Gray Iron Castings for Valves, Flanges and Pipe Fittings.

3. ASTM A240 - Standard Specification for Heat Resisting Chromium and Chromium Nickel Stainless Steel Plate, Sheet and Strip for Pressure Vessels.

4. ASTM A276 - Standard Specification for Stainless Steel Bars and Shapes.

5. ASTM A436 - Standard Specification for Austenitic Gray Iron Castings.

6. ASTM A536 - Standard Specification for Ductile Iron Castings.

7. ASTM B30 - Standard Specification for Copper Base Alloys in Ingot Form.

8. ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings

B. American Water Works Association (AWWA)

1. AWWA C111 - Rubber Gasket Joints for Ductile Iron Pressure Pipe and Fittings.
2. AWWA C500 - Metal-Seated Gate Valves Supply Service
3. AWWA C504 - Rubber Seated Butterfly Valves
4. AWWA C507 - Ball Valves, 6 in through 48 in (150mm through 1200mm)
5. AWWA C508 - Swing Check Valves for Waterworks Service, 2-in (50mm through 24 in (600mm) NPS
6. AWWA C509 - Resilient Seated Gate Valves for Water Supply Service
7. AWWA C511 - Reduced-Pressure Principle Backflow-Prevention Assembly
8. AWWA C540 - Power Actuating Devices for Valves and Sluice Gates
9. AWWA C550 - Protective Epoxy Interior Coatings for Valves and Hydrants
10. AWWA C800 - Underground Service Line Valves and Fittings

C. American National Standards Institute (ANSI)

1. ANSI B1.20.1 - Specifications, Dimensions, Gauging for Taper and Straight Pipe Threads (except dry seals).
2. ANSI B16.1/16.42/16.5 - Cast Iron/Ductile Iron/Steel and Stainless Steel Pipe Flanges and Flanged Fittings
3. ANSI B16.10 - Face to Face and End to End Dimensions of Valves
4. ANSI B16.104 - Butterfly Valves

D. American Iron and Steel Institute (AISI)

E. Manufacturer's Standardization Society of the Valve and Fittings Industry (MSS)

1. MSS SP 61 - Pressure Testing of Steel Valves.
2. MSS SP 67 - Butterfly Valves.
3. MSS SP 70 - Cast Iron Gate Valves, Flanged and Threaded Ends.
4. MSS SP 71 - Cast Iron Swing Check Valves, Flanges and Threaded Ends.
5. MSS SP 72 - Ball Valves with Flanged or Butt Welding Ends for General Services.

6. MSS SP 78 - Cast Iron Plug Valves, Flanged and Threaded Ends.

7. MSS SP 80 - Bronze Gate, Globe, Angle and Check Valves.

8. MSS SP 82 - Valve Pressure Testing Methods

9. MSS SP 98 - Protective Coatings for the Interior of Valves, Hydrants and Fittings.

F. National Electrical Manufacturers Association (NEMA)

G. Underwriters Laboratories (UL)

H. Factory Mutual (FM)

I. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.06 QUALITY ASSURANCE

A. Qualifications

1. Valves and actuation systems shall be products of well established firms who are fully experienced, minimum 10 years, reputable and qualified in the manufacture of the particular equipment to be furnished.

2. The equipment shall be valves shall be mated to actuators at manufacturers or integrators facility. Actuated valves shall be fully tested and certified ready for installation prior to shipment to the job site. In no case shall actuators be mounted to the valves in the field.

3. All valves of the same type shall be the product of one manufacturer.

4. Valve actuators in each below category shall be the product of one manufacturer, Contractor shall coordinate this requirement with actuated valves included in the scope of vender furnished equipment specified in Division 11, 13, 14 and 15.
   a. 120 volt, single phase for valves 3 inch and below
   b. 480 volt, three phase
   c. Pneumatic
   d. Hydraulic

B. Certifications

1. The manufacturers shall furnish an affidavit of compliance with Standards referred to herein as specified in Paragraph 1.03C above. Refer to PART 3 for testing required for certain items in addition to that required by referenced standards.

C. Provide the services of a qualified and factory trained service representative of the manufacturer to provide operational and maintenance instruction, for a 1 day, 8 hour period for each type of the following equipment, as applicable:

1. 480 volt electric actuators.

2. Pneumatic actuators.

3. Hydraulic cylinder actuators.

4. Pressure regulating valves.

5. Surge relief valves.

6. Pinch valves.

D. Inspection of the units may also be made by the Engineer or other representative of the Owner after delivery. The equipment shall be subject to rejection at any time due to failure to meet any of the specified requirements, even though submittal data may have been accepted previously. Equipment rejected after delivery shall be marked for identification and shall be removed from the job site at once.

1.07 SYSTEM DESCRIPTION

A. All of the equipment and materials specified herein are intended to be standard for use in controlling the flow of water, wastewater, sludge, air, and chemicals as noted on the Drawings.

B. Valves, appurtenances and miscellaneous items shall be installed as shown on the Drawings and as specified, so as to form complete workable systems.

C. Unless otherwise noted all electrically powered valve operators shall have:

1. Valves larger than 3-in: electric operators 460 Volt, 3 Phase, 60 Hz.

2. Valves 3-inch and under: electric operators, 120 Volt, 1 Phase, 60 Hz.

3. See other paragraphs for additional requirements.

1.08 DELIVERY, STORAGE AND HANDLING

A. Reference is made to Section 01610 for additional information.

B. Packing and Shipping

1. Care shall be taken in loading, transporting and unloading to prevent injury to the valves, appurtenances, or coatings. Equipment shall not be dropped. All valves and appurtenances shall be examined before installation and no piece shall be installed which is found to be defective. Any damage to the coatings shall be repaired as acceptable to the Engineer.

2. Prior to shipping, the ends of all valves shall be acceptably covered to prevent entry of foreign material. Covers shall remain in place until after installation and connecting piping is completed.

a. All valves 3-in and larger shall be shipped and stored on site until time of use with wood or plywood covers on each valve end.
b. Valves smaller than 3-in shall be shipped and stored as above except that heavy cardboard covers may be used on the openings.
c. Rising stems and exposed stem valves shall be coated with a protective oil film which shall be maintained until the valve is installed and put into use.
d. Any corrosion in evidence at the time of acceptance by the Owner shall be removed, or the valve shall be removed and replaced.
e. Actuated valve assemblies shall be blocked and secured to prevent any strain on the mounting arrangement during transit and storage. All electrical/pneumatic/hydraulic components shall be protected from weather and moisture in any form.

C. Storage and Protection

1. Special care shall be taken to prevent plastic and similar brittle items from being directly exposed to the sun, or exposed to extremes in temperature, to prevent deformation. See the individual piping sections and manufacturer's information for further requirements.

1.09 MAINTENANCE

A. Special tools and the manufacturer's standard spare parts, if required for normal operation and maintenance, shall be supplied with the equipment in accordance with Section 01730 and where noted, as specified herein. Tools shall be packaged in a steel case, clearly and indelibly marked on the exterior to indicate equipment for which tools are intended.

B. Provide one Operations and Maintenance manual for each type of valve and operator supplied under this specification in accordance with Section 01782 and Section 01782S.

C. Included within the Operations and Maintenance manuals, provide a list of all spare and replacement parts with individual prices and location where they are available.

1.10 VALVE DESIGNATIONS AND SCHEDULE

A. Valve locations and basic types are shown on the Drawings. The specific valve type and trim required is identified by the valve call outs. The valve call outs include an alpha-numeric Tag that indicates the required valve type/trim for that location. The products specified in Section 2 below each have a Tag identifier. Powered actuator type is identified by symbology on the P&IDs. If a valve Tag is not included on the Drawing call outs, Contractor shall submit an RFI requesting valve identification.

B. The Contractor shall refer to the P&IDs and Mechanical Drawings and prepare a Valve Schedule for each process valve in the Project. Contractor's first submittal under this Section shall be the Valve Schedule, which shall include a unique valve Number as labeled on the P&IDs. Submit with the Valve List a copy of the Contract Drawing P&IDs indicating each unique valve Number next to the valve symbol. This valve schedule shall NOT include the valves furnished in Plumbing and HVAC sections of Division 15.

C. The valve schedule shall include: valve Number; valve Tag; valve size; end connections, operator type and reference Drawing number(s). The valve tag convention shall be consistent with the P&ID Sheet on which it is shown. Identical valves in the same position in parallel processes (EX. Pump inlet/outlet isolation valves where there are 3 parallel pumps of same type) shall have same tag number followed by a hyphen and quantifier -1, 2, 3 etc. Where electric, hydraulic or pneumatic actuators are supplied their type shall be so noted with an E, H or P. Modulating duty actuators shall be noted with an M following the actuator type notation.

D. The Contractor shall include the Valve Number and Tag with each valve shop drawing submittal.

E. An excerpt of an EXAMPLE schedule is as follows:

Number	Tag	Size	Ends	Operator	Drawing Number
1000	BFV1	2-in	Flanged	Lever	I-4, M-12
1002-, 1,2,3	BFV3	8-in	Lugged	Gear/Handwheel	I-5, M-15
1005	PV1	6-in	Flanged	EM	I-7, M-16

PART 2 PRODUCTS

2.01 MATERIALS AND EQUIPMENT - GENERAL

A. Reference is made to Division 1 for additional requirements, including nameplates, provisions for temporary pressure gauges, protection against electrolysis and anchor bolts.

B. The use of a manufacturer's name and/or model or catalog number is for the purpose of establishing the standard of quality and general configuration desired.

C. Valves shall be of the size shown on the Drawings or as noted and as far as possible equipment of the same type shall be identical and from one manufacturer.

D. All products shall be new and unused. All valves and as far as possible equipment of the same type shall be identical and from one manufacturer.

E. Valves and appurtenances shall have the name of the maker, nominal size, flow directional arrows, working pressure for which they are designed and standard referenced, cast in raised letters or via riveted stainless steel nameplate upon some appropriate part of the body.

F. Unless otherwise noted, items shall have a minimum working pressure of 150 psig or be of the same working pressure as the pipe they connect to, whichever is higher and suitable for the pressures noted where they are installed.

G. Provide all special adaptors as required to ensure compatibility between valves, appurtenances and adjacent pipe.

H. Valves and actuators located outdoors but not within a building; within maximum 2-ft above liquid; in vaults; or where otherwise noted shall be especially designed for submerged service where water may completely submerge the valve and operator. All other units shall be as a minimum weather tight.

I. No alternative materials will be considered for approval unless complete documentation is provided regarding their satisfactory long-term use in similar conditions; in addition, the consideration of any substitution will be considered only if the superiority of the proposed materials is the intent of the substitution, and only if sufficient evidence is provided to document that superiority.

2.02 VALVE ACTUATORS – MANUAL

A. Nut actuated valves shall be provided where indicated and where installed in valve boxes or accessed through floor penetrations.

1. Provide one tee handle wrench for every four nut actuated valves. Tee handle extension length shall be determined based on the nut height as shown on the Drawings, and coordinated during the submittal process. Tee handle wrench length shall provide tee handle approximately 3 feet above floor of vantage point. Provide one nut wrench for each nut differing 1.5 feet or more from vantage point description.

B. See the Paragraph 2.01H above for submergence requirements.

C. The valve manufacturer shall supply, mount and test all actuators on valves at the factory. The valves and their individual actuators shall be shipped as a unit.

D. Manually actuated butterfly valves 6 inches and smaller for fluid service shall have a 10 position, spring retained ratcheting handle. Handle shall be fusion bonded epoxy coated steel or cast iron, hardware, spring and ratcheting plate shall be 316 stainless steel. Manually actuated butterfly valves for air service 6 inches and smaller shall have a memory stop handle with infinite throttling position capability. Memory stop plate and all hardware shall be 316 stainless steel.

E. Except as otherwise shown on the Drawings or specified herein, all valves 3-in diameter or larger, with the valve hand wheel center line located 7-ft or more above the operating floor, shall be provided with chain wheel operators complete with chain guides and hot dipped galvanized steel chain, which loop within 4-ft of the operating floor. These requirements shall supersede positioning lever actuator requirements of manual butterfly valves 6 inches and smaller.

F. All actuators shall be capable of moving the valve from the full open to full close position and in reverse and holding the valve at any position part way between full open or closed.

G. Each operating device shall have cast on it the word "OPEN" and an arrow indicating the direction of operation.

H. Floor boxes for operating nuts recessed in concrete shall be standard cast iron type, cast in place, with fastening top by Clow, Trumbull, or equal.

I. Stem guides shall be of the adjustable wall bracket type, bronze bushed, with maximum spacing of 10-ft as manufactured by Clow; Rodney Hunt, Trumbull, or equal. Extended operating nuts

and/or stems shall have universal joints and pin couplings, if longer than 10-ft and a rating of at least five times the maximum operating torque. Stem adaptors shall be provided.

J. Where required by the installation, or as specified, provide the following: extended stem; floor stand and handwheel; position indicator and etched or cast arrow to show direction of rotation to open the valve; resilient, moisture-resistant seal around stem penetration of slab.

K. Gear Actuators

1. Unless otherwise noted, gear actuators shall be provided for the following: plug and ball valves larger than 3-in diameter; butterfly valves larger than 6 inch diameter; where specified and/or indicated on the Drawings; where manual operator effort is greater than 40 lbs rim pull.

2. Actuators shall be capable of being removed from the valve without dismantling the valve or removing the valve from the line.

3. Gear actuators for quarter turn valves shall be of the worm or helical worm gear type with output shaft perpendicular to valve shaft, having a removable hand wheel mounted on the output shaft. Where shown on the Drawings, a 2 inch cast iron operating nut shall be provided. Actuators shall conform to AWWA C504 except where more stringent requirements are provided hereinafter. Worm shall be hardened steel, driven gear shall be bronze. Bearings shall be permanently lubricated, with bronze bearing bushings provided to take all thrusts and mechanical shaft seals to contain lubricants. Housings shall be sealed to exclude moisture and dirt, allow the reduction mechanisms to operate in lubricant and be constructed of cast iron, ASTM A126, Grade B, or of ductile iron, ASTM A536. Gear housing bodies for thermoplastic valves may be cast aluminum or fabricated steel to reduce weight. Gear actuators shall indicate valve position and have adjustable stops.

4. Where indicated on the Drawings, gear actuators for butterfly valves shall be of the travelling nut type with output shaft perpendicular to valve shaft, having a removable hand wheel mounted on the output shaft. Unless noted they shall conform to AWWA C504. Stem shaft shall be machine cut alloy steel, nut and cross head shall be bronze, lever shall be ductile iron. Nut Actuators for valves 24-in and smaller shall be slotted lever design, actuators for valves greater than 24 inch shall be link and lever design. Mechanism shall be lubricated with water resistant extreme pressure NLGI No. 2 grease. Bevel gear reduction box shall be mounted on the actuator when required to meet specified manual operating effort requirements Gear actuators shall have mechanical, external indication of valve position and have adjustable threaded stops secured to the stem with spring pins. Stop shall be capable of withstanding 450-fts-lb of input torque. Stop adjustment requiring shims are not acceptable.

5. Manual Input torque to produce required valve operating torque for worm and travelling nut gear operators shall not exceed 80 ft-lbs. In addition, hand wheel rim pull shall not exceed 20 lbs for valve sizes up to 12 inches, 40 lbs for valve size between 14 and 20 inches, 60 lbs for valve size 24 and greater. Minimum hand wheel size shall be 8 inches for up to 12 inch valve size, 12 inches for up to 16 inch valve size, 18 inches for up to 20 inch size.

6. Gear actuators for multi turn valves shall be of the bevel or spiral bevel type with output shaft perpendicular to valve shaft, having a removable hand wheel mounted on the output shaft. Gearing shall be machine cut steel designed for smooth operation. Bearings shall be permanently grease lubricated, with dual anti-friction ball bearings on the output shaft and mechanical shaft seals to contain lubricants. The output flange of the primary gear reducer shall be designed to meet an appropriate MSS or ISO standard to allow mounting to the secondary gear reducer. The ring gear shall ride on ball bearings. The stem nut shall be bronze alloy, shouldered, and ride on needle bearings. Housing components shall be o-ring sealed to exclude moisture and dirt, constructed of cast iron, ASTM A126, Grade B, or of ductile iron, ASTM A536. Gear housing bodies for thermoplastic valves may be cast aluminum or fabricated steel to reduce weight. Manual operator input effort to the hand wheel shall be a maximum of 30 lbs for operating the valve from full open to full close, under any conditions. Maximum hand wheel size shall be 24-in diameter.

L. Additional valve actuator requirements are included with the individual valve types and as noted in Paragraph 1.02 above.

M. All position indication and direction of opening arrows shall be embossed, stamped, engraved, etched or raised castings. Decals or painted indications shall not be allowed.

N. Unless otherwise noted, all valves larger than 3-in nominal diameter shall be provided with position indicators at the point of operation.

2.03 VALVE ACTUATORS – POWERED

A. General

1. Electric actuators for ¼ turn valves three inches and under which do not have submergence requirements, and which exhibit a maximum torque specified below shall be operated on 120 volt single phase power as specified below. All other actuators shall be operated on 480 volt power.

2. The actuators shall conform to AWWA Standard C540, insofar as applicable and as herein specified. Actuators shall be O-ring sealed, watertight to standard NEMA 4X/6, submersion to 6 feet for 30 minutes. Actuators installed in vaults below grade and elsewhere subject to submergence shall be watertight to standard NEMA 6P/IP68, 15 ft for 72 hours minimum. Actuators installed in hazardous locations as noted on the Electrical Drawings and/or area classification sheets of the Architectural Drawings shall be FM certified explosion proof for Class 1 Division 1 & 2, Groups C & D and also meet the standard NEMA 4X/6 rating.

3. Valve service/operation shall be as indicated on the P&IDs and as specified in the Control Descriptions in Section 13305.

4. Actuators shall be configured as required to provide for part turn or multi-turn and be coupled with gearboxes as required to obtain the speed and operating torque as required for the valve or gate it controls.

5. Modulating actuators shall contain proportional control unit and be capable of 1200 starts per hour, open-closed valve actuators shall not require a proportional control unit, and be capable of 60 starts per hour.

6. Where shown on the Instrumentation Drawings, actuators shall have a digital control module, to allow valves or gates to be positioned remotely via a 2-wire non-proprietary field bus protocol. The digital control module shall be equipped with serial communication ports to allow actuation to be linked by a two wire local area network utilizing Modbus function code (report by exception) and arranged in a self-healing ring configuration, with multi-drop taps to each actuator.

B. 120 Volt Single Phase Reversing, Non Spring Return Electric Actuators for ¼ Turn Valves, 100 to 1000 in-lb Torque Range

1. Valve actuators shall be sized by the valve supplier meeting the requirements of AWWA C540. Actuators shall be mounted on the valves in the valve supplier's facility, and factory tested.

2. Actuators shall operate on 120 volt, 60 Hz single phase, power supply. Enclosure rating shall be NEMA 4X, constructed of cast aluminum or steel alloy, powder coated or fusion bonded epoxy finish.

3. Power train shall be self-locking planetary epicyclical gear design, consisting of hardened steel and or hardened bronze alloy gears with bronze bearings. Housing penetrations shall be sealed with mechanical seals. Housing shall be equipped with space heaters. Valve mounting system shall be ISO 5211.

4. Actuator shall be designed for open/close/jog reversing service. Proportional/modulating service shall be provided where required in the equipment specifications or Instrumentation Drawings. Actuators shall have visual mechanical indication of position. Manual override shall be direct worm drive with minimum 5 inch diameter hand wheel. Hand wheel size shall be provided such that a maximum 40 lb rim pull is required.

5. Motors shall be designed specifically for valve actuation service, with Class F insulation, with split phase capacitor protection. Duty cycle shall not be less than 40% at 100 deg F. for open/close duty, and 100% for modulating duty. 90 degree travel time shall vary from 10 to 20 seconds depending on actuator size. Actuators shall have SPDT contacts for remote valve position indication.

6. Actuators shall be P Series as manufactured by Promation Engineering, Brooksville, FL, or equal.

C. 480 Volt Powered Actuators for Part Turn or Multi-Turn Valve Operation

1. Per Section 15200.

2.04 BUTTERFLY VALVES: TAG TYPE BFV

A. See Section 02522 for requirements.

2.05 GATE VALVES TAG TYPE NOTED BELOW

A. Gate Valves 3 inch and Smaller: Tag Type GV

1. Gate valves 2.5-in diameter and smaller shall have screwed ends and shall be bronze body. Gate valves 3-in diameter shall be flanged end, iron or bronze body. Gate shall be brass, bronze, or Type 304 stainless steel solid wedge; union bonnet; silicon bronze rising-stem; equal to Jenkins Figure 47CUJ, division of Crane Valve Group; Lunkenheimer Figure 3127, Cincinnati Valve Co, Fairbanks Figure U-0252, or equal. Model numbers referenced above are for screwed ends, flanged shall be equal construction with appropriate end connections. Iron body valves shall be installed in steel or iron pipelines.

B. Tapping Valves and Sleeves: Tag Type TPGV

1. Under no circumstances shall a standard gate valve be used for a tapping valve. Tapping valves shall comply with the same requirements as solid wedge, resilient seat or double disc gate valves except they shall have the flanged end and port opening modified for tapping service. Tapping valves shall be provided with plugged flush port at bottom of gate guide and plugged tap for pressure/leak testing. Valves shall be capable of passing a full nominal sized cutter without damage to the valve. The tapping sleeve shall be gray cast iron or ductile iron mechanical joint type with the outlet flange conforming to MSS SP 60.

2.06 BALL VALVES: TAG TYPE NOTED BELOW

A. General Service Ball Valves: Tag Type BV1

1. Valves shall be bronze or stainless steel to match the piping material, resilient seated, full port, threaded or solder end three piece bolted body type valves. Manual valves shall have locking levers. The body and cap shall be ASTM B584 brass or 316 stainless steel, SAE Grade 8 steel body bolts, the ball and stem of Type 316 stainless steel and the seats and seals of glass reinforced TFE. The balls shall be full floating, non-lubricated. Valve seats shall be easily accessible and replaceable.

2. Valves shall be Apollo Series 82-100/200, Milwaulkee BA-300 series; or equal.

B. Corrosion Resistant Ball Valves 2-1/2 Inch and Smaller: Tag type BV2.

1. Valves shall be two-piece stainless steel full port; solid ball construction with bottom loading stems, and adjustable packing with manual locking lever actuator.

2. Body shall be ASTM A276, Type 316 or ASTM A351 GR CF8M stainless steel, 2000 psig rated at 200 Deg F, FNPT ends. Ball and stem shall be type 316 stainless steel. Seats and seals shall be reinforced PTFE.

3. Valves shall be Jamesbury Series 6F as manufactured by Metso Automation; KF Contromatics Series 8000, equal by Milwaukee; or equal.

C. Corrosion Resistant Ball Valves 3 Inch and Larger: Tag Type BV3.

1. Valves shall be two-piece full port stainless steel, solid, floating ball construction with bottom loading stems. Working pressure 250 psig; end connections shall be 150 lb full face flange.

2. Body: Stainless steel, ASTM A351, Grade C8M, Type 316. Ball/stem: ASTM B164 Ni-Cu Alloy- (alloy 400) Seats/seals: Reinforced PTFE.

3. Shall be Model WKM Dynaseal 310C or equal

D. Methanol Service Ball Valves: Tag Type BV4.

1. Valves shall be two way, one-piece body, standard ball, circular port. Ends shall be flanged, Class 150, ANSI B16.5. Valves shall be fire safe, anti-static, meeting the following standards: API 607, BS-5146 App B, BS-5351, FM 7440, EXES 3-14-1-2A.

2. Body/ball/stem: Type 316 Stainless steel; stem seal shall be flexible graphite; seals shall be type 316 stainless steel, TFE-coated for 2-in and smaller, Graph-lock for 2-1/2-in and larger; seats shall be TFE.

3. Valves shall be Worcester Controls Series AF51, equal by Jamsbury, or equal.

E. Slurry Service Ball Valves: Tag Type BV5

1. High solids and slurry service ball valves shall be resilient seated, threaded, three piece bolted body, swing out design, all of Type 316 stainless steel. The body, caps, ball, stem and all other internal components shall be of Type 316 stainless steel. External components shall be of carbon steel. The seats and seals shall be of TFE. The valves shall have full floating ball and shall be non-lubricated. Valve seats and seals shall be easily accessible and replaceable. Valves shall be rated for at least 250 psi and shall be as manufactured by Jamesbury; WKM or equal.

F. Flanged Iron Body Ball Valves Tag Type BV6

1. Valves shall be cast or ductile iron body with interior and exterior epoxy coating, full port design. Flanges shall be flat faced Class 125 lb, valve face to face dimensions shall be equal to ANSI 16.10 for gate valves. Ball shall be 316 stainless steel or PFA infused cast iron, seats and seals shall be reinforced PTFE. Valves 4 inch and larger shall be provided with gearbox and handwheel.

2. Valves shall be Sureflow type 125BVIS, American Valves Series 4000; or equal.

G. V-Port Ball Valves for Process Flow Control: Tag Type VPB1.

1. Valves shall be 3 piece, bolted body, soft seat, V-port insert design. Ends shall be flanged, Class 150, ANSI B16.5. Valves actuator shall be electric motorized, modulating. Valve characteristics shall provide for the operating conditions shown on the Drawings.

2. Body: Type 316 stainless steel; Ball and characterized insert: Type 316 stainless steel with hard chrome face. Shaft: Type 316 stainless steel, one piece. Seats: 316 stainless steel filled PTFE, replaceable; Packing: PTFE. Fasteners: Type 316 stainless steel.

3. Valves shall be Marwin CV 3000, or equal.

2.07 CORPORATION STOPS: TAG TYPE CS

A. 3/4" through 2" Corporation Stops shall be ball valve type, meeting AWWA Standard C800-01, Sec. 4.2.3 (High Pressure), withstanding working pressures up to 300 psi. The body, ball, operating stem, T-head, and service line connector shall be manufactured from red brass and conform to ASTM B62 and/or ASTM B584, UNS No. C83600. The ball shall be fluorocarbon coated and shall float on two EPDM seats and be watertight in both directions. The operating stem and nut shall be one piece, held in place by a mating machined flange on the stem and in the body. The operating stem shall have an EPDM O-ring to provide a watertight seal against the body.

B. Inlet threads shall be AWWA Taper, except where used with service clamps, where threads shall be IPS threads. All thread types and diameters shall conform to AWWA C800. The inlet threads will be integral to the body. The waterway diameter shall be approximately equivalent to the nominal size of the stop, and shall accommodate the maximum cutter size established by AWWA C800. The outlet shall be a compression connection meeting AWWA C800 Sec. 4.4.9.

C. Corporation Stops shall be FB Style Ballcorp, as manufactured by The Ford Meter Box Company, Inc., Wabash, Indiana, or equal by Mueller – Model H-15008 (or H-15013), James Jones Corporation, or McDonald. Where corporation stops are used with plastic pipe, a brass companion flange shall be provided on the outlet of each corporation stop.

2.08 AIR RELEASE AND VACUUM RELIEF VALVES: TAG TYPE NOTED BELOW

A. All pipeline air and vacuum valves shall be supplied with isolation gate or ball valves with operator handle or lever removed. Isolation valves shall be of same metallurgy as the connecting piping or nipples.

B. Relief valves shall be properly vented and piped to drain.

C. Valve pressure rating shall be at least equal to the attached pipe's rating.

D. Air and Vacuum Valves for sewage service shall have connections for draining and flushing with isolation ball valves for connection size up to 3 inch, and solid wedge gate valves for size 4 inch and larger.

E. Air Release Valves: Tag Type ARV

1. Small orifice assembly air release valves shall automatically release air accumulations from the pipe while under positive pressure. When the valve body fills with air, the float mechanism shall fall to open the small orifice and exhaust the air to atmosphere. When the air has been exhausted, the float mechanism shall be buoyed up and shall tightly close the small orifice. The small orifice assembly shall be furnished with 304 stainless steel body and cover, and shall use 316 stainless steel hardware. The float mechanism shall be constructed of polypropylene or 316 stainless steel. All wetted components shall be polypropylene, Buna-N or 316 stainless steel. A resilient, Buna N seat shall provide drop tight closure.

2. Separate air release valves shall be Vent-O-Mat Model RBXb, equal as ARI of the special type for use with non-clean water.

3. For clean water acceptable manufacturers are Cla-Val, GA Industries-LLC, Val-matic, and ARI.

F. Vacuum Relief Valves: Tag Type VRV

1. Large orifice assembly vacuum valves shall automatically allow air to enter pipeline when pressure falls below atmospheric pressure. Vacuum relief valves shall not be configured to release air.

2. Vacuum relief valves shall be constructed as specified in subparagraph G below, except providing vacuum relief only, as manufactured by Cla-Val, ARI, Dorit, GA Industries or Vent-O-Mat or as indicated on the Drawings.

G. Combination Air and Vacuum Relief Valves: Tag Type Noted Below

1. Valves shall be single body, solid multiple float design configured to release large amounts of air during pipeline filling, release small amounts of air accumulated during pipeline operation, and allow large volume of air entry during pipeline. Single or segmented float shall be solid thermoplastic and shall not deform under any operating conditions. The body and float design shall limit the transient pressure rise to not more than twice the valve working pressure. Valve design shall incorporate an over pressure safety feature that will fail without an explosive effect, such as is normally the case when highly compressed air is released suddenly. Valves shall have intake area equal to nominal size of the valve. Valve bodies shall be smooth contoured for solids flushing, and shall have ports for flush and drain. Valve body shall be easily dismantled with single split coupling, top entry bolted flange or be of cylindrical construction with flanged ends secured with external tie rods. Valves shall be rated for 250 psi service pressure.

2. General Service Combination Air/Vacuum Valve: Tag Type CAV1
   a. Body shall be ductile iron, 304 stainless steel or 316 stainless steel.
   b. Floats shall be HDPE or 316 stainless steel
   c. Internal wetted components shall be 316 stainless steel
   d. Seals and elastomers shall be Neoprene or EPDM.

e. External bolting shall be 316 stainless steel
f. Manufacturer shall be Vent-O-Mat RGXII, A.R.I. D-026, Dorit DAV, APCO ASU

3. Saline Water Service Combination Air/Vacuum Valve: Tag Type CAV2
   a. Body shall be 316 stainless steel or cast nylon.
   b. Floats shall be HDPE or Monel
   c. Internal wetted components shall be Monel
   d. Seals and elastomers shall be Neoprene or EPDM.
   e. External bolting shall be 316 stainless steel.
   f. Pump discharge
   g. Manufacturer shall be Vent-O-Mat RBX, A.R.I. D-026, Dorit DAV

4. Pump Discharge Air/Vacuum valve: Tag Type CAV3
   a. Body shall be 316 stainless steel or cast nylon.
   b. Floats shall be HDPE or Monel
   c. Internal wetted components shall be Monel
   d. Seals and elastomers shall be Neoprene or EPDM.
   e. External bolting shall be 316 stainless steel.
   f. Provide valve with throttling control device
   g. Manufacturer shall be Cla-Val 33A, Vent-O-Mat RBX, A.R.I. D-026, Dorit DAV

5. Valves shall be as manufactured by GA Industries or equal by Vent-O-Mat, Model RBX 2521 or 1631 or as indicated on the Drawings

2.09 SURFACE PREPARATION AND SHOP COATINGS

A. **All valves (inclusive of valve actuators) shall be finished painted by way of spray application prior to installation. Provide touch up paint after installed and commissioned.**

B. Notwithstanding any of these specified requirements, all coatings and lubricants in contact with potable water shall be certified as acceptable for use with that fluid.

C. If not specified herein, coatings shall comply with the requirements of Section 09915 and 09901. In case of a conflict, the requirements of this Section govern.

D. If the manufacturer's requirement is not to require finished coating on any interior surfaces, then manufacturer shall so state and no interior finish coating will be required, if acceptable to the Engineer.

E. The exterior surface of various parts of valves, operators, floor stands and miscellaneous piping shall be thoroughly cleaned of all scale, dirt, grease or other foreign matter and thereafter one shop coat of an approved rust inhibitive primer such as Inertol Primer No. 621 shall be applied in accordance with the instructions of the paint manufacturer or other primer compatible with the finish coat provided.

F. Unless otherwise noted, interior ferrous surfaces of all valves shall be given a shop finish of an asphalt varnish conforming to AWWA C509, (except mounting faces/surfaces) or epoxy

conforming to AWWA C550 with a minimum thickness of 16 mils or as required by Division 9 whichever is greater.

G. Ferrous surfaces obviously not to be painted shall be given a shop coat of grease or other suitable rust resistant coating. Mounting surfaces shall be especially coated with a rust preventative.

H. Special care shall be taken to protect uncoated items and plastic items, especially from environmental damage.

2.10 FACTORY INSPECTION AND TESTING

A. Factory inspection, testing and correction of deficiencies shall be done in accordance with the referenced standards and as noted herein.

B. See Division 1 for additional requirements. Also refer to PART 1, especially for required submission of test data to the Engineer.

C. In addition to all tests required by the referenced standards, the following shall also be factory tested:

1. Pressure regulating valves shall be factory tested at the specified pressures and flows.

2. Butterfly valves shall be factory tested to demonstrate drop tight closure at the specified conditions.

3. All types of air and vacuum valves.

PART 3 EXECUTION

3.01 INSTALLATION - GENERAL

A. All valves and appurtenances shall be installed per the manufacturer's instructions in the locations shown, true to alignment and rigidly supported. Gearboxes, electric, hydraulic and pneumatic actuators shall be installed at the valve supplier's facility, completely adjusted and tested. Valve and actuator assemblies shall not be mated in the field under any circumstance.

B. In no case shall stems be installed upside down- or vertical in the 6 o'clock position. Unless otherwise indicated on the Drawings:

1. Gate, Globe, Ball valves shall be installed with stem vertical in the 12 o'clock position.

2. Plug valves shall be installed with stem horizontal and plug opening to the top of the body unless position will not allow proper actuator access, in which case stem shall be vertical in the 12 o'clock position.

3. Butterfly valves 12 inch and smaller may be installed with stem horizontal or vertical in the 12 o'clock position, 14 inch and larger shall be installed with the stem horizontal unless

position will not allow proper actuator access, in which case stem shall be vertical in the 12 o'clock position.

C. Install all brackets, extension rods, guides, the various types of operators and appurtenances as shown on the Drawings, or otherwise required. Before setting these items, check all Drawings and figures which have a direct bearing on their location. The Contractor shall be responsible for the proper location of valves and appurtenances during the construction of the work.

D. All materials shall be carefully inspected for defects in construction and materials. All debris and foreign material shall be cleaned out of openings, etc. All valve flange covers shall remain in place until connected piping is in place. All operating mechanisms shall be operated to check their proper functioning and all nuts and bolts checked for tightness. Valves and other equipment which do not operate easily, or are otherwise defective, shall be repaired or replaced at no additional cost to the Owner.

E. Where installation is covered by a referenced standard, installation shall be in accordance with that standard, except as herein modified, and the Contractor shall certify such. Also note additional requirements in other parts of this Section.

F. Unless otherwise noted, joints for valves and appurtenances shall be made up utilizing the same procedures as specified under the applicable type connecting pipe joint and all valves and other items shall be installed in the proper position as recommended by the manufacturer. Contractor shall be responsible for verifying manufacturers' torquing requirements for all valves.

3.02 INSTALLATION OF MANUAL OPERATIONAL DEVICES

A. Unless otherwise noted, all operational devices shall be installed with the units of the factory, as shown on the Drawings or as acceptable to the Engineer to allow accessibility to operate and maintain the item and to prevent interference with other piping, valves and appurtenances.

B. Valve operators and indicators shall be rotated to display toward normal operation locations.

C. Floor boxes, valve boxes, extension stems and low floor stands shall be installed vertically centered over the operating nut, with couplings as required and the elevation of the box top shall be adjusted to conform to the elevation of the finished floor surface or grade at the completion of the Contract. Boxes and stem guides shall be adequately supported during concrete placement to maintain vertical alignment.

3.03 INSPECTION, TESTING AND CORRECTION OF DEFICIENCIES

A. See also Division 1. Take care not to over pressure valves or appurtenances during pipe testing. If any unit proves to be defective, it shall be replaced or repaired to the satisfaction of the Engineer.

B. Functional Test: Prior to plant startup, all items shall be inspected for proper alignment, quiet operation, proper connection and satisfactory performance. After installation, all manual valves shall be opened and closed in the presence of the Engineer to show the valve operates smoothly from full open to full close and without leakage. Valves equipped with electric, pneumatic or

hydraulic actuators shall by cycled 5 times from full open to full closed in the presence of the Engineer without vibration, jamming, leakage, or overheating. Pressure control and pressure relief valves shall be operated in the presence of the Engineer to show they perform their specified function at some time prior to placing the piping system in operation and as agreed during construction coordination meetings.

C. The various pipe lines in which the valves and appurtenances are to be installed are specified to be field tested. During these tests any defective valve or appurtenance shall be adjusted, removed and replaced, or otherwise made acceptable to the Engineer.

D. Various regulating valves, strainers, or other appurtenances shall be tested to demonstrate their conformance with the specified operational capabilities and any deficiencies shall be corrected or the device replaced or otherwise made acceptable to the Engineer.

3.04 CLEANING

A. All items including valve interiors shall be inspected before line closure, for the presence of debris. At the option of the Engineer, internal inspection of valve and appurtenances may be required any time that the likelihood of debris is a possibility. All pipes and valves shall be cleaned prior to installation, testing disinfection and final acceptance.

3.05 DISINFECTION

A. Disinfection of valves and appurtenances on all potable water lines and where otherwise noted, shall be as noted in Paragraph 1.03B above.

END OF SECTION

SECTION 15114
ELECTRO-HYDRAULIC VALVE ACTUATORS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor and materials required and install, test, and make complete ready for operation, Pump Control Valve System including resilient seated Ball Valve, and electro-hydraulic type valve actuator with accessories as shown on the Drawings and as specified herein. Furnish all necessary hardware associated with actuator-to-valve mounting.

1.02 MEASUREMENT AND PAYMENT

A. No separate payment for Electro-Hydraulic Valve Actuator will be made under this section. Include the cost for this work in the lump sum Base Bid.

1.03 RELATED WORK

A. Ball type pump control valves are included in Section 15953.

B. Mechanical piping, valves, pipe hangers and supports are specified in their respective sections of Division 15.

C. Painting, in addition to the requirements in this Section, is specified in Division 9.

D. **Control Description is included in Section 13305.** Instrumentation and control work, except as specified herein, is included in Division 13. SCADA input and output signal requirements for monitoring/control are further defined in the P&ID Drawings, Instrumentation Drawings, and Division 13.

E. Electrical work, in addition to the requirements of this Section, is specified in Division 16.

1.04 REFERENCES

A. The following is a list of standards that may be referenced in this section:

1. Joint Industry Conference (JIC): Standards for Hydraulic Cylinders.

2. ANSI ISA -96-06 (Sept 2014): ANSI ISA Standard for Hydraulic Actuators

3. National Electrical Manufacturer's Association (NEMA) 250-91, Enclosures for Electrical Equipment (1,000 Volts Maximum).

4. Underwriters Laboratories (UL).

1.05 DEFINITIONS

A. Fail Close (or Fail Safe): The actuator shall close the valve upon loss of power.

1.06 SUBMITTALS

A. Submit to the Engineer for review, as provided in Section 01330, shop drawings showing details of fabrication and installation of all items furnished under this Section. **This equipment is critical to complete the project on schedule. CONTRACTOR is responsible for coordinating with equipment manufacturer to ensure submittal is provided to the ENGINEER as specified in Section 01112 – Time Critical for the Completion of the Project Submittals and timely delivery.**

B. Shop Drawings and Product Data

1. Certified dimensional drawings of each item of equipment and auxiliary apparatus to be furnished including but not limited to electro-hydraulic type valve actuator mounted to the resilient seated ball valve specified in Section 15953.

2. Certified mechanical and electrical connection details. Power and control wiring diagrams including terminals and numbers.

3. Literature and drawings describing the equipment in sufficient detail, including parts list and materials of construction, to indicate full conformance with the detailed Specifications.

4. Manufacturer's certified data showing valve and actuator characteristics of torque, speed, power requirements and consumption, options provided, operational flexibility characteristics to be provided, and total unit weight. Catalog sheets showing general information and options available will not be acceptable.

5. Manufacturer's catalog information, descriptive literature, and specifications.

6. Functional description of internal and external instrumentation and controls to be supplied including list of parameters monitored, controlled or alarmed.

7. Valve torque requirements at given ΔP shut-off. Actuator output torque, to include a minimum of 50% safety factor.

8. Field performance test procedures.

C. Shop Drawings of Control Panel including as a minimum the following information:

1. Out-to-out dimensions of Panel.

2. Layout of exterior panel faces.

3. Conduit and piping connections sizes and locations.

4. Interior Panel layout.

5. Schedule of control components and catalog data sheets for the same.

6. Schematic wiring diagram for and interlocks with pump motor circuit.

D. Manufacturer's installation instructions

E. Manufacturer's Certifications:

1. Submit manufacturer's certification that he has carefully examined the Contract Documents in detail, including the arrangement and conditions of proposed electrical, mechanical, and structural systems affecting the performance of the equipment, and the detailed requirements of manufacturing and subsequent installation of the equipment.

2 Submit manufacturer's certification that there are no omissions, ambiguities or conflicts in the Contract Documents or in the pumping station piping layout that affects the equipment, as shown on the Drawings, which have not already been clarified in writing.

F. Operation and Maintenance Data in accordance with Section 01782 - Operation and Maintenance Data.

G. Manufacturer's Field Report

1. Submit the equipment manufacturer's Certificate of Physical Checkout and Installation.

2. Submit the equipment manufacturer's Certificate of Field Testing.

3. Submit the equipment manufacturer's Certificate of Functional Testing.

1.07 QUALITY ASSURANCE

A. Overall Responsibility

1. To insure equipment compatibility the actuator manufacturer shall be responsible for furnishing the Pump Control Valve System equipment including resilient metal seated Ball Valve, electro-hydraulic type valve actuator, actuator controller, mounting connections and all interconnecting cables. The actuator manufacturer shall have responsibility for the function of the complete system in accordance with the intent of these specifications and shall be experienced in similar work. Also, the actuator manufacturers shall be responsible for coordinating with the valve supplier for all specified testing of ball valve and complete valve/actuator assembly, start-up, training, and warranty.

B. The actuator manufacturer shall be responsible for obtaining torque requirements from the respective valve manufacturer based on the specified flow and pressure conditions, and sizing valve actuator. Valve manufacturer shall supply these torque values as specified in Section 15953.

C. The actuator manufacturer shall design and fabricate mounting hardware for attaching each actuator to corresponding valve based upon valve top-works dimensions supplied by Valve manufacturer as specified in Section 15953. Mounting design shall be included as part of actuator manufacturer drawing submittals.

D. The actuator manufacturer shall mount and calibrate each actuator to corresponding valve at valve manufacturer facility. Mounting procedure shall be assisted by the valve manufacturer and follow any specific instructions/direction provided by valve manufacturer per Section 15953.

E. The actuator manufacturer shall give two- week notification to Contractor & valve manufacturer prior to shipping of actuators to valve manufacturer.

F. Valve manufacturer shall give two week notice to actuator manufacturer prior to mounting actuators to valves. The actuator manufacturer shall be present to witness mounting of actuators to valves at valve manufacturer's factory per Section 15953.

G. The valve manufacturer shall fully assemble valve and actuator in their factory, with assistance from actuator manufacturer, and perform testing with control panel prior to shipping. Perform manufacturer's standard functional tests in valve factory on each actuator unit on each job valve.

H. The actuator manufacturer shall submit in writing to Contractor & Engineer that all actuator and valve assemblies are properly mounted and calibrated prior to shipment from the valve manufacturer facility to the job-site.

I. The actuator manufacturer shall provide on-site installation assistance by actuator manufacturer technician.

J. The valve and actuator manufacturer shall submit in writing to Contractor & Engineer that all actuator and valve assemblies are properly installed at job-site.

K. Manufacturer shall submit to the engineer a list of furnished units of the same general design, type and comparable size specified herein, which have been used and provided satisfactory service under similar test, service and operating conditions for at least five years.

L. Contractor shall retain overall responsibility for equipment coordination, installation, testing, and operation.

1.08 SYSTEM DESCRIPTION

A. Provided below is a table with information on the pump control valve system that will be operated with an electro-hydraulic valve actuator.

Emergency Closure Speed Range and Initial Time	0-60 sec; Set initial time to fail close at 30 sec
Normal Opening/Closure Speed Range and Initial Time	0-180 sec, Set initial time to open/close at 60 sec

Fail Mode	Fail Close
Pump Discharge Pressure at Duty Point	82.7 psig
Pump Shut-off Pressure	127.8 psig
Pump Flow at Duty Point	13,888 gpm
Pump Backpressure (min) Requirements at full speed	47.5 psig

1.09 WARRANTY

A. The actuator manufacturer shall provide a warranty valid for all equipment supplied under this Section and obtain from the selected valve OEM a warranty valid for all equipment supplied under Section 15953- Resilient Seated Ball Type Pump Control Valve for a period of four (4) years commencing from the time of final acceptance by the Owner. This warranty shall include no fewer than two annual site visits by a factory maintenance technician of the actuator manufacturers.

1.10 SPARE PARTS

A. The actuator manufacturer shall provide one complete set of spare parts appropriately stored and protected for long term storage.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Resilient Seated Valve

1. As Specified in Section 15953

B. Actuator

1. REXA, Inc.

2.02 ELECTRO-HYDRAULIC ACTUATORS

A. General:

1. Furnish electro-hydraulic actuators, defined in Part 1.08 A. The actuators shall be specifically designed for 100 percent continuous duty for modulating service on pump discharge control valves.

2. The actuator shall be rated for indoor service, being constructed of anodized aluminum & steel with a two part epoxy or powder coating for maximum corrosion resistance.

3. Signal repeatability shall be a minimum of 0.10% of full travel. Response shall be virtually instantaneous with zero overshoot of target position.

4. Actuators must be designed with sufficient force output capable to meet the maximum required torque for each valve. A safety factor of 1.5x shall be applied to the maximum required valve torques using raw values from the valve manufacturer without safety factors already applied.

B. Actuator

1. The valve actuators shall be supplied as a complete assembly that includes a hydraulic actuator (and remote skid, if applicable), an electronics enclosure containing a dedicated programmable microprocessor controller and electrical cables connecting the aforementioned components.

2. The hydraulic actuator shall clearly indicate valve position locally, via a visible, mechanical apparatus, such as a color-coded rotary indication.

3. The actuators shall come equipped with a mechanical means to operate the actuator when electrical supply power is not available. Said mechanical means should be independent of the actuator hydraulics and capable of being isolated during normal operation of the actuator. A declutcheable manual hand-wheel is preferred.

4. The valve actuators shall have at least two modes of operation, one for local control and the other for automatic control. Local control is defined as an operational state where the actuator can be controlled at the electronics of said actuator manually by an operator. Automatic mode is defined as the operational state where the actuator is controlled remotely by a SCADA, DCS, etc. It is also recommended that the actuators have a third mode dedicated to set-up and calibration.

5. Upon loss of primary power or control signal, the actuators shall fail closed via a nitrogen charged accumulator system. Speed for a full stroke closure shall be set at 30 seconds and adjustable in the field via a needle valve. Upon loss or discontinuation of control signal, the actuator shall be capable of failing and hydraulically locking fully open, fully closed, or in last position.

C. Hydraulic Power Unit

1. Each hydraulic actuator shall consist of a quarter turn, rack & pinion cylinder assembly which shall be coupled via hard hydraulic tubing & quick connect cables to a remotely mounted hydraulic power drive/module & accumulator skid. Each skid will be dedicated to a specific cylinder/valve assembly. Skid shall be located within 10 feet of each cylinder/valve assembly and mounted vertically. Hydraulic actuator must provide direct transfer of rotary travel to the valve. Actuator manufacturer shall furnish and install hard hydraulic tubing between a remotely mounted hydraulic power drive/module & accumulator skid and actuator cylinder.

2. All the hydraulic actuator components shall be capable of being mounted in any position.

3. The actuator hydraulics will employ food grade oil for the hydraulic medium.

4. The actuator shall provide sufficient force throughout entire valve stroke to overcome valve breakaway/seating friction and process dynamics. The hydraulic assembly shall be designed to operate at a standard internal hydraulic operating pressure of 2,000 psig, but will only generate the amount of internal psig required to transfer hydraulic volume into rotary force capable of overcoming torque required to more the valve as required at any given moment. In addition, the hydraulic actuators shall contain pressure limiting devices that allow the user to limit the internal pressure build-up of the hydraulics to 2,200-2,300 psig maximum, and field adjustable to lower values, in order to protect the internals of the hydraulics.

5. The actuator hydraulics shall be supplied from the manufacturer containing at maximum 500 or 1,000 cubic inches of oil as required by selected valve, completely purged of air and hermetically sealed off from the environment. Actuator shall require no additional oil volume after it ships from the manufacturer. No oil filters are to be incorporated into the hydraulic design of the required actuators.

6. The hydraulic power drive/module assembly shall consist of a drive train apparatus containing a bi-directional gear pump and a hydraulic circuit regulating equal volumes of oil flow into and out of the hydraulic cylinder. Hydraulic circuit shall provide dual action, acting as a check valve in one direction and a throttling valve for the hydraulic pump in the opposite direction. The valves shall direct hydraulic flow from the pump to cause the actuator to stroke in the direction indicated by the controller.

7. The hydraulic power drive/module assembly shall also contain a motor that is directly coupled to the pump within the hydraulic manifold. The motor shall only operate when a valve position change is required. Motors shall be of a brushless servo motor design.

8. During normal operation, when the motor/pump is stopped, the hydraulic circuit shall be closed, securely locking the actuator in place.

D. Power and Feedback Cable

1. All cables for connections between the electronics, the hydraulic cylinder and skid of the actuator shall be supplied by the actuator manufacturer. Quick connect cables in lengths of 25 feet will be used.

2. All external cable connections between SCADA and the actuator shall be supplied and installed by the contractor. Conduits entries into the actuator control enclosure shall be made according to the actuator manufacturer instructions. Separate conduits for all high voltage and low signal wiring connections must be supplied by The Contractor, no exceptions.

E. Power Requirements

1. 3 phase, 60 hertz, 480 volt source shall be utilized for new actuators. The actuator manufacturer shall provide any reduced voltage transformer required for the actuators.

F. Control Panel

1. A single panel shall be furnished for each electro-hydraulic actuator. Control panel shall include a five-button pushbutton control display. Actuator controls shall be contained within a NEMA 4X stainless steel enclosure suitable for indoor mounting at the location shown on the Drawings.

2. The control panel shall provide automatic and local operations to permit valve to be operated through an external 4 – 20 mA input control signal for modulating service or through a local actuator display on the control enclosure to position the valve as required.

3. The control panel shall incorporate self-diagnostics. In the event of actuator failure or system malfunction, an alarm shall indicate locally and remotely the type of error. The error type may include loss of signal, incorrect direction, and loss of feedback.

4. Control enclosure shall include a display that will always show the current mode status of the actuator, the current position of the actuator and any alarm states. A continuous position feedback system shall be provided between the valve actuator and the SCADA system. All valve actuators shall include the ability to transmit a 4-20 mA continuous position indication signal for remote monitoring by the SCADA system. The valve actuators shall be designed with passive position transmitters. The PLC panel that controls the valve will power the valve position feedback signal, as shown on the P&IDs.

5. Refer to Division 13, P&IDs, and the electrical Drawings for indication of valve control panel communication with the plant SCADA system.

G. Actuator Performance

1. The speed of the actuator shall be electronically adjustable via programming of the actuator electronics. Standard speed setting under during normal motor operation shall be approximately 60 seconds for full quarter-turn rotation.

2. Normal operation and closing speed shall be a nominal 60 seconds and shall be capable of being adjustable from 0 – 180 seconds. The Fail-Close actuator shall set the rate of closing upon power failure for 30 seconds, but shall be field adjustable from 0– 60 seconds.

3. The actuator shall be capable of throttling the valve during pump start and shutdown based on pump/pump control valve operation sequence as specified in Section 13305. Back pressure control shall be provided by throttling the valve during low back pressure conditions as specified above. The low back pressure set point shall be fully adjustable.

4. The valve actuators shall be capable of providing sufficient torque to operate under specific valve operating conditions. Supplier shall verify with valve manufacturer. Refer to Paragraph 1.08 A and Section 15953 for valves conditions.

H. Identification Tagging Requirements

1. Provide a stainless steel tag bearing the valve tag number for each actuator.

2.03 SHOP/FACTORY FINISHING

A. Prime and finish coat exposed metal surfaces with coating and application in accordance with Division 9 in the factory unless stainless steel is used, then no painting is required.

B. Manufacturer shall provide materials for touch-up and recoating as necessary if coating damage occurs prior to final acceptance.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install Pump Control Valve and electro-hydraulic actuator System in accordance with Drawings, Technical Specification Sections, approved shop drawings, and manufacturers' installation instructions.

1. For Pumps No. 5 through No. 8, only one pump may be taken out of service at a time to install new pump control valves/actuators.

2. For Pumps No. 1 through No. 4, two pumps may be taken out of service at a time to install new pump control valves/actuators.

3. Pump control valves/actuators installation work sequence shall start from Pump No. 5, from west to east, coinciding with associated electrical work.

B. The Electro-Hydraulic Actuator manufacturer shall be responsible for coordinating with valve manufacturer for mounting of all supplied actuators to the valves with all necessary mounting hardware furnished by actuator manufacturer, furnishing electrical wiring between the actuators and their associated panel.

C. Contractor shall be responsible for installing electrical conduit and pulling electrical wiring to each individual actuator and between the associated panels per instructions of the actuator manufacturer.

D. Support actuator per written instructions from manufacturer so that there is no movement detectable in the actuator body when the valve is operated under full locked-torque conditions.

E. Lubricate all required parts prior to placing actuator in service.

3.02 FACTORY TESTING

A. Perform manufacturer's standard factory tests to ensure operation of valve and control panel prior to shipment for installation with valve body. Repeat tests on each complete valve/actuator assembly prior to shipment to the jobsite.

3.03 FIELD QUALITY CONTROL

A. Manufacturer's representative to assist CONTRACTOR in performing the following tasks.

1. Check completed installation.

2. Service system using lubricants recommended by manufacturer.

3. Make any necessary adjustments. Valve speed controls and time delay relay to be adjusted to eliminate water hammer on loss of power.

B. Performance test:

1. Conduct performance testing on each valve/actuator assembly once installed. Upon installation, conduct Equipment Checkout, Field Testing and Functional Testing. Each pump shall be field tested with the new pump control valve and actuator system and demonstrated a successful pass of the required testing and a functional installation before a subsequent pump can be replaced with new pump control valve and actuator.

2. Perform under actual or approved simulated operating conditions. To simulate power failure condition, the following testing procedure shall be followed:
   a. Associated high service pump(s) shall be turned off.
   b. Associated pump discharge butterfly valve shall close.
   c. In local mode, open the pump control valve manually to fully open position.
   d. Open the pump discharge butterfly valve and shut off power to the pump control valve.
   e. Field adjust set-point for valve fail close speed.

3. Test for a continuous 48-hour period without malfunction.

4. Adjust, realign, or modify units (as necessary) and retest until acceptable.

5. Actuator/valve assemblies shall stroke in a smooth and controlled manner.

6. If required, take corrective action and the units shall be retested to ensure full compliance with the specified requirements. All costs associated with the field tests or any required corrective action shall be borne by the Contractor.

C. Manufacturer's Installation Report

1. Submit within 30 days after installation inspection.

2. Include the following in report.
   a. Description of each deficiency found.
   b. Recommended corrective action(s).
   c. Statement that High Service pump control valves and associated control panels are properly installed and adjusted except as noted.

3.04 VENDOR TRAINING AND MANUFACTURER'S SERVICES

A. Provide vendor training for Pump Control Valve and actuator System.

1. Provide eight hours of vendor training. Vendor training shall include both classroom training at the Owner's facility and hands-on training on the Owner's equipment.

2. Vendor training session topics shall include sufficient information and skills training on the theory, design, and site specific operation and maintenance practices, including, but not limited to, routine monitoring with normal and abnormal parameters, troubleshooting techniques, and preventive and corrective maintenance requirements to operate and maintain equipment and systems.

3. A training video shall be provided. A training video shall be professionally made of the vendor training session. The training video must be representative of the equipment furnished for this project. The training video shall be in DVD format as required by Specification 01782S.

4. Documentation for vendor training shall be provided to each participant which includes actual manuals for the equipment and drawings and schematics of equipment supplied for this project.

B. A manufacturer's representative who has a complete knowledge of the proper startup, installation, operation and maintenance shall be provided as noted below:

MANUFACTURER'S REPRESENTATIVE DUTIES

Services Provided by Factory Representative	**Minimum # of Trips[a]**	**Minimum Time On Site Per Trip[a] (8 hr. working days)**
1. Supervise Installation	6	6 days
2. Inspect and Approve Installation[b]	1[c]	1 day
3. Supervise Testing	2[d]	4 days
4. Instruct Owner in Proper Startup and O&M	1[e]	1 day

[a] The manufacturer's factory representative shall be present at frequent enough intervals to ensure proper installation testing and initial operation of the equipment.
[b] The manufacturer's factory representative shall provide to the Engineer a written certification that each unit has been installed in accordance with the manufacturer's recommendations.
[c] May be done immediately following completion of Item 1 if acceptable to the Engineer.
[d] May be done immediately following completion of Item 2 if acceptable to the Engineer.
[e] This instruction may be given following completion of Item 3, provided that the test is successful, the O&M Manuals have been approved, and if it is acceptable to the Engineer.

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SECTION 15120
PIPING SPECIALTIES

PART 1 GENERAL

1.01 SCOPE OF WORK

A. This Section specifies piping appurtenances which are not specifically covered in other sections. Specific piping materials, systems and related installation and testing requirements are included in other sections of Divisions 2 and 15.

B. The items shall include the following:

1. Chemical Injection Assembly
2. Unions
3. Flanged Joints
4. Dielectric Connectors
5. Plugs and Caps
6. Miscellaneous Adaptors
7. Vents and Drains
8. Service Clamps
9. Quick Connect Couplings
10. Mechanical Sleeve Seals
11. Flexible Connectors
    a. Sleeve Couplings
    b. Split or Grooved Couplings
    c. Flange Adapters
    d. Pump and Equipment Flexible Connectors
    e. Flexible Connectors
12. Harnessing and Restraints
13. Pressure Gauges
14. Diaphragm Seals for Gages
15. Appurtenances and Miscellaneous Items
16. Color Coding and Labeling

1.02 MEASUREMENT AND PAYMENT

A. No separate payment will be made for work performed under this Section. Include the cost for this work in the lump sum Base Bid.

B. Payment for extra unit price work shall be as defined in the extra unit price schedule.

1.03 RELATED WORK

A. Submittals are specified in Section 01330.

B. Field Painting is included in Section 09901.

C. Shop Preparation, and Painting is included in Section 09915.

D. Piping Materials and Systems are included in Division 15.

E. Piping – General Requirements is specified in Section 15051.

F. Valves are included in Section 15100.

1.04 SUBMITTALS

A. General submittals for piping, piping systems and pipeline appurtenances are listed below. Submittals shall be in accordance with Section 01330. It is not intended that all submittals listed below be provided for all piping materials and systems. Refer to individual System or Piping Sections for specific submittals.

B. Shop Drawings and Product Data

1. Piping layouts in full detail and in AutoCAD or equivalent software.

2. Location of pipe hangers and supports.

3. Location and type of backup block or device to prevent joint separation.

4. Large scale details of wall penetrations and fabricated fittings.

5. Schedules of all pipe, fittings, special castings, couplings, expansion joints and other appurtenances in detail per each process area.

6. Catalog cuts of joints, couplings, harnesses, expansion joints, gaskets, fasteners and other accessories.

7. Catalog cuts of all pipeline appurtenances specified herein.

8. Brochures and technical data on coatings and linings and proposed method for application and repair.

C. Samples

D. Design Data

E. Test Reports

1. Copies of certified shop tests showing compliance with appropriate standard.

2. Copies of all field test reports, signed by Contractor and Engineer.

F. Certificates

1. Copies of certification for all welders performing work in accordance with ANSI B31.1.

G. Manufacturer's Installation (or application) instructions.

H. Statement of Qualifications

I. Manufacturer's Field Report

J. Project Record Document

K. Operation and Maintenance Data in accordance with Section 01782.

L. Warranties

1.05 REFERENCE STANDARDS

A. American Society for Testing and Materials (ASTM)

1. ASTM A36 – Standard Specification for Structural Steel.

2. ASTM A126 – Gray Iron Casting for Valves, Flanges and Pipe Fittings.

3. ASTM A183 – Carbon Steel Track Bolts and Nuts.

4. ASTM A278 – Gray Iron Castings for Pressure Containing Parts for Temperatures up to 650EF.

5. ASTM A307 – Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.

6. ASTM A325 – Standard Specification for High Strength Bolts for Structural Steel Joints.

7. ASTM A536 – Ductile Iron Castings.

8. ASTM A575 – Standard Specification for Steel Bars, Carbon, Merchant Quality, M Grade.

9. ASTM B62 – Standard Specification for Composition Bronze or Ounce Metal Castings.

10. ASTM B88 – Standard Specification for Seamless Copper Water Tube.

B. American National Standards Institute (ANSI)

1. ANSI A13.1 – Scheme for the Identification of Piping Systems.

2. ANSI B1.1 – Unified Inch Screw Threads (UN and UNR Thread Form).

3. ANSI B2.1 – Specifications, Dimensions, Gauging for Taper and Straight Pipe Threads (except dry seals).

4. ANSI B16.1 – Cast Iron Pipe Flanges and Flanged Fittings Class 25, 125, 250 and 800.

5. ANSI B16.5 – Pipe Flanges and Flange Fittings.

6. ANSI B18.2 – Square and Hex Bolts and Screws Inch Series Including Hex Cap Screws and Lag Screws.

7. ANSI B31 – Code for Pressure Piping, B31 Interpretation.

8. ANSI B31.1 – Power Piping.

9. American Welding Society (AWS).

10. AWS B3.0 – Welding Procedure and Performance Qualifications.

C. American Water Works Association (AWWA)

1. AWWA C 110 – Ductile Iron and Gray Iron Fittings 3 in Through 48 in, for Water and Other Liquids.

2. AWWA C 111 – Rubber Gasket Joints for Ductile Iron and Gray Iron Pressure Pipe and Fittings.

3. AWWA C 200 – Steel Water Pipe – 6-in and larger.

4. AWWA C 606 – Grooved and Shouldered Type Joints.

5. AWWA Manual M11 – Steel Pipe – A Guide for Design and Installation.

D. Plumbing and Drainage Institute (PDI)

1. WH 201 – Water Hammer Arrestors

E. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.06 QUALITY ASSURANCE

A. All materials shall be new and unused.

B. Install piping to meet requirements of local codes.

C. All grooved joint specialties shall be the products of a single manufacturer, and be of the same manufacturer as the adjoining couplings.

D. Provide manufacturer's certification that materials meet or exceed minimum requirements as specified. Reference to standards such as ASTM and ANSI shall apply to those versions in effect at the time of bid opening.

E. Coordinate dimensions and drilling of flanges with flanges for valves, pumps and other equipment to be installed in piping systems. Bolt holes in flanges to straddle vertical centerline.

F. Reject materials contaminated with gasoline, lubricating oil, liquid or gaseous fuel, aromatic compounds, paint solvent, paint thinner and acid solder.

G. Pipe joint compound, for pipe carrying flammable or toxic gas, must bear approval of Underwriters' Laboratories or Factory Mutual Engineering Division.

H. Unless otherwise specified, pressures referred to in all Piping Sections are expressed in pounds per square in gage above atmospheric pressure, psig and all temperature are expressed in degrees Fahrenheit.

1.07 DELIVERY, STORAGE AND HANDLING

A. During loading, transportation and unloading, take care to prevent damage to pipes and coating. Carefully load and unload each pipe under control at all times. Place skids or blocks under each pipe in the shop and securely wedge pipe during transportation to ensure no injury to pipe and lining.

PART 2 PRODUCTS

2.01 MATERIALS AND EQUIPMENT

A. Specific piping materials and appurtenances are specified in the respective Piping or System Sections. The use of a manufacturer's name and/or model number is for the purpose of establishing the standard of quality and general configuration desired.

B. Equipment shall be of the size shown on the Drawings or as noted and as far as possible equipment of the same type shall be identical and from one manufacturer.

C. Equipment shall have the name of the maker, nominal size, flow directional arrows (if applicable), working pressure for which they are designed and standard referenced specifications cast in raised letters or indelibly marked upon some appropriate part of the body.

D. Unless otherwise noted, items shall have a minimum working pressure of 150 psig or be of the same working pressure as the pipe they connect to, whichever is higher and suitable for the pressures noted where they are installed.

2.02 CHEMICAL INJECTION ASSEMBLY

A. Provide chemical injection assembly on 48-inch temporary bypass pipelines and 30-inch temporary filter backwash supply pipeline as shown on the Drawings and specified herein.

B. Injection quills shall consist of a ball type corporation stop assembly with bushing on the inlet thread nozzle and with male outlet threads to accept packing nut assembly; packing nut assembly with gasket and Teflon antifriction ring; injection quill assembly; stainless steel safety chain. A ball check valve shall be included with the Injection Quill Assembly and shall either meet the ball check valve requirements in Section 15100 or shall be a spring loaded ball check valve per injection quill manufacturer. Injection quill length shall provide installed quill end located one third into process pipe diameter. All wetted components shall be compatible with the applied chemical solution and the pipeline pressure and velocity as recommended by the equipment supplier.

C. Performance:

Chemical Service	Pipeline Flow (GPM) Min/Avg/Max	Pipeline Diameter (In)	Chemical Flow Rate (GPH)	Typical Injector Model by Inyo Process
Caustic (25%)	6,400/18,700/27,800	48	8.8-175.3	CS-100-S-S-22-F
Fluoride (23%)	6,400/18,700/27,800	48	0.6-7.8	CS-100-S-H-22-F
Liquid Ammonium Sulfate (40%)	6,400/18,700/27,800	48	3.7-39.6	CS-100-S-S-22-F
Sodium Hypochlorite (12.5%)	6,400/18,700/27,800	48	29.2-157	CS-100-S-H-22-F
Sodium Hypochlorite (12.5%)	6,400/18,700/27,800	30	29.2-157	CS-100-S-H-22-F

D. Injection Assembly units to be constructed as follows:

1. Isolation Valve: Brass.

2. Solution Tube: Hastelloy C-276 for sodium hypochlorite, Hastelloy C-276 for fluoride, type 316 stainless steel for liquid ammonium sulfate and caustic. Length as recommended by the manufacturer.

3. End Style: Flat

4. Chemical Injection Assembly: as manufactured by Saf-T-flo, Inyo Process or Engineer approved or Equal.

2.03 UNIONS

A. Unions shall be brass or bronze unions for joining nonferrous pipe; malleable brass or bronze seated iron or steel unions for joining ferrous pipe; PVC unions for joining PVC pipe; CPVC unions for joining CPVC pipe.

B. Unions for chemical feed systems shall be socket union type with gasket material compatible with process fluid.

C. Unions are not required in installations using grooved mechanical couplings. (The couplings shall serve as unions.)

2.04 FLANGED JOINTS

A. Flanged Joints. Bolt and nuts, Type 316 stainless steel, bolt number and size same as flange standard; studs - same quality as machine bolts; 1/16 inch thick rubber gaskets with cloth insertions; rust resistant coatings.

2.05 DIELECTRIC CONNECTORS

A. Dielectric pipe fittings/insulators and unions shall be used to prevent galvanic action wherever valves or piping of dissimilar metals connect. This shall be particularly the case for copper, brass and bronze piping connecting to cast iron or steel piping systems, etc.

B. Dielectric unions shall be used for 2 inches and smaller connections unless flanged connection shown on Drawings. Steel union nuts shall meet ASTM A575 requirements. The steel or ductile iron connection end shall have a steel body and shall have accurately machined taper tapped pipe threads in accordance with ANSI B2.1. The copper connection end shall be a copper solder joint that meets requirements of ASTM B88. Dielectric unions shall be rated for at least 250 psig at 210°F.

C. Dielectric flange unions shall be used for connections 2-1/2 inches and larger. Cast iron flanges shall meet ASTM A126; the copper solder end shall meet ASTM B62 and the pipe thread shall meet ANSI B2.1. Dielectric flange unions shall be rated for at least 175 psig at 210°F.

D. Dielectric unions and flange unions shall be as manufactured by Epco Inc., Cleveland, OH or equal.

E. Dielectric waterway fittings may be used for connections 8 inches and smaller. Zinc-electroplated ductile iron or steel pipe nipple with inert thermoplastic lining and grooved or threaded ends; Style 47 as manufactured by Victaulic Company, Easton, PA.

F. Flange insulating kits shall be as acceptable to the Engineer, as manufactured by PSI or equal.

G. Insulated sleeve couplings and flange adaptors shall be similar to those units as specified elsewhere.

2.06 PLUGS AND CAPS

A. Provide standard plug or cap as required for testing; plugs, caps suitable for permanent service.

B. Plug or cap or otherwise cover all piping work in progress.

2.07 MISCELLANEOUS ADAPTORS

A. Between different types of pipe and/or fittings special adapters may be required to provide proper connection. Some of these may be indicated on the Drawings or specified with individual types of pipe or equipment. However, it is the Contractor's responsibility to ensure proper connection between various types of pipe, to structures and between pipe and valves, gates, fittings and other appurtenances. The Contractor shall provide all adapters as required, whether specifically noted or not.

B. As required, these adapters shall be suitable for direct bury, with proper dielectric insulation and as a minimum, if metallic (not stainless steel or galvanized), with two coats of Coal Tar Epoxy.

2.08 VENTS AND DRAINS

A. 1/2 inch vents shall be provided at the high point in each system. Vent connections may be tapped, provided the tap will accept three full threads on the bronze nipple. On the chemical system piping, the vent shall have a valve and the vent line routed to the nearest drain.

B. 1–inch drains shall be provided to permit drainage of each system; provide hose end valve.

2.09 SERVICE CLAMPS

A. Use applicable City standards for service clamps; in the absence of such standards use the following.

B. Service clamps for outlet sizes up to 2 inches shall have malleable or ductile iron bodies which extend at least 160 degrees around the circumference of the pipe and shall have neoprene gaskets cemented to the saddle body. Bodies shall be tapped for IPS. Clamps shall be of the double strap design. Service clamps shall be Style 91 as manufactured by Dresser Industries, Inc. or equal as manufactured by Smith Blair; Mueller or equal.

C. Service clamps for outlet sizes 4 inches through 12 inches where the outlet size is not greater than half the size of the main pipe shall have ductile iron bodies and a neoprene circular cross section O-ring gasket confined within the body. Outlet shall be AWWA C 110 flange or AWWA C 111 mechanical joint as required for the application. Straps shall be alloy steel, minimum 1/4 inch by 1–1/2 inches in cross section and fabricated with 3/4 inch threaded ends. Service clamps shall be Fig. A-10920 or A 30920 as manufactured by American Cast Iron Pipe Company or equal.

2.10 QUICK CONNECT COUPLINGS

A. Fill station quick connect couplings shall be of the cam and groove type consisting of a male adapter conforming to Specification US Federal standard A-A-59326. Male adapters shall be designed to receive a female coupler without requiring threading, bolting, or tools. Connections shall remain tight and leakproof under pressures up to 100 psig. Each adapter shall be furnished with a female coupler dust cap with Type 316 stainless steel cams, complete with an 18 inch long Type 316 stainless steel security chain. The coupling assembly for the hydrofluosilicic acid fill station shall consist of a PVDF male adapter with a PVDF female coupler dust cap as manufactured by Flo-Couplings, or equal. All other coupling assemblies shall consist of Type 316 stainless steel male adapters and female coupler dust caps as manufactured by Sivacon, Ever-tite, or equal.

B. Chemical feed service flushing quick connects shall consist of PVDF female couplers with Type 316 stainless steel cams as manufactured by Flo-Couplings, or equal. Connections shall remain tight and leakproof under pressures up to 100 psig.

C. Adapters shall be furnished in accordance with the Drawings, or as required by the installation.

2.11 MECHANICAL SLEEVE SEALS

A. Mechanical sleeve seals shall be used to secure and seal the annular space around all new sleeved and core drilled wall penetrations.

B. A single seal shall be provided for all sleeve and cores in walls up to 14 inches thick; dual sleeves shall be provided in larger walls.

C. Galvanized steel wall sleeves and concrete core diameter shall be sized sufficiently large to accommodate the modular elements, per the manufacturer's recommendations. Provide Type 316L sleeves in all wetted process basins.

D. Bolts and hardware shall be carbon steel, zinc plated. Pressure plates shall be corrosion resistant acetal resin.

E. Mechanical sleeve seals shall consist of modular bolted, synthetic rubber sealing elements, Link Seal, manufactured by Thunderline Corp., or equal.

2.12 FLEXIBLE CONNECTORS

A. Sleeve Couplings

1. Provide plain end type ends to be joined by sleeve couplings as stipulated in AWWA C201.
   a. Join welds on ends by couplings without pipe stops. Grind flush to permit slipping coupling in at least one direction to clear pipe joint.
   b. Outside diameter and out of round tolerances shall be within limits specified by coupling manufacturer.
   c. Provide lugs in accordance with ASTM A36.

d. Provide hardened steel washers in accordance with ASTM A325.
e. Plastic plugs shall be fitted in coupling to protect bolt holes.
f. Nuts and bolts:
   1) Provide bolts and bolt studs in accordance with ASTM A307 and ANSI B1.1 with hexagonal or square heads, coarse thread fit, threaded full length with ends chamfered or rounded.
   2) Project ends 1/4 inch beyond surface of nuts.
   3) Hexagonal nuts with dimensions in accordance with ANSI B18.2 and coarse threads in accordance with ANSI B1.1.

2. Middle ring of each mechanical coupling shall have a thickness at least equal to that specified for size of pipe on which coupling is to be used and shall not be less than 10 inches long for pipe 30 inches and larger and not less than 7 inches long for pipe under 30 inches in diameter.
   a. Omit pipe stop from inner surface of middle rings of couplings whenever necessary to permit removal of valves, flowmeters and other installed equipment.
   b. Provide pipe stops in other couplings.

3. Clean and shop prime with manufacturer's standard rust inhibitive primer.

4. Furnish gaskets of a composition suitable for exposure to the fluid service.

5. Where shown on the Drawings, anchor sleeve coupled joints with harness bolts. Weld harness lugs to steel pipe in accordance with AWWA M-11.
   a. Joint harness bolts shall be of sufficient length, with harness lugs placed so that coupling can be slipped at least in one direction to clear joint. Provide harnesses of sufficient number and strength to withstand test pressure.
   b. Each harness shall have a minimum of two 5/8 inch diameter bolts.

6. Unless otherwise specified with the individual type of pipe, sleeve couplings (mechanical couplings) shall be ITT (formerly Smith Blair) Style 411; Dresser Style 38, similar models by Baker or equal, with the pipe stop removed.

7. Similar insulation type couplings shall be provided at the face of buildings, between different type metals or where otherwise noted.

8. In addition to those locations noted on the Drawings, sleeve couplings shall be provided on all piping where it connects with a structure or buried directly under a structure at the structure's expansion joints. Special treatment will be required where pipe is encased in concrete, utilizing minimum 3 inch thick styrofoam placed perpendicular to the horizontal centerline of the coupling.

B. Split or Grooved Couplings

1. Split couplings shall be cast in two or more parts. When secured together with ASTM A449 and A183 bolts and nuts, couplings shall engage grooved or shouldered pipe ends and encase a pressure-responsive elastomeric gasket to create a pipe seal. Gasket material shall be as recommended by the manufacturer for the service required.

2. Split couplings shall be as manufactured by Victaulic Company of America; Numbers below refer to Victaulic Co. items, for reference only.

3. Unless otherwise specified with the individual type of pipe:
   a. Flexible split ring couplings for steel pipe shall be:
      1) grooved ends – Style 77 (sizes through 12 inches) or W77 (sizes 14 through 24 inches)
      2) shouldered ends – Style 44
   b. Rigid split ring couplings shall be:
      1) grooved ends – rigid type with Style 07 couplings with offsetting angle-pattern bolt pads for steel pipe through 12 inches; Style W07 for sizes 14 through 24 inches; and for high pressure applications Style HP 70 couplings on steel pipe less than 18 in diameter; with sufficient wall thickness per AWWA C606, on standard groove on manufactured steel or other pipe.
      2) shouldered ends – Style 44 coupling on ductile iron over 24-in diameter or without sufficient wall thickness per AWWA C606 or on manufactured steel pipe or thin wall stainless steel pipe.
         a) Vic-Rings (Shoulders) for Style 44 couplings shall be manufactured by Victaulic Company, and shall be of a type suitable for the intended service.

4. Ductile iron pipe for use with Victaulic Style 31 split type coupling joints shall have radius grooved ends conforming to AWWA C606. Pipe shall have grooved ends to provide either a rigid joint or flexible joint as shown on the Drawings and as specified herein. Flexible joint grooving shall permit expansion and contraction, and angular deflection. Rigid joint grooving shall allow no angular or linear movement. Minimum pipe wall thickness for grooved pipe shall be the following class:

Size	Class
4 thru 16	53
18	54
20	55
24	56

5. Grooved couplings for steel and stainless steel piping shall have roll grooving, machine roll or cut grooving, or ring collars fully welded to the pipe or fitting.
   a. Stainless steel pipe shall be grooved with tools specifically designed for stainless steel pipe, equipped with 'RX' roll sets.

6. Rigid split couplings may be substituted for flanges as noted on the Drawings and in the individual pipe specifications.

7. Certain minimum thickness of pipe walls are required by AWWA C606 and coupling manufacturers for use of various type split couplings with certain pipes. The Contractor shall be responsible for utilizing at least those minimum wall thicknesses required (unless a greater thickness is specified or required in the individual pipe specifications) with split couplings.

8. If minimum thicknesses are not utilized with grooving, then a shouldered end treatment with couplings as noted shall be utilized.

C. Flanged Adaptors

1. Flanged adaptor connections for grooved or shouldered end pipe compatible with split couplings at fittings, valves and equipment shall be VIC Flange Style 341 for AWWA ductile iron pipe or Style 741 or W45R for steel pipe sizes as manufactured by the Victaulic Company of America.

2. Flanged adaptor connections for plain end pipe at fittings, valves and equipment shall be Victaulic "Depend-O-Lok®", Dresser Style 127 or 128, similar models by ITT (formerly Smith Blair); Baker or equal.

D. Pump and Equipment Flexible Connectors

1. The flexible connectors shall be expansion/vibration joints of the single arch type of butyl rubber construction with carcass of high grade woven cotton or suitable synthetic fiber and individual solid steel ring reinforcement. Soft rubber fillers shall be integrally cured into the arches to provide a smooth flow path to prevent settling of material into the arch. Joints shall be constructed to pipeline size and to meet working pressures and corrosive conditions similar to the line where installed. Joints shall have full faced fabric reinforced butyl flanges integral with the body.

2. Split steel or ductile iron back up rings shall be provided to ensure a good joint. Rings shall be designed for mating with ANSI Standard minimum 150 lb flanges. All joints shall be finish coated with Hypalon, or equal paint.

3. Expansion/vibration joints shall be furnished with control (harness) units. Harness units shall consist of minimum two drilled plates, stretcher bolts, and rubber washers backed by metal washers. The stretcher bolts shall prevent over elongation of the joint. Extra nuts shall be provided on the stretcher bolts on the inside of the plate to prevent overcompression. All nuts, bolts and plates shall be galvanized unless piping system requires a higher grade material.

4. The manufacturer of the expansion joints shall be a member of the Rubber Expansion Joint Division of the Fluid Sealing Association. Expansion joints shall be Style 1025 filled arch as manufactured by General Rubber Corp., South Hackensack, NJ or similar products of Mercer Rubber; Goodall Rubber.

5. In addition to other locations shown on the Drawings, expansion joints shall be utilized in all exposed piping, within one foot of a building expansion joint, and on the suction and discharge side of all positive displacement pumps, compressors and rotating machinery, as close to the unit as possible.

E. Flexible Connectors

1. Provide one flexible connector for the seal water connection to each pump stuffing box. Connectors shall be of hose of Buna N or similar resilient material, with fiber reinforcement, rated minimum 150 psi with bronze or Type 304 stainless steel NPT end fittings and shall be 12 inches in length. Connectors shall be for the purpose of isolating pump vibration from the seal water piping.

2. In steel piping systems through 12 inches, three flexible type grooved joint couplings may be used in lieu of a flexible connector at equipment connections for vibration attenuation and stress relief. Couplings shall be placed in close proximity to the source of the vibration. Victaulic Style 77.

3. Operation pressure unless otherwise specified.

2.13 HARNESSING AND RESTRAINT

A. Where harnessed couplings or adapters are noted, they shall conform to AWWA Manual M11 except as modified by the Drawings or this Specification.

B. Unless otherwise noted, size and material for tie rods, clamps, plates and hex nuts shall be as shown on the Drawings, or, if not shown on the Drawings, shall be as required in AWWA Manual M11. Manufactured restraining clamp assemblies shall be as manufactured by Stellar Corporation, Columbus, OH, or fabricated equal.

C. Restrained joints (such as welded, locking mechanical joints) shall be of the type specified with the individual type of pipe. If not specified, restrained (locking) mechanical joint pipe shall be of the manufacturer's standard design utilizing a locking device (ring or ears) integrally cast with the pipe.

D. For sizes through 18 inch diameter ductile iron pipe only, the following may be used as an alternative to other restraint system:

1. The optional mechanical joint restraints shall be incorporated in the design of a follower gland. The gland shall be manufactured of ductile iron conforming to ASTM A536. Dimensions of the gland shall be such that it can be used with the standardized mechanical joint bell and tee head bolts as specified with the pipe.

2. The restraint mechanism shall consist of numerous individually activated gripping surfaces to maximize restraint capability. The gripping surfaces shall be wedges designed to spread the bearing surfaces on the pipe. Twist off nuts, sized same as tee head bolts, shall be used to ensure proper actuating of restraining devices. When the nut is sheared off, standard hex nut shall remain.

3. The mechanical joint restraint device for ductile iron pipe shall have a working pressure of at least 250 pounds per square inch with a minimum safety factor of 2:1.

4. The mechanical joint restraint devices shall be of the type listed below or equal.

5. For Ductile Iron Pipe: EBAA Iron, Inc. Megalug 1100 series or equal by Star Pipe Products.

E. Joint restraint for PVC pipe shall be EBAA Iron, Inc. Megalug Series 2000PV or equal by Star Pipe Products (Stargrip).

F. The Contractor shall be responsible for anchorage including restraint as noted elsewhere in Division 15.

2.14 PRESSURE GAGES

A. Bosses, connections, or nipples for gages shall be provided as acceptable to the Engineer. Unbossed tappings shall not be acceptable. Where gage tappings are not available in the suction or discharge nozzle, the necessary tapping in the adjacent piping shall be made.

B. In addition to the locations shown on the Drawings, pressure gages shall be furnished and installed on the upstream and downstream sides of pressure reducing stations and in the suction and discharge nozzle of all pumps, compressors and similar equipment. Additional pressure gages shall be furnished and installed as specified with individual equipment.

C. Gages shall be furnished as part of a complete factory assembly, including gage, snubber, liquid fill, diaphragm seal (if shown on Drawings), isolation valve and connecting piping. Assembly shall be done in an instrumentation house using Vacuum Fill equipment in accordance with manufacturer's recommendations.

D. Unless otherwise noted, gage rating shall be from 0 to at least 2.5 percent higher than the rating of the pipe it is connected to.

E. For Liquid Service

1. Pressure gages shall have an aluminum case and shall be 2-inch nominal diameter with a full sized Type 316 stainless steel Bourdon tube and a 300 series stainless steel movement. The gages shall be liquid filled with food grade oil and shall be provided with a filler/breather cap. The socket shall be 1/4 inch NPT Type 316 stainless steel with a bottom connection and the dial shall be a white background with black markings. Gages shall be ANSI Grade A plus or minus 1 percent of scale and shall have a blowout back design.

2. Gages for the above services shall be Model 344Y liquid filled with mineral or food grade oil as manufactured by Crosby Valve & Gage Co., or equal by U.S. Gage; Ashcroft or Trerice.

F. For Chemical System Service

1. Pressure gages shall be as specified in Paragraph 2.16E and shall be 4-inch nominal diameter.

G. Air Service

1. Unless otherwise noted, pressure gages for low pressure air pipelines shall have a range of 0 to 15 psig.

2. Pressure gages shall have an aluminum case and shall be 4-inch nominal diameter with a Type 316 stainless steel Bourdon tube and a 300 series stainless steel movement. The socket shall be 1/2 inch NPT Type 316 stainless steel with a bottom connection. Gages shall have an accuracy of at least plus or minus 0.25 percent of scale. Gages shall be furnished with needle valve isolation.

3. Gages for air service shall be Model 5840 as manufactured by Marsh Instrument Co., Skokie, IL or equal.

H. Gages shall be furnished from standard ranges of the manufacturer, with dual range (ft and psi) scales, and with scales as approved during submittals.

2.15 DIAPHRAGM SEALS FOR GAGES

A. Diaphragm seals shall be installed for all pressure gages and pressure switches not on clean water lines, to protect pressure gages and pressure switches from contact with the fluid in the pipeline. Gages shall be furnished as part of a complete factory assembly, including gage, snubber, diaphragm seal, liquid fill, bar stock isolation valve and threaded red brass interconnecting piping. Furnish also a 1/4 inch backflushing connection and ball valve.

B. Diaphragm seals shall be minimum 2-inch diameter, or as required for the connected pressure gages. The diaphragm shall be "thread attached" to both piping and pressure switches or gages. Furnish mineral or food grade oil fill between the diaphragm seal and the gage.

1. Diaphragm seals shall have an upper housing of cadmium plated carbon steel, with the lower housing of material specifically chosen according to the fluid type and pressure being monitored with Type 304 stainless steel bolts. Diaphragms shall be Teflon.

2. Each diaphragm seal shall be connected to its respective piping or equipment with threaded red brass pipe and fittings. Pipe size and diaphragm tap size shall match the size of the gage tap on the equipment, but shall not be less than 3/4 inch, except for connections to plant water piping which shall be minimum 1/2 inch. Furnish a ball valve shut off valve between the pipeline or equipment and the diaphragm seal.

3. Each diaphragm seal shall have a minimum 1/4 inch NPT flush connection with ball valve and gage tap to match the size of the gage.

4. Furnish pulsation dampeners adequate to prevent pulsation and/or vibration of the gage indicator under all system operating conditions.

5. Pump gages shall connect to the diaphragm seal by a flexible Type 304 stainless steel capillary tube. Gages shall be mounted on a support stand independent of the pump and piping, to minimize vibration of the gages caused by vibration of the equipment or piping.

Mount both the suction and discharge gages at the same elevation. Furnish supports as specified in Section 15140, or attach gages to the seal water assembly support (where applicable).

6. Diaphragm seals shall be Type SG by Mansfield and Green, equal by Ashcroft, or equal.

2.16 APPURTENANCES AND MISCELLANEOUS ITEMS

A. All gaskets, glands, bolts, nuts and other required hardware shall be provided for connection of piping and appurtenances. Bolts and nuts shall be high strength, Type 316 stainless steel if submerged, buried, or subject to splashing and hot dipped galvanized otherwise, with tee head and hexagon nut. All other hardware shall be of the size, type and number as required and recommended by the piping or appurtenance manufacturer and as specified herein.

B. All gaskets for flanges shall be full face and suitable for 200°F operating temperature, unless higher temperature required on individual systems and the fluids carried. See also Division 1.

C. Plugs, caps and similar accessories shall be of the same material as the pipe and of the locking type, unless otherwise noted.

D. Unions shall be of the same material as the pipe, except for dielectric connections.

E. Special protective tape shall be fabric reinforced petroleum tape as manufactured by Denso Inc., Houston, TX or equal.

2.17 COLOR CODING AND LABELING

A. General

1. Provide a complete color coding system in compliance with the TCEQ Water Hygiene Division consisting of preprinted labels, Setmark Marking System, as manufactured by Seton or equal. Coding shall comply with the requirements of the PIPING SCHEDULE as indicated in Section 09901.

2. Pipe labeling is required for all new or modified systems.

3. Piping system identification shall comply with the requirements of ANSI A13.1.

4. Colors listed in 09901 are general. Actual colors will be selected based on a comparison to the existing plant color codes, except as otherwise indicated; samples shall be furnished for all pipe paint colors; with chips from existing piping where new service lines are connecting.

5. Labeling shall follow recommendations of ASME A13.1 – 2007 Scheme for the Identification of Piping Systems.

6. Labels and Directional Arrows
   a. Apply labels with directional arrows at connections to equipment, valves, branch fittings, at least one wall, floor, or ceiling boundary within a room and at intervals not greater than 30 feet.
   b. At each label, arrows indicating direction of flow shall point away from label. If flow may be in both directions, use double headed arrows.
   c. Lettering shall bear the full pipe system name as scheduled.
   d. Lettering height shall be as follows:

Outside Pipe Diameter	Minimum Letter Height
3/4-in to 1-in	1/2-in
1-in to 2-in	3/4-in
2-in to 6-in	1-in
8-in to 10-in	2-in
Over 10-in	3-in

   e. Two labels minimum each room, crawl space or compartment, unless otherwise approved.

PART 3 EXECUTION

3.01 GENERAL

A. All dirt, scale, weld splatter, water and other foreign matter shall be removed from the inside and outside of all pipe and sub-assemblies prior to installing.

B. All pipe joints and connections to equipment shall be made in such a manner as to produce a minimum of strain at the joint.

C. Install piping in a neat manner with lines straight and parallel or at right angles to walls or column lines and with risers plumb. Run piping so as to avoid passing through ductwork or directly under electric light outlets and/or interference with other lines. All work shall be accomplished using recognized methods and procedures of pipe fabrication and in accordance with the latest revision of applicable ANSI Standards, ASME Codes and Pipe Fabrication Institute Standards.

   1. Use full length of pipe except where cut lengths are necessary. Do not spring or deform piping to make up joints.

   2. Pipe shall be cut square, not upset, undersize or out of round. Ends shall be carefully reamed and cleaned before being installed. Bending of pipe is not permitted. Use fittings for all changes in direction.

   3. Do not use bushings except where specifically approved by the Engineer. Reducers shall be eccentric to provide for drainage from all liquid bearing lines and facilitate air removal from water lines.

4. Verify the locations and elevations of any existing piping and manholes before proceeding with work on any system. Any discrepancies between the information shown on the Drawings and the actual conditions found in the field shall be reported at once to the Engineer. No claim for extra payment will be considered if the above provision has not been complied with.

5. Where lines of lower service rating tie into services or equipment of higher service rating the isolation valve between the two shall conform to the higher rating.

6. Mitering of pipe to form elbow is not permitted.

7. All piping interiors shall be thoroughly cleaned after installation and kept clean by approved temporary closures on all openings until the system is put in service. Closures should be suitable to withstand the hydrostatic test.

8. End caps on pre cleaned pipe shall not be removed until immediately before assembly. All open ends shall be capped immediately after completion of installation.

D. Test Connections

1. Provide 1/2 inch female NPT test connection equipped with 1/2 inch brass plug on all pump suction and discharge lines. Where indicated on the Drawings, test connections should be equipped with bar stock valve and gage. Provide test connections at all steam traps. The connection shall be located on the discharge side of the trap between the trap and the first valve. It shall consist of a 1/2 inch branch connection terminated with a gate valve.

E. Unions

1. Unions screwed or flanged shall be provided where indicated and in the following locations even if not indicated.
   a. In long runs of piping to permit convenient disassembly for alterations or repairs.
   b. In by-passes around equipment.
   c. In connections to tanks, pumps and other equipment between the shut-off valve and the equipment.
   d. In connections on both sides of traps, controls and automatic control valves.
   e. Unions are not required in installations using grooved mechanical couplings. (The couplings shall serve as unions.)

F. Vents and Drains

1. Provide vents and drains in the following places:
   a. Water Lines – Vents at high points and drains at low points.
   b. Air Lines – Drains at low points.

3.02 UNIONS

A. Use unions or Victaulic couplings to allow dismantling of pipe, valves and equipment.

3.03 WELDING

A. Welding in accordance with ANSI Standard B31 and AWS B3.0.

B. Install welding fittings on all welded lines. Make changes in direction and intersection of lines with welding fittings. Do not miter pipes to form elbows or notching of straight runs to form tees, or any similar construction. Do not employ welder who has not been fully qualified in above specified procedure and so certified by approved welding bureau or similar locally recognized testing authority.

3.04 GROOVED JOINTS

A. Grooved joint couplings and specialties shall be installed in accordance with the manufacturer's written installation instructions.

3.05 FLANGED JOINTS

A. Make flanged joints with bolts; bolt studs with nut on each end; or studs with nuts where one flange is tapped. Use number and size of bolts conforming to same ANSI Standard as flanges. Before flange pieces are assembled, remove rust resistant coating from machined surfaces, clean gaskets and smooth all burrs and other defects. Make up flanged joints tight, care being taken to prevent undue strain upon valves or other pieces of equipment.

3.06 SLEEVE COUPLINGS

A. Install tierods, pipe clamps or bridles when sleeve type couplings or fittings are used in piping systems where indicated, and at changes in direction or other places as necessary, to prevent joints from pulling apart under pressure. Use bridles and tierods at least 3/4 inch in diameter, except where tierods replace flange bolts of smaller size; in which case, fit with nut on each side of pair of flanges. Joint harnessing shall conform, as a minimum, to the requirements for the bolts and tie bolt lugs as set forth in AWWA Manual M11.

3.07 WALL SLEEVE SEALS

A. Use expandable rubber segmented sealing device with corrosion-resistant fasteners to make watertight the annular space between pipe and sleeve. Determine the required inside diameter of each individual wall opening or sleeve to fit the pipe and seal to assure a watertight joint as recommended by the manufacturer, before ordering, fabricating or installing. Install pipe concentrically through wall sleeve. Install and tighten seal per manufacturer's instructions.

3.08 TESTING

A. Test all pipelines for water/gas tightness as specified in the Piping or System sections. Furnish all labor, testing plugs or caps, pressure pumps, pipe connections, gages and all other equipment required. Testing shall be performed in accordance with one or more of the testing procedures contained in Section 15051 as specified in each Piping or System section. All testing shall be performed in the presence of the Engineer.

B. Repair faulty joints or remove defective pipe and fittings and replace as approved by the Engineer. Retest.

3.09 DISINFECTION

A. After satisfactory testing, all piping specialties associated with water lines and potable water facilities shall be thoroughly disinfected in accordance with Specification Sections 02514.

B. Water being flushed from structures or pipelines after disinfection with a chlorine residue of 2 mg/L or greater, shall be treated with a dechlorination solution, in a method approved by the Engineer, prior to discharge to natural streams or upon the ground. If the disinfection water is bled slowly into the plant drain system, Engineer shall determine if dechlorination is required.

END OF SECTION

SECTION 15140
PIPE HANGERS, SUPPORTS AND RESTRAINTS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment, and incidentals, and install a complete system of pipe hangers, supports, restraints, structural connections, concrete inserts, anchor bolts, and expansion units, including all hanging, restraining, expansion, and supporting devices for supporting and restraining piping as shown on the Drawings and as specified herein.

B. The absence of pipe supports, additional restraints, and details on the Drawings shall not relieve the Contractor of the responsibility for providing them. Pipe supports and restraints indicated on the Drawings are shown only to convey the intent of the design for a particular location and are not intended to represent a complete system. Not all pipe supports and restraints are indicated on the Drawings; if not shown, required pipe supports' design is included in the Contractor's scope of work.

1. Piping smaller than 12-in: Supports and restraints are shown only where specific types and locations are required; additional supports and restraint design and installation will be required and are the responsibility of the Contractor.

2. Piping 12-in and larger: Support and restraint systems are generally as indicated on the Drawings; Contractor shall provide supports as shown, but may augment or propose alternative means if they coordinate better with support products provided by the Contractor for the systems he is required to design.

C. The requirements and references of Section 15051 apply to Section 15140 although all may not be specifically indicated in Section 15140. For specific items: in case of a conflict between Section 15140 and the requirements and references of any other Sections, the requirements of individual Sections shall take precedence over Section 15140, unless specifically noted otherwise.

D. This is a Reference Section; therefore not all the items included in Section 15140 may be required in the Project. Please refer to the Drawings for items specifically required in this Project.

1.02 MEASUREMENT AND PAYMENT

A. No separate payment will be made for work performed under this Section. Include the cost for this work in the lump sum Base Bid Price.

1.03 DEFINITIONS

A. Ferrous Metal: Iron, steel, stainless steel, and alloys with iron as principal component.

B. Wetted or submerged: Submerged, less than 1-ft above liquid surface, below top of channel wall, under cover or slab of channel or tank, or in other damp locations.

C. "Pipe" or "piping" shall mean all pipe, piping system(s), hose, tube, fittings, joints, valves, and similar appurtenances.

D. Supports: wherever the word "supports" or "pipe supports" are used, they shall mean pipe supports, hangers, structural connections, concrete inserts, anchors, guides, bolts, expansion units, restraints and all restraint, hanging, supporting, allowing controlled expansion, or other means of attaching piping along with the necessary appurtenances.

E. See also Section 15051.

1.04 RELATED WORK

A. Concrete is included in Division 3.

B. Miscellaneous metal is included in Section 05500.

C. Field painting is included in Division 9.

D. Pipe and fittings are included in respective sections of Divisions 13 and 15.

E. Piping Specialties are included in Section 15120.

F. Valves and appurtenances are included in Section 15100.

G. Hangers and supports pertaining to HVAC and Plumbing systems are included in their respective Sections.

1.05 SUBMITTALS

A. See also Sections 15051 and 01330.

B. Shop Drawings

1. Submit complete sets of shop drawings in AutoCAD of all items to be furnished under Section 15140, including complete layouts, schedules, location plans, and complete total bill of materials for all pipe support systems.

2. Submittals shall include a representative catalog cut for each different type of item indicating the materials of construction, important dimensions and range of pipe sizes for which that item is suitable.

3. Complete piping drawings as submitted for each piping submittal indicating type of support, location, magnitude of load transmitted to the structure, magnitude and direction of thermal expansion and thrust forces and type of expansion fittings, anchor, guide and other pipe supporting appurtenances including structural fasteners.

4. Where standard items are not suitable, submit detailed drawings showing materials and details of construction for each type of special item. Show also revisions to support, restraint and expansion, systems resulting from changes in related piping system layout, or addition of flexible joints. Provide detailed information on anti-seize compound.

5. Submit complete design data for all systems under Section 15140 to show conformance with Section 15140.

C. Quality Control Submittals

1. Submit maintenance information on all items in Section 15140.

2. Submit support system calculations.

3. All supports and appurtenances shall conform to the latest applicable requirements of ANSI B31.1, except as supplemented or modified by the requirements of Section 15140.

D. Support System Design

1. Contractor shall engage the services of an independent registered professional engineer ordinarily engaged in the business of pipe support systems analysis, to analyze system piping and service conditions, and to develop a detailed support system, specific to the piping material, pipe joints, valves, and piping appurtenances proposed for use.
   a. The proposed support system engineer shall have at least 5 years of experience in the analysis and design of similar systems, including the use of commercial and custom pipe supports and in the use of commercial pipe stress software programs. Provide a detailed resume, including references from projects within the past 5 years. The use of support systems engineer shall be subject to the approval of the Engineer.

2. The support system design shall include:
   a. Criteria by piping system.
   b. Summary of Contractor-selected related components including joints, class, valves, appurtenances, etc., and commercial supports and especially including pipe materials.
   c. Dead weight and dynamic analysis, including system thermal effects and pressure thrusts. Computer-based software system equivalent to ADLPIPE.
      1) Each system shall be presented in an isometric graphic and shall show the resolved and resultant force and moment systems, as well as all recommended hangers, supports, anchors, restraints, and expansion/flexible joints.
   d. Submit a support system design to the Engineer for approval.
      1) After the work is installed, but before it is filled for start-up and testing, the support system design engineer shall inspect the work and shall certify its complete adequacy. Each system shall be inspected and certified in the same way.
      2) Submit a report, including all field modifications and including all certificates.
      3) The report shall bear the stamp of a professional engineer registered in State of Texas and shall be subject to the approval of the Engineer.
   e. All aspects of the analysis and design shall comply with the provisions of ANSI B31.1 and the referenced standards.

f. Support arrangements shall be coordinated to eliminate interference with similar systems to be installed under HVAC, Plumbing and Electrical; to account for structural expansion joints and to maintain access for both personnel and for the removal of equipment.

1.06 REFERENCE STANDARDS

A. Manufacturer's Standardization Society of the Valve and Fittings Industry (MSS)

1. MSS SP58 - Pipe Hangers and Supports-Materials, Design and Manufacture

2. MSS SP69 - Pipe Hangers and Supports-Selection and Application

3. MSS SP89 - Pipe Hangers and Supports-Fabrication and Installation

B. American Society for Testing and Materials (ASTM)

1. ASTM A36 - Standard Specification for Carbon Structural Steel

2. ASTM A307 - Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength

C. American National Standards Institute (ANSI)

1. ANSI B31.1 - Power Piping

1.07 DESIGN REQUIREMENTS

A. General

1. All supports and appurtenances shall be of approved standard design, unless otherwise acceptable to the Engineer and shall be adequate to maintain the supported load in proper position under all operating conditions. Any reference to a specific figure number of a specific manufacturer is for the purpose of establishing a type and quality of product and shall not be considered as proprietary. Note that different materials required, as specified in paragraph 2.01K, may require different figures or model numbers than those shown.
   a. The minimum working factor of safety for all items, with the exception of springs, shall be 5 times the ultimate tensile strength of the material, assuming 10-ft of water-filled pipe being supported and normal test pressures.
   b. Design for all loads using a safety factor of 5.

2. All items shall be designed with liberal strength and stiffness to support, restrain and allow expansion of the respective pipes under the maximum combination of peak loading conditions to include pipe weight, liquid weight, liquid movement and pressure forces, thermal expansion and contraction, vibrations, and all probable externally applied forces.

3. All of the equipment specified herein is intended to support, restrain and allow expansion of the various types of pipe and piping systems shown on the Drawings. It shall be the

responsibility of the Contractor to develop final details and any details associated with special conditions not already covered to meet the system conditions (in particular system temperatures and pressures) specified in the respective Divisions 2, 11, 13, and 15.

4. Supports shall be sufficiently close together such that the sag of the pipe is within limits that will permit drainage and avoid excessive bending stresses from concentrated loads between supports.

5. Complete design details of the pipe system components shall be submitted for review and approval as specified in PART 1. No support shall be installed without approved support system drawings.

B. If not specified in Section 15140, related piping appurtenances shall comply with other and related requirements Sections of Divisions 2 or 15. Also, additional supports and restraints and related requirements, are indicated on the Drawings.

C. Seismic Design and restraint requirements, in accordance with the Structural Design criteria shall be included.

PART 2 PRODUCTS

2.01 GENERAL

A. All pipe and appurtenances connected to equipment shall be supported in such a manner as to prevent any strain being imposed on the equipment. When manufacturers have indicated requirements that piping loads shall not be transmitted to their equipment, submit certification stating that such requirements have been complied with.

B. All pipe and tubing shall be supported as required to prevent significant stresses in the pipe or tubing material, valves, fittings and other pipe appurtenances, and to support and secure the pipe in the intended position and alignment. All supports shall be designed to adequately secure the pipe against excessive dislocation due to thermal expansion and contraction, internal flow forces, and all probable external forces such as equipment, pipe and personnel contact. Any structural steel members required to brace any piping from excessive dislocation shall conform to the applicable requirements of Section 05500 and shall be furnished and installed under Section 15140.

C. Contractor may propose minor adjustments to the piping arrangements in order to simplify the supports, or in order to resolve minor conflicts in the work. Such an adjustment might involve minor change to a pipe centerline elevation so that a single trapeze support may be used.

D. Where flexible sleeve, split ring, vibration, or other couplings are required at equipment, tanks, etc., the end opposite to the piece of equipment, tank, etc shall be rigidly supported to prevent transfer of force systems to the equipment. No fixed or restraining supports shall be installed between a flexible coupling and the piece of equipment.

E. All pipe and appurtenances connected to the equipment shall be supported in a manner to prevent any strain from being imposed on the equipment or piping system.

F. Pipe supports shall not induce point loadings but shall distribute pipe loads evenly along the pipe circumference.

G. Supports shall be provided at changes in direction and elsewhere as shown in the Drawings or as specified herein. No piping shall be supported from other piping or from metal stairs, ladders, and walkways, unless specifically directed or authorized by the Engineer.

H. Pipe supports shall be provided to minimize lateral forces through valves, both sides of flexible split ring type couplings and sleeve type couplings, and to minimize all pipe forces on pump housings. Pump housings shall not be utilized to support connecting pipes.

I. Effects of thermal expansion and contraction of the pipe shall be accounted for in the pipe support selection and installation.

J. Insofar as is possible, floor supports shall be given preference. Where specifically indicated, concrete supports, as shown on the Drawings may be used. Base elbow and base tees shall be used where possible.

K. Restraints, flexible connections, expansion items, and related items as included in other specifications (especially Sections 15120 and other individual pipe sections) and shown on the Drawings.

L. Materials of Construction for all Supports:

1. All materials shall be certified as resistant to the fluid being carried and the location where they are installed, while providing di-electric protection between dissimilar metals and cushioning as required between metallic and non-metallic surfaces. The following shall apply unless specifically indicated otherwise, or acceptable to the Engineer.

2. For restraints and flexible couplings as noted above.

3. For support of metallic pipe:
   a. Submerged, buried, or within outdoor structures (vaults, etc): Type 316 stainless steel.
   b. Within chemical areas: Vinyl ester fiberglass reinforced plastic (FRP) for pipe size up to 2-in, epoxy coated steel for 2.5-in size and larger.
   c. Other locations: steel with galvanizing where noted or if not otherwise noted, coating as required in Division 9; all with dielectric protection.
   d. Additional requirements (including dielectric insulation): see following paragraphs.

4. For support of non-metallic pipe:
   a. Submerged, buried, or within outdoor structures: Type 316 stainless steel or FRP.
   b. Within chemical areas: vinyl ester FRP.
   c. Other locations: steel with galvanizing where noted or if not otherwise noted, coating as required in Division 9; all with local stress protection shields.
   d. Additional requirements (including stress protection shields): see following paragraphs

5. Wherever stainless steel is noted, it shall be Type 316 unless noted otherwise.

2.02 INSULATION

A. See Paragraph 2.14 and Drawings.

2.03 SUPPORT AND RESTRAINT SYSTEMS

A. Steel or Ductile Iron Piping

1. Cast iron and ductile iron, steel and stainless steel piping shall be supported at a maximum support spacing of 10-ft with a minimum of one support per pipe section at the joints.

2. Support spacing for ductile iron, steel, and stainless steel piping 2-in and smaller diameter shall not exceed 5-ft.

B. Copper Piping

1. Supports for copper pipe shall be copper plated or shall have a 1/16-in plastic coating.

2. Support spacing for copper piping and tubing 2-in and smaller diameter shall not exceed 5 ft and greater than 2-in diameter shall not exceed 8-ft.

3. Where pipe supports come in contact with copper piping, provide protection from galvanic corrosion by: wrapping pipe with 1/16-in thick neoprene sheet material and galvanized protection shield; isolators similar to Elcen, Figure No. 228; or copper-plated or PVC-coated hangers and supports.

C. Non-Metallic Piping

1. All uninsulated non-metallic piping such as PVC, CPVC, HDPE, PVDF, etc shall be protected from local stress concentrations at each support point. Protection shall be provided by non-metallic protection shields or other method as approved by the Engineer.
   a. Where pipes are bottom supported 180 degrees, arc shields shall be furnished. Where 360-degree arc support is required, such as U-bolts, protection shields shall be provided for the entire pipe circumference. All U-bolts or clamps for non-metallic pipes shall be plastic coated.
   b. Protection shields shall have an 18-gauge minimum thickness, not be less than 12-in in length, and be securely fastened to pipe with Type 316 stainless steel straps not less than 1/2-in wide.

2. Individually supported PVC pipes shall be supported as recommended by the manufacturer except that support-spacing shall be manufacturers recommendation minus 2-ft down to 5-ft spacing recommendation, then spacing shall be 3-ft.

3. Supports for horizontal multiple PVC plastic piping:
   a. Shall be continuous wherever possible.

b. Multiple, suspended, horizontal plastic PVC pipe runs, where possible, shall be supported by ladder type cable trays such as: Electray Ladder by Husky-Burndy; The Globetray by the Metal Products, a Division of United States Gypsum or equal.
c. Rung spacing shall be 12-in. Tray width shall be approximately 6-in for single runs and 12-in for double runs.
d. Ladder type cable trays shall be furnished complete with all hanger rods, rod couplings, concrete inserts, hanger clips, etc required for a complete support system. Individual plastic pipes shall be secured to the rungs of the cable tray by strap clamps or fasteners similar to: Globe, Model M-CAC; Husky-Burndy, Model SCR or equal.
e. Spacing between clamps shall not exceed 9-ft. The cable trays shall provide continuous support along the length of the pipe. Individual clamps, hangers, and supports in contact with plastic PVC pipe shall provide firm support but not so firm as to prevent longitudinal movement due to thermal expansion and contraction.

D. Framing Support System

1. Beams: Size such that beam stress does not exceed 25,000 psi and maximum deflection does not exceed 1/240 of span.

2. Column Members: Size in accordance with manufacturers' recommended method.

3. Support Loads: Calculate using weight of pipes filled with water.

4. Maximum Spans:
   a. Steel and ductile iron pipe, 3-in diameter and larger: 10-ft centers, unless otherwise shown.
   b. Other pipelines and special situations: Same as noted in previous paragraphs. May require supplementary hangers and supports.

E. All vertical pipes shall be supported at each floor or at intervals of not more than 12-ft by approved pipe collars, clamps, brackets, or wall rests and at all points necessary to ensure rigid construction. All vertical pipes passing through pipe sleeves shall be secured using a pipe collar.

2.04 ANCHOR BOLTS/SYSTEMS

A. Anchoring Devices: Design, size, and space support anchoring devices, including anchor bolts, inserts, and other devices used to anchor support, to withstand shear, and pullout loads imposed by loading and spacing on each particular support. ADHESIVE ANCHOR BOLTS SHALL NOT BE ALLOWED ON ANY PIPE SUPPORT HUNG BELOW A ROOF OR CEILING, unless specifically noted otherwise.

B. Expansion anchors shall be equal to Kwik Bolt as manufactured by Hilti USA, Tulsa, Oklahoma; or Wej-it by Wej-it Expansion Products, Inc., Broomfield, CO. The length of expansion bolts shall be sufficient to place the wedge portion of the bolt a minimum of 1-in behind the steel reinforcement.

C. Unless otherwise noted: use Type 304 stainless steel anchoring parts/bolts and hardware for non-submerged supports, Type 316 stainless steel for submerged anchors.

1. Size of anchor bolts as designed by manufacturer, 1/2-in minimum diameter or as shown on the Drawings.

D. Anchors to concrete in chemical areas shall be epoxy secured vinyl ester FRP all thread, insertion depth and size as required by the manufacturer for the design loads. Nuts, bolts and hardware shall all be vinyl ester FRP construction. Floor supports and anchors shall be installed prior to application of chemical resistant seamless flooring systems.

2.05 HANGER RODS

A. Paragraph 2.01 may require different materials. Where use of steel is allowed, hanger rods shall be hot-rolled steel, machine-threaded, and, except for stainless steel, galvanized after fabrication. The strength of the rod shall be based on its root diameter.

1. Hanger rods shall be attached to concrete structures using concrete inserts similar to F&S, Figures 180, 571, or 150; or continuous concrete inserts per F&S. Inserts shall be malleable iron or steel with galvanized finish.

2. Beam-clamps, C-clamps, or welded-beam attachments shall be used for attaching hanger rods to structural steel members.

B. Minimum rod size for metallic rod hangers: (* For pipe diameters less than 14-in, if using pipe roller, use 2 hanger rods with minimum diameter noted below for pipe's diameter).

	Nominal Pipe/ Tube Diameter		Minimum Hanger Rod Diameter
1.	Less than 2-1/2	=	1/4-in*
2.	3-in - 8-in	=	1/2-in*
3.	10-in - 14-in	=	3/4-in*
4.	16-in - 20-in	=	2 at 1-in
5.	24-in	=	2 at 1-1/4-in
6.	30-in	=	2 at 1-1/2-in

2.06 SINGLE PIPE HANGERS

A. See Paragraph 2.01 for materials.

B. Unless otherwise indicated, pipe hangers and supports shall be standard catalogued components, conforming to the requirements of MSS-41, 58, or 69 and shall be of the following type:

1. Grinnell Co., Inc., Figure 104, 260, or 171.

2. Equal models by: B-Line; F&S Central, Brooklyn, NY; Elcen Metal Products Co., Franklin Park, IL; or Unistrut Northeast, Cambridge, MA.

C. Single pipes shall be supported by hangers suspended by hanger rods from structural steel members, concrete ceilings, bottom of trapeze hangers, and wall-mounted steel angle brackets.

D. Where pipes are near walls, beams, columns, etc and located an excessive distance from ceilings or underside of beams, welded steel wall brackets similar to Carpenter and Patterson, Figure Nos. 69-68, 84, or 139 shall be used for hanging pipe. Where single pipes rest on top of bracket pipe supports, attachments shall meet requirements as specified under multiple pipe hangers.

2.07 MULTIPLE PIPE HANGERS

A. Paragraph 2.01 may require different materials than those noted below.

B. Suspended multiple pipes, running parallel in the same horizontal plane that are adjacent to each other, shall be suspended by trapeze type hangers or wall brackets. Trapeze hangers shall consist of galvanized structural steel channel (where steel is allowed) supported from galvanized threaded rod or attached to concrete walls, columns, or structural steel support members. See previous paragraphs about multiple PVC pipe supports.

C. Except as otherwise specified herein, pipe anchors used for attaching pipe to trapeze or multiple pipe wall brackets shall be anchor or pipe chairs similar to F&S, Figure Nos. 158, 419, 160A, 160B, as required. Material of construction shall be galvanized steel where allowed. Chair U bolts shall be tightened to allow freedom of movement for normal expansion and contraction except where pipe must be anchored to control direction of movement or act as a thrust anchor.

2.08 SINGLE PIPE SUPPORTS FROM BELOW

A. Paragraph 2.01 may require different materials than those noted below.

B. Single pipes located in a horizontal plane close to the floor shall be Pedestal type: Schedule 40 pipe stanchion, saddle and anchoring flange.

1. Nonadjustable Saddle: MSS SP 58, Type 37 with U-Bolt
   a. Grinnell, Figure 259.
   b. B-Line, Figure B3090.
   c. F&S, Figure 427.

2. Adjustable Saddle: MSS SP 58, Type 38 without clamp
   a. Grinnell, Figure 264.
   b. B-Line, Figure B3093.

C. Pipes less than 3-in in diameter shall be held in position by supports fabricated from steel C channel, welded post base similar to Unistrut, Figure P2072A; and pipe clamps similar to

Unistrut, Figures P1109 through 26 (except see paragraph 2.01 for alternate materials required). Where required to assure adequate support, fabricate supports using two vertical members and post bases connected together by horizontal member of sufficient load capacity to support pipe. Wherever possible, supports shall be fastened to nearby walls or other structural member to provide horizontal rigidity. More than one pipe may be supported from a common fabricated support.

D. Unless otherwise noted, pipes 3-in in diameter and larger shall be supported by adjustable stanchions. Stanchions shall provide at least 4-in adjustment and be flange mounted to floor.

E. Use yoked saddles for piping whose centerline elevation is 18-in or greater above the floor and for all exterior installations.

F. Provide neoprene waffle isolation pad under anchoring.

G. Pipe roller type supports may be used where noted on the Drawings.

2.09 WALL SUPPORTED SINGLE AND MULTIPLE PIPES

A. Single or multiple pipes located adjacent to walls, columns, or other structural members shall be supported using welded steel wall brackets (except see Paragraph 2.01 for alternate material requirements) as manufactured by Grinnell, Figure 195 or Elcen, Figure 57.

B. Where noted, multiple pipes may be supported on C-channel with steel brackets similar to Unistrut pipe clamps; with pipe anchor chairs; or equal.

C. Individual pipes, up to 8-in diameter, where noted, may use MSS Type 8 pipe clamps as noted on the Drawings.

D. All members shall be securely fastened to wall, column, etc., using double-expansion shields or other method as approved by the Engineer. Additional wall bearing plates shall be provided where required.

2.10 BASE ANCHOR SUPPORT

A. Where pipes change direction from horizontal to vertical via a bend, a welded or cast base bend support (except see Paragraph 2.01 for alternate material requirements) shall be installed at the bend to carry the load. The base bend shall be fastened to the floor, pipe stanchion, or concrete pedestal using expansion anchors or other method as approved by the Engineer.

B. Where shown on the Drawings, pipe bends shall be supported using concrete supports. Pipes shall be securely fastened to the concrete supports with suitable metal bands as required and approved by the Engineer. A neoprene insert shall be used to isolate the piping from the poured concrete.

2.11 VERTICAL PIPE SUPPORTS

A. Where vertical pipes are not supported by a Unistrut type system as specified, they shall be supported in one of the following methods. See Paragraph 2.01 for alternative materials required.

1. For pipes 1/4-in to 2-in in diameter, an extension hanger ring shall be provided with an extension rod and hanger flange. The rod diameter shall be as recommended by the manufacturer for the type of pipe to be supported. The hanger ring shall be steel- or PVC-clad depending on the supported pipe. The hanger ring shall be equal to Carpenter & Patterson, Figure Nos. 81 or 81CT. The anchor flange shall be galvanized malleable iron similar to Carpenter and Patterson, Figure No. 85.

2. For pipes equal to or greater than 2-in in diameter, extended pipe clamps similar to Carpenter & Patterson, Figure No. 267 may be used. The hanger shall be attached to concrete structures using double expansion shields or to steel support members using welding lugs similar to Carpenter & Patterson, Figure No. 220.

B. Pipe supports shall be provided for closely spaced vertical piping systems required to provide a rigid installation. The interval of vertical support spacing shall be as specified, but in no case shall vertical interval exceed 12-ft. The support system shall consist of a framework suitably anchored to floors, ceilings, or roofs.

C. Unless otherwise specified, shown, or specifically approved by the Engineer, vertical runs exceeding 12-ft shall be supported by base elbows/tees, clamps, brackets, wall rests, and pipe collars, all located as required to ensure a rigid installation.

D. Pipe riser clamps, per MSS SP58, shall be used to support all vertical pipes extending through floor slabs. Riser clamps shall be galvanized steel (unless other materials required in Paragraph 2.01) manufactured by:

1. Carpenter & Patterson, Figure No. 126.

2. Grinnell, Figure 261.

3. B-Line, Figure B3373.

4. Or equal.

E. Copper-clad or PVC-coated clamps shall be used on copper pipes. Insulation shall be removed from insulated pipes prior to installing riser clamps. Insulation shall not be damaged by clamp installation.

2.12 SPECIAL SUPPORTS

A. Frame work supports

1. Vertical and horizontal supporting members shall be U-shaped channels similar to Unistrut, Series P1000. Vertical piping shall be secured to the horizontal members by pipe clamps or pipe straps. All components shall be of materials as previously noted. See also Paragraph 2.08.

2. For piping 3-in and smaller, the framework shall be as manufactured by the Unistrut Corporation; Globe-Strut as manufactured by the Metal Products Division of U.S. Gypsum; or equal. For piping larger than 3-in, the support frame shall be fabricated from structural steel shapes and secured through the use of drop in, adhesive or expansion anchors.

3. The assemblies shall be furnished complete with all nuts, bolts, and fittings required for a complete assembly including end caps for all Unistrut members.

4. Electrical Conduit Support: Under Division 16.

5. The design of each individual framing system shall be the responsibility of the Contractor. Shop drawings, as specified in Paragraph 1.03, shall be submitted and shall show all details of the installation, including dimensions and types of supports. In all instances the completed frame shall be adequately braced to provide a complete rigid structure when all the piping has been attached. See also Paragraph 2.03D.

B. Supports not otherwise described in Section 15140 shall be fabricated or constructed from standard structural steel shapes in accordance with applicable provisions of Section 05500 or Unistrut-type frame; have anchor hardware similar to items previously specified herein; shall meet the minimum requirements listed below; and be subject to the approval of the Engineer.

C. Additional Pipe Support Situations

1. Supporting Multiple Chemical and Related Piping:

2. Location: indicated on Drawings or otherwise required, especially adjacent to chemical pumps.

3. Use: framework support.

4. Materials: FRP, with proper local stress protection.

2.13 SHOP FACTORY FINISHING

A. Prepare and prime metallic (except non-stainless steel) supports in accordance with Division 9.

2.14 ACCESSORIES

A. Insulation Shield: Install on insulated non-steel piping. Oversize the rollers and supports as required. Manufacturers: Grinnell, Figure 167; B-Line, Series B3151.

B. Welding Insulation Saddle: Install on insulated metal pipe. Oversize the rollers and supports as required. Manufacturers: Grinnell, Figure 160; or B-Line, Series B316.

C. Vibration Isolation Pad: Install under base flange of pedestal type pipe supports adjacent to equipment, and where required to isolate vibration. Isolation pads to be neoprene, waffle type, manufacturers Mason Industries, Type W; or Korfund.

D. Dielectric Barrier

1. Install between carbon steel members and copper or stainless steel pipe.

2. Install between stainless steel supports and non-stainless steel ferrous metal piping.

3. All stainless steel piping shall be isolated from all ferrous materials, including galvanized steel by use of neoprene sheet material and protection shields.

E. Electrical Isolation: Install 1/4-in by 3-in neoprene rubber wrap between submerged metal pipe and oversized clamps.

PART 3 EXECUTION

3.01 INSTALLATION

A. Proceed with the installation of piping and supports only after any building structural work has been completed and new concrete has reached its 28-day compressive strength.

B. The installation of pipe support systems shall in no way interfere with the operation of any overhead bridge cranes, monorails, access hatches, etc. No piping shall be supported from metal stairs, other pipes, ladders, and walkways unless specifically directed or authorized by the Engineer. The installed systems shall not interfere with maintenance and operational access to any equipment installed under Section 15140, or any other Section.

C. Pipe supports shall be provided to minimize lateral forces through valves, both sides of split type couplings and sleeve type couplings (within four pipe diameters), and to minimize all pipe forces on pump housings. Pump housings shall not be utilized to support connecting pipes.

D. Inserts for pipe hangers and supports shall be installed on forms before concrete is placed. Continuous metal inserts shall be embedded flush with the concrete surface. Before setting these items, all Drawings and figures shall be checked that have a direct bearing on the pipe location. Responsibility for the proper location of pipe supports is included under Section 15140.

E. Apply anti-seize compound to all nuts and bolts. Supports installed without the approved compound shall be dismantled and correctly installed, at no additional cost to the Owner.

F. Support no pipe from any other pipe above it.

G. Install support systems in accordance with MSS SP69 and MSS SP89, unless shown otherwise. Install pipe anchors where required to withstand expansion thrust loads and to direct and control thermal expansion.

H. Repair mounting surfaces to original condition after attachments are made.

I. Support large or heavy valves, fittings, and appurtenances independently of connected piping.

J. Brace horizontal pipes movement by both longitudinal and lateral sway bracing.

K. Where supports are required in areas to receive chemical resistant seamless flooring, install supports prior to application of flooring system.

3.02 TESTING

A. All pipe support systems shall be tested after installation in conjunction with the respective piping pressure tests. If any part of the pipe support system proves to be defective or inadequate, it shall be repaired or augmented under Section 15140 to the satisfaction of the Engineer.

3.03 FIELD FINISHING

A. Paint atmospheric exposed surfaces as specified in Division 9.

END OF SECTION

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SECTION 15200
ELECTRIC VALVE ACTUATORS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Specification for electric valve actuators for listed valves.

1. High Service Pump Station 30-inch Pump Control Valves as specified in Section 15954.

2. UV1 and UV2 Area Temporary Bypass Piping 30-inch Temporary Filter Backwash Control Valves as specified in Section 15100 and as shown on the Drawings.

1.02 MEASUREMENT AND PAYMENT

A. No separate payment will be made for electrical valve actuators. Include the cost for this work in the lump sum base bid.

1.03 SUBMITTALS

A. Submit the following under the provisions of these specifications – Section 01330 Submittals:

1. Outline drawings with dimensions

2. Equipment arrangement drawings

3. Mounting bolt location drawings

4. Electrical schematics and wiring diagrams

5. Current, potential, and power transformer curves

6. Electrical fuse/circuit breaker characteristic

7. Equipment performance curves and data

8. Bill of installation/assembly materials

9. Equipment weights

10. Completed manufacturer's data sheets

11. Catalog data

B. **This pump control valev and actuator equipment is critical to complete the project on schedule. CONTRACTOR is responsible for coordinating with equipment manufacturer to ensure submittal is provided to the ENGINEER as specified in Section 01112 – Time Critical for the Completion of the Project Submittals and timely delivery.**

1.04 WARRANTY

A. The warranty shall take affect after field installation of the valve actuators and shall be in force for four (4) years following the final acceptance of the overall project.

B. The warranty shall include on-site, factory authorized, repair or replacement of all parts or the entire system, travel time, and travel expenses for warranty parts and labor.

PART 2 PRODUCTS

2.01 ACCEPTABLE MODEL/MANUFACTURERS

A. Rotork IQ Series, or equal by Limitorque, Auma, or EIM.

2.02 MATERIALS AND EQUIPMENT

A. The actuators shall be required for coordinated installation on a wide range of valve actuators as indicated on the Drawings and/or described in the specifications. The actual location, rating, operating voltage, number of phases, ancillary components, and the actual number of units required shall be determined by reviewing the Drawings and specifications.

B. The electric actuators shall consist of a three phase electric motor, worm gear reduction, absolute position encoder, electronic torque sensor, reversing motor contactor, electronic control, protection, and monitoring package, manual override hand-wheel, valve interface bushing, 32 character LCD, and local control switches all contained in an enclosure that is sealed to NEMA 4, 4X, 6, and IP68 requirements. Actuator design life shall be one million drive sleeve turns.

C. The power transmission shall be completely bearing supported, and consist of a hardened alloy steel worm and bronze alloy worm gear, oil-bath lubricated using a synthetic oil designed specifically for extreme pressure gear transmission service.

D. The motor shall be 3 phase, 60 cycle, 460 volt, with Class F insulation, and a thermistor embedded within the motor windings to prevent damage due to overload. The motor shall be easily removed through the use of a plug-in connector and shaft coupling. The existing 3 phase, 60 cycle, 480 volt source shall be utilized for new actuators, Vendor shall provide any reduced voltage transformer required for operator.

E. Valve position shall be sensed by a 15 bit, optical, absolute position encoder. Open and closed positions shall be stored in permanent, non-volatile memory. The encoder shall measure valve position at all times, including both motor and handwheel operation, with or without three phase power present, and without the use of a battery.

F. An electronic torque sensor shall be included. The torque limit may be adjusted from 40 - 100% of rating in 1% increments. The motor shall be de-energized if the torque limit is exceeded. A boost function shall be included to prevent torque trip during initial valve unseating. A jammed valve protection feature, with automatic retry sequence, shall be incorporated to de-energize the motor if no movement occurs.

G. The reversing contactor shall be mechanically interlocked to prevent simultaneous energizing of the open and close coils. The control module shall also include an auto reversal delay to inhibit high current surges caused by rapid motor reversals. The control transformer shall include vacuum impregnated coils and dual primary fuses. A phase correction circuit shall be included to correct motor rotation faults caused by incorrect site wiring. The phase correction circuit shall also detect the loss of a phase and disable operation to prevent motor damage.

H. Remote control may be configured a 2, 3, or 4 wires for open-stop-close control. Terminals must be provided for an emergency shutdown.

I. A padlockable LOCAL-STOP-REMOTE switch and an OPEN-CLOSE switch shall be included for local valve actuator control. The control switches shall not penetrate the controls cover and shall be designed to electrically isolate the actuator internal components from the external environment. The OPEN-CLOSE switch may be configured for maintained or push-to-run (inching) control.

J. Four latched contacts shall be provided for remote indication of valve position, configured as 1-NO and 1-NC for both the open and closed positions. The contacts may be configured to represent any other actuator status, mid-travel position, switch to local, over-torque, motor over-temperature, manual operation, switched to remote, switched to stop, valve moving, close torque switch, open torque switch, hardware failure, ESD active, inhibit active, or valve jammed.

K. All calibrations shall be accomplished by the use of a provided Bluetooth setting tool.

L. All customer connections shall be located in a terminal chamber that is separately sealed from all other actuator components.

M. A handwheel and declutch lever shall be provided for manual operation. The handwheel shall not rotate during electric operation nor can a seized motor prevent manual operation.

N. The actuators shall be provided with a non-contacting, internally powered, electrically isolated position transmitter to provide a 4 to 20 mAdc signal that is proportional to valve position.

O. The actuators shall be equipped with a modulating controller that alters the valve position in proportion to a 4 to 20 mAdc analog command signal.

P. Actuator shall include, as standard, an interrupter timer. Pulsed operation shall be independently adjustable in opening and closing directions.

Q. The gearing for the actuators shall be designed to provide 150% of the worst case torque that is calculated to be developed by the associated valve. The worst case torque condition may be developed during seating, un-seating, or travel. Calculations shall be included as a part of the shop drawing submittal for each valve to formally illustrate the rating compliance of the actuator. **For High Service Pump Station 30-inch Pump Control Valves as specified in Section 15954, the valve actuator shall be designed to stroke 100% based on full torque at pump shut-off head to allow for closing the valve against a running pump.**

R. The valve actuators, and converters in some cases, required shall each be provided to the project through the associated valve manufacturer/supplier. The valve manufacturer/supplier shall have the unit responsibility for all such systems.

S. Controller

1. Controllers shall be specifically designed to perfectly coordinate with the valve actuators indicated on the Drawings and/or described in the specifications. All controllers shall be suitable for outdoor installation. If the controller must be supplied in a control panel, all requirements of Specification 13330 shall apply.

2. For connection of the valves to the controller, a wiring diagram shall be provided to the electrical contractor including type of wire to be used and terminals on which to terminate.

3. The controller must include an operator interface that allows the operator to control the valves as well as read the statuses and alarms.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install the valves and associated actuators as shown on the Drawings.

B. Interconnect all electrical/instrumentation/control related wiring as illustrated on the Drawings or as required by the application.

END OF SECTION

SECTION 15500
HVAC - GENERAL PROVISIONS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. This Section specifies the general requirements of the HVAC work to be performed and described in other Division 15 sections, and shall not void any of the requirements specified under the General Conditions or General Requirements.

B. Furnish all labor, materials, equipment, services and incidentals required and install and test a complete HVAC system as specified and shown on the Contract Drawings.

C. The requirements specified herein shall be modified only if specified otherwise for particular application in other Divisions.

D. Work to be included under the "Scope of Work" of each HVAC Specification Section listed above shall include all labor, material, equipment, tools and services necessary to furnish, deliver, unload, install, test and place in satisfactory operation the equipment, services and systems as called for under each HVAC Section including any incidental work not shown, or not specified but which can reasonably be inferred as belonging to the various systems and necessary in good practice to provide complete and fully operational systems.

E. This HVAC specification is incomplete without the information contained on the Drawings and in the Equipment Schedules.

F. Description of the work included in each Section is not intended to in any way limit the above broad statement, but is intended as a more specific mention of the most important items included therein.

G. Design Conditions:

1. Outdoor Design Conditions
   a. The following outside design conditions will be used, based on climate data at Houston Intercontinental Airport, as documented in the 2013 ASHRAE Fundamentals Handbook:
   b. Summer (0.4%): 97.2°F Dry-bulb,.76.6°F Wet-bulb
   c. Winter (99.6%): 30.3°F Dry-bulb

2. For air-cooled condensing unit selection, the summer design dry bulb temperature shall be plus 10 degrees F above ambient unless otherwise indicated on the drawing schedules.

3. Indoor Design Conditions
   a. Refer to individual HVAC drawings and sequences of operation for indoor design conditions and setpoints.

4. Capacity of equipment is indicated at actual operating conditions, unless otherwise noted. Size equipment to perform as indicated at site elevation and scheduled conditions.

H. Job Conditions

1. Examine Contract Documents to determine how other work will affect execution of mechanical work.

1.02 MEASUREMENT AND PAYMENT

A. No separate payment will be made for work performed under this Section. Include the cost for this work in the lump sum Base Bid Price.

1.03 RELATED WORK

A. The following work related to, but not covered under the HVAC work, will be done under other related Divisions as listed below.

1. Temporary heating, electric power and lighting.

2. Trenching, excavation and backfill, except for items specified herein.

3. Concrete work, except for furnishing of required anchor bolts, sleeves and templates, which shall be furnished with equipment.

4. Structural steel and miscellaneous metal, except for supplementary steel required for hangers, equipment supports, anchors and guides, which shall be furnished with equipment.

5. Flashing and counterflashing, except for items specified herein.

6. Painting, except for factory finished equipment, shop painting and identification labeling.

7. Plumbing, except water and drain connections to HVAC equipment, is included in other Sections.

8. Refer to other divisions for electrical requirements.

9. Electrical field power and interlock wiring, except for field wiring for automatic temperature HVAC controls as specified and as shown on the HVAC Drawings.

10. Motor starters and disconnects, except for those furnished as an integral part of equipment supplied under this Division, shall be provided under Electrical.

B. Related Documents:

1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.04 SUBMITTALS

A. Shop Drawings - Submit to the Owners Designated Representative, in accordance with Division 01, all shop drawings and product data specified in this Section and in each individual HVAC Specification Section. All information should be provided at one time for each specification section. Incomplete submittals will be rejected. Submittals shall include the following minimum information:

1. Equipment Schedules – Provide Equipment Schedules in a format equivalent to Equipment Schedules on Contract Drawings. Provide all data indicated on the Equipment Schedules.

2. Catalog Cutsheets – Provide for each equipment unit and accessory. Indicate options from cutsheets with arrows, or equivalent. Indicating options with a highlighter marker is unacceptable, as it does not transmit during the copying process. Indicate specification number and equipment tag number on all cutsheets. As a minimum, provide information for the following:
   a. Catalog data for all motors to include operating efficiency.
   b. Catalog data on vibration isolators, including materials of construction, operating efficiency and layout diagrams that locate the isolators on the equipment by model number.
   c. Catalog data on bearings and confirmation of bearing life for the service specified.
   d. Information on coatings as specified in the coating section.
   e. Catalog data on selected filters: types and sizes, quantity of modules required for each filter type and efficiency ratings performance data.
   f. For belt drive equipment, provide drive data indicating sheave sizes, belt size, number and length.

3. Drawings – Provide description of the proposed unit, general equipment arrangement, equipment dimensional data, materials of construction, location and size of outside air, return air and supply air openings, clearance requirements for maintenance access and equipment operation and equipment operating weights, furnished specialties and accessories. Significant dimensional differences between the specified equipment verses the proposed equipment shall be noted on the equipment submitted. Indicate specification number and equipment tag number on all drawings.

4. Equipment Performance Curves for equipment with fans and pumps - Indicate fan/pump size, type, arrangement, materials of construction, weight, motor horsepower, type, power supply and motor frame size. Each submittal shall include pertinent fan/pump performance (operating data) information and a performance curve showing the fan operating point or range, including operating efficiency, flow rate, pressure and BHP. The minimum size of the actual fan curve shall be no less than 6-in by 8-in. The use of faxed copies of curves is not acceptable. Provide certified test data for all fans. For pumps show NPSHR. For fans show shutoff head.

5. Accessories – A list of all accessories and options to be furnished shall be included on each submittal.

6. Spare Parts List – Provide manufacturer's recommended spare parts list.

7. Certification that equipment capacities meet requirements on Equipment Schedules based on indicated design criteria as specified.

8. Detail mounting and securing structure.

9. Warranty Information

10. Wiring Diagrams - Provide power, signal, and control wiring for all equipment.

11. Provide nameplate data and arrangement for approval by Owners Designated Representative.

12. Equipment and materials shall be in strict accordance with the Specification requirements. Fully explain and itemize any exceptions to, or deviations from the Contract Specifications with references to the individual specification sections.

13. Where corrosion resistance is required, provide conformation of material suitability for the specified service.

14. For units that will be shipped exposed, provide a description of the protective packaging that will be used during transit.

15. All submittals shall contain a statement that all specification Sections have been read and complied with. The certification statement shall be made by all of the following that are applicable; the Contractor, sub-contractor and the vendor. The statement shall be an individual statement for each party involved, and shall be included with every submittal and resubmittal.

B. In the event the vendor and/or manufacturer starts procurement and/or fabrication prior to receipt of approved shop drawings, then vendor/manufacturer does so at their own risk.

C. Operation and Maintenance Manuals

1. Submit to the Owners Designated Representative, as provided in Division 01, Operating and Maintenance Manuals for each piece of equipment. Personnel familiar with the operation and maintenance of the specific information shall prepare manuals.

2. Equipment shall be identified with the Engineers Equipment Numbers and Identification as shown in the Schedules and on the Drawings.

3. Provide information in three ring binders. All sheets shall have reinforced punches. Tabbed dividers shall separate all sections. Drawings will be bound in the manual, or contained in envelopes bound into the manual. Provide with complete Table of Contents.

4. Contents - All of the information listed above under 'Shop Drawings' shall be incorporated into the O&M manuals including the following additional information. The O&M manuals shall be consolidated into a complete package, without duplicate information.

a. Installation Instructions shall include unpacking, installing, aligning, checking and testing instructions. Foundation data, allowable piping loads, and electrical design shall be included.
b. Operating Instructions shall include pre-operational checks, start up and shut down procedures, and descriptions of all control modes. Include emergency procedures for all fault conditions and actions to be taken for all alarms. Procedures for long term storage shall be included.
c. Maintenance Instructions shall include preventative and corrective maintenance measures. Items such as inspection, calibration, lubrication, tests, etc., shall be covered. A complete list of materials for preventative maintenance shall be included. Instructions for assembling, disassembling, repairing and reordering parts shall be included in the instruction manual for corrective maintenance. Schedules for tests of other functions are to be included. Provide a list of tools required to service the equipment. Trouble shooting instructions to include a trouble-shooting guide shall be included. The instruction manual shall list all special materials, tools, and test equipment that are required to perform troubleshooting and all phases of maintenance. Provide exploded view drawings or other similar drawings of all assemblies showing all parts which are separately replaceable for maintenance.
d. Test and Startup Reports – Test reports shall include date and time of successful testing and startup of each system, including names and contact information of all individuals (i.e. manufacturer's representative, Owner, etc.) present for testing.
e. Air/Water Test and Balance Reports.
f. Sequences of Operation and associated air flow schematics.

D. In general, corrections or comments or lack there-of, made relative to submittals during review shall not relieve the Contractor from compliance with the requirements of the Drawings and Specifications. Submittals are for review of general conformance with the design concepts of the project and general compliance with the contract documents. The Contractor is responsible for the final design conforming and correlating all quantities and dimensions, selecting fabrication processes and techniques of construction, coordinating the work of all trades, and performing the work in a safe and satisfactory manner. Items resubmitted by Contractor shall specifically reference comments made on submittal review documents. Failure to do so may prolong submittal review process and cause additional incurred costs.

1.05 REFERENCE STANDARDS

A. The latest published issue of Standards or Recommendations of the following listed Societies, Associations or Institutes are part of this Section. These shall be considered as minimum requirements. Specific requirements of this Section and/or Drawings shall have precedence. In case of conflict between published requirements, the Engineer shall determine which is to be followed.

B. Abbreviation and the title of Federal, State and industry standards, technical societies, associations and institutes and other organizations used are as follows:

1. AABC – Associated Air Balance Council

2. ACGIH – American Conference of Governmental Industrial Hygienists

3. ADC – Air Diffusion Council
4. ABMA – American Bearing Manufacturers Association
5. AMCA – Air Movement and Control Association
6. ANSI – American National Standards Institute
7. ARI – Air Conditioning and Refrigeration Institute
8. ASHRAE – American Society of Heating, Refrigerating and Air Conditioning Engineers
9. ASME – American Society of Mechanical Engineers
10. ASTM – American Society for Testing and Materials
11. CTI – Cooling Tower Institute
12. FM – Factory Mutual Engineering and Research Corp.
13. IBR – Institute of Boiler and Radiator Manufacturers
14. IEEE – Institute of Electrical and Electronics Engineers
15. NIST – National Institute of Standards and Technology
16. NEBB – National Environmental Balancing Bureau
17. NEC – National Electrical Code
18. NEMA – National Electrical Manufacturers Association
19. NFPA – National Fire Protection Association
20. OSHA – Occupational Safety and Health Administration
21. SMACNA – Sheet Metal and Air Conditioning Contractors National Association
22. UL – Underwriters Laboratories
23. State and city building, plumbing and mechanical codes.
24. American Gas Association.
25. Authorities having jurisdiction.

C. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.06 QUALITY ASSURANCE

A. The Contractor shall be fully responsible for the proper execution and performance of the work described herein. It shall be their responsibility to inspect all installation conditions and bring to the attention of the Owners Designated Representative any conditions which may affect their work adversely. They shall report to the Owners Designated Representative prior to commencing any portion of this work, any conditions unsuitable for the installation of their portion of the work.

B. Mention herein or indication on the Drawings of equipment, materials, operation or methods shall require that each item mentioned or indicated be provided to make a complete system ready for continuous operation.

C. Attention is called to the necessity for elimination of transmission of vibration from mechanical equipment to building structures. All equipment, therefore, shall be carefully selected and installed to meet this condition and isolators and water hammer arrestors shall be provided where required.

D. All equipment of a given type shall be furnished by or through a single manufacturer or as specified on the schedules.

E. Inspection by the Owners Designated Representative or failure to inspect shall not relieve the Contractor of responsibility to provide materials and perform the work in accordance with the documents.

F. Use all new materials unless otherwise specified. Materials and equipment shall be free from all defects and imperfections that might affect the serviceability of the finished product. No used equipment or materials will be allowed.

G. The Owners Designated Representative reserves the right to sample and test any materials after delivery and to reject all components represented by a sample that fails to comply with the specified requirements.

H. All equipment shall be UL listed and stamped with all testing agency seals.

I. Use of asbestos or material containing asbestos shall be strictly prohibited.

J. All rotating parts of equipment shall be statically and dynamically balanced at the factory.

K. Guarantee that all equipment meets the design and performance requirements specified, and alter and/or replace, at no cost to the Owner any piece of equipment which fails to meet these requirements.

L. If, during the performance of the work, the Contractor finds a conflict, error or discrepancy between or among one or more of the Sections or between or among one or more Sections and the Drawings, furnish the higher performance requirements. The higher performance requirement shall be considered the equipment, material, device or installation method which represents the most stringent option, the highest quality or the largest quantity.

M. Where Drawings and Specifications are in conflict with one another, the information on the Drawings shall take precedence.

1.07 DRAWINGS

A. The Drawings are essentially diagrammatic, although all work shown on the Drawings is approximately shown to scale. Figured dimensions and detailed drawings shall be followed in every case. Size and routing of piping and ductwork are shown, but it is not intended to show every offset, crossover, transition or fitting nor every structural difficulty that may be encountered. To carry out the true intent and purpose of the Drawings, the Contractor shall provide all necessary parts for a final installed system which conforms to the structure, avoids obstructions and provides required clearances and passageways. The Contractor shall be responsible to coordinate the system installation and routing with the work of all other trades.

B. Do not change sizes indicated on the Drawings without written approval of the Engineer.

C. When significant changes in equipment locations, devices and distribution systems are required, obtain approval of the Engineer before making changes.

D. The absence of duct and pipe supports and details on the Drawings shall not relieve the Contractor of the responsibility for providing them.

E. The location of all equipment, ductwork and piping shall be considered as approximate only and the right is reserved by the Engineer to change at any time, before the work is installed, the position of such equipment, ductwork and piping to meet structural conditions and to provide proper headroom clearance or for other sufficient causes and such changes shall be made without additional expense to the Owner.

F. For locations of building elements, refer to dimensioned architectural/structural drawings.

G. Field measurements take precedence over dimensioned drawings.

1.08 CODES, LOCAL CODE AMENDMENTS AND ORDINANCES

A. Comply with all the laws, ordinances, codes, rules and regulations of the State, local or other authorities having jurisdiction over any of the work specified herein. All such laws, ordinances, codes, rules and regulations governing this work shall be a part of the Specifications. Where the requirements of the Specifications and Drawings are more stringent than the codes, ordinances, etc., the Contract Documents shall take precedence.

B. Obtain all required permits and pay all legal fees for the same and in general take complete charge and responsibility for all legal requirements pertaining to this Section of the work.

C. If any work is performed and subsequent changes are necessary to conform to the regulations, such change shall be made as part of this work at no additional cost to the Owner.

1.09 DELIVERY, STORAGE AND HANDLING

A. Refer to general requirements under Division 01 and the following specific requirements.

B. All materials and equipment shall be inspected for size, quality and quantity against approved shop drawings upon delivery.

C. Delivery schedule of all equipment shall be coordinated with the Contractor. Equipment ready for shipment prior to the agreed on shipping date shall be stored without cost to the Owner by the manufacturer.

D. Deliver equipment and materials to the site in the manufacturer's original, unopened containers and packaging. All materials shall be suitably packed for shipment and long term storage. Each package shall be labeled to indicate the project and the contents of each package. Where applicable, equipment numbers shall be marked on the container.

E. All equipment and materials shipped that are exposed such as on a flatbed truck shall be protected during transit. The equipment and materials shall be protected from moisture, road salt, dirt and stones or other materials thrown up from other vehicles. Electrical components shall be protected as above, but with special attention to moisture. The method of shipment protection shall be defined in the submittals.

F. Instructions for the servicing and startup of equipment in long term or prolonged storage shall accompany each item.

G. All equipment and materials shall be stored in a covered dry location off of the ground. When required to protect the materials they shall be stored in a temperature-controlled location.

H. Provide covering and shielding for equipment and materials to protect from damage.

I. Repair, restore and replace damaged items.

J. Protect equipment and materials and finishes during handling and installation to prevent damage.

1.10 COORDINATION

A. The Drawings indicate the extent and general arrangement of the systems. If any departures from the Drawings or specifications are deemed necessary, details of such departures and the reasons therefore shall be submitted as soon as practical for review. No such departures shall be made without the prior written concurrence of the Engineer.

B. Equipment and HVAC units shall fit into the space available with adequate clearance for service as determined by the Engineer. Submitted equipment or units, which do not meet these criteria, shall be rejected. Do not assume that all of the manufacturers listed as acceptable manufacturers will provide equipment or units that will fit in the space allocated. Selection of acceptable manufacturers is not based on whether the manufacturer's standard stock unit will fit

into every space allocated. A custom or semi-custom HVAC unit may be required to meet project space and performance requirements.

C. Refer to the Structural and Architectural Drawings which indicate the type of construction in which the work shall be installed. Locations shown on the HVAC Drawings shall be checked against the general and detailed drawings of the construction proper. All measurements must be taken at the building.

D. The Contractor shall coordinate the location and placement of all concrete inserts and welding attachments with the structural engineer.

E. The Contractor shall assume full responsibility for coordination of the HVAC systems with the work of all trades, including; scheduling, and verification that all structures, ducts, piping and the mounting of equipment are compatible.

F. It shall be the responsibility of the subcontractor to have employed a competent coordinator of mechanical systems and as such to provide all coordination of drawings or sketches as may be required or deemed necessary by the Engineer to obtain the required ceiling heights and eliminate conflicts with all piping, ducts, electrical, process mechanical and installations of all other trades.

1.11 ENGINEERING SERVICES

A. When engineering services are specified to be provided by the Contractor, the Contractor shall retain a licensed professional engineer to perform the services. The engineer shall be licensed at the time the work is done and in the State in which the project is located. If the State issues discipline specific licenses, the engineer shall be licensed in the applicable discipline. In addition, the engineer shall be experienced in the type of work being provided.

B. All work is to be done according to the applicable regulations for professional engineers, to include signing, sealing and dating documents. When submittals are required by a professional engineer, in addition to state required signing and sealing, a copy of the current wallet card or wall certificate indicating the date of expiration shall be included with the submittal.

C. Provide one original and three copies of the licensed professional engineer's certification.

1.12 WARRANTY

A. Warrant all material and workmanship included herein. Warranty shall include parts & labor for a period of 1 year from date of final acceptance by Owner. The Contractor shall be responsible for all cost incurred in furnishing and installing the replacement equipment.

1.13 NOISE CRITERIA

A. The selection of pumps, fans, air handling equipment, air conditioners, heating ventilating and air conditioning machinery and mechanical equipment and the installation of the system components such as duct work and piping shall be such as not to exceed to maximum permissible noise for non-equipment spaces as defined in Table 2, Design Guidelines for HVAC

System Noise in Unoccupied Spaces contained in the 1995 edition of the ASHRAE Application Handbook. Under no conditions shall the noise created by equipment exceed the levels of permissible noise exposures of occupational areas as established by the OSHA and other Federal, State and local safety and health standards, codes and ordinances.

B. Preferential consideration shall be given to equipment that does not generate a noise level in excess of 80 dBA at a distance of (5) feet in any direction from the unit under operating conditions.

C. Refer to Equipment Schedules for sound criteria. Provide sound data for fans, ventilating equipment and air-conditioning units as listed in the Equipment Datasheets for the following frequency bands: 63, 125, 250, 500, 1000, 2000, 4000 and 8000 Hz. Data shall be the sound power level (reference 10^12 watts per octave band) and to include the dBA at 5 feet. The equipment supplier shall provide actual data for the equipment submitted. If the space does not meet the required criteria, and the noise level of the equipment is found to be the cause, the equipment supplier shall be responsible for the modifications required to correct the condition.

1.14 START-UP SUPERVISION

A. An authorized representative of the manufacturer shall perform the initial startup of the equipment. The Contractor shall provide personnel as required to assist with the startup of each piece of equipment and system and assist with making all adjustments as necessary so that the system is placed in proper operating condition.

B. The Owners Designated Representative shall witness startup. The use of local sales representatives to perform this work is not acceptable, unless the manufacturer provides documented evidence that the sales representative has been specifically trained for this work.

1.15 DEFINITIONS

A. Particular terminology used under this Division is defined as follows:

1. Air Conditioning – Environmental control of temperature, humidity, cleanliness and air circulation, including the cooling of an enclosed space.

2. Air Conditioner or Air Conditioning Unit – One or more field erected or factory made assemblies, which includes the refrigeration compressor condenser assembly, for the handling and control of air temperature, humidity, and cleanliness used for cooling.

3. Fan Unit – Any unit or assembly containing a fan, motor and drive.

4. Temperature Controller – Any device which is used to modulate the automatic temperature control system by a change in temperature at the location of the controller.

5. Readily Accessible – Shall mean that the unit shall be accessible without the need for ladders, harness or other device. Basically the unit shall be accessible at operator level. It shall also mean that no equipment, piping, or other systems shall need to be removed or dismantled to access the unit.

6. Easily Accessible - Shall mean that the unit shall be accessible without the need for removing or dismantling any equipment, piping, or other systems; however it may require the use of a ladder of harness to reach the unit.

1.16 SPARE PARTS

A. Spare parts shall include all special items on the manufacturer's standard list of spare parts.

B. In addition to special items, the following spare parts shall be provided:

1. Furnish all special tools required for normal operation and proper servicing of the equipment.

2. Spare parts shall include all items on the manufacturer's standard list of spare parts and the following for each unit:
   a. One complete set of drive belts for each piece of belt driven equipment.

3. Provide a minimum of 4 or 10 percent of the total units rounded to the next full unit whichever is greater for each size and rating of the following components.
   a. Panel light bulbs
   b. Fuses

C. Pack spare parts in containers suitable for extended storage without deterioration of the parts (minimum one container per building). Containers shall be clearly labeled designating contents, pieces of equipment for which intended and equipment identification numbers.

PART 2 PRODUCTS

2.01 MATERIALS

A. Construction shall be manufacturer's standard painted steel materials. Refer to equipment schedules on Drawings for additional requirements. Uncoated steel shall not be acceptable unless specifically indicated otherwise in the Drawings or equipment specifications.

2.02 ELECTRICAL EQUIPMENT

A. Certain items of electrical equipment which are furnished under this Section shall meet the requirements specified in the Electrical Divisions of the Contract Documents.

B. Electric Motors

1. Electric motors in NEMA frame sizes shall conform to the requirements in Division 01, unless otherwise specified herein.

2. The motor manufacturer shall confirm that motors used to power equipment are provided with bearings that will provide a bearing life equal to the driven equipment or better. Confirmation shall be included with shop drawing submittal.

3. Motors will be selected to be non-overloading over the entire operating range of the equipment. A safety factor of 25 percent will be added to all motors up to and including 50 horsepower. A safety factor of 15 percent will be added to all motors over 50 horsepower. Motors indicated on the schedules are to be considered a minimum. This sizing is not to limit compliance with the above requirements.

4. Provide motors with equipment to be driven by variable frequency drive (VFD) machines compatible with VFD controllers. Locate disconnects on outside of equipment enclosures or guards.

5. Motors shall be premium efficiency type as rated by NEMA. Where premium efficiency motors are not available for the motor size specified, provide high-efficiency motors.

C. Electrical enclosures and panels, including HVAC control panels and associated switches, lights, pushbuttons and other controls components, shall be suitable for the environment and electrical classification for the space they are located in and shall meet NEC requirements. Refer to the electrical drawings for the space classifications and NEMA designations.

D. Where a conflict with NEMA rating occurs between or within Drawings and Specifications, the more restrictive NEMA rating shall govern.

E. Final installation shall provide minimum clearance to electrical components including control panels as required by the manufacturer and by NEC. No ductwork/piping/etc shall encroach on access clearance. Contractor shall re-install at no additional cost to owner if any component, system or sub-system violates this clearance requirement.

2.03 FLAME AND SMOKE RATINGS

A. All materials, including adhesives, surface coatings, sealers, assemblies of several materials, insulation, jacketing, finish, etc, shall have flame spread ratings not over 25 (fire resistive) and smoke development ratings not over 50 and fuel contributed rating not over 50, as established by tests conducted in accordance with the Federal Standard 00136B, National Bureau of Standards Radiant Energy Fire Test and the National Fire Code of the NFPA.

B. These requirements shall apply to all circumstances whether the materials are field applied or have been applied by a manufacturer in his/her shop, or elsewhere, prior to delivery to the project for installation.

2.04 EQUIPMENT VIBRATION ISOLATORS AND MOUNTINGS

A. General

1. Unless otherwise specified in this Division all machinery or vibrating mechanical equipment shall be isolated from the building structure by vibration isolators with a minimum deflection as specified. Operating equipment that can transmit objectionable vibration and noise must be installed with special types of vibration isolators such as flexible connectors to ductwork, piping and wiring. In more critical areas and under

particular conditions, additional vibration isolators shall be installed as specified in other related Sections in this Division, or in specific equipment schedules.

2. All equipment shall be provided with attachment points for floor or suspended mounting that will safely transmit all loads including seismic to the supports.

3. The vibration isolator manufacturer shall be responsible for the proper selection of vibration isolators suitable for the particular application. Selection of the vibration isolator shall include the following factors:
   a. Equipment Weight and weight distribution
   b. Operating thrust and wind loading
   c. Equipment operating frequencies
   d. Type of building support structure
   e. Seismic forces as required by the applicable building codes to include shear, tension and compression due to the code specified loads

4. Except for the Owner Furnished equipment, vibration isolators shall be furnished with the equipment.

5. All floor mounted vibration isolators shall be bolted to the floor, pad or framing on which they rest. Bolts shall be arranged to prevent transmission of vibration through the bolts.

6. All isolation devices for a single piece of equipment shall be selected for a uniform static deflection according to distribution of weight in the equipment.

7. All pieces of equipment that have a variation in weight during operation or maintenance such as, but not limited to, cooling towers and hoppers, shall have built in vertical limit restraints to limit motion to a maximum of 1/4 in.

8. Makeup air units with independently mounted fan sections shall be provided with tension adjustable thrust restraints to counteract reaction forces due to air flow. Restraints shall be arranged to allow a maximum 1/4 in of motion at startup or shutdown.

9. Isolators exposed to the weather, in rooms classified on electrical drawings as damp, wet, or corrosive or where called for on the Drawings shall be provided with corrosion protection. Steel parts other than springs shall be galvanized. Parts subject to wear, rubbing, shall be non-corrosive material such as rubber or stainless steel. Springs and hardware shall be material of equal or greater corrosion resistance than the associated ductwork.

10. After installation of equipment, isolators shall be adjusted for proper loading and distribution of weight.

11. In general, packaged rooftop equipment does not need isolation rails if fan motor assembly and compressor are internally isolated.

B. Types – The following types of vibration isolators may be used.

1. Isolation for Suspension
   a. Isolation hangers for suspension of equipment and piping shall have a single element of elastomer for 1/4 in deflection, a double or a single molded element of 1/2 in deflection, a single spring element with an elastomer grommet for up to 3/4 in deflection and a combination of an elastomer and spring elements in series for 1 in deflection and up contained within a structural rigid one piece steel hanger box. Springs shall have a minimum ratio of outside diameter to operating spring height of 0.8 and an additional travel to solid equal to 50 percent of the specified deflection.
   b. The neoprene element shall have a bushing to prevent hanger rod contact with the housing box. The lower rod shall be free to swing in a 30 degree arc without touching the spring or the housing.

2. Rigidly Mounted Equipment
   a. When equipment doesn't require vibration isolation, it shall be firmly attached to the building structure. Bolts and support structure shall include allowances for seismic loads as required by the applicable building codes to include shear and moment loads.

2.05 SEISMIC RESTRAINTS

A. Seismic restraints shall be provided for all HVAC systems including but not limited to all piping, ductwork, free standing, suspended, or wall mounted HVAC equipment and panels installed under related Sections in this Division. Refer to the Structural General Sheets for Site class, Seismic design category, assigned seismic use group or building category as defined in the IBC, Design Spectral Response Acceleration at Short Periods (0.2 Second) (SDS), and Design Spectral Response Acceleration at 1-Second Period (SD1).

1. Component Importance Factor: systems not required for life safety and not containing hazardous materials 1.0.

2. Component Response Modification Factor: Reference ASCE 7-05.

3. Component Amplification Factor: Reference ASCE 7-05.

B. Materials of construction for seismic supports shall be the same as those specified for equipment supports and hangers, and duct and pipe hangers. All bolts shall be 316 stainless steel regardless of the specified support material.

C. Where the seismic criteria and size of piping and ductwork are within the limits of the latest edition of the SMACNA Seismic Restraint Manual, the restraints as defined in the manual can be used. Restraints shall be selected from Tables for Seismic requirements stated above.

D. The Contractor shall provide vibration isolation and seismic-restraint details indicated to comply with performance requirements and design criteria, including analysis data signed and

sealed by the qualified professional engineer responsible for their preparation, licensed in the state of Texas. This will include but not be limited to the following:

1. Provide seismic loadings to the vibration isolation supplier based on actual equipment being used to allow the proper selection of vibration isolators. Include rated load, rated deflection, and overload capacity for each vibration isolation device.

2. Provide sizing of bolts for attachment of non-vibrating equipment to the structure based on the actual equipment being used.

3. Provide design of required additional bracing for equipment when vibration isolators or bolts are not adequate to withstand seismic forces.

4. Provide design of bracing for all suspending equipment.

5. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.
   a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an evaluation service member of ICC-ES or other agency acceptable to authorities having jurisdiction.
   b. Annotate to indicate application of each product submitted and compliance with requirements.

E. Provide design of bracing for all piping and ductwork that exceeds the limitations of the SMACNA Seismic Restraint Manual.

1. Provide design of bracing for all piping and ductwork.

2. Where piping or ductwork are subject to thermal expansion, the loads caused by the thermal expansion and contraction shall be included in the design of the restraint bracing.

F. Signed and sealed calculations and details shall be submitted for record purposes.

G. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.

H. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval by ICC-ES, or preapproval by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

2.06 EQUIPMENT GUARDS

A. Use suitable structural frames with minimum 12 GA, 3/4-IN mesh, or expanded metal mesh, 316 stainless steel material.

B. Attach to equipment by bolts with wing nuts, or other approved connectors.

C. At belts, provide opening for measuring RPMs.

D. Provide at belts, couplings, moving machinery and equipment in accord with OSHA.

E. Design for easy access to belts and other items requiring replacement.

PART 3 EXECUTION

3.01 INSTALLATION

A. All products shall be installed according to the applicable manufacturer's recommendations, the details shown on the Drawings and as specified herein and in other related Sections in this Division.

B. The Contractor shall start up each piece of equipment and system and shall make all adjustments so that the system is placed in proper operating condition.

C. Install all equipment, ductwork, piping and trim in accordance with the manufacturer's printed instructions and install rigid, plumb and true to line, with all parts in perfect working order.

D. The Contractor shall not install any equipment or materials until the Owner and Owners Designated Representative(s) have approved all submittals. If any equipment or materials are installed prior to approval of the submittals, it shall be at the Contractor's risk.

E. Provide necessary anchoring devices and supports.

1. Use structural supports suitable for equipment, or as indicated.

2. Check loadings and dimensions of equipment with shop drawings.

3. Do not cut, or weld to, building structural members.

4. Provide equipment supports even though not detailed on mechanical, architectural and structural drawings.

F. Verify that equipment will fit support layouts indicated. Where substitute equipment is used, revise indicated supports to fit.

G. Arrange for necessary openings to allow entry of equipment. Where equipment cannot be installed as structure is being erected, provide and arrange for building in of boxes, sleeves or other devices to allow later installation or purchase equipment in manufactured sections to allow move-in and reassembly.

H. Provide all penetrations through roofs prior to installation of roofing.

I. For penetrations required after installation of roofing:

1. Arrange and pay for repairs and flashing work by authorized roofer; provide counterflashings.

J. Install rain hoods and metal counter flashings as indicated, and to make penetrations of mechanical work through walls and roofs water and weathertight.

1. Furnish clamps, waterproofing material and labor.

2. Where metal flashings are applied over concrete, paint concrete with 1/8 IN of mastic cement first.

3. Set flashing in mastic cement, watertight.

K. Arrange and pay for repairs and replace roof construction which is damaged by this work by authorized roofer in a manner which will not nullify roof warranty.

L. Do not use equipment exceeding dimensions indicated on detail drawings or arrangements that reduce required clearances or exceed specified maximum dimensions.

M. Install equipment, piping and ductwork to permit easy access for normal maintenance.

1. Maintain easy access to filters, motors, drives, compressors, and arrange piping, conduit, ducts and related work to facilitate maintenance and to meet or exceed NEC required clearances.

2. Relocate items which interfere with access or NEC required clearances.

3.02 EQUIPMENT PADS

A. Coordinate with General Work for installation of concrete foundations (isolation pads) or housekeeping pads required for mechanical equipment..

B. Set anchor bolts for equipment or as indicated on Structural Contract Documents.

3.03 CLEANING AND DISINFECTION

A. All equipment, coils, fan wheels, motors, ductwork and piping shall be left in a thoroughly cleaned condition. Refer to specification sections and Division 01 for additional information.

B. Clean specialties such as traps and strainers.

C. All piping shall be thoroughly flushed to remove all foreign materials prior to any cleaning procedure. All strainer baskets shall be removed, cleaned and reinstalled at the completion of the cleaning operation and also at the completion of all system and equipment final tests. All flushing and cleaning shall be to the satisfaction of the Owners Designated Representative.

Furnish, install and remove all temporary piping and equipment used in the cleaning and flushing operations. Cleaning and flushing shall be performed as specified in other Sections.

3.04 TESTS AND INSPECTIONS

A. General – Test and inspect all systems and put into satisfactory operation prior to final acceptance by Owner. Test the work as required by the Owners Designated Representative during the progress of the work to demonstrate the strength, durability and fitness of the installation. Furnish all instruments, ladders, lubricants, test equipment and personnel required for the tests; including manufacturer's representatives for testing and startup of all supplied equipment. Balancing and testing shall be performed as specified herein and by related Sections in this Division. All testing shall be performed, witnessed, and signed off in the presence of the Owners Designated Representative.

B. Final Tests – Tests of all systems shall be carried out as required by the Owners Designated Representative prior to final acceptance of the systems for the purpose of demonstrating satisfactory functional and operating efficiency as well as adjustment. All failure modes, safeties, alarms, and interlocks shall be included in the functional testing. During this period, the setting of all automatic controls shall be checked and sufficient measurements taken to ensure that conditions are correct and that capacities are adequate to meet the specified requirements. Provide competent personnel to conduct all tests. Systems will not be considered complete until all tests have been concluded to the satisfaction of the Owners Designated Representative and all other parties having jurisdiction. In event of leakage or defects, tests must be repeated until all faults are corrected. All tests shall be performed in the presence of the Owners Designated Representative. The general operating tests shall be performed under as near design conditions as possible. Four signed and witnessed copies of records of all tests, measurements, settings of throttling devices and nameplate data shall be submitted to the Owners Designated Representative.

C. Contractor shall demonstrate satisfactory performance of all equipment and systems for a minimum period of 5 working days prior to final acceptable by Owner.

D. Test and Inspection Reports – Contractor shall submit certified and witnessed test reports, verifying that equipment is operating per the contract documents and design conditions. Where the individual specification sections require factory-trained representatives to make inspections and/or assist with testing. The name and contact information of said individuals shall be in the test and inspection reports. Four copies of records of all tests, measurements, settings of throttling devices and nameplate data shall be submitted to the Owners Designated Representative.

3.05 BALANCE OF ROTATING EQUIPMENT

A. All machines shall be balanced both statically and dynamically by the manufacturer within the limits of best commercial practices. The term machine, as used above, is to be considered as any piece of equipment which contains rotating components. All machines furnished shall have operating speed not exceeding 80 percent of the first critical speed.

3.06 TRAINING

A. Provide the Owner with training instruction for the proper operation maintenance, inspection, troubleshooting, etc. of equipment and systems installed under this Section. Refer to individual specification sections and Division 01 for additional requirements.

3.07 EQUIPMENT IDENTIFICATION

A. Equipment shall be provided with labels. Labeling of equipment is included in related Sections in this Division, but it shall be part of the work of this Section to assist as required to identify the equipment for proper marking.

3.08 TEMPORARY OPERATION

A. Properly maintain and service all equipment and systems until the particular equipment or the system has been accepted by the Owner. Contractor shall follow manufacturer's recommended maintenance schedule during this period.

B. This maintenance shall include compliance with the manufacturer's operating and maintenance instructions as well as periodic checking, cleaning, and/or replacement of belts, strainers and filters and the lubrication of moving parts and all required adjustments.

C. Contractor shall repair any equipment and systems that fail, leak or get damaged. Any systems that cannot be repaired to the satisfaction of the Owners Designated Representative shall be replaced in kind, without additional cost to the Owner

D. Records of all maintenance and lubrication work performed on Owner or Contractor furnished equipment shall be maintained at the construction or installation site and be available at all times for a review by the Owner or Owners Designated Representative. At the request of the Owner or Owners Designated Representative copies of these records shall be submitted for information and/or review.

3.09 PROTECTION

A. Materials, fixtures and equipment shall be properly protected at all times and all pipe openings shall be temporarily capped or plugged so as to keep dirt and debris out. Keep plug or cap in place until final connections are made.

B. Protect nameplates on all equipment from damage and paint.

3.10 OPPOSITE SEASON STARTUP

A. At first heating or cooling season following final acceptance, start up systems not started due to lack of seasonal design load. The Contractor shall make any necessary modifications to the initial adjustments to produce optimum system operation.

3.11 PAINTING AND COATINGS

A. Unless otherwise specified, all machinery and factory finished equipment such as pumps, fans, air handling units, air conditioning units, and other items of manufacture shall be hot dipped galvanized, aluminum, stainless steel, or will have a factory applied finish, color as standard with the manufacturer. Components fabricated from stainless steel do not require a coating finish unless otherwise specified. All tanks, supporting steel, hangers, rods and all other uncoated or non-galvanized steel other than standard piping and fittings shall have a shop coat consisting of a suitable primer and finish coat. If not factory applied, the prime coat shall be as specified in the contract documents painting specification. All items not factory or shop primed prior to installation shall be suitably cleaned of rust and mill scale by wire brushing, sanding, or other means and prime painted, immediately after installation.

B. The Contractor shall be responsible for the repair of all defects, blemishes, holidays and the like apparent in manufactured coatings and shall ensure that the materials used for such repair shall match and be compatible with the manufacturer's standard color, coatings and practices. Surfaces to be repaired or recoated are to be prepared as recommended by the paint or coating supplier. Care shall be taken not to paint over nameplates.

C. Furnish touch up paint for the various types of equipment furnished and deliver unopened paint to the Owner at completion of the project. The amount of touch-up paint supplied shall be sufficient to cover 15 percent of the applicable painted surfaces or one pint, whichever is greater.

D. Where specified, or called for on the drawings or the following schedule, special corrosion resistant/protective coatings shall be provided. Whenever a protective coating is specified, the equipment shall be coated both inside and out. Whenever necessary to provide full coverage of the equipment, the equipment shall be completely disassembled to allow proper preparation and coating application. Any component that would block the coating process shall be removed. Equipment provided with gaskets or liners shall be coated before the application of the gasketing or liner. The equipment Vendor shall test rotating equipment after coating to confirm dynamic balance. If work needs to be done to correct the equipment balance, the integrity of the coating must be corrected after such work.

E. Ductwork connections to units that require corrosion resistant coatings shall be made with flanges. Flanges shall be factory drilled before coating. Resilient washers suitable for the environment shall be used to protect the coating from the bolts in the flange. The use of self-tapping screws or other fastening methods that will damage the coating are not acceptable.

F. All items to be provided with a protective coating shall have the following data on the coating included with the unit submittal. Submittal shall include vendor data sheets on the specific coating being used, corrosion resistance data sheets, detailed application data sheets to include surface preparation procedures. For baked coatings submit a letter from the coating manufacturer, that the company doing the actual coating operation is an approved coating company. When an equipment supplier provides the coating, the information shall be supplied by the coating manufacturers.

G. Coatings shall be of the following types:

1. MANUFACTURER STANDARD COATINGS
   a. Coating material shall be manufacturer's standard as specified in the schedule below. Surfaces shall be prepared, primed and coated as required by the coating supplier. Heat curing shall be provided where required by the coating supplier.

H. Any holidays, runs, sags, blisters, or inclusions in the coating are unacceptable and will be corrected. With the approval of the Engineer, small areas no more than 4-in by 4-in may be corrected in the field. Larger faults shall be returned to the coater to be repaired. The faulty material shall be removed by sanding and in the case of blisters, the edges feathered. The material used for recoating shall be manufactured by the same manufacturer as the original coating and shall be suitable for field repairs. The touch up material shall have the same corrosion resistance as the original coating, and if the original coating required an ultraviolet protection, the same protection will be provided as part of the repair. The final mil thickness of the repaired coating shall be equal to the originally specified thickness. Where baked coatings have been damaged, the repair shall be made with heat applied to the repaired surface to cure the coating. After curing a solvent test as recommended by the manufacturer shall be used to confirm that the coating is cured.

I. The coating manufacturer shall supply direct to the Engineer, a set of coupons showing the final appearance of the cured coatings. Any coating that does not match the supplied coupons will be rejected.

END OF SECTION

SECTION 15855
HVAC –DIRECT EXPANSION (DX) AIR HANDLING UNITS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish and install all self-contained wall-mounted air-handling units with filters as shown on the Drawings, scheduled and as specified herein.

B. Refer to Section 15500 for HVAC General Provisions relating to the work of this Section.

1.02 MEASUREMENT AND PAYMENT

A. No separate payment will be made for work performed under this Section. Include the cost for this work in the lump sum Base Bid Price.

1.03 RELATED WORK

A. Remote disconnects shall be provided under Division 16.

B. Refer to Division 16 for electrical requirements.

C. Refer to Drawings for HVAC controls prior to purchasing equipment. Equipment supplier shall verify that equipment is provided with all components, controls options, etc. to fulfill the intent of the HVAC control sequence.

1.04 EQUIPMENT SCHEDULES

A. This Section is incomplete without the information contained in the schedules. All equipment shall be of the type, capacity and arrangement as listed on the schedules. Units shall consist of the components listed in the schedule and those components obviously required for the type of unit. The order of component assembly will be as called for on the schedule. Particular attention must be paid to the remarks and notes in these schedules.

1.05 SUBMITTALS

A. Submit all shop drawings and Operating and Maintenance Manuals with all information required per Sections 01300, 01340, 01782 and 15500.

1.06 REFERENCE STANDARDS

A. Refer to Section 15500 and the following specific standards.

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

1. ASHRAE 52 - Method of Testing Air-Cleaning Devices Used in General Ventilation for Removing Particulate Matter.

C. National Fire Protection Association (NFPA)

1. NFPA 90A - Standard for the Installation of Air Conditioning and Ventilating Systems

2. NFPA 90B - Standard for the Installation of Warm Air Heating and Air Conditioning Systems.

D. American Society for Testing and Materials (ASTM)

1. ASTM C581 - Standard Practice for Determining Chemical Resistance of Thermosetting Resins Used in Glass- Fiber- Reinforced Structures Intended for Liquid Service.

2. ASTM C1071 - Standard Specification for Thermal and Acoustical Insulation (Glass Fiber, Duct Lining Materials).

E. Association of Home Appliance Manufacturers (AHAM)

F. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.07 QUALITY ASSURANCE

A. Refer to Section 15500 and the following specific requirements related to this Section.

B. Guarantee that refrigerant cooling equipment will provide indicated cooling capacities in Equipment Schedules.

1.08 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 3.

B. Coordinate installation of equipment supports/roof curbs with Division 7.

C. Units shall fit into the space available with adequate clearance for service as required by the manufacturer. Submitted units, which do not meet these criteria, shall be rejected. Do not assume that all of the manufacturers listed as acceptable manufacturers will provide a unit that will fit in the space allocated. Selection of acceptable manufacturers is not based on whether the manufacturer's standard stock unit will fit into every space allocated. A custom or semi-custom air-handling unit may be required to meet project space and performance requirements.

1.09 WARRANTY - GUARANTEE

A. Refer to Section 15500 for general warranty requirements and the following specific requirements related to this Section.

B. Compressor shall have 5-year parts warranty. For split systems, warranty is five year parts only, no labor.

PART 2 PRODUCTS

2.01 GENERAL

A. In general, units shall be factory fabricated, completely factory-assembled, tested and shipped in one piece with fan, coils, filters, access panels/doors, fan motor, motor base, drive, drive guard, dampers, condensate pans, complete controls, vibration isolators with seismic restraints and other components as specified herein, indicated on the Drawings and as required for safe and satisfactory operation of the equipment.

B. Units shall be designed to provide an integrated assembly when all of the components are assembled. All transition sections and filler pieces required between sections are to be provided as part of the unit.

C. Support brackets or rails are to be provided with the unit. Type of support is to be as required by the schedules and as shown on the Drawings, e.g. hung, floor mounted, etc. All air-handling units shall be provided with lugs, brackets or field supplied devices to allow the unit to be firmly bolted to the structure or fastened to specified vibration isolators. The lugs, brackets or field supplied devices shall be sized to withstand the expected seismic loads for the area and type of application. Location of the attachments shall be based on the equipment being hung or base mounted as shown on the Drawings and the schedules.

D. Units not mounted on vibration isolators shall have all rotating components internally isolated from the main unit with vibration isolators.

2.02 SELF-CONTAINED WALL-MOUNTED AIR-HANDLING UNITS

A. General - Shall be factory assembled, high-efficiency packaged units suitable for exterior installation, complete with cabinet fan, heating section (where required per the Equipment Schedules), DX-refrigerant cooling section, compressors, refrigerant piping system, condenser, condenser fans and drives, factory wired control module, filters, dampers, access sections with hinged access doors, motor, motor base, drive, drive guard and vibration isolators. No outside air is to be introduced into the room by these units. Units shall be fully assembled and charged with refrigerant at the factory, ready for installation at the site via single-point electrical connection. Support brackets, lugs or other suitable support device are to be provided with the unit to allow the unit to be firmly bolted to the structure. The lugs, brackets or field supplied devices shall be sized to withstand the expected loads for the area and type of application. Units shall have all rotating components internally isolated from the main unit with vibration isolators. Equipment shall be as manufactured by Bard, Inc. or approved equal and shall be the model number and type as called out on the Equipment Schedules.

B. Casings - Shall be zinc-coated, galvanized sheet steel construction with structural framing members as required. Provide with manufacturer's standard weather-resistant baked enamel finish. Color shall be selected and approved by the Engineer from the manufacturer's full color range. Pressure class rating of casing shall be for the total fan static pressure, with all sections of the unit of the same pressure class. The unit shall be insulated with 1-in mat faced or neoprene coated fiberglass insulation, 1 lb minimum density, installed with stick clips and adhesives to prevent erosion of the insulation. The base of the unit shall be equally insulated

and all insulation edges sealed to prevent erosion. The casing shall enclose all components for weather protection, with gasketed access doors provided for all sections to facilitate maintenance. Doors shall have provision for key locking to prevent unauthorized tampering. All access doors shall be equally insulated as unit walls. Top of housing shall be constructed to prevent buckling and ponding of water.

C. Supply Air Fan - Fans shall be centrifugal cabinet fans, high-efficiency type, with belt drives, adjustable V-belt type. All bearings for fan and motor shall be as defined in this Section. Extended external lubrication fittings shall be provided. Fan motor shall be thermally protected with fan assembly internally isolated. Backwardly curved wheels shall be airfoil type. All fans shall be statically and dynamically balanced before shipment. All fans shall be AMCA rated for sound and air performance. Where called for on the schedules, fans shall be of spark-proof construction. On spark-proof fans, bearings shall not be placed in the air stream.

D. Evaporator Cooling Coil Section – Refrigerant-based, 3/8-inch seamless copper tubes with aluminum fins mechanically bonded to copper tubes, galvanized steel frame, copper suction header and distribution tubes. Coil mounting shall minimize air by-pass around the coil. Coils shall be pressure and leak tested at 300 psig with air under water. Coils shall be certified per ARI Standards. Provide 1 or 2 independent refrigerant circuits as called out on the Equipment Schedules.

E. Condensate drain pan – Material shall be stainless steel or plastic and be positioned under the entire coil. Stainless steel pan shall be formed of 20-gauge steel, welded watertight. Drain pan shall be fitted with 1-in NPT, non-corrosive plastic drain connection and sloped for complete drainage, allowing for no standing water in the pan. Drain pan shall be insulated.

F. Heating section - Electric heating coils shall be open resistance, nickel-chrome heating type with coil and unit UL listed. Coils and coil controls shall meet NEC and UL requirements. The following built-in accessories and safety controls, in addition to the NEC and UL required safety controls, shall be included: primary over temperature, thermal cut-out (automatic reset), secondary thermal protection (manual reset), fan/heater interlock and heater staging control via the unit's control module.

G. Condenser section – shall be air-cooled type, integral to the packaged unit. All rotating components shall be internally isolated with vibration isolators from the main unit. The condenser shall have propeller or centrifugal fans as shown on the schedules. Exposed fans shall be provided with fan guards. All fans shall be statically and dynamically balanced before shipment, permanently lubricated and provided with built-in thermal overload protection. Condenser coils shall be 3/8-inch seamless copper tubes with aluminum fins mechanically bonded to copper tubes. Coils shall be leak tested at 200 psig and pressure tested at 450 psig with air under water. Provide condenser coils with louver panels or hail guards made of 18-gauge steel, consisting of hood and coil guard. Hood shall be primed and painted to match unit casing. Wire guards shall not be acceptable.

H. Compressors - shall be of the type, number and capacity specified on the Equipment Schedules. Compressors shall be provided with unloading or hot gas by-pass as required by the schedule. Compressor shall include suction strainer, crank case oil sight glass, oil strainer and oil heater and forced feed lubrication. Compressor controls shall include three-phase manual reset

overload protection, hi-low refrigerant pressure cutout, manual reset low oil pressure cutout, non-cycle pump down relay. In addition, multiple compressor units shall have a compressor sequence switch.

I. Filters - See schedule for filter types by unit. Filter Box shall have tracks for the specified filter types to allow filter replacement from either side. Sealing material shall be provided at tracks and ends to prevent air by-passing the filters. Disposable Filters (start-up) shall be framed filters, 1-in or 2-in thickness as scheduled. Filter pressure drop for clean filters at 500 fpm face velocity shall be 0.2-in WG for 1-in thickness and 0.15-in WG for 2-in thick filters. Filter shall have 30 to 35 percent efficiency on ASHRAE Test Standard 52. Manufacturers and type shall be American Air Filter Co. AmAir 300X; Farr Co. 30/30; Cambridge Aeroplate or approved equal. A total of three complete sets of filter media shall be provided for each unit. Each filter section shall be provided with a differential pressure gage accurate to within plus/minus 2 percent of full scale. Pressure range of gages shall be three times the clean pressure loss of the filters provided. Gage casing shall be cast aluminum. Gage shall be mounted indoors.

J. Refrigerant Piping System - A complete refrigerant piping system shall be factory fabricated and installed in the unit. Piping shall be Type K copper tubing with joints silver brazed. Brazing shall be done with an inert gas purge. Complete refrigerant system shall be cleaned, leak tested and charged with refrigerant.

K. Unit Control Panel - A factory wired control panel shall be furnished and mounted on the unit. Panels shall include all controls required and all safety controls and interlocks, control devices, motor starters and terminal strip for remote wired devices. Control sequence shall be as specified on the Drawings. Control voltage shall not exceed 120V. A complete wiring diagram shall be permanently attached to the inside of the panel door. Where specific area classifications are called for or shown on the electrical drawings, all equipment and wiring shall be in conformance with the requirements for that classification. Unit shall be single point connection.

L. Accessories – Provide with remote wall mounted thermostat with temperature and setpoint display.

M. Energy efficiency rating shall be a minimum of 9.0 EER per ASHRAE 90.1-2010 for Single Package Vertical Air Conditioners (SPVAC).

N. Acceptable manufacturers – Packaged wall units shall be of the type as specified herein and equal to the unit with the manufacturer and model number as called on the Equipment Schedules on the Drawings. Acceptable manufacturers are Bard and Marvaire.

2.03 LABELING

A. Provide each piece of equipment with a factory-applied stainless steel nameplate permanently attached to the exterior of the equipment, in an accessible location, external to any insulated surface and observable while the equipment is in operation. As a minimum, include the following applicable information on the nameplate:

1. Manufacturer's name.

2. Equipment Model Number
3. Equipment tag number.
4. Purchasers order number.
5. Serial Number
6. Manufacturer's size and type
7. Air Flow Rate – CFM.
8. Airside Design Pressure – in. W.G.
9. Fan Horsepower and RPM.
10. Cooling Capacity – Total and Sensible Cooling, MBH.
11. Heating Capacity – MBH or KW.
12. For gas-fired equipment, Type of Fuel Approved for use.
13. Refrigerant Type.
14. Volts/Phase/Hertz
15. List of each individual component's electrical data: volts, amps or watts, phase
16. Date of manufacture.
17. Approving Agency Seals.

PART 3 EXECUTION

3.01 INSTALLATION

A. Equipment shall be installed in accordance with manufacturer's recommendation. Provide piping and ductwork connections in accordance with the requirements of the other related Sections.

B. Install units' level and plumb, maintaining manufacturer's recommended clearances.

C. Where applicable, install units' level on structural platform. Coordinate wall penetrations with wall construction. Secure units to structural support with anchor bolts.

D. The Contractor shall not install any equipment or materials until the Owner has approved all submittals. If any equipment or materials are installed prior to approval of the submittals, it shall be at the Contractor's risk.

E. When units are shipped disassembled, field connect all sections together as shown on the Drawings to form single air handling unit. Seal all joints with gaskets and/or sealants.

F. Ground equipment. Refer to Division 16 for requirements.

G. Do not operate equipment without filters. Do not run equipment with dirty filter pressure drop more than twice clean filter pressure drop. A total of three complete sets of filters shall be provided. The first set is to be installed for start-up, test and balancing. The second set shall be installed after final cleanup and acceptance by the Owner. The third set shall be turned over to the Owner as a spare.

H. The Contractor shall start up each piece of equipment and system and shall make all adjustments so that the system is placed in proper operating condition.

3.02 FIELD QUALITY CONTROL

A. Perform the following field quality-control tests and inspections and prepare test reports:

1. After installing air-handling units, and where applicable the associated condensing units, and after electrical circuitry has been energized, test units for compliance with requirements. Start units to confirm proper motor rotation and unit operation.

2. Inspect for and remove shipping bolts, blocks, and tie-down straps.

3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Remove malfunctioning units, replace with new units, and retest as specified above.

3.03 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service. Complete installation and startup checks according to manufacturer's written instructions and do the following:

1. Inspect for visible damage to unit casing.

2. Inspect for visible damage to heater.

3. Inspect for visible damage to fans.

4. Inspect internal insulation.

5. Verify that labels are clearly visible.

6. Verify that clearances have been provided for servicing.

7. Verify that controls are connected and operable.

8. Verify that filters are installed.

9. Clean heating coil and inspect for construction debris.

10. Adjust vibration isolators.

11. Lubricate bearings on fan.

12. Inspect fan-wheel rotation for movement in correct direction without vibration and binding.

13. Adjust fan belts to proper alignment and tension.

14. Start unit according to manufacturer's written instructions.
    a. Complete startup sheets and attach copy with Contractor's startup report.
    b. Inspect and record performance of interlocks and protective devices; verify sequences.
    c. Operate unit for an initial period as recommended or required by manufacturer.
    d. Calibrate thermostat.
    e. Inspect outside-air dampers and return-air damper settings.
    f. Inspect controls for correct sequencing of heating and emergency shutdown.
    g. Measure and record the supply, outside and return airflows.

15. Verify operation of control panel, including pilot-light operation and failure modes. Inspect all alarms and safety devices.

16. After startup and performance testing, change filters, vacuum heat exchanger, lubricate bearings, adjust belt tension, and inspect operation of power vents.

END OF SECTION

SECTION 15860
HVAC – METAL FANS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish and install all fans and fan accessories as shown and scheduled on the Drawings, and as specified herein.

B. This HVAC specification is incomplete without the information contained on the Drawings and in the Equipment Schedules.

C. Due to corrosive nature at plant, fans shall be all aluminum construction as a minimum, including all associated accessories, including dampers.

D. Refer to Section 15500 for HVAC General Provisions related to the work of this Section.

1.02 MEASUREMENT AND PAYMENT

A. No separate payment will be made for work performed under this Section. Include the cost for this work in the lump sum Base Bid Price.

1.03 RELATED WORK

A. HVAC Controls is under Section 15950. Sequences of operation and control are in the HVAC Drawings.

B. Remote disconnects shall be provided under Division 16.

C. Refer to Division 16 for electrical requirements.

1.04 EQUIPMENT SCHEDULES

A. This Section is incomplete without the information contained in the drawings and schedules. All fans shall be of the type, capacity and arrangement as listed on the drawings and schedules. Units shall consist of the components shown, and listed on the drawings and schedules and those components obviously required for the type of unit. Particular attention must be paid to the remarks and notes in the schedules.

1.05 SUBMITTALS

A. Submit all shop drawings and Operating and Maintenance Manuals with all information required per Sections 01330, 01340, 01782 and 15500.

1.06 REFERENCE STANDARDS

A. These standards shall be considered as minimum requirements. This is a general list and not all standards listed are necessarily referenced elsewhere in this Section. Specific requirements of

this Section and/or Drawings shall have precedence. The Owners Designated Representative shall resolve conflicts between published requirements.

B. Titles and abbreviation of Federal, State and industry standards, technical societies, associations and institutes and other organizations, which may be used, are as follows:

1. Air Diffusion Council (ADC)
2. American Bearing Manufacturers Association (ABMA)
3. Air Movement and Control Association (AMCA)
4. American National Standards Institute (ANSI)
5. Air Conditioning and Refrigeration Institute (ARI)
6. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE)
7. American Society of Mechanical Engineers (ASME)
8. American Society for Testing and Materials (ASTM)
9. Factory Mutual (FM)
10. Institute of Electrical and Electronic Engineers (IEEE)
11. National Institute of Standards and Technology (NIST)
12. National Electrical Code (NEC)
13. National Electrical Manufacturers Association (NEMA)
14. National Fire Protection Association (NFPA)
15. Occupational Safety and Health Administration (OSHA)
16. Sheet Metal and Air Conditioning Contractors National Association (SMACNA)
17. Underwriters Laboratories (UL)

C. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.07 COORDINATION

A. Coordinate installation of equipment supports/roof curbs with Division 7.

1.08 NOISE CRITERIA

A. Refer to Section 15500 and individual Equipment Schedules.

1.09 WARRANTY - GUARANTEE

A. Refer to Section 15500 for warranty requirements.

B. Guarantee that all equipment meets the design and performance requirements specified, and alter and/or replace, at no cost to the Owner any piece of equipment, which fails to meet these requirements. Include any work and factory trained supervision necessary.

PART 2 PRODUCTS

2.01 GENERAL

A. The use of a manufacturer's name and model number is for the purpose of establishing the standard quality, grade, type, size, physical arrangement, performance characteristics and availability.

B. Fans shall be factory assembled, complete with fan wheel, fan housing or cabinet, bearings, drives, OSHA approved guards, motor, motor base, unit base and vibration isolators, dampers, and bird screens unless otherwise specified. All fans shall be provided with lugs, brackets or field supplied devices to allow the fan to be firmly bolted to the structure or fastened to specified vibration isolators. The lugs, brackets or field supplied devices shall be sized to withstand the expected seismic and wind loads for the area and type of application. Location of the attachments shall be based on the equipment being hung or base mounted as shown on the Drawings and the schedules.

C. All fans shall be statically and dynamically balanced prior to shipment from factory.

D. Where belt drives are used, motors shall be provided with adjustable slide bases. Adjustable sheaves and slide bases shall be selected so that the midpoint of the adjustable range matches the fan schedule data. Drives selected shall have a safety factor of 1.5 times motor horsepower.

E. All fans shall be AMCA certified for air performance and sound ratings tested in accordance with AMCA 300.

F. Motor shall be selected to be non-overloading for the entire fan curve range and for the reasonable expected temperature and humidity. Schedule motor sizes are minimum. If a larger motor is required for the fan proposed, the larger motor shall be provided at no additional cost.

G. Fans shall be assembled with OSHA shaft, drive, and motor guards. Provide access for greasing bearings, tachometer readings of fan and motor speed without removing the cover. Cover shall be properly ventilated to prevent motor overheating.

H. The noise level of the equipment operating in the field shall not exceed 85 dBA overall sound pressure level (referenced to 20 micro pascals) at a distance of 3-ft from equipment surfaces.

Provide octave band sound data if another noise level is specified in the schedule or if sound data submission is specified in the schedules.

I. Additional requirements are contained herein for specific fan types and in the schedules.

J. Section 15500 contains general requirements for vibration isolators, bearings and motor drives. Adhere to those requirements and the specific requirements in this Section.

K. When bearings are not accessible, extended grease lines and fittings shall be supplied. Multiple bearing extended grease lines and fittings shall terminate in the same location.

L. Provide inlet and outlet screens for fans that are not directly duct connected.

M. Fans shall be UL listed and AMCA certified.

2.02 RECIRCULATION FANS

A. Recirculation fans shall have a tubular housing, inlet and outlet OSHA guards, and mounting hardware to allow the fan to swivel. The housing shall be made of welded heavy gauge steel, minimum 14 gauge, and powder coated. Propeller fan shall be aluminum and be statically and dynamically balanced. The motor shall be high efficiency and direct drive type. Provide wall and/or ceiling mounting brackets from fan manufacturer when available. Field fabricated mounting brackets shall be heavy duty, minimum of 12 gauge steel, with anti-sway supports to prevent fan from swaying when started, stopped, or under normal operating conditions. Mounting hardware shall be secured to a wall or structural member with fasteners approved for the specific application. Fan attachment and swivel shall lock or have sufficient friction to remain in place when fan is operating. All exposed steel shall be powder coated. Bottom of fans shall be mounted 8'-0" above finished floor, unless noted otherwise. Manufacturers shall be Greenheck, Loren Cook, or equal.

B. Supports shall be galvanized with galvanized hardware.

2.03 LABELING

A. Provide each piece of equipment with a factory-applied stainless steel nameplate permanently attached to the exterior of the equipment, in an accessible location, external to any insulated surface and observable while the equipment is in operation.

B. As a minimum, include the following information on the nameplate:

1. Manufacturer's name.
2. Equipment Model Number
3. Equipment tag number.
4. Purchasers order number.
5. Serial Number

6. Manufacturer's size and type
7. Air Flow Rate – CFM.
8. Design Pressure (inch W.G.).
9. Fan Horsepower and RPM.
10. Volts/Phase/Hertz
11. Date of manufacture.
12. Approving Agency Seals.

PART 3 EXECUTION

3.01 INSTALLATION

A. The fans shall be installed in accordance with the instructions of the manufacturer and as shown on the Drawings.

B. The Contractor shall not install any equipment or materials until the Owner and Engineer have approved all submittals. If any equipment or materials are installed prior to approval of the submittals, it shall be at the Contractor's risk.

C. Ensure that lubricating fluids and greases have been applied according to manufacturer's recommendations. Contractor shall be responsible for all start-up checks and adjustments and shall perform them unless they are done by the manufacturer's representative.

D. Statically and dynamically balance each fan to assure vibration free operation.

3.02 FIELD QUALITY CONTROL

A. Perform field quality-control inspections per pre-startup checklists from the manufacturer. Replace any damaged or malfunctioning equipment with new equipment.

3.03 EQUIPMENT IDENTIFICATION

A. Provide each equipment unit with an equipment tag label. Refer to Section 15190 for identification requirements.

END OF SECTION

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SECTION 15953
RESILIENT METAL SEATED BALL TYPE PUMP CONTROL VALVE FOR HIGH SERVICE PUMP STATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Furnish all labor and materials required and install, test, and make complete ready for operation, eight (8) 24-inch AWWA C507 Pump Control Valves as shown on the Drawings and as specified herein.

1.02 MEASUREMENT AND PAYMENT

A. No separate payment for Resilient Seated Ball Type Pump Control Valves will be made under this section. Include the cost for this work in the lump sum Base Bid.

1.03 RELATED WORK

A. Disinfection of Waterlines. Section 02514.

B. Electro-Hydraulic Valve Actuators. Section 15114.

C. Pipe and fittings are included in Division 15.

D. **Control Description is included in Section 13305.** Instrumentation and control work, except as specified herein, is included in Division 13. SCADA input and output signal requirements for monitoring/control are further defined in the P&ID Drawings, Instrumentation Drawings, and Division 13.

E. Electrical work is included in Division 16.

1.04 REFERENCES

A. Reference Standards: Comply as a minimum with applicable provisions and recommendations of the following:

1. ANSI B16.1 - Cast Iron Pipe Flanges and Flanged Fittings.
2. AWWA C507 - Ball Valves.
3. AWWA C550 - Interior Coatings for Valves.
4. ASTM A-126 - Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
5. ASTM A-395 - Ductile Iron Castings.
6. ASTM A-48 - Gray Iron Castings.

7. ASTM A-316 - Stainless Steel.

8. Institute of Electrical and Electronic Engineers (IEEE).

9. National Electric Code (NEC).

10. National Electrical Manufacturers Association (NEMA).

1.05 SYSTEM DESCRIPTION

A. High Service pump control valve system to consist of the following major components.

1. Pump discharge control valve.

2. Electro-hydraulic actuator per Section 15114 and per contract Drawings.

3. Functional Requirements:
   a. Normal pump starting: Adjustable opening speed of 0 to 180 seconds. Set initial time to open at 60 seconds.
   b. Normal pump stopping: Adjustable closing speed of 0 to 180seconds. Set initial time to close at 60 seconds.
   c. Loss of power: Fail close. Adjustable opening speed of 0 to 60 seconds. Set initial time to fail close at 30 seconds.
   d. Throttling- The valve shall be capable of throttling during pump start and shutdown based on pump/pump control valve operation sequence as specified in Section 13305. Back pressure control shall be provided by throttling the valve during low back pressure conditions as specified above. The low back pressure set point shall be fully adjustable.

4. Pump Discharge Pressure at Duty Point: 82.7 psig

5. Pump Flow at Duty Point: 13,888 gpm

6. Pump Shut-off Pressure: 127.8 Psig

7. Pump Backpressure (min) Requirements: 47.5 psig

1.06 SUBMITTALS

A. Submit project specific shop drawings and product data under provisions of Section 01330 - Submittals. **This equipment is critical to complete the project on schedule. CONTRACTOR is responsible for coordinating with equipment manufacturer to ensure submittal is provided to the ENGINEER as specified in Section 01112 – Time Critical for the Completion of the Project Submittals and timely delivery.**

B. Submit a list of not less than five installations where pumping equipment of the type and approximate size specified has been in successful operation for at least five years.

C. Submit locations of the nearest permanent service headquarters of the equipment submitted.

D. Shop drawing for ball valves. Include at least the following information on shop drawing.

1. Size of valve and weight of all components.

2. Pressure rating of valve and pressure loss versus flow performance.

3. Integral valve supports and relation to pump floor support. Include elevations on Drawing.

4. Catalog bulletin or other manufacturer's literature illustrating and describing valve construction and operation. Indicate materials of construction and associated referenced standards. Mark out inapplicable data and options.

5. Valve torques and top-work dimension as required in Part 1.07 B.2.

E. Manufacturer's installation instructions for valve, and operator.

F. Manufacturer's Certifications:

1. Submit manufacturer's certification that he has carefully examined the Contract Documents in detail, including the arrangement and conditions of proposed electrical, mechanical, and structural systems affecting the performance of the equipment, and the detailed requirements of manufacturing and subsequent installation of the equipment.

2. Submit manufacturer's certification that there are no omissions, ambiguities or conflicts in the Contract Documents or in the pumping station piping layout that affects the equipment, as shown on the Drawings, which have not already been clarified in writing.

G. Operation and Maintenance Manuals

1. Furnished manuals in accordance with Specification Section 01782 - Operation and Maintenance Data.

1.07 QUALITY ASSURANCE

A. Manufacturer's Qualifications:

1. Valve provided under this section shall be a standard production in regular production by manufacturers whose products have proven reliable in similar service for at least five years.

2. Manufacturer shall satisfy the City Engineer that it is capable of the following:
   a. Providing local factory trained personnel to service the equipment when needed within a 48-hour period.
   b. Providing all needed spare parts for the equipment within a 48-hour period.

B. Coordination Responsibility

1. In order to ensure equipment compatibility, the electro-hydraulic actuator manufacturer shall be responsible for providing all pump control valve system equipment, including valves, actuators, and all control and accessories. Refer to Section 15114 for coordination responsibilities requirements.

2. The valve manufacturer shall provide the following information to both the Contractor and actuator manufacturer, including this information in the valve submittal:
   a. Maximum raw seating/break torque (no safety factor added)
   b. Maximum raw operating/running torque in either direction (no safety factor added)
   c. Maximum raw allowable stem torque (no safety factor added)
   d. Valve top-work dimension for use to design mounting hardware

3. The valve manufacturer shall sign off submittal drawings for actuator mounting details as designed by the actuator manufacturer within two-weeks upon receiving.

4. The valve manufacturer shall conduct hydrostatic and Proof-of-Design tests of each valve in accordance with the latest edition of AWWA C507 as defined herein in this Section. All testing documentation shall include in the submittal for Engineer review. Submit valve manufacturer's certificate that valves are in full compliance with the valve specification.

5. The actuator manufacturer shall mount and calibrate each actuator to corresponding valve at valve manufacturer facility. Mounting procedure shall be assisted by the valve manufacturer and follow any specific instructions/direction provided by valve. The actuator manufacturer shall give two- week notification to Contractor & valve manufacturer prior to shipping of actuators to valve manufacturer. The actuator manufacturer shall ship all actuators and mounting hardware to the valve manufacturer's factory for assembling actuator to valve.

6. Valve manufacturer shall give two week notice to actuator manufacturer prior to mounting actuators to valves. The actuator manufacturer shall be present to witness mounting of actuators to valves at valve manufacturer's factory. The actuator manufacture must confirm to deliverable schedule requirements so as not to hold up shipment of the assembly. .The valve manufacturer shall fully assemble valve and actuator in their factory, with assistance from actuator manufacturer, and test with control panel prior to shipping. Perform manufacturer's standard functional tests in valve factory on each actuator unit on each job valve.

7. The valve manufacturer shall submit in writing to Contractor & Engineer that all actuator and valve assemblies are properly mounted and calibrated prior to shipment from the valve manufacturer facility to job-site.

8. The valve and actuator manufacturers shall submit in writing to Contractor & Engineer that all actuator and valve assemblies are properly installed at job-site.

9. Contractor shall retain overall responsibility for equipment coordination, installation, testing, and operation.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Deliver equipment to site, all store and protect equipment under provisions of Section 01600 - Material and Equipment.

B. Store all equipment off the ground in enclosed shelter to protect from damage and exposure to the elements until installed.

1.09 EVALUATION AND SELECTION

A. The City reserves the right to select any equipment which is deemed to be in its best interest.

1.10 WARRANTY

A. The valve manufacturer shall provide a warranty valid for equipment supplied under this Section for a period of four (4) years commencing from the time of final acceptance by the Owner. This warranty shall include no fewer than two annual site visits by a factory maintenance technician. Warranty shall be supplied in writing to both the actuator manufacturer and Contractor, identifying both proper valve manufacturer contacts and local representatives. Warranty shall state that valve/actuator assembly has been designed and successfully installed as of commissioning date and shall also define expiration date of warranty period for the valve.

1.11 SPARE PARTS

A. The valve manufacturer shall provide one complete set of spare parts.

PART 2 PRODUCTS

2.01 MANUFACTURER(S)

A. Resilient Seated Ball Valve:

1. GA Industries

2. Henry Pratt Company

2.02 MATERIALS AND/OR EQUIPMENT

A. Pump Control Ball Valve

1. Pump control ball valves shall be pressure Class 150 and consist of a main valve body assembly and an electro-hydraulic mechanical actuator as referenced in Part 1.05. The valve, actuator, and associated controls shall be furnished completely assembled, tested, and ready for field installation and wiring.

2. The valve shall have a full, circular, unobstructed waterway and exceed the minimum design requirements of AWWA C507, latest edition.

a. Ball Valve Construction
   1) Body: The valve body shall be constructed of cast iron ASTM A126 Class B. The valve body may be a one-piece or multi-piece casting with integral inlet and outlet flanges. The valve body shall include integral mounting pads for supporting the weight of the valve body. Vent and drain connections shall be provided. Inlet and outlet flanges shall be flat faced and drilled in accordance with ANSI B16.1 for Class 125 cast iron flanges.
   2) Body Seat: Metallic body seat shall be made from either bronze or stainless steel. Valve seats shall be capable of being adjusted or replaced in the field without requiring removal of the valve from the line.
   3) Rotor: The valve ball or rotor shall be constructed of ductile iron ASTM A536 Gr. 65-45-12.
   4) Ball or Rotor Seats: The ball or rotor shall employ either a hydraulically-activated seating arrangement to minimize wear of the resilient rotor seat, or a 316 spherical stainless steel seating surface on the ball.
   5) Shaft: The rotor shall be connected to the drive mechanism by means of an 18-8 stainless steel shaft securely attached to the rotor trunnion. Plated steel shafts are not acceptable.
   6) Bearings: Sleeve type bearings shall be constructed of Teflon-lined backing, bronze or stainless steel.
   7) Seals: Where the rotor trunnions pass through the body assembly, O-ring seals of Buna-N or other suitable AWWA material shall be provided.

2.03 BALL VALVE ACTUATOR

A. Refer to Section 15114 for requirements of the electro-hydraulic actuator.

2.04 SHOP/FACTORY FINISHING

A. Prime and finish coat exposed metal surfaces with coating and application in accordance with Division 9 in the factory unless stainless steel is used, then no painting is required.

B. Manufacturer shall provide materials for touch-up and recoating as necessary if coating damage occurs prior to final acceptance.

2.05 PERFORMANCE REQUIREMENTS - CONTROLS

A. Each valve shall be furnished with a LOCAL-REMOTE (L/R) switch. In the Local position, the valve is controlled locally by the open/close/stop pushbuttons.

B. In the REMOTE position, the valve is controlled by PLC logic for pump/valve sequence. Refer to Section 13305 Control Description and P&IDs for additional information.

PART 3 EXECUTION

3.01 ERECTION/INSTALLATION/APPLICATION AND/OR CONSTRUCTION

A. Install pump control valve system in accordance with Drawings, Technical Specification Sections, approved shop drawings, and manufacturer's installation instructions.

B. For Pumps No. 5 through No. 8, only one pump may be taken out of service at a time to install new pump control valves.

C. For Pumps No. 1 through No. 4, two pumps may be taken out of service at a time to install new pump control valves.

D. Pump control valves replacement work sequence shall start from Pump No. 5, from west to east, coinciding with associated electrical work.

3.02 FACTORY TESTING

A. Perform hydrostatic and Proof-of-Design tests of each valve in accordance with the latest edition of AWWA C507. The valve and actuator functional testing shall be coordinated with the actuator manufacturer, in accordance with the assembly plans and schedule of the actuator manufacturer.

3.03 FIELD QUALITY CONTROL

A. Manufacturer's representative to assist CONTRACTOR in performing the following tasks.

1. Check completed installation.

2. Service system using lubricants recommended by manufacturer.

3. Make any necessary adjustments. Valve speed controls and time delay relay to be adjusted to eliminate water hammer on loss of power.

B. Performance test:

1. Conduct performance testing on each valve/actuator assembly once installed. Upon installation, conduct Equipment Checkout, Field Testing and Functional Testing. Each pump shall be field tested with the new pump control valve and actuator system and demonstrated a successful pass of the required testing and a functional installation before a subsequent pump can be replaced with new pump control valve and actuator.

2. Perform under actual or approved simulated operating conditions. To simulate power failure condition, the following testing procedure shall be followed:
   a. Associated high service pump(s) shall be turned off.
   b. Associated pump discharge butterfly valve shall close.
   c. In local mode, open the pump control valve manually to fully open position.

d. Open the pump discharge butterfly valve and shut off power to the pump control valve.
e. Field adjust set-point for valve fail close speed.

3. Test for a continuous 48-hour period without malfunction.

4. Adjust, realign, or modify units (as necessary) and retest until acceptable.

5. Actuator/valve assemblies shall stroke in a smooth and controlled manner.

6. If required, take corrective action and the units shall be retested to ensure full compliance with the specified requirements. All costs associated with the field tests or any required corrective action shall be borne by the Contractor.

C. Manufacturer's Installation Report

1. Submit within 30 days after installation inspection.

2. Include the following in report.
   a. Description of each deficiency found.
   b. Recommended corrective action(s).
   c. Statement that High Service pump control valves and associated control panels are properly installed and adjusted except as noted.

3.04 CLEANING

A. After system is in service, clean dirt, oil, and grease from equipment and touch up factory finishes damaged during installation. Complete field painting of items without factory finishes.

3.05 VENDOR TRAINING AND MANUFACTURER'S SERVICES

A. Provide vendor training for Pump Control Valve

1. Provide eight hours of vendor training. Vendor training shall include both classroom training at the Owner's facility and hands-on training on the Owner's equipment.

2. Vendor training session topics shall include sufficient information and skills training on the theory, design, and site specific operation and maintenance practices, including, but not limited to, routine monitoring with normal and abnormal parameters, troubleshooting techniques, and preventive and corrective maintenance requirements to operate and maintain equipment and systems.

3. A training video shall be provided. A training video shall be professionally made of the vendor training session. The training video must be representative of the equipment furnished for this project. The training video shall be in DVD format as required by Specification 01782S.

4. Documentation for vendor training shall be provided to each participant which includes actual manuals for the equipment and drawings and schematics of equipment supplied for this project.

B. A manufacturer's representative who has a complete knowledge of the proper startup, installation, operation and maintenance shall be provided as noted below:

MANUFACTURER'S REPRESENTATIVE DUTIES

Services Provided by Factory Representative	Minimum # of Trips[a]	Minimum Time On Site Per Trip[a] (8 hr. working days)
1. Supervise Installation	6	6 days
2. Inspect and Approve Installation[b]	1[c]	1 day
3. Supervise Testing	2[d]	4 days
4. Instruct Owner in Proper Startup and O&M	1[e]	1 day

[a] The manufacturer's factory representative shall be present at frequent enough intervals to ensure proper installation testing and initial operation of the equipment.
[b] The manufacturer's factory representative shall provide to the Engineer a written certification that each unit has been installed in accordance with the manufacturer's recommendations.
[c] May be done immediately following completion of Item 1 if acceptable to the Engineer.
[d] May be done immediately following completion of Item 2 if acceptable to the Engineer.
[e] This instruction may be given following completion of Item 3, provided that the test is successful, the O&M Manuals have been approved, and if it is acceptable to the Engineer.

END OF SECTION

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SECTION 15954
TRIPLE OFFSET DISC TYPE PUMP CONTROL VALVE
FOR HIGH SERVICE PUMP STATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. This section includes the furnishing and installation of eight (8) 30-inch diameter triple offset combined function tilting disc check valves with hydraulic dampening and control system(s) that will be used as a control valve in a single engineered valve package that protects and isolates pumps as shown on Drawings and as specified herein.

1.02 MEASUREMENT AND PAYMENT

A. No separate payment for disc valves and control systems will be made under this section. Include the cost for this work in the lump sum Base Bid.

1.03 RELATED WORK

A. Disinfection of Waterlines. Section 02514.

B. Pipe and fittings are included in Division 15.

C. Electrical Valve Actuators are included in Section 15200.

D. **Control Description is included in Section 13305**. Instrumentation and control work, except as specified herein, is included in Division 13. SCADA input and output signal requirements for monitoring/control are further defined in the P&ID Drawings, Instrumentation Drawings, and Division 13.

E. Electrical work is included in Division 16.

1.04 REFERENCES

A. Reference Standards: Comply as a minimum with applicable provisions and recommendations of the following:

1. ANSI B16.5 – Pipe Flanges and Flanged Fittings.

2. AWWA C550 - Interior Coatings for Valves.

3. ASTM A-126 - Gray Iron Castings for Valves, Flanges, and Pipe Fittings.

4. ASTM A-395 - Ductile Iron Castings.

5. ASTM A-48 - Gray Iron Castings.

6. ASTM A-316 - Stainless Steel.

7. Institute of Electrical and Electronic Engineers (IEEE).

8. National Electric Code (NEC).

9. National Electrical Manufacturers Association (NEMA).

1.05 SYSTEM DESCRIPTION

A. High Service pump control valve system to consist of the following major components.

1. Pump discharge control valve.

2. Functional Requirements:
   a. Normal pump starting: Adjustable opening speed of 0 to 180 seconds. Set initial time to open at 60 seconds.
   b. Normal pump stopping: Adjustable closing speed of 0 to 180 seconds. Set initial time to close at 60 seconds.
   c. Loss of power: Fail Close. Adjustable opening speed of 0 to 60 seconds. Set initial time to fail close at 30 seconds.

3. Pump Discharge Pressure at Duty Point: 82.7 psig

4. Pump Flow at Duty Point: 13,888 gpm

5. Pump Shut-off Pressure: 127.8 psig

6. Pump Backpressure (min) Requirements: 47.5 psig

1.06 SUBMITTALS

A. Submit project specific shop drawings and product data under provisions of Section 01330 - Submittals. **This equipment is critical to complete the project on schedule. CONTRACTOR is responsible for coordinating with equipment manufacturer to ensure submittal is provided to the ENGINEER as specified in Section 01112 – Time Critical for the Completion of the Project Submittals and timely delivery.**

B. Submit a list of not less than five installations where Valve of the type and approximate size specified has been in successful operation for at least five years.

C. Submit locations of the nearest permanent service headquarters of the equipment submitted.

D. Shop drawing for disc valves and valve operators. Include at least the following information on shop drawing.

1. Size of valve and weight of all components.

2. Pressure rating of valve and pressure loss versus flow performance.

3. Illustration of how operator is mounted on valve.

4. Clearance dimensions of valve operator assembly.

5. Integral valve supports and relation to pump floor support. Include elevations on Drawing.

6. Catalog bulletin or other manufacturer's literature illustrating and describing valve construction, operation, and controls. Indicate materials of construction and associated referenced standards. Mark out inapplicable data and options.

7. Schedule of hydraulic dampening unit and catalog data sheet for same.

8. Manufacturer's literature on valve operator.

E. Manufacturer's installation instructions for valve, and operator.

F. Manufacturer's Certifications:

1. Submit manufacturer's certification that he has carefully examined the Contract Documents in detail, including the arrangement and conditions of proposed electrical, mechanical, and structural systems affecting the performance of the equipment, and the detailed requirements of manufacturing and subsequent installation of the equipment.

2. Submit manufacturer's certification that there are no omissions, ambiguities or conflicts in the Contract Documents or in the pumping station piping layout that affects the equipment, as shown on the Drawings, which have not already been clarified in writing.

G. Operation and Maintenance Manuals

1. Furnished manuals in accordance with Specification Section 01782 - Operation and Maintenance Data.

H. Factory Testing Video in accordance with Part 3.02 B.

I. Manufacturer's Field Report

1. Submit the equipment manufacturer's Certificate of Physical Checkout and Installation.

2. Submit the equipment manufacturer's Certificate of Field Testing.

3. Submit the equipment manufacturer's Certificate of Functional Testing.

1.07 QUALITY ASSURANCE

A. All materials used shall be new, of high grade, and with properties best suited to the work required.

B. Manufacturer's Qualifications:

1. Triple offset disc valve provided under this section shall be a standard production in regular production by manufacturers whose products have proven reliable in similar service for at least five years.

2. Manufacturer shall satisfy the City Engineer that it is capable of the following:
   a. Providing local factory trained personnel to service the equipment when needed within a 48-hour period.
   b. Providing all needed spare parts for the equipment within a 48-hour period.

3. Each complete system to be designed and factory tested by manufacturer.

C. Coordination Responsibility

1. In order to ensure equipment compatibility, one manufacturer shall be responsible for furnishing all pump control valve system equipment, including valve and electrical actuator.

2. The Contractor shall name a pump control valve manufacturer, who will have responsibility for the function of the complete system in accordance with the intent of these Specifications. The named manufacturer shall be experienced in similar work.

3. Manufacturer shall submit to the engineer a list of furnished units of the same general design, type and comparable size specified herein, which have been used and provided satisfactory service under similar test, service and operating conditions for at least five years.

4. Contractor shall retain overall responsibility for equipment coordination, installation, testing, and operation.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Deliver equipment to site, all store and protect equipment under provisions of Section 01600 - Material and Equipment.

B. Store all equipment off the ground in enclosed shelter to protect from damage and exposure to the elements until installed.

1.09 MAINTENANCE

A. Furnish all special tools and test equipment required for the proper servicing of all equipment as specified in Section 01610. All such tools and test equipment shall be furnished in a suitable steel tool chest complete with lock and duplicate keys.

B. All spare parts shall be properly protected for long periods of storage and packed in containers that are clearly identified with indelible markings as to contents.

C. Furnish the following spare parts.

Quantity	Item
One complete set	Valve Seat
One complete set	Pump Control Valve assembly including electrical actuator and hydraulic dampening unit box crated for long term storage
Eight sets	Laminated Seal Rings
Eight sets	O-rings
Eight Sets	Shaft Lip Seals
Eight sets	Hose Lines for Hydraulic Cylinder
Eight sets	Seal Rings for Hydraulic Cylinder
Eight sets	Gaskets for Hydraulic Cylinder

1.10 EVALUATION AND SELECTION

A. The City reserves the right to select any equipment which is deemed to be in its best interest.

1.11 WARRANTY

A. The actuator manufacturer shall provide a warranty valid for all equipment supplied under this Section and Section 15200 – Electrical Valve Actuator for a period of four (4) years commencing from the time of final acceptance by the Owner. This warranty shall include no fewer than two annual site visits by a factory maintenance technician to facilitate unit maintenance, service, repair, calibration, etc.

PART 2 PRODUCTS

2.01 MANUFACTURER(S)

A. Triple Offset Disc Valve:

1. Adams Valve Type AZI-AGF (contact Andrew Teske with Baro Companies 281-561-0900)

2. Engineer Approved equal

2.02 MATERIALS AND/OR EQUIPMENT

A. Pump Control Disc Valve

1. Pump Control Disc Valves shall be a multi-function combination valve with an electric actuator and self-contained hydraulic damping unit. The valve, actuator, and associated controls shall be furnished completely assembled, tested, and ready for field installation and wiring.

2. The valve shall be a full function automatic flow control valve that is capable of preventing backflow, capable of throttling control, and capable of being used as an isolation valve.

3. The valve body shall be constructed of carbon steel ASTM A572 Grade 50 (DIN 1.0570). Inlet and outlet flanges shall be drilled in accordance with ANSI B16.47 Series A for steel flanges. The valve body shall incorporate an integral valve support provisions appropriately reinforced and gusseted for all expected dead and live loads. Lifting provisions shall be incorporated on the valve body.

4. The valve body seating surface shall be 316 stainless steel.

5. Each valve shall have a single carbon steel disc with an offset pivot point located above the centerline of the valve. The offset disc shall be capable of closing with minimum backflow for tight shutoff and non-slam operation. The offset pivot disc shall require minimal torques while seating and unseating

6. The disc seal ring shall be constructed of laminated graphite with stainless steel inserts

7. The drive shaft shall be made of 431 stainless.

8. The valve shall be equipped with a totally enclosed lubricated gearbox driven by an electric actuator with manual override.

2.03 VALVE ACTUATOR

A. The actuators shall be operated by electric power. A method of manual operation shall be provided in the event that the primary power source is not available. **Each valve actuator shall be designed to stroke 100% based on full torque at pump shut-off head to allow for closing the valve (100% closed) against a running pump.**

B. The valve shall be capable of operating in the following modes:

1. Isolation Shutoff – The valve must be able to isolate the flow in reverse direction.

2. Pump Start-Up Empty System – When the system is empty, the valve must be throttled to provide sufficient back pressure on the pump.

3. Pump Start-Up Full System – When the system is full, the valve must be able to open fully without throttling.

4. Pump Protection – Constant, fail safe pump protection as a tilting disc check valve.

5. Non-Return Tilting Disc Check Valve – Automatic backflow prevention when flow is decreased or stopped.

6. Throttling – The valve shall be capable of throttling during pump start and shutdown based on pump/pump control valve operation sequence as specified in Section 13305. The actuator shall also provide back pressure control by throttling during low back pressure conditions as specified above, while continuing to function as a check valve. The low back pressure set point shall be fully adjustable.

7. Water Hammer Dampening – Valve disc closure shall be controlled by a multi-stage dampening unit device. The speed of each dampening stage shall be field adjustable. The hydraulic damping unit shall consist of a hydraulic cylinder, an oil reservoir, adjustable closing springs, hydraulic control block, check valves, a pressure compensator and throttle valves in order to adjust the closing character of the valve movement. The closing speed controlled by the damping of the hydraulic cylinder shall be preset as specified in Part 2.05 A and field adjustable.

8. Combined Function – A lost motion coupling shall be used in the connecting piece of the actuator gear to the valve shaft that ensures the primary function of the check valve such that the valve disc can close automatically from any intermediate or completely open position. Throttling of the valve is achieved by the electric actuator and signaled in 4- 20 mA to the control unit using the electronic position indicator.

9. Furnish position limit switch and electronic position indication in addition to visual position indication. Refer to Section 15200 for additional requirements.

2.04 SHOP/FACTORY FINISHING

A. Prime and finish coat exposed metal surfaces with coating and application in accordance with Division 9 in the factory unless stainless steel is used, then no painting is required.

B. Surfaces in contact with potable water shall be coated with a coating system that is NSF-61 listed.

C. Manufacturer shall provide materials for touch-up and recoating as necessary if coating damage occurs prior to final acceptance.

2.05 PERFORMANCE REQUIREMENTS - CONTROLS

A. Each valve shall be furnished with a LOCAL-REMOTE (L/R) switch. In the Local position, the valve is controlled locally by the open/close/stop pushbuttons.

B. In the REMOTE position, the valve is controlled by PLC logic for pump/valve sequence. Refer to Section 13305 Control Description and P&IDs for additional information.

PART 3 EXECUTION

3.01 ERECTION/INSTALLATION/APPLICATION AND/OR CONSTRUCTION

A. Install pump control valve in accordance with Drawings, Technical Specification Sections, approved shop drawings, and manufacturer's installation instructions.

B. Contractor shall coordinate all required electrical connections such as thermal protections contacts for motors, limit switches, torque switches, etc.

C. For Pumps No. 5 through No. 8, only one pump may be taken out of service at a time to install the new pump control valves.

D. For Pumps No. 1 through No. 4, two pumps may be taken out of service at a time to install the new pump control valves.

E. Pump control valve replacement work sequence shall start from Pump No. 5, from west to east, coinciding with associated electrical work.

3.02 FACTORY TESTING

A. Perform manufacturer's standard factory tests to ensure operation of valve, electrical actuator, and control panel prior to shipment for installation with valve body. Repeat tests on each complete valve/actuator assembly prior to shipment to the jobsite.

B. A factory testing video shall be provided. The factory testing video shall be professionally made and must be representative of the equipment furnished for this project. The factory testing video shall be in DVD format and included in the submittal.

3.03 FIELD QUALITY CONTROL

A. Manufacturer's representative to assist CONTRACTOR in performing the following tasks.

1. Check completed installation.

2. Service system using lubricants recommended by manufacturer.

3. Make any necessary adjustments on the hydraulic dampening units. Valve speed controls and time delay relay to be adjusted to eliminate water hammer on loss of power.

B. Performance test:

1. Conduct performance testing on each valve/actuator assembly once installed. Upon installation, conduct Equipment Checkout, Field Testing and Functional Testing. Each pump shall be field tested with the new pump control valve and actuator system and demonstrated a successful pass of the required testing and a functional installation before a subsequent pump can be replaced with new pump control valve and actuator.

2. Perform under actual or approved simulated operating conditions. To simulate power failure condition, the following testing procedure shall be followed:
   a. Associated high service pump(s) shall be turned off.
   b. Associated pump discharge butterfly valve shall close.
   c. In local mode, open the pump control valve manually to fully open position.
   d. Open the pump discharge butterfly valve and shut off power to the pump control valve.
   e. Field adjust set-point for valve fail close speed.

3. Test for a continuous 48-hour period without malfunction.

4. Adjust, realign, or modify units (as necessary) and retest until acceptable.

5. Actuator/valve assemblies shall stroke in a smooth and controlled manner.

6. If required, take corrective action and the units shall be retested to ensure full compliance with the specified requirements. All costs associated with the field tests or any required corrective action shall be borne by the Contractor.

C. Manufacturer's Installation Report

1. Submit within 30 days after installation inspection.

2. Include the following in report.
   a. Description of each deficiency found.
   b. Recommended corrective action(s).
   c. Statement that High Service pump control valves and associated control panels are properly installed and adjusted except as noted.

3.04 CLEANING

A. After system is in service, clean dirt, oil, and grease from equipment and touch up factory finishes damaged during installation. Complete field painting of items without factory finishes.

3.05 VENDOR TRAINING AND MANUFACTURER'S SERVICES

A. Provide vendor training for Pump Control Valve and actuator System.

1. Provide eight hours of vendor training. Vendor training shall include both classroom training at the Owner's facility and hands-on training on the Owner's equipment.

2. Vendor training session topics shall include sufficient information and skills training on the theory, design, and site specific operation and maintenance practices, including, but not limited to, routine monitoring with normal and abnormal parameters, troubleshooting techniques, and preventive and corrective maintenance requirements to operate and maintain equipment and systems.

3. A training video shall be provided. A training video shall be professionally made of the vendor training session. The training video must be representative of the equipment furnished for this project. The training video shall be in DVD format as required by Specification 01782S.

4. Documentation for vendor training shall be provided to each participant which includes actual manuals for the equipment and drawings and schematics of equipment supplied for this project.

B. A manufacturer's representative who has a complete knowledge of the proper startup, installation, operation and maintenance shall be provided as noted below:

MANUFACTURER'S REPRESENTATIVE DUTIES

Services Provided by Factory Representative	Minimum # of Trips[a]	Minimum Time On Site Per Trip[a] (8 hr. working days)
1. Supervise Installation	6	6 days
2. Inspect and Approve Installation[b]	1[c]	1 day
3. Supervise Testing	6[d]	6 days
4. Instruct Owner in Proper Startup and O&M	1[e]	1 day

[a] The manufacturer's factory representative shall be present at frequent enough intervals to ensure proper installation testing and initial operation of the equipment.

[b] The manufacturer's factory representative shall provide to the Engineer a written certification that each unit has been installed in accordance with the manufacturer's recommendations.

[c] May be done immediately following completion of Item 1 if acceptable to the Engineer.

[d] May be done immediately following completion of Item 2 if acceptable to the Engineer.

[e] This instruction may be given following completion of Item 3, provided that the test is successful, the O&M Manuals have been approved, and if it is acceptable to the Engineer.

3.06 PERFORMANCE WARRANTY BOND

A. The Contractor shall obtain from the triple offset disc type pump control valve and actuator Manufacturer and provide to the Owner, a Performance Warranty Bond equal to 100 percent of the price of the labor, materials and equipment provided under this Section, in a form acceptable to and for the benefit of the Owner, guaranteeing that the pump control valve system meets the performance requirements specified. The bond shall remain in effect until all equipment tests are designated as passing by the City and Engineer and Substantial Completion is granted. Both the Owner and the Contractor shall be named as Obligees.

B. The triple offset disc type pump control valve and actuator Manufacturer shall warrant the pump control valve system performance and guarantee the system performance to meet the requirements listed herein and Section 13305. Should the performance requirements not be attained, the following provisions shall be exercised.

C. In the event the pump control valve system fails to meet the shop and field acceptance performance tests specified, the Owner has the option to reject the equipment and require modification and/or replacement so as to meet the performance requirements. The Contractor shall be fully responsible for all corrective actions or replacement and shall perform subsequent test runs at no costs to the Owner until the defects are corrected. After modification or replacement of the pump control valve system, the Contractor shall retest the system as specified for the original testing. The Contractor shall pay for the retest of the system and any subsequent tests required, including additional engineering costs (CDM Smith) associated with retesting.

D. If the system is modified and additional tests (maximum of three re-tests allowed per unit) are conducted as outlined above, and the system still does not meet the warranty conditions, then the Owner may elect to file a claim on the bond.

END OF SECTION

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SUPPLEMENTARY SPECIFICATION

SECTION 16010S
BASIC ELECTRICAL REQUIREMENTS

The following supplement modifies Section 16010 – Basic Electrical Requirements. Where a portion of the Specification is modified or deleted by this Supplementary Specification, the unaltered portions of the Specification shall remain in effect.

1. Delete paragraph 1.02 D and replace with the following paragraph:

   "D. Equipment and material shall confirm to requirements of these specifications."

2. Delete text, "the wastewater" from paragraph 1.03.B.1.

3. Delete subparagraph titled, "Utility Water Systems" and associated sublistings titled, "River Water, Well Water and City Water" from paragraph 1.04.a.

4. From paragraph 1.04.a, under the subparagraph "Electric Power Supply Characteristics (Available to Contract):", include the following:

	Voltage	Phase	Hz	Wire	Delta or Wye
1	12,470	3	60	3	Wye
2	480	3	60	3	Wye

5. Add the following paragraphs 1.05 and 1.06:

   "1.05 DEFINITIONS

   A. Project Manager is defined as the City's Project Manager.

   1.06 MEASUREMENT AND PAYMENT

   A. No separate payment will be provided for work performed under this Section. Include the cost for this work in the lump sum base bid.

   B. Refer to Section 01270 – Measurement and Payment."

6. Change "City Engineer" to "Project Manager".in Paragraph 3.02.A.

7. Delete text, "the wastewater" from paragraph 3.03.B.

8. Change "City Engineer" to "Project Manager" in Paragraph 3.03.C.

9. Change "station" to "plant" in Paragraph 3.03.D.

END OF SECTION

Approved by:

Sonny Do, P.E.
Acting Assistant Director
Engineering and Construction Division
Department of Public Works and Engineering

10/1/15
Date

Section 16010

BASIC ELECTRICAL REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Basic requirements specifically applicable to the work of Division 16 – Electrical Requirements.

B. The Contractor shall furnish equipment, materials, and labor for assembly and installation plus check-out and start-up of the complete electrical system as shown on the Drawings and stipulated in the Specifications.

1.02 REFERENCES

A. As a minimum requirement, the electrical system shall be constructed in accordance with:

1. American National Standards Institute/National Fire Protection Association (ANSI/NFPA), No. 70 - National Electrical Code (NEC).

2. City of Houston Building Code.

3. Other applicable Codes and Standards as referenced in other Master Specifications.

B. Comply with local, county, state and federal regulations and codes in effect as of date of purchase.

C. Equipment of foreign manufacture must meet U.S. codes and standards.

D. Equipment and materials shall conform to requirements of specification and to the criteria provided in data sheets for the project.

1.03 QUALITY ASSURANCE

A. Product Conformance Certificate and Quality Assurance Release. Submit an overall conformance certificate for electrical components signed by the person responsible for product quality. Specifically identify the purchased material or equipment by project name and location, purchase order number, supplements, and item number where applicable, including materials and services provided by others. Indicate that all requirements have been met and identify any approved deviations.

B. Field Inspection

1. Electrical work shall be inspected and approved by the local code inspector, the wastewater inspector, and the Project Manager prior to starting the 7-day test or scheduling training.

2. Contractor shall give a minimum of one day notice to the Inspector that the installation is ready for inspection and two days notice to the Project Manager.

3. Concealed work shall be inspected before it is covered:

   a. Conduit with stub-ups, underground in duct banks before concrete is poured.

   b. Conduit in slabs, walls and ceilings, complete with boxes.

4. Electrical equipment and materials shall be inspected upon arrival by the Project Manager for compliance with specifications.

1.04 SITE CONDITIONS

a. Take the following site conditions into consideration when fabricating, erecting, installing and wiring electrical equipment under this contract:

Plant Location _____

Houston, Texas

Plant Type and Size

Plant Site Elevation

Seismic Zone Zone 0

Wind Velocity 90 mph

Temperature, Min./Max.:

• Coldest Winter Month	High 60 degrees F	Low 41 degrees F
• Warmest Summer Month	High 94 degrees F	Low 73 degrees F
• Lowest Expected	11 degrees F	
• Highest Expected	107 degrees F	

Rainfall:

- Annual 45 inches
- Design 3.4 inches/hour, 8.4 inches/24 hours

Design Relative Humidity: 98%

Station Barometric Pressure:

- Average Annual 29.5 inches Hg Absolute.

Utility Water Systems:	Design Pressure	Design Temp.
• River Water	_____ PSI	_____ degrees F
• Well Water	_____ PSI	_____ degrees F
• City Water	_____ PSI	_____ degrees F

Electric Power Supply Characteristics (Available to Contractor):

	Voltage	Phase	Hz	Wire	Delta or Wye
1					
2					
3					

PART 2 PRODUCTS

2.01 COMPONENT DESIGN

A. Components utilized in the construction of the material or equipment shall be of the latest proven design, new and in current production. Do not use obsolete components or components to be phased out of production.

2.02 FACTORY INSPECTION

A. Provide free access with prior notice for the Project Manager at all times to the shop where the material or equipment is being fabricated or tested. Provide reasonable facilities for inspection, witnessing tests, and examining records. Give 7-days notice prior to starting tests which are scheduled for factory inspection.

PART 3 EXECUTION

3.01 PREPARATION

A. Verify dimensions and ratings of equipment and materials to ensure proper fit and performance.

3.02 INSTALLATION

A. Install equipment and materials in accordance with the Drawings and manufacturer's written instructions. If field conditions necessitate changes in electrical installation, obtain approval from the City Engineer.

3.03 DEMONSTRATION

A. Test the electrical system to specification requirements and to demonstrate correct installation and operation of equipment.

B. Before 7-days test, demonstrate the system to the wastewater inspector and the Project Manager. Show the system to be fully operational. All alarms, safetys, and communication points to central and locally must operate in both full-automatic and back-up modes. Use fresh water in the test medium.

C. Operate the system continuously for a period of 7 days in full automatic, without failure, to qualify as acceptable. "Failure" is considered any problem that requires correction by maintenance personnel, such as: high or low water level, any motor alarm, power failure, phase failure, communication failure, PLC failure, transducer failure, or UPS failure. This would exclude conditions not under the control of Contractor, such as: evident lightning strikes, 25-year rains, local power utility power failure longer than the specified duration of service from UPS. Failures due to uncontrollable situations would allow the 7-day test to continue, as soon as test conditions are restored and the City Engineer is notified.

D. The existing station shall remain in service during this test.

END OF SECTION

SECTION 16060
ELECTRICAL DEMOLITION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Electrical Demolition. Electrical Demolition is as indicated on the Contract Drawings.

1.02 MEASUREMENT AND PAYMENT

A. No separate payment will be made for work performed under this Section.

1.03 REFERENCES

A. Temporary wiring of systems to maintain operation of facilities while undergoing modifications and demolition shall be provided in accordance with:

1. American National Standards Institute/National Fire Protection Association (ANSI/NFPA), No. 70 – National Electrical Code (NEC), Article No. 590 – Temporary Installations.

1.04 SUBMITTALS

A. Provide annotated project drawing sheets (in 11x17 size) to illustrate sequence of the temporary hook-ups, disconnection, demolition of systems, and equipment removal.

B. Schedule in advance with City Engineer for every required installation of temporary facilities, shut down, transition, and equipment relocation or demolition.

1.05 QUALITY ASSURANCE

A. Verify field measurements and circuiting arrangements are as shown on drawings.

B. Verify that wiring and equipment serve only facilities to be removed. Remove all abandoned wiring and above slab conduits.

C. Demolition items on the Contract Drawings are based on casual field observation and existing record documents. Report discrepancies to the City Engineer before disturbing existing installations.

D. By beginning demolition, the Contractor accepts existing conditions and warrants that he will maintain service to equipment and items not scheduled or indicated for removal. And that he will return to the City, all items and systems not removed in good operating condition, or discard it at city option at no cost to the City.

PART 2 PRODUCTS

2.01 MATERIALS AND EQUIPMENT

A. Materials and equipment for patching and extending work: As specified in individual Sections.

2.02 DESIGN AND CONSTRUCTION

A. Temporary electrical wiring and facilities shall be designed and constructed in strict compliance with NEC - Article No. 590.

PART 3 EXECUTION

3.01 PREPARATION

A. Coordinate power outages with Northeast Water Purification Plant Manager to provide continuous service to operating equipment.

B. Existing Electrical Equipment: Maintain existing system in service until new system is complete and ready for service. Disable system only to make switchovers and connections. Obtain permission from the City Engineer at least 21 days before partially or completely disabling any system. Minimize outage duration.

C. Provide temporary wiring and connections to maintain existing systems in service during construction. If work must be performed on energized equipment or circuits, use personnel experienced in such operations. Work to be carried out on energized equipment shall receive prior approval from the City Engineer.

D. Disconnect electrical systems in walls, floors, and ceilings scheduled for removal.

3.02 DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK

A. Remove, relocate, and extend existing installations to accommodate new construction.

1. Turn device off, remove abandoned wiring to source of supply, mark as spare.

2. Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes. Cut conduit flush with walls and floors, and patch surfaces.

3. Disconnect abandoned outlets and remove devices. Remove abandoned outlets if conduit servicing them is abandoned and removed. Provide blank cover for abandoned outlet boxes not removed.

4. Disconnect and remove abandoned panelboards and distribution equipment.

5. Disconnect and remove electrical equipment supports, anchors, and devices serving utilization equipment that has been removed.

6. Repair, using current project specifications, adjacent construction and finishes damaged during demolition and extension work.

7. Maintain access to existing active equipment installations during construction. Modify installations or provide access panels as appropriate.

8. Extend existing installations, using materials and methods as specified for new work, where indicated.

3.03 DISPOSAL AND SALVAGE

A. When items are to be removed, first check with the City Engineer and walk the demolition area to determine if any items are to be salvaged. Deliver all items designated for salvage to a location determined by the City within the City limits.

B. Equipment and Materials, that are not designated to be salvaged shall become the property of the Contractor, to be removed and properly disposed of by the Contractor.

3.04 CLEANING AND REPAIR

A. Clean and repair existing equipment and materials which remain or are to be reused.

B. Panelboards: Clean exposed enclosure surfaces inside and out, check tightness of electrical connections. Replace damaged circuit breakers and provide closure plates for vacant positions. Replace missing or damaged enclosure hardware, latches, and deadfronts as required. Provide new nameplate and typed circuit directory showing final circuiting arrangement.

C. Transformers: Clean exposed enclosure surfaces inside and out. Check tightness of electrical connections. Replace missing hardware and provide new nameplate.

END OF SECTION

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SECTION 16111
CONDUIT, FITTINGS, AND BODIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Specification for Conduit, Fittings and Bodies. See Specification Section 16402, Underground Duct Banks, for additional requirements.

1.02 MEASUREMENT AND PAYMENT

A. No separate payment will be made for work performed under this Section. Include the cost for this work in the lump sum Base Bid.

B. Payment for extra unit price work shall be as defined in the extra unit price schedule.

1.03 RELATED SECTIONS

A. Specification 16195, Electrical Identification.

B. Specification 16402, Underground Duct Banks.

1.04 REFERENCES

A. American National Standards Institute (ANSI)

1. ANSI C80.1: Rigid Steel Conduit - Zinc Coated
2. ANSI C80.3: Electrical Metallic Tubing - Zinc Coated
3. ANSI C80.4: Fittings for Rigid Metal Conduit
4. ANSI C80.5: Rigid Aluminum 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: Liquid Tight 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: Liquid Tight Flexible Metal Electrical Conduit

2. UL 6: Rigid Metal Electrical Conduit

3. UL 514B: Fittings for Conduit and Outlet Boxes

4. UL 651: Schedule 80 Rigid PVC Conduit

5. UL 651A: Type EB and A Rigid PVC Conduit and HDPE Conduit

6. UL 797: Electrical Metallic Tubing

7. UL 886: Electrical Outlet Boxes and Fittings for Use in Hazardous Locations

8. UL 1684: Reinforced Thermosetting Resin Conduit

1.05 SUBMITTALS

A. Submit the following under the provisions of Section 01330 - Submittal Procedures:

1. Manufacturer's cut sheets, catalog data

2. Installation, terminating and splicing procedure

3. Instruction for handling and storage

4. Dimensions and weight

5. Code compliance certificate

6. Conformance certificate

1.06 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. Liquid tight 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.

1.07 DELIVERY STORAGE AND HANDLING

A. Package conduit in 10-foot bundles maximum, except for PVC conduit which may be up to 20 feet in length, 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.

B. Store conduit above ground on racks to prevent corrosion and entrance of debris.

PART 2 PRODUCTS

2.01 MATERIALS AND EQUIPMENT

A. Design Conditions. Use electrical conduit, fittings, and bodies designed for service in areas as specified in Section 16010 - Basic Electrical Requirements and this section to form a continuous raceway system for power, control, and instrument cables or any combination thereof.

B. Conduit and Fittings

1. Rigid Aluminum Conduit and Fittings
   a. Rigid Aluminum Conduit, bends, nipples, bodies, etc., shall be manufactured from aluminum alloy 6063-T1 and shall comply with the latest ANSI C80.5 requirements. Acceptable manufacturers of Rigid Aluminum conduit are Allied and Sapa Extrusions.
   b. Fittings for Rigid Aluminum Conduit shall be cast aluminum with aluminum covers attached to the conduit fitting by stainless steel captive screws (Crouse-Hinds Mark 9 or equivalent).
   c. Straps for Aluminum conduit shall be 316 SS with 316 SS hardware.

2. Rigid Steel Conduit and Fittings
   a. Rigid Steel Conduit, bends, nipples, bodies, etc., shall be hot-dipped galvanized and shall comply with the latest ANSI C80.1, UL 6, Federal Specification WW-C-581D, and NEC Article 344.
   b. Mild steel tubing shall be used for conduit, nipples, and couplings, and shall be free of defects on both the inner and outer surfaces.
   c. Fittings and 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.

3. PVC-Coated Rigid Galvanized Steel Conduit and Fittings
   a. PVC-coated conduit, fittings, bodies, and covers shall be Form 8 and conform to NEMA RN 1 (Type A). Rigid steel galvanized conduit and fittings shall conform to Federal Specifications WW-C-581 D and ANSI C 80.1. PVC-coated rigid metal

conduit must be UL listed with PVC as the primary corrosion protection. Conduit bodies shall conform to UL 514 B and Federal Specification W C 58 C. PVC-coated fittings for general service locations must be UL listed with the PVC as the primary corrosion protection. Provide sufficient coating for touch-up after installation.

b. PVC-coated couplings shall be of the ribbed type.
c. Condulet covers shall have a V-Notch seal and encapsulated stainless steel thumb screws.
d. Condulets and covers shall be of malleable iron or ferroalloy material before coating.
e. Urethane coating shall be a minimum of 2 mil thickness on the interior of the conduit and the interior of fittings, condulets, covers, and bodies.
f. All PVC coated conduits and fittings shall be supplied by the same manufacturer.
g. Straps for PVC-coated conduit support shall be 316 SS with 316 SS hardware.

4. Electrical Metallic Tubing and Fittings
   a. Electrical Metallic Tubing (EMT) shall be galvanized steel tubing and shall comply with the latest ANSI C80.3 and UL 797 requirements.
   b. EMT fittings shall be galvanized malleable iron or steel compression type which tighten around the tubing by use of hex compression nuts. EMT connectors shall have insulated throats. Zinc or pot metal compression fittings are not acceptable. Set screw EMT fittings are also not acceptable.

5. Liquid Tight Flexible Metal Conduit and Connectors
   a. Use liquid tight flexible metal conduit with spiral-wound, square locked, hot dip galvanized steel strip, manufactured in accordance with UL 1 and Federal specification WW-C-566C.
   b. Connectors used with liquid tight flexible metal conduit shall be 316 Stainless Steel for 2 inch conduit size and smaller. The material of connectors larger than 2 inch shall match the conduit material, for that area of construction. Aluminum conduit areas shall be aluminum connectors and PVC coated RGS conduit areas shall be PVC coated galvanized steel connectors. Fittings shall be 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. Liquid tight flexible metal conduit connectors for use in hazardous areas shall comply with UL 886, NEC Article 501, and Federal Specification W-C-586C.

6. PVC Conduit and Fittings
   a. Use PVC conduit, bends, and fittings, which comply with NEMA TC2, W-C-1094, and NEC Article 352 for above ground and underground installation. Conduit shall be Schedule 40 where conduit is concrete encased and Schedule 80 for all other applications.
   b. Supports, straps and hardware for exposed PVC conduit shall be 316 SS.

7. Epoxy Fiberglass Conduit and Fittings
   a. Use epoxy fiberglass conduit, bends and fittings which comply with UL 1684 and NEC Article 352 for underground applications.
   b. Where used for bends greater than 15 degrees in underground duct bank conduits, provide epoxy fiberglass bends with a deep socket PVC coupling factory attached to each end of each bend.

c. When used for stub-ups, provide an epoxy fiberglass elbow with a vertical epoxy fiberglass nipple to extend the conduit upward to a termination point. Join the elbow to the nipple with an epoxy fiberglass straight socket connection joined with epoxy adhesive. On the top of the epoxy fiberglass nipple, provide an epoxy fiberglass conduit adapter to transition to rigid aluminum conduit. On the underground end of the epoxy fiberglass elbow, provide a factory attached deep socket PVC coupling to transition to Schedule 40 PVC conduit.
d. Epoxy fiberglass conduit shall have a wall thickness of 0.070" for sizes ¾" through and including 4" conduit. A wall thickness of 0.096" shall be provided for 5" epoxy fiberglass conduit.
e. An acceptable manufacturer of epoxy fiberglass conduit is Champion Fiberglass, 6400 Spring Stuebner Road, Spring, TX 77389, 281-655-8900.

8. Cable Tray and Fittings
   a. Cable tray, bends, and covers shall be Aluminum with 316 Stainless Steel hardware. All tray accessories shall be specifically designed for the series of tray installed, field fabricated tray items are not acceptable. Cable tray shall be installed according to the latest revision of NEMA VE 2.
   b. Dimensions: unless otherwise indicated on the drawings. Depth: 6", Width 24". Fittings shall have a minimum radius of 12 inches.
   c. Type: unless otherwise indicated on the drawings all tray shall be Ladder type with 6 inch rung spacing.
   d. Support: all tray support components shall be specifically designed for the series of tray installed. Tray supports shall have a maximum spacing of 8'-0". Splice plates shall be "wedge lock" design with locking hardware.
   e. Fittings: all conduit entrance fittings shall be UL Listed and designed for the tray utilized.
   f. Grounding: any disconnected sections of the tray system shall be bonded with copper grounding "jumpers". All boding hardware shall be 316 Stainless Steel. Any splice plate connection that exceeds 0.00033 Ohms shall have supplemental bonding with a copper jumper.

PART 3 EXECUTION

3.01 PREPARATION

A. Ensure that the conduit system to be installed is sized properly for the cable and wire requirements.

B. Verify the actual physical conduit route from the conduit plan drawings and prepare the conduit support system.

C. Verify the equipment locations to which the conduit will be connected and determine detail requirements for connections.

3.02 INSTALLATION

A. Install Rigid Aluminum Conduits in all indoor and outdoor locations, unless a different type of conduit is identified below for a specific application. The minimum bending radius for Rigid Aluminum Conduits containing 5 kV and higher voltage cables shall be 30" for conduits 4" and smaller and 36" for conduits 5" and larger. If smaller radius bends are required at a particular location for Rigid Aluminum Conduits containing 5 kV and higher voltage cables, secure approval from the Engineer before proceeding with smaller radius bends.

B. Install Schedule 80 PVC conduits in all indoor areas where chemicals are stored, metered, pumped or processed.

C. Install Rigid Steel Conduits inside valve vaults and valve manholes.

D. Install Schedule 40 PVC conduits for all underground applications including all single conduits, duct banks, and where conduits are encased in concrete slabs. See Specification 16402, Underground Duct Banks, for additional requirements. For stub-ups, use epoxy fiberglass elbows with an appropriate length epoxy fiberglass nipple to extend the conduit to the surface of the concrete or 12" above grade where concrete will not be poured. Install a conduit adapter with threaded plug flush with the top surface of the concrete or 12" above grade in dirt areas where concrete will not be poured. The threaded plug shall be removed when the conduit is extended.

E. EMT conduits shall only be used where concealed in walls of air conditioned rooms or above lay-in ceilings in air conditioned rooms. EMT conduits shall not be installed exposed at any locations.

F. Run exposed conduit parallel or perpendicular to walls, ceilings or main structural members. Group multiple conduits together where possible. Conduit shall not interfere 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. A minimum overhead clearance of 8'-0" shall be maintained in passageways.

G. Installation and support of conduits shall be from steel or concrete structures using Type 316 stainless steel Unistrut P1000 (or equivalent by other vendors) attached with Type 316 stainless steel bolts, expansion anchors and associated hardware. Furnish necessary Type 316 stainless steel conduit straps, clamps, fittings, rods and supports for the conduit in accordance with standard construction practices. Above lay-in ceilings in air conditioned rooms, EMT conduits shall be supported using hot-dip galvanized steel Unistrut P1000 (or equivalent by other vendors) with hot-dip galvanized steel hardware.

H. Identify conduits at termination points like MCC, light fixtures, control panels, receptacles, and junction boxes.

I. Not more than 3 equivalent 90 degree bends will be permitted between outlets. Provide bonded expansion fittings at building expansion joints.

J. 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.

K. 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. Threads shall be cut 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.

L. Make up changes in direction of conduit using elbows or fittings. Do not use pull boxes to make direction changes unless specifically designated otherwise.

M. Field fabricated bends shall be free of indentations or elliptical sections. The radius of the bends shall not be less than listed in Paragraph 3.02 (this paragraph) of this specification.

N. Protect all conduit terminations from mechanical injury. Prevent the entry of moisture and foreign mater into the conduit system shall be prevented by properly capping terminations.

O. Avoid trapped runs of conduit, if possible. When they are necessary, provide drainage using a "tee" condulet equipped with a drain. Conduit is likely to pass through areas with a temperature differential of 20 degrees F or more. Seal penetrations with a proper seal fitting at the wall or barrier between such areas. For conduit passing through walls separating pressurized areas from non-pressurized areas, install sealing fittings at the wall on the non-pressurized side.

P. Fit all conduit crossing building or structure expansion joints with approved expansion fittings, except that fittings will not be required when conduit crossing an expansion joint is supported on trapeze hangers in such a way that at no time will the conduit be under stress due to expansion. Install bonding jumpers around expansion joint fittings.

Q. Where conduit terminates in sheet metal enclosures 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.

R. Provide liquid tight 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 Contract Drawings.

S. Seal all openings or holes where conduits pass through walls or floors. When passing thru a firewall or floor, use a fire-rated seal. Certain walls, as indicated on the drawings, require environmental (air-tight) seals; seal as indicated on the Drawings.

T. Install explosion-proof seals in conduit runs crossing or entering a hazardous classified area (as shown on Contract Drawings). Install type CSBE removable sealing fittings to seal pump cables between wet well and first junction box.

U. Unless otherwise indicated on the Contract Drawings, install expansion fittings every 300 feet within a straight conduit run and where conduit crosses building expansion joints, using bonding straps to ensure ground continuity.

V. Parallel runs of conduit may be supported by structural steel racks. When two or more racks are arranged one above the other, provide vertical separation of not less than 12 inches between racks, unless otherwise indicated on the Contract Drawings. Space conduits on the racks at least enough to provide 1/4-inch clearance between hubs on adjacent conduits at terminations and to allow room for fittings.

W. Fill conduit racks no more than 75 percent of their capacity, providing usable space for future conduit. To ensure this, conduits leaving the rack horizontally shall be offset up or down so that future conduits may be installed in the space remaining. Construct conduit racks to permit access for wire or cable pulling at all pull points, even when future conduits are added to fill the racks.

X. Where conduit racks are supported on rods from beam clamps or by some other non-rigid suspension system, install rigid supports at no more than 50-foot intervals to give lateral stability to the rack.

Y. Conduit racks or hangers must in no way interfere with machinery (or its operation), piping, structural members, process equipment, or access to anticipated future equipment. 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.

Z. 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.

AA. Support conduit runs with Type 316 stainless steel conduit clamps, hangers, straps and Type 316 stainless steel metal framing channel attached to structural steel members.

BB. Install conduits supported from building walls with at least 1/4-inch clearance from the wall to prevent the accumulation of dirt and moisture behind conduit.

CC. The minimum conduit size shall be 3/4-inch.

DD. Provide conduit tags for conduits as indicated in Specification 16195, Electrical Identification.

END OF SECTION

SECTION 16120
600-VOLT INSULATED WIRE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Specifications for 600-volt insulated wire for power and controls.

1.02 MEASUREMENT AND PAYMENT

A. No separate payment will be made for work performed under this Section. Include the cost for this work in the lump sum Base Bid.

B. Payment for extra unit price work shall be as defined in the extra unit price schedule.

1.03 RELATED SECTIONS

A. Section 16195 - Electrical Identification.

1.04 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)

1.05 SUBMITTALS

A. Submit the following under the provisions of Section 01330 - Submittal Procedures.

1. Manufacturer's cut sheets, catalog data

2. Instruction for handling and storage

3. Dimensions and weight

4. Conformance certificate

1.06 QUALITY ASSURANCE

A. Tests. Cable shall meet all the requirements of Part 6 of ICEA S-61-402.

B. Conformance Certificate and Quality Assurance Release. Submit a conformance certificate signed by the person responsible for product quality. The certificate shall specifically identify the purchased material or equipment; such as by the project name and location, purchase order number, supplements, and item number where applicable, including materials and services provided by others. The certificate shall indicate that requirements have been met and identify any approved deviations.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Ship wire and cable on manufacturer's standard reel sizes unless otherwise specified. Where cut lengths are specified, mark reel footage accordingly. Each reel shall contain one continuous length of cable. Provide impact protection by wood lagging or suitable barrier across the traverse of the reel. Provide moisture protection by using manufacturer's standard procedure or heat shrinkable self-sealing end caps applied to both ends of the cable.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Southwire

B. Cerro Wire

C. Encore Wire

D. Okonite Company

2.02 600-VOLT INSULATED WIRE

A. Design. Provide insulated wire designated as XHHW-2 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 90 degrees C in wet locations while installed in underground duct, conduit or in control panels.

B. Conductors. Provide conductors which are Class B, concentric-stranded, annealed uncoated copper with physical and electrical properties complying with ASTM B3 and B8 and Part 2 of ICEA S-61-402.

C. Insulation. Each conductor shall be insulated with cross linked synthetic polymer. The insulation thickness shall match the dimensions listed in Table 310-13 of the National Electrical Code (NEC) for type XHHW-2 wire.

D. Wire Marking

1. Wire marking shall be in accordance with National Electrical Code (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. Single conductor color coding for power conductors follows. When colored insulated conductors are not available, wrap color tape around ends of conductors.

System Voltage	A	B	C	Neutral	Ground
120/240 Volt 1Ph/3w	Black	Red		White	Green
208/120 Volt 3Ph/4w	Black	Red	Blue	White	Green
120/240 Volt 3Ph/4w	Black	Orange	Blue	White	Green
480/277 Volt 3Ph/4w	Brown	Purple	Yellow	Grey	Green
Ground					Green

2.03 600-VOLT INSULATED MULTI-CONDUCTOR CABLE

A. Multi-conductor cable shall consist of an assembly of individual XHHW-2 insulated wires with an overall flame retardant PVC jacket over the multi-conductor assembly. The PVC jacket minimum thickness shall be 45 mils.

B. Cable Marking

1. Wire marking shall be in accordance with National Electrical Code (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.

2.04 POWER CONDUCTOR SIZES NO. 12 AND 10 AWG

A. Dry Locations

1. Minimize splices

2. Use twist type pressure connectors which screw-on conductors to splice wires. Connectors shall be factory insulated for 600 volts and rated for 105 degrees C.

3. Use Buchanan B-CAP wire connectors or 3M Scotchlok spring connectors.

B. Wet Locations

1. Minimize splices

2. Splice conductors with copper (not CU/AL) crimp type compression sleeves. Cover splices with heat shrink sleeves, Raychem Type WCSM (tubing type sleeves) or Raychem Type CRSM (split sleeve with stainless steel closure spline).

2.05 POWER CONDUCTORS NO. 8 AWG AND LARGER

A. All locations

1. Minimize splices.

2. Splice conductors with copper (not CU/AL) crimp type compression sleeves. Cover splices with heat shrink sleeves, Raychem Type WCSM (tubing type sleeves) or Raychem Type CRSM (split sleeve with stainless steel closure spine).

3. Terminate power conductors no. 8 AWG and larger with copper crimp type compression lugs. Conductors 4/0 AWG and larger shall be terminated with long barrel two-hole lugs.

2.06 CONTROL WIRES

A. Dry Locations

1. Do not splice control wires unless there is no other way to make the installation.

2. Terminate all control wires on terminal blocks in junction boxes, terminal cabinets, control cabinets and in equipment. Use insulated crimp type tin-plates copper terminals with locking fork ends (upturned leg ends) to terminate control wires on terminal blocks.

B. Wet Locations

1. Do not splice control wires unless there is no other way to make the installation.

2. Splice conductors with copper (not CU/AL) crimp type compression sleeves. Cover splices with heat shrink sleeves, Raychem Type WCSM (tubing type sleeves) or Raychem Type CRSM (split sleeve with stainless steel closure spine).

PART 3 EXECUTION

3.01 PREPARATION

A. Complete the cable raceway systems and underground duct banks before installing cables.

B. Verify sizing of raceways and pull boxes to ensure proper accommodation for the cables.

C. Check the length of the cable raceway system against the length of cable on the selected reel.

D. Clean conduits of all foreign matter before cables are pulled.

3.02 INSTALLATION

A. Wiring Methods

1. Use XHHW-2 wire for lighting, power and control wiring where conductors are enclosed in raceways like in above ground conduit systems or in underground duct banks.

2. Do not use solid conductors.

3. Use conductors not smaller than No. 12 AWG stranded for lighting circuits.

4. Use conductors not smaller than No. 14 AWG for control circuits, unless specifically directed otherwise on the Contract Drawings.

5. Splice conductors only where absolutely necessary. Splices must be minimized. Use the longest conductor lengths possible to reduce the number of splices.

6. Splices associated with taps for lighting and control circuits are allowed.

7. Make splices in accessible junction boxes.

B. Wire and Cable Identification

1. Provide wire and cable tags for control wiring ad indicated in Specification Section 16195, Electrical Identification.

2. Provide color coding tape on power wire and cables without colored insulation or jackets.

C. Single Conductors in Conduit and Duct bank

1. Install cables in accordance with the manufacturer's instructions and the National Electrical Code (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 Polywater J pulling lubricant.

D. 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 a megger insulation test on every conductor in accordance with the operating instructions. Provide a test report for conductors size 4/0 AWG and larger. Tests for conductors size 250 kcmil and larger shall be witnessed by a City Engineer designated representative.

E. Termination

1. After the 600-volt wiring system has been tested with satisfactory results, reconnect wire.

END OF SECTION

SECTION 16123
MEDIUM VOLTAGE POWER CABLE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Specifications for medium voltage power cable.

1.02 MEASUREMENT AND PAYMENT

A. No separate payment will be made for work performed under this Section. Include the cost for this work in the lump sum Base Bid.

B. Payment for extra unit price work shall be as defined in the extra unit price schedule.

1.03 RELATED SECTIONS

A. Section 16195 – Electrical Identification.

1.04 REFERENCES

A. American Society for Testing and Materials (ASTM).

1. ASTM B3: Soft or Annealed Copper Wires

2. ASTM B8: Concentric-Lay-Stranded Copper Conductors, Hard, Medium Hard, Soft

B. Institute of Electrical and Electronics Engineers (IEEE), IEEE 383-2.5.

C. Insulated Cable Engineers Association (ICEA).

1. ICEA P-45-482: Short-Circuit Performance of Metallic Shielding and Sheaths of Insulated Cable.

2. ICEA S-68-516: Ethylene-Propylene-Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy (NEMA WC-8).

D. Underwriters' Laboratories (UL), UL 1072: Medium-Voltage (Type MV) Solid-Dielectric Cables

E. American National Standards Institute/National Fire Protection Association (ANSI/NFPA), 70 National Electrical Code (NEC), Chapter No. 3 - Wiring Methods and Materials.

1.05 SUBMITTALS

A. Submit the following under the provisions of Section 01330 - Submittal Procedures.

1. Completed engineer's data sheets

2. Completed manufacturer's data sheets

3. Manufacturer's cut sheets, catalog data

4. Name of electrical testing company to be employed

5. Impulse voltage test record

6. Installation, terminating and splicing procedure

7. Instruction for handling and storage

8. Dimensions and weight

9. Conformance certificate

1.06 QUALITY ASSURANCE

A. Tests

B. Cable shall be tested at the factory to confirm that the cable complies with requirements of Parts 2, 3, 4, and 5 of ICEA S-68-516. Test methods shall comply with the requirements of Part 6 of ICEA S-68-516.

1. Where applicable, the cable shall meet the requirements of the vertical tray flame test as described in IEEE 383-2.5.

1.07 DELIVERY STORAGE AND HANDLING

A. Ship cable on manufacturer's standard reel sizes unless otherwise specified. Where cut lengths are specified, mark reel footage accordingly. Each reel shall contain one continuous length of cable.

1. Reels shall be of the type specified on the data sheets. Provide impact protection by wood lagging or suitable barrier across the traverse of the reel. Provide moisture protection by manufacturer's standard procedure or heat shrinkable self-sealing end caps applied to both ends of the cable.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS (IF REQUIREMENTS OF THIS SPECIFICATION ARE SATISFIED)

A. Okonite Company

B. Prysmian Cables & Systems

C. General Cable Corporation

D. Southwire Corporation

2.02 MATERIALS AND EQUIPMENT

A. Design. Provide cable with the following design characteristics. Cable shall be UL listed type MV-105, rated at 15 kV with 100% insulation level. Cables will be used on three phase, 60 HZ systems operating 4.16 kV.

B. Conductors. Provide conductors which are bare, uncoated copper, class B stranded per ASTM B3, B8 and B33.

C. Conductor Shielding. Use conductor with a shield composed of extruded semi-conducting compound applied in accordance with the Part 2 of ICEA S-68-516.

D. Insulation. Conductor insulation shall be extruded ethylene propylene rubber (EPR) with a thickness of 175 mils (15 kV).

E. Insulation Shielding. Provide each insulated conductor with an extruded insulation shield consisting of a nonmetallic covering located directly over the insulation and a copper tape shield helically applied over the insulation shield. The materials used in the insulation shield and the method of construction shall comply with Part 4 of ICEA S-68-516 and UL-1072.

1. The short-circuit capacity of the conductor insulation shielding shall be the larger value of either the capacity defined in ICEA P-45-482 or that shown in the following table:

Shield Diameter Inches	Short-Circuit Amps for 8 Cycles	Short-Circuit Amps for 16 Cycles
1/2	1400	1000
3/4	2100	1500
1	2800	2000
1-1/4	3500	2500
1-1/2	4200	3000
1-3/4	5000	3500
2	5700	4000
2-1/4	6400	4500
2-1/2	7100	5000
2-3/4	7800	5500
3	8500	6000

F. Jacket. When medium voltage power cables are enclosed in conduit, duct or in other raceway systems, the cables shall be of the non-armored type with an overall nonmetallic PVC jacket covering single conductor cables as specified conforming to the requirements of Part 4 of ICEA S-68-516.

G. Splices shall be Raychem Type HVS.

H. Cable Terminations. Raychem Type HVT-Z. Use non-skirted heat shrinkable stress control tubing for indoor termination.

I. Motor Lead Connection Kit. Raychem MCK-5V.

J. Marking. Mark the jacket of cables as required by paragraphs 201, 202, 203, and 204 of UL 1072, unless otherwise specified.

K. Pulling lubricant. Polywater J.

PART 3 EXECUTION

3.01 TESTING EXISITNG MSGR FEEDERS

A. Prior to beginning any work perform Partial Discharge tests, as described below in Paragraph 3.03 G., on feeder circuits from Plant 3 MSGR Unit 2 and MSGR Unit 35 to existing Intertie Switchgear. Each circuit has a length of over 4000 feet.

3.02 PREPARATION

A. Complete cable raceway systems, underground duct banks, and cable support systems 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. Do not install or work on insulated or jacketed cables in temperatures below 32 degrees F.

3.03 INSTALLATION

A. Cable in Conduit and Ductbank

1. Clean conduits of all foreign matter before cables are pulled.

2. Install cables in accordance with the manufacturer's instructions and the National Electrical Code (NEC). Do not exceed maximum wire tension, maximum insulation pressure, and minimum bending radius.

3. Pull cables into conduits using adequate lubrication to reduce friction. Lubricants must not be harmful to the conductor insulation.

B. Cable in Tray (Not Used)

C. Preparation for Termination

1. Install the minimum number of splices possible.

2. Make terminations of cables at switchgear and motors as indicated in Paragraph 2.02 of this specification.

3. Use copper crimp-on terminal lugs and connectors for all sizes of conductors.

4. Use crimp-on lugs with long barrel and two-hole tongues, except in places where terminations space is limited.

D. Cable Identification

1. Attach conduit tags to medium voltage power cables in manholes and at termination points in switchgear, transformer motors, VFDs and similar location. See Specification Section 16195, Electrical Identification.

E. Fire Proofing

1. Fireproof each set of feeder cables which enter a manhole in a conduit (A, B, and C phases) for the entire length exposed in a manhole. Use 2 layers of Scotch 77 tape with Scotch 69 glass cloth overlay wrapped in the opposite direction. Provide a minimum 50 percent overlay of each layer of Scotch 77 tape.

F. Tests

1. Before connecting the medium voltage cables, test insulation integrity.

2. Contractor shall employ an electrical testing company with minimum 10 years experience in testing industrial electrical equipment, to perform Megger and Partial Discharge tests on newly installed cables. The technician performing the tests shall have a minimum of two years experience performing the specified tests and shall be certified by the manufacturer of the test equipment.

G. Submit name and qualifications of the electrical testing company and testing technicians for review and approval by owner's representative prior to testing cables.

1. The megger test shall be the first test performed. Use a 10 kV DC megohms meter, Biddle Megger No. MIT-1020, and perform cable insulation tests in accordance with the operating instructions. The technician performing the megger test shall determine if the tested cable is satisfactory and suitable for partial discharge testing.

2. Termination
   a. After the cable has been megger tested with satisfactory results, terminate the medium voltage cable at both ends to designated terminal points.
   b. Tighten connection bolts with a torque wrench to specified torque levels.

3. The Partial Discharge test shall be the second test performed. The cable system to be tested shall be energized at the normal system voltage after all splices, terminations and connections to equipment have been made. The tests shall be made by Emerson Network Power, contact Norris Chamberlin at 804-836-2336. Use a HVPD-Longshot PD Spot Tester (or approved equal). Analysis of Partial Discharge tests shall be made with PDGold software. A report shall be generated for each tested cable which includes: PD Value versus Phase, PD value versus Time Intensity, Fractal Chart and Fingerprint. The technician performing the Partial Discharge Test shall determine if the tested cable is satisfactory or the cable must be replaced.

4. Record test data for each cable test, complete with signatures of the City Engineer or designated representative who witnesses the testing. All Megger and Partial Discharge cable tests for the entire project shall be combined in three ring binders and submitted as part of the O&M manuals.

END OF SECTION

SECTION 16126
INSTRUMENTATION CABLE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Specifications for instrumentation cable.

1.02 MEASUREMENT AND PAYMENT

A. No separate payment will be made for work performed under this Section. Include the cost for this work in the lump sum Base Bid.

B. Payment for extra unit price work shall be as defined in the extra unit price schedule.

1.03 RELATED SECTIONS

A. Section 16195 – Electrical Identification.

1.04 REFERENCES

A. American Society for Testing and Materials (ASTM).

1. ASTM B3: Soft or Annealed Copper Wires.

2. ASTM B8: Concentric-Lay-Stranded Copper Conductors, Hard, Medium Hard, Soft.

3. ASTM B33: Tinned Soft or Annealed Copper Wire for Electrical Purposes.

B. Institute of Electrical and Electronics Engineers (IEEE), IEEE 383-2.5: IEEE Standard for Type Test of Class IE Electric Cables, and Field Splices.

C. Insulated Cable Engineers Association (ICEA).

1. ICEA S-61-402: Thermoplastic-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy (NEMA WC-5).

2. ICEA S-66-524: Cross-Linked-Thermosetting-Polyethylene-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy (NEMA WC-7).

3. ICEA S-68-516: Ethylene-Propylene-Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy (NEMA WC-8).

D. Underwriters' Laboratories (UL).

1. UL 44: Rubber Insulated Wires and Cables.

2. UL 83: Thermoplastic Insulated Wire and Cables.

E. American National Standards Institute/National Fire Protection Association (ANSI/NFPA), NFPA No. 70 - National Electrical Code (NEC), Chapter No. 3 - Wiring Methods and Materials, Article 725 - Class 1, Class 2, and Class 3 Remote Control, Signaling, and Power-Limited Circuits.

1.05 SUBMITTALS

A. Submit the following under the provisions of Section 01330 – Submittal Procedures:

1. Completed manufacturer's data sheets, cut sheets, and catalog data.

2. Installation, terminating and splicing procedure (including bending radius and pulling tension data).

3. Instruction for handling and storage.

4. Dimensions and weight.

1.06 QUALITY ASSURANCE

A. Tests

1. Cable shall be tested at the factory to confirm that the cable complies with requirements of ICEA Section 7.7.9 of S-66-524 or 7.5.9 of S-68-516.

2. Where applicable, the cable shall meet the requirements of the vertical tray flame test as described in IEEE 383-2.5.

1.07 DELIVERY, STORAGE AND HANDLING

A. Ship cable on manufacturer's standard reel sizes unless otherwise specified. Where cut lengths are specified, mark reel footage accordingly. Each reel shall contain one continuous length of cable. Provide impact protection by wood lagging or suitable barrier across the traverse of the reel. Provide moisture protection by manufacturer's standard procedure or heat shrinkable self-sealing end caps applied to both ends of the cable.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Alpha Wire Corporation

B. Belden Division, Cooper Industries, Inc.

C. General Cable Company

D. Houston Wire and Cable

E. Okonite Company

F. Southwire Corporation

2.02 MATERIALS AND EQUIPMENT

A. Design. Provide cable with the following design characteristics. The cable shall consist of multiple conductors. The cable assembly shall be UL listed, flame, oil and sunlight resistant, and certified for continuous operation in wet or dry locations while installed in underground duct or conduit. Each conductor shall be individually insulated. Pairs and triads shall have conductors which are twisted together with a drain wire, shielded, and covered with a jacket. Multi-pair/triad cables shall consist of the required number of electrically isolated, shielded pairs or triads, which are bundled together and covered by a PVC overall jacket.

B. Conductors. Provide conductors which are Class B, concentric stranded, annealed tinned copper whose physical and electrical properties comply with ASTM B3, B8 or B33.

C. Insulation. Each conductor shall have 600-volt PVC insulation. The minimum insulation thickness shall not be less than 15 mils of PVC with a 4 mil nylon jacket with an overall 90 degree C rating.

D. Drain Wire. Provide drain wire which is Class B, seven-stranded, tin-coated copper in accordance with ASTM B3, B8, or B33. The drain wire shall not be less than two AWG sizes smaller than the insulated conductor's size, except for multiple pair triad drain wires, which shall not be less than the insulated conductor size.

E. Shielding. Provide shielding consisting of laminated, nonburning, mylar-backed aluminum tape applied helically around a twisted pair or triad with the aluminum side in continuous contact with the drain wire. Wrap the tape around each twisted pair or triad with a 25 percent minimum overlap.

F. Jacket. The pair or triad outer jacket shall be a minimum of 45 mils of PVC.

G. Conductor Identification. Use individual conductors in single-pair and single-triad cables which are color coded black and white; and black, white and red, respectively. Multi-pair triad cables shall have one conductor in each pair or triad colored white, and all other conductors shall be color coded in sequence.

H. Cable Marking. Print cable marking information on the jacket of each cable at 2-foot intervals. Use a permanent printing method with color sharply contrasting the jacket color.

2.03 TERMINATIONS

A. Terminate instrument cables on terminal blocks in junction boxes, terminal cabinets control cabinets and in equipment. Use insulated crimp type tin-plated copper terminals with locking fork ends (upturned leg ends) to terminate instrument cables on terminal blocks.

B. Instrument cables shall not be spliced in underground pull boxes.

2.04 CABLE IDENTIFICATION

A. Provide cable tags for instrument cables as indicated in Specification Section 16195, Electrical Identification.

PART 3 EXECUTION

3.01 PREPARATION

A. Complete cable raceway systems, underground duct banks and cable support systems 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. Do not install or work on PVC insulated or jacketed cables in temperatures below 32 degrees F.

E. Clean conduits of foreign matter before cables are pulled.

F. Provide at least 25 percent spare pairs or triads.

3.02 INSTALLATION

A. Cable in Conduit and Duct bank

1. Install cables in accordance with the manufacturer's instructions and NEC Article 725 - Class 1, Class 2, and Class 3 Remote Control, Signaling and Power Limited Circuits. Do not exceed maximum wire tension, maximum insulation pressure and minimum bending radius.

2. Pull cables into conduits using Polywater J lubricant to reduce friction. Lubricants must not be harmful to the conductor insulation or cable jacket.

B. Cable in Tray. (Not Used)

C. Termination

1. Do not splice conductors. Use insulated crimp type tin-plated copper terminals with locking fork ends (upturned leg ends) to terminate cables to terminal blocks.

2. For shielded control cable, terminate the shield and ground at one end only, preferably at the control panel end for instrument and communication cable and at the supply end for electronic power cables.

3. Mark wiring on both ends with circuit numbers or loop tag numbers. Heat shrink wire tags after wire terminals have been installed.

D. Tests

1. Before connecting the cables, test insulation integrity and conductor continuity.

2. Use a 500 VDC megohms meter and perform the cable insulation test in accordance with the operating instructions.

3. Termination. After the 600-volt instrument cable has been tested with satisfactory results, the cable shall be terminated at both ends to the designated terminal points.

END OF SECTION

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SECTION 16131
DEVICE, PULL, JUNCTION AND TERMINAL BOXES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Specifications for device, pull, and junction boxes.

1.02 MEASUREMENT AND PAYMENT

A. No separate payment will be made for work performed under this Section.

1.03 RELATED SECTIONS

A. Specification 16195, Electrical Identification.

1.04 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

1.05 SUBMITTALS

A. Submit the following under provisions of Section 01330 – Submittal Procedures:

1. Manufacturer's cut sheets, catalog data

2. Instruction for handling and storage

3. Installation instructions

4. Dimensions and weights

1.06 DELIVERY, STORAGE AND HANDLING

A. Pack and crate boxes to permit ease of handling and to provide protection from damage during shipping, handling and storage.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Stainless Steel 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

2.02 MATERIALS AND EQUIPMENT

A. Pull, Junction and Terminal Boxes

1. Provide UL-approved junction boxes and pull boxes manufactured from Type 316 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 Type 316 stainless steel continuous hinge, closure hasps, mounting tabs and all - 316 stainless steel hardware.
3. Furnish the door with neoprene gasket and provision for padlock.

B. Device Boxes

1. Provide UL-approved boxes designed and manufactured to house electrical devices like receptacles and switches, and in conformance with NEMA FB1 and NEC Article 370.

2. Supply boxes that are cast aluminum or 316 stainless steel, suitable for corrosive and wet atmosphere.

C. Hardware for all Boxes

1. Mounting Hardware: Type 316 Stainless steel

2. Conduit Connectors: Watertight, as manufactured by Myers Hubs, or equal.

PART 3 EXECUTION

3.01 PREPARATION

A. Review the Contract Drawings and provide the proper type boxes.

3.02 INSTALLATION

A. Boxes described in this specification shall be used both in dry and wet, corrosive areas, both inside and outside locations.

B. Install boxes in accordance with NEC Article 370 in locations indicated on the Contract 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.

END OF SECTION

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SECTION 16140
WIRING DEVICES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Specifications for wiring devices including:

1. Receptacles
2. Wall switches.
3. Wall plates and cover plates.

1.02 MEASUREMENT AND PAYMENT

A. No separate payment will be made for work performed under this Section.

1.03 RELATED SECTIONS

A. Specification 16195, Electrical Identification.

1.04 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.

1.05 SUBMITTALS

A. Submit the following under provisions of Section 01330 - Submittal Procedures:

1. Product Data: Manufacturer's product literature and specifications including dimensions, weights, certifications and instructions for handling, storage and installation.

1.06 DELIVERY, STORAGE AND HANDLING

A. Pack and crate devices to permit ease of handling and protect from damage during shipping, handling and storage.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Hubbel Inc. Wiring Devices Division

B. Pass & Seymour/Legrand.

C. TayMac Corporation

2.02 MATERIALS AND EQUIPMENT

A. Standards: Conform to NEMA WD1 for general requirements and NEMA WD6 for dimensional requirements.

B. Manufacture devices to heavy-duty industrial specification grade with brown nylon bodies back and side wiring provisions and green-colored grounding screws.

C. Receptacles:

1. Duplex-type extra heavy duty 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. In indoor industrial areas, provide cast aluminum cover plates.

3. In indoor finished areas, provide Type 302 stainless steel cover plates.

PART 3 EXECUTION

3.01 PREPARATION

A. Verify that device boxes are correctly placed.

B. Verify that the correct quantity, size and type of wires are pulled to each device box.

C. Verify that wiring has been checked at both ends.

D. Prepare wire ends for connection to devices.

E. Inspect each wiring device for defects.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install devices plumb and level.

C. Install switches with OFF position down.

D. Install receptacles with grounding pole on top.

E. Connect wiring device grounding terminal to outlet box with bonding jumper.

F. Connect wiring devices by wrapping conductors clockwise around screw terminals.

G. Install cover plates on switch, receptacle and blank outlets in finished areas.

H. Energize and test devices for proper operation.

END OF SECTION

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SECTION 16161
PANELBOARDS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Specifications for panelboards.

1.02 MEASUREMENT AND PAYMENT

A. No separate payment will be made for work performed under this Section.

1.03 RELATED SECTIONS

A. Specification 16195, Electrical Identification.

1.04 REFERENCES

A. American National Standards Institute/National Electrical Manufacturers Association (ANSI/NEMA)

1. NEMA AB1: Molded Case Circuit Breakers

2. NEMA PB1: Panelboards

3. NEMA PB1.1: Instruction for Safe Installation Operation and Maintenance of Panelboards rated 600 volts or less.

4. NEMA PB1.2: Application Guide for Ground-fault Protective Devices for Equipment

B. Federal Specifications, FS W-C-375A: Circuit Breakers, Molded Case, Branch Circuit and Service.

C. American National Standards Institute/National Fire Protection Association (ANSI/NFPA), NFPA No. 70 - National Electrical Code (NEC), Article 384 - Switchboards and Panelboards.

1.05 SUBMITTALS

A. Submit the following under provisions of Section 01330 – Submittal Procedures:

1. Manufacturer's cut sheets and catalog data

2. Breaker arrangement

3. Breaker characteristic curves

4. Instruction for handling and storage

5. Installation instructions

6. Dimensions and weights

1.06 DELIVERY, STORAGE AND HANDLING

A. Have panelboards packed and crated to permit ease of handling and to provide protection from damage during shipping, handling and storage.

B. Contractor shall store panelboards in a dry environment and protect panelboards from moisture during construction.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Cutler-Hammer

B. Square D Company

2.02 MATERIALS AND EQUIPMENT

A. Basic Requirements

1. Use panelboards manufactured and tested in accordance with NEMA PB 1.

2. Provide circuit breakers of industrial grade, manufactured and tested in accordance with NEMA AB 1 and Federal Specification FS W-C-375.

B. Rating

1. Voltage rating, current rating, number of phases, number of wires and number of poles are indicated on Contract Drawings.

2. Branch circuit breaker interrupting capacity shall be minimum 10,000 ampere RMS symmetrical for 208V, and 240V; 25,000 ampere RMS symmetrical for 277V and 480V.

C. Circuit Breakers: Molded case, bolt-on thermal magnetic type with number of poles and trip ratings as shown on the Contract Drawings. Provide ground fault interrupters with trip rating where shown on the Contract Drawings.

D. Bus System

1. Bus Bars: 98 percent conductivity copper. Provide a solid copper neutral bar in 4-wire panelboards. Include copper ground bus in all panels. Provide split-bus panels where shown on Contract Drawings.

2. Main: Circuit breaker or main lugs only as indicated on the Contract Drawings or as required to meet the current interrupting ratings.

E. Box and Trim

1. Construction: Code grade steel, ample gutter space, flush door, flush snap latch and lock.

2. Trim: Surface or flush as required. Enclose panelboards located outdoors, or in other wet and corrosive areas in NEMA 4X weatherproof Type 316 stainless steel enclosures. Enclose indoor panelboards in a NEMA 1 enclosure with manufacturer's standard gray enamel finish.

3. Directory: Typed card, with glass cover in frame on back of door giving the circuit numbers and the area or equipment served.

F. Conduit Connectors: Watertight, as manufactured by Myers Hubs, or equal.

PART 3 EXECUTION

3.01 PREPARATION

A. Review Drawings to verify that panelboards are correct for the application.

3.02 INSTALLATION

A. Install the panelboard in accordance with NEMA PB 1.1 and NEC Article 384.

B. Mount panelboards 6'-0" (to top of cabinet) above finished floor or grade, typical. If Panelboard may not be mounted at 6'-0" to top notify Engineer for acceptance.

C. In wet and corrosive areas, including outdoor locations, install panel enclosures on spacers to provide approximately 1/4-inch between back of cabinet and mounting surface.

D. In wet and corrosive areas, including outdoor locations, connect conduit to the bottom of enclosure and to the lower 30 percent of the sides using watertight connectors.

END OF SECTION

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SECTION 16170
GROUNDING AND BONDING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Grounding electrodes and conductors

B. Equipment grounding conductors

C. Bonding

D. Power system grounding

E. Communication system grounding

F. Electrical equipment and raceway grounding and bonding

G. Control equipment grounding

1.02 MEASUREMENT AND PAYMENT

A. No separate payment will be made for work performed under this Section.

1.03 RELATED SECTIONS

A. Specification 16195, Electrical Identification.

1.04 REFERENCES

A. American Society for Testing and Materials (ASTM)

1. ASTM B3: Soft or Annealed Copper Wires

2. ASTM B8: Concentric-Lay-Stranded Copper Conductors, Hard, Medium Hard, Soft

3. ASTM B33: Tinned Soft or Annealed Copper Wire for Electrical Purposes

B. Institute of Electrical and Electronics Engineers (IEEE)

1. IEEE 142-82: Recommended Practice for Grounding of Industrial and Commercial Power Systems

2. IEEE 383-2.5: IEEE Standard for Type Test of Class IE Electric Cables, Field Splices, and Connections for Nuclear Power Generating Stations.

C. Underwriters' Laboratories (UL)

1. UL 83: Thermoplastic Insulated Wire and Cables

2. UL 467: Grounding and Bonding Equipment

D. National Fire Protection Association (NFPA), NFPA No. 70 - National Electrical Code (NEC), Article No. 250 - Grounding.

1.05 SUBMITTALS

A. Submit the following under the provisions of Section 01330 – Submittal Procedures:

1. Manufacturer's cut sheets and catalog data

2. Installation, terminating and splicing procedure

3. Instruction for handling and storage

4. Dimensions and weight

1.06 QUALITY ASSURANCE

A. Tests

1. Use insulated cable conforming to requirements of the vertical tray flame test as described in IEEE 383-2.5.

2. Test grounding system in the field in accordance with procedures outlined in Part 3 - Execution.

1.07 DELIVERY, STORAGE AND HANDLING

A. Ship grounding 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.

B. Provide impact protection by wood lagging or suitable barrier across the traverse of the reel. Pack and crate other materials specified to withstand normal abuse during shipping, handling and storage.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Cable

1. American Insulated Wire Company

2. General Cable Company

3. Okonite Company

4. Pirelli Cable Corporation

5. Rome Cable Corporation

6. Triangle Wire and Cable, Inc.

7. Southwire Corp

B. Ground Rods and Connectors:

1. Blackburn

2. Copperweld

3. Thomas & Betts

C. Exothermic Connections:

1. Burndy Corporation (Therm-O-Weld)

2. Erico Products (Cadweld)

D. Grounding Connectors:

1. Burndy Corporation

2. O.Z. Gedney

3. Thomas & Betts

2.02 MATERIALS AND EQUIPMENT

A. Design. Provide grounding cable and materials with the following characteristics:

1. Use a grounding system designed in accordance with NEC Article No. 250 - Grounding, and the IEEE 142-82 - Recommended Practice for Grounding of Industrial and Commercial Power Systems.

B. Materials

1. Use grounding conductors, bare or insulated, which are manufactured and tested in accordance with applicable standards ASTM B3, ASTM B8 and ASTM B33.

2. Provide a main ground system of No. 4/0 AWG, Class C stranded, bare copper cable. Generally, taps shall be sized as follows:

a.	Main ground loop or grid	#4/0 minimum
b.	Switchgear, motor control	#4/0
c.	centers and power transformers	#4/0
d.	Motors 200 hp and above	#4/0
e.	Power panels - AC and DC	#2/0
f.	Control panels and consoles	#2/0
g.	Building columns	#4/0
h.	Fencing posts	#2/0

C. Where single conductor insulated grounding conductors are called for, use 600 volt insulation. Use ground conductors identified with green insulation or green tape marking.

D. Supply identifying ribbon which is PVC tape, 3 inches wide, red color, permanently imprinted with "CAUTION BURIED ELECTRIC LINE BELOW" in black letters as specified in Section 16195, Electrical Identification.

E. Utilize flexible copper braid across hinged chain link or fence gates to bond the movable portion to the grounded fence post.

PART 3 EXECUTION

3.01 REPARATION

A. Complete site preparation and soil compaction before trenching and driving ground rods for the underground grid.

B. Verify from Contract Drawings the exact location of stub-up points for grounding of equipment, fences and building or steel structures.

3.02 CONSTRUCTION CRITERIA

A. Local pushbutton and selector switch stations, two-wire control devices, disconnect switches, lighting transformers, panelboards, operator panels, benchboards, and the enclosures of other electrical apparatus shall be grounded through an equipment grounding conductor run with the power supply or control circuit conductors or shall be grounded as shown on the Contract Drawings.

B. Ground all three phase motors, in addition to the grounding conductors in the motor feeder, with a separate No. 4/0 AWG cable to motor frame.

C. Motors having power supplied by multiconductor cable shall be grounded by a separate grounding conductor in the cable and where supplied by single conductor cable in conduit by a grounding conductor pulled in the conduit. Connect ground conductors to the ground bus in the motor control center and to the ground terminal provided in the motor conduit box.

D. Do not ground the insulated bearing pedestals of large motors.

E. Connect ladder-type cable trays to the grounding electrode system. Use 4/0 AWG grounding conductor in power cable tray and #2 AWG in instrument and control cable trays. Provide NEC and U.L.-approved ground clamps.

F. All conduits must contain an equipment grounding conductor of at least one #12 AWG.

3.03 INSTALLATION

A. Equipment Grounding

1. Make grounding connections to surfaces which are dry and cleaned of paint, rust, oxides, scales, grease and dirt to ensure good conductivity. Clean copper and galvanized steel to remove oxide before making welds or connections.

2. Use the exothermic welding process for below-grade grounding connections, except at ground rods. Use mechanical connectors or thermal connections for above-grade grounding connections as shown on the Contract Drawings.

3. Make grounding connections to electrical equipment, vessels, mechanical equipment and ground rods in accordance with the Contract Drawings.

4. Ground tanks and vessels by making connections to integral structural supports or to existing grounding lugs or pads, and not to the body of the tank or vessel.

5. Leave ground connections to equipment visible for inspection. Protect this type connection with PVC non-metallic conduit.

6. Make connections to motor frames and ground buses with lugs attached to the equipment by means of bolts. Do not use motor anchor bolts or equipment housing for fastening lugs of grounding cable.

7. Where the wiring for lighting systems consists of single conductor cables in conduit, provide each conduit with an equipment grounding conductor. Use a grounding conductor with green colored insulation and ground equipment in the lighting system.

B. Raceway and Support Systems Grounding

1. Install raceway, cable rack or tray and conduit so that it is bonded together and permanently grounded to the equipment ground bus, according to the Contract Drawings. Connection to conduit may be grounding bushing or ground clamp.

2. Install raceway at low voltage motor control centers or other low voltage control equipment so that it is bonded and grounded, except that any conduit which is effectively grounded to the sheet metal enclosure by bonding bushing or hubs need not be otherwise bonded.

3. Where a grounding conductor is run in or on a cable tray, bond the grounding conductor to each section of cable tray with a cable tray ground clamp.

4. Where only grounding conductor is installed in a metal conduit, bond both ends of the conduit to the grounding conductor.

5. Provide flexible "jumpers" around raceway expansion joints. Use copper bonding straps for steel conduit. Install jumpers across cable tray joints which have been parted to allow for expansion and any hinged cable tray connections.

C. Fences and Gates (Not Used)

D. Power System Grounding

1. Solidly ground the secondary neutral of transformers to the ground grid. See Contract Drawings for details.

2. Solidly ground the neutral of lighting, instrument and control transformers.

E. Cable Armor and Shields

1. For shielded control cable, terminate and ground the shield at one end only, preferably at the control panel end for instrument and communication cable and at the supply end for electronic power cables. Maintain shield continuity by jumpering the ground shield across connection point where it is broken at junction boxes, or other splice points. Insulate these points from ground.

2. Connect the ground wire in power cable assemblies at each terminal point to a ground bus, if available, or to the equipment enclosure. Do not carry these ground wires through a "doughnut" current transformer (CT) used for ground fault relaying; do carry ground leads from stress cones through CTs. Ground power cable armor and shield at each terminal point.

F. Test

1. Perform ground resistance tests after underground installation and connections to building steel are complete, unless otherwise noted on applicable Contract Drawings.

2. Make tests at each ground test well using a "fall of potential" test method. Each ground test well shall not exceed a maximum resistance of 5 ohms. Where measured values exceed this figure, install additional ground rods as required to reduce the resistance to the specified limit.

G. Inspection. Inspection of the grounding system by the City Engineer and the local Code Inspector must take place before the grid trenches are backfilled.

END OF SECTION

SECTION 16171
LOW VOLTAGE MOTORS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Specification for low voltage motors.

1.02 MEASUREMENT AND PAYMENT

A. No separate payment will be made for work performed under this Section.

1.03 REFERENCES

A. American National Standards Institute/Anti-Friction Bearing Manufacturers Association (ANSI/AFBMA): Load Ratings and Fatigue Life for Ball Bearings.

B. American National Standards Institute/national Electrical Manufacturers Association (ANSI/NEMA): MG 1 - Motors and Generators.

C. American National Standards Institute/National Fire Protection Association (ANSI/NFPA): NFPA 70 - National Electrical Code (NEC).

D. American National Standards Institute/Institute of Electrical and Electronics Engineers (ANSI/IEEE)

1. IEEE112 – Standard Test Procedure for Polyphase Induction Motors and Generators

2. IEEE114 – Standard Test Procedure for Single-Phase Induction Motors

E. American National Standards Institute/Underwriters Laboratories, Inc. (ANSI/UL)

1. UL547 – Thermal Protectors for Motors

2. UL674 – Electric Motors and Generators for Use in Hazardous Locations, Class I Groups C and D, Class II Groups E, F and G

F. Institute of Electrical and Electronics Engineers (IEEE)

1. 85 – Test Procedure for Airborne Sound Measurements on Rotating Electric Machinery

2. 43 – Recommended Practice for Testing Insulation Resistance of Rotating Machinery

G. American Society of Heating, Refrigerating, and Air-conditioning Engineers, Inc./ Illumination Engineering Society of North America (ASHRAE / IES): 90.1-1989, Table 5.1 – Minimum Acceptable Nominal Full-load Motor Efficiencies for Single Speed Polyphase Motors.

1.04 SUBMITTALS

A. Submit the following under the provisions of Section 01330 – Submittals:

1. Outline drawings
2. Completed motor data sheets
3. Assembly drawings
4. Anchor bolt location drawings
5. Electrical schematics and wiring diagrams
6. Equipment performance curves and data
7. Bill of installation/assembly materials
8. Equipment weights
9. Catalog data
10. Assembly/disassembly sizes and weights
11. Operating instructions
12. Maintenance and lubrication recommendations
13. Recommended spare parts for startup including prices
14. Special maintenance tool requirements
15. Recommended spare parts list for one year operation
16. Quality control procedures
17. Nondestructive test procedures
18. Acceptance test procedure
19. Surface preparation and painting procedure
20. Shipping, handling, and storage procedures
21. Installation/erection procedure
22. Code compliance certificate
23. Electrical equipment heat run test records

24. Nameplate data

25. Performance/acceptance test report

26. Size of the largest three phase power factor correction capacitor unit which can be connected to three phase motors.

1.05 QUALITY ASSURANCE

A. Tests

1. Inspect and test motors in accordance with specified NEMA standards. Test polyphase motors to the requirements of ANSI/IEEE 112. Test single phase motors to the requirements of ANSI/IEEE 114. See data sheets for other standard test requirements that may be specified.

1.06 DELIVERY, STORAGE AND HANDLING

A. Prepare each unit for the type and mode of shipment specified. The preparation shall be suitable for at least six months of outdoor storage from time of shipment requiring no disassembly prior to operation (except for bearing and seal inspections).

B. Provide instructions as necessary to preserve the integrity of the storage preparation after the equipment arrives at the jobsite.

C. Coat exterior machined surfaces with a suitable rust preventative.

D. After drained and cleaned, coat internal areas of bearings and auxiliary equipment in oil lubrication systems fabricated from carbon steel with a suitable oil-soluble rust preventative.

E. Provide threaded openings with steel caps or solid-shank steel plugs. Do not use nonmetallic plugs or caps.

F. When sleeve bearings are furnished, block the rotor to prevent axial and radial movement.

G. When space heaters are furnished, make heater leads accessible without disturbing the shipping package. Tag the leads for identification.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. General Electric.

B. Reliance Electric.

C. Siemens.

D. Toshiba.

E. U.S. Motors.

F. TECO-Westinghouse Motor Company.

G. Baldor.

2.02 DESIGN

A. This specification defines the minimum requirements for low-voltage, random-wound, squirrel-cage, induction motors in the NEMA frame sizes for nonclassified electrical area service.

B. Use this specification for the selection and purchase of induction motors purchased separately or furnished with driven equipment as a package.

C. This specification, along with the reference documents make up the requirements for motors up to and including 300 hp. Use driven equipment specifications to supplement this specification and identify special project requirements.

D. Motors purchased with this specification will drive vertical pumps. Motors will be installed in a plant environment that may include high humidity, storms, salt-laden air, insects, plant life, fungus, rodents as well as traces of petroleum and/or chemicals.

E. Motors shall perform satisfactorily for the application and unusual conditions specified on the data sheets.

F. Make motors suitable for operation in an outdoor corrosive and wet environment.

G. When motors are furnished with the driven equipment as a package, motors shall also meet the requirements of the driven equipment specification.

H. Design motors for operation at a temperature of up to 40o/104oF ambient and at an elevation of up to 1000 m/3300 ft above sea level.

2.03 PERFORMANCE REQUIREMENTS

A. Confirm motors have ample capacity to supply the maximum output demanded by the driven equipment and have a speed-torque-current characteristic appropriate to the driven equipment. Where new motors are provided for existing pumps, match new motor characteristics to pumps.

B. Confirm motors ability to overcome starting load inertia and accelerate the load to rated speed within 15 seconds at 80 percent of rated nameplate voltage, without exceeding the motor time-temperature damage curve.

C. Design and construct motors for continuous full load duty. Motors may also operate intermittently.

D. Three-phase induction motors shall be ANSI/NEMA MG 1 Design B. Motors driving high-torque loads may be NEMA Design C or D, providing so stated in the proposal.

E. Single-phase fractional horsepower motors shall be NEMA Design N.

F. The single speed, polyphase motors shall have efficiencies which exceed those shown in ASHRAE/IES Standard 90.1 - 1989, Table 5-1 and ANSI/NEMA MG-1-1998 Table 12-10. Provide motors commonly preferred to as "Premium Efficiency" in the industry.

2.04 ENCLOSURES AND FRAMES

A. Motors shall be provided with NEMA Type TEFC enclosures.

B. Motors frames, enclosures, terminal boxes, fan cover guards and air passages shall be cast iron or heavy fabricated steel of such design or proportions as to hold all motor components rigidly in proper position, and shall meet all NEMA requirements for the type of enclosure employed. End bells shall be cast iron. Steel sheet or plate used shall have a thickness of at least 1/8 in. Fans, breathers, drains, screens, covers and hardware shall be corrosion-resistant materials. Fractional horsepower motors may have rolled steel stator frame and cast iron brackets with integral mounting feet.

C. Make motor enclosure fans low inertia, non-sparking type, and suitable for bidirectional rotation and mount on hub with stainless steel bolts.

D. Furnish each enclosure with a stainless steel automatic breather/drain located at the low point of the enclosure.

E. Motor frame and enclosure shall have provisions for grounding to the main grounding system. Drill and tap rear foot on horizontal motors and the flange base on vertical motors on the junction box side for a service post ground connector.

F. Provide motors weighing more than 300 lbs. with lifting eyebolts, rings or lugs capable of supporting the weight of the motor.

2.05 ELECTRICAL REQUIREMENTS

A. Motors shall be rated as follows:

1. 460 volts, three phase, 60 Hz.

2. 230 volts, three phase, 60 Hz.

3. 230 volts, single phase, 60 Hz.

4. 115 volts, single phase, 60 Hz.

B. Induction motors shall be random-wound, squirrel-cage rated for continuous duty and suitable for across-the-line starting, at rated voltage.

C. Determine motor speed, torque and special operating requirements from the requirements of the driven equipment. See Section 11210 – Vertical Axial Flow Pumps and other specifications for Driven Equipment.

D. Use copper for motor windings and terminal leads. Aluminum is not an allowable material for any portion of the motor other than die-cast rotor (fabricated aluminum rotors are not acceptable). Copper rotors shall not be fabricated using brazing maler and any copper alloy must contain less than two percent phosphorous.

E. Three-phase single speed AC motors shall be provided with three leads.

F. Motors shall have a 1.15 service factor (SF) rating unless specified otherwise.

G. Motor insulation shall be a minimum of Class F epoxy nonhygroscopic material with temperature rise limited to Class B design rise of 90oC by resistance method at 1.15 SF. Inverter Duty Motors shall have the highest voltage rated insulation system available for application on the output of VFD's (Variable Frequency Drives). As a minimum, inverter duty motors shall use Phelps–Dodge type QS magnet wire which is pulse resistant, in combination with the motor manufacturer's insulation system.

H. Motors shall operate successfully under running conditions at rated load with variation in voltage and frequency up to the limits set by ANSI/NEMA MG 1-12.44.

I. Unless specified otherwise, motors shall be suitable for the number of full-voltage starts as required by ANSI/NEMA MG 1-12.50 as a minimum.

J. Locked rotor kVA/HP shall not exceed 5.0

K. Motors operated on VFD's shall be rated as inverter duty.

2.06 TERMINAL BOXES

A. Make motor terminal boxes weatherproof and with threaded conduit entrances with water-resistant seals between boxes and motor frame. Design the line-terminal box to allow box to be rotated in four 90 degree steps for bottom, side or top entry of conduit or cable. The line terminal box shall match the location indicated on project drawings. Locate a separate terminal box for space heaters adjacent to the line terminal box. Provide a separate terminal box for RTD's.

B. Size the line terminal box so that feeder cables can be connected to motor leads for terminals without damage to the cable or the leads. Oversize the terminal box to exceed the minimum volumes shown in the NEC Section 430-12 and provide adequate space to mount and enclose all devices mounted within.

C. Furnish the line terminal box with suitable compression ring-type, permanently numbered, cable connectors for incoming bolted-cable connections and one clamp-type ground terminal lug of sufficient size to contain a conductor the same size as motor leads.

D. Wire accessory leads to a terminal board in a terminal box or boxes separate from the line leads. Supply separate terminal boxes for the leads for space heaters, and temperature detectors, current transformers, and other similar accessories, when supplied.

2.07 ELECTRICAL ACCESSORIES

A. For motors 25 Hp and larger, provide space heaters for optimum uniform heating of the stator winding and prevent condensation in the motor at ambient temperature when motor is not in operation. Space heaters shall be rated 240 V but shall be connected for operation at 115V. Space heaters shall have maximum sheath temperature of 150° C and shall be approved for the specified hazardous area classification, if so classified.

B. Provide motors larger than 200 horsepower with a minimum of six, three-wire, 100 ohm, platinum RTDs, two per phase, spaced equally around the circumference of the stator. Include three additional spare RTD's, one per phase, as spares and label as spares.

C. Provide motors larger than 200 horsepower with three-wire, 100 Ω, platinum RTDs, one per bearing.

2.08 BEARINGS AND LUBRICATION

A. Provide oil-lubricated anti-friction ball or roller bearings for motors 100 Hp and larger. Provide grease lubricated bearings for motors less than 100 Hp.

B. Motors shall have proper bearing insulation to prevent circulation of shaft currents and resulting damage. Provide also insulating means for any oil-supply connections and monitoring equipment to prevent electrical bypassing of the bearing insulation.

C. Unless specified otherwise, oil lubricated bearings shall have an L10 rating life in accordance with ANSI/AFBMA 9, of at least 100,000 hours. Grease lubricated bearings shall have a rating life of at least 40,000 hours.

D. Provide oil-lubricated bearing housings and a reservoir of sufficient depth, to serve as a settling chamber for foreign materials, with a drain plug, and vents as required, accessible from the exterior of the motor. Furnish oil-lubricated motors with a constant oil-level sight gauge mounted on the motor housing and marked with running- and stopped-oil levels.

E. Provide motors with suitable seals to prevent moisture from entering through the shaft openings. For applications where hoses and water are used for cleanup, provide an Inpro/Seal isolator (labyrinth seal) on the shaft end of the motor.

F. For in-line pumps, special high thrust bearings are required for drive motors, except for pumps where the thrust bearings are provided as an integral part of the pump.

2.09 ADDITIONAL REQUIREMENTS FOR VERTICAL MOTORS

A. Solid shaft vertical motors are acceptable for all applications except when the connection to the driven equipment consists of sectional driven shaft which may unscrew and lengthen in the event of reversal of direction.

B. Design vertical motor thrust bearings conservatively to carry maximum axial thrusts (up and down) imposed by driven equipment.

C. Vertical motors shall have oil-lubricated, top and bottom bearings.

D. Vertical motor bases shall be NEMA Type P.

E. Provide vertical motors with a positive, non-reversing, corrosion-resistant ("anti-ratchet") mechanism.

F. Provide vertical motors with fan-end splash shields.

G. Where new motors are being provided for existing pumps, motor mounting must match the existing pump, and new shaft couplings shall be provided to couple the pump to the new motor.

2.10 ROTOR BALANCING AND VIBRATION

A. Balance motor rotors dynamically according to NEMA standards. Depositing weld metal, solder and the like on the rotor to effect a balance will not be acceptable. Remove parent metal to achieve balance without affecting the structural strength of the rotor. Chiseling or sawing parent metal is prohibited.

B. Measure vibration in all directions with the motor running uncoupled at no load, normal voltage and frequency, and at each speed of the operating range. Motor vibration shall not exceed the total amplitude, peak-to-peak values given in ANSI/NEMA MG 1-Part 7 as measured in accordance with ANSI/NEMA MG 1-Part 7. Perform a second test and measure vibration in all directions with the motor running coupled to the load with normal load, normal voltage, normal frequency, and typical speed.

2.11 NAMEPLATES

A. Fasten motor stainless steel nameplates securely to the motor with stainless steel screws. Nameplates shall include as a minimum the information required by ANSI/NEMA MG 1-16.61.

2.12 FINISH

A. Motors shall be primed and finished using the motor manufacturer's standard epoxy painting system unless specified otherwise.

B. Cover internal surfaces, e.g., shaft, rotor, stator, and other similar components, with a corrosion-resistant coating of epoxy or equal material for increased life.

2.13 NOISE LEVELS

A. Determine motor noise level in accordance with IEEE 85. Levels or noise generated by a motor shall not exceed 85 dbA at a distance of 1 m/3.3 ft unless specified otherwise on the data sheet.

B. Noise level requirements may be also covered by a separate noise requirements specification included with the driven equipment specification.

2.14 GE MULTILIN SETTINGS

A. For new motors protected by GE Multilin motor management relays, motor manufacturer shall provide all recommended settings for Multilin relays.

PART 3 EXECUTION

3.01 PREPARATION

A. Verify motor and motor base match pump bolt configuration.

3.02 INSTALLATION

A. Install the motor in accordance with the Manufacturer's published instructions using the necessary tools and instrument to ensure proper fit and alignment with the driven machine.

B. Provide the services of a third party electrical testing company to set and certify that GE Multilin settings have been made in accordance with the motor manufacturer's recommendations.

C. Before coupling up with the driven machine, the following work should be performed.

1. Test the motor winding insulation resistance in accordance with IEEE 43.

2. Terminate cables to the motor leads.

3. Energize motor momentarily to check rotation.

4. Check shaft of driven machine to ensure free movement.

D. Couple motor up with driven machine.

E. Record motor nameplate data.

END OF SECTION

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SECTION 16195
ELECTRICAL IDENTIFICATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Specification for electrical identification including:

1. Nameplates and labels
2. Wire and cable markers
3. Conduit markers
4. Cable tray markers
5. Underground warning tape
6. Warning labels

1.02 MEASUREMENT AND PAYMENT

A. No separate payment will be made for work performed under this Section.

1.03 REFERENCES

A. American National Standards Institute/National Fire Protection Association (ANSI/NFPA)

1. No. 70 - National Electrical Code (NEC)
   a. Article 110 - Requirements for Electrical Installation
   b. Article 430 - Transformers and Transformer Vaults

B. City of Houston Building Code.

C. Other applicable Codes and Standards as referenced in other Sections.

D. Underwriters Laboratories. U.L. Standards No. 224 - Extruded Insulated Tubing

1.04 SUBMITTALS

A. Submit the following under the provisions of Section 01330 – Procedures:

1. Manufacturer's cut sheets and catalog data
2. Description of materials used
3. Label or nameplate dimensions

4. Engraving or imprint legends

5. Instruction for handling and storage

6. Installation instructions

1.05 DELIVERY, STORAGE AND HANDLING

A. Pack materials to permit ease of handling and to provide protection from damage during shipping, handling and storage.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Brady U.S.A. Incorporated

B. Ideal Electric Company

C. Raychem Corporation

D. 3M Electrical Products Division

E. Thomas & Betts

F. Tyton Corporation

2.02 MATERIALS AND EQUIPMENT

A. Nameplates and Labels

1. Provide an identification nameplate for each item of electrical equipment engraved with the equipment name. Use the description shown on the Contract Drawings.

2. For nameplates, use 3-ply phenolic material engraved to show black lettering on a white background. Size the nameplates approximately 1 inch wide and 3 inches long for 3 lines of 3/16 inch - 16 letters with a 0.8 condensed factor. Attach nameplates with stainless steel screws.

3. Generally, provide large pieces of equipment with engraved nameplates; provide additional nameplates at pushbuttons and other local devices. Provide identification for all other electrical equipment, device or enclosure not furnished with readily noticeable tag, nameplates or other means of identification.

4. Install nameplates on the front cover of transformers stating the transformer service location number or identification number, the panelboard or device served, and main breaker feeding the transformer (MCC No.), and the drawing number on which the transformer schematic is shown.

5. Furnish equipment, such as motor starters, safety switches, welding receptacles and circuit breakers, with 1" x 3" plastic nameplates stating description of item served.

6. Provide nameplates for motors giving the driven equipment description, and MCC the number. Nameplates shall be mounted adjacent to motors.

7. Install nameplates on the outside and inside of doors to circuit breaker panelboards (i.e., lighting, instrument or receptacle panels). State the panelboard name, the drawing number on which the panelboard schedule shows, and the main breaker feeding the panel (MCC No. or Power Panel name).

8. Type panelboard directories and insert them inside panelboard doors.

9. Place a large nameplate approximately 3"x5" on control panels, relay panels, junction boxes and similar enclosures with electrical devices mounted inside. The large nameplates shall identify the enclosure.

10. Provide a nameplate on MCC motor starter doors duplicating motor nameplate data.

11. Provide warning label on front and inside actuator controllers in accordance with NEC. Identify controller as having two (2) sources of electric power if such is the case.

B. Wire and Cable for Control Wiring

1. Use pre-printed tubular heat-shrink type wire and cable tags. Place a tag at each end of each wire and cable for all control wiring.

2. Select tags manufactured so that the heat-shrink process makes the imprint permanent and solvent-resistant.

3. Use tags that are self-extinguishing, conforming to U.L. Standard No. 224 for print performance, heat shock and flammability.

4. Provide tag material that is flexible, radiation cross-linked polyolefin with 3 to 1 shrink ratio, rated 600 volts, and white in color.

5. Cable in cable tray shall be marked at each end and at every cable tray drop out to a motor, control panel, or switchgear.

C. Conduit Tags

1. Provide conduit tags made of stainless steel, approximately 2 inches x 1 inch x 19 gage.

2. Stamp the conduit number or conduit identification on the tag.

3. Punch tags for tie fasteners. Fasten tags to the conduits with stainless steel braided wire.

D. Underground Warning Tape

1. Provide detectable warning tape made of 4 mil thick polyolefin film, 3 inches wide, suitable for direct burial and resistant to alkalis, acids and other common soil substances.

2. Use red tape with black legend printed in permanent ink.

E. Warning Labels

1. Place OSHA safety labels on enclosures and boxes 100 cubic inches or more containing electrical equipment or terminations.

2. Provide OSHA color codes for the labels. Use labels made from 4 mil vinyl with pressure sensitive adhesive backing.

3. The warning label caption is DANGER - 480 VOLTS for 480 volt systems. For voltages higher than 600 volts, provide warning labels with "DANGER - HIGH VOLTAGE - KEEP OUT".

4. Labels shall be 5 inches x 3-1/2 inches for small equipment and 10 inches x 7 inches for large equipment and electrical room doors.

PART 3 EXECUTION

3.01 PREPARATION

A. Degrease and clean surfaces where adhesive labels will be applied.

B. Drill and tap holes for nameplates to be fastened, with stainless screws.

C. Prepare the cable ends for termination and conductor markings.

D. Identify conduits at terminating points and select conduit tag marking as indicated on the Contract Drawings.

3.02 INSTALLATION

A. Install nameplates and labels in accordance with the manufacturer's instructions and the Contract Drawings.

B. Apply wire and cable tags in accordance with manufacturer's instructions using a heat gun with properly sized nozzle for the application. Tag the wires and cables at both ends.

C. Tag conduits at junction boxes, pull boxes control panels, transformers, switchgear and similar location and at other termination points.

D. Identify cable trays at the time of installation with the alphanumeric number shown on the Contract Drawings. Label cable trays on the outside rail.

E. Place the tray identifier at each point where the tray designation changes and at 200 foot intervals in between, but not less than two per run.

F. Identify underground conduits, cables or duct banks using the underground delectable warning tape. The underground grounding grid, including laterals, shall be identified with underground delectable warning tape. Install one tape per trench at 12 inches below grade or as indicated on the Contract Drawings. For wide trenches or duct banks, install one warning tape per 18-inch width.

G. Apply the 5 inch by 3-1/2 inches warning labels to disconnect switches, panelboards, terminal boxes, and similar devices in accordance with manufacturer's instruction and the Contract Drawings. Apply the 10 inch x 7 inch warning labels to larger control panel enclosures, motor control centers and to entrance doors to rooms containing electrical power and control equipment.

END OF SECTION

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SECTION 16280
5 KV CAPACITOR BANK

PART 1 GENERAL

1.01 SCOPE

A. Furnish all labor, materials, equipment and incidentals to install 5 kV power factor correction capacitors for High Service Pump Motors as indicated in the drawings and as specified herein.

B. This specification contains the minimum requirements for the design, manufacture and testing of 5 kV power factor correction capacitor banks for use on a 4.16 kV, three phase, 60 Hertz, low resistance grounded system.

C. This specification covers the electrical characteristics and mechanical features of three phase, 60 Hertz, self-contained, free standing, metal enclosed capacitor banks. The application of these units is for power factor improvement.

1.02 STANDARDS

A. The 5 kV power factor correction capacitor banks shall be designed and tested in accordance with the latest standards of NEMA, NEC, IEEE and ANSI.

1.03 SUBMITTALS

A. The following information shall be submitted to the Engineer:

1. Front view elevation
2. Floor plan
3. Top view
4. Nameplate schedule
5. Conduit entry/exit locations
6. Equipment ratings including:
   a. Voltage
   b. Continuous current
7. Major component ratings including:
   a. Capacitor unit KVAR rating
   b. Continuous current
8. Product data sheets.

1.04 QUALIFICATIONS

A. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of five (5) years. Submit the name of the proposed vendor for this equipment with a list of similar installations for approval prior to the vendor starting design, shop drawings or fabrication. Once the vendor is approved, design, shop drawings and fabrication may proceed.

1.05 DELIVERY, STORAGE AND HANDLING

A. Equipment shall be handled and stored in accordance with manufacturer's instructions. One (1) copy of these instructions shall be included with the equipment at time of shipment.

1.06 OPERATION AND MAINTENANCE MANUALS

A. Equipment operation and maintenance manuals shall be provided with each assembly shipped and shall include instruction leaflets and instruction bulletins.

PART 2 EQUIPMENT

2.01 RATINGS

A. The system operating voltage shall be 4.16 kV.

B. The minimum capacity of the power factor correction capacitor system shall be 250 kVARs.

C. The capacitor system shall be rated for continuous duty at 55° C ambient at 3,300 ft. (1,000 meters) and below.

D. A +/- 15% variation in nominal line voltage shall not affect the life of the capacitor system.

E. Capacitor bank BIL rating shall be 60 kV.

F. Capacitor bank shall be Delta connected.

2.02 CONSTRUCTION

A. Capacitor Bank Enclosure

1. The capacitor bank shall be installed in a NEMA 1 ventilated indoor free standing enclosure. The enclosure shall be front accessible by means of a padlockable hinged door. The enclosure steel thickness shall be minimum 11 gauge.

2. The enclosure shall be bolted together with formed steel doors and side sheets. The top of the enclosure shall be flat. The enclosure shall have an ANSI No. 61 light gray powder coat paint finish.

3. The capacitor bank enclosure shall have a 4" base channel.

4. The capacitor bank enclosure shall have a 0.25" x 2" copper ground bus..

5. Insulators inside the capacitor enclosure shall be rated 60 kV BIL.

6. The capacitor bank enclosures shall be shipped fully assembled and shall be shipped on wood pallets for ease of handling and installation.

7. Each capacitor bank enclosure shall have removable lifting eyes.

8. Each capacitor bank enclosure door shall have a "DANGER HIGH VOLTAGE" warning label.

9. Each capacitor bank enclosure door shall have a "CAPACITOR TAKES A MINIMUM OF 5 MINUTES TO DISCHARGE TO 50 VOLTS" sign.

10. The enclosure door shall have heavy-duty hinges. Doors shall be padlockable and have three point latching. Doors shall have welded grounding studs and shall be bonded to the equipment ground bus.

11. The enclosure door frame and door shall have door stops to stop the door at 105°.

B. Incoming Medium Voltage Power Cable

1. The unit shall have terminals for the attachment of incoming 5 kV power cables. Incoming cables will have stress cone terminations. Provide ample space for stress cone terminated cables. Incoming cables will be through the top of the enclosure.

C. Capacitor Units

1. Capacitor units shall be low loss and manufactured per IEEE STD. 18. Capacitor units to be one or more 3-phase units.

2. Each capacitor unit shall have Internal discharge resistors to drain voltage to 50 volts or less in five minutes.

3. Capacitor units shall be suitable for operation at a minimum of 135 percent of rated current.

4. Capacitor units shall be rated for a minimum of 60 kV BIL.

5. Each capacitor unit shall be grounded to the enclosure ground bus.

2.03 NAMEPLATES

A. Each unit shall have a rating nameplate attached to the outside of the enclosure. The lettering shall be black, 3/16-inch high, on a white background. See Specification 16195, Electrical Identification, for more information. Attach nameplates with stainless steel screws.

PART 3 EXECUTION

3.01 FACTORY TESTING

A. All capacitors shall be tested in compliance with NEMA, and ANSI requirements for capacitance, dissipation factor, terminal to terminal and terminal to case dielectric strength, and oil leaks. All capacitor cells shall be traceable through construction and testing. Provide test reports for each unit tested.

END OF SECTION

5.1 RELAY SETTING RECORD (SIEMENS 7SJ601) FOR "SWGR-S" SIEMENS SWITCHGEAR

Date 20-Mar-14

RELAY		RELAY DESCRIPTION		CT	PHASE SETTINGS							GROUND SETTINGS							COMMENTS
					Long Time			Short Time		Instantaneous		Long Time			Short Time		Instantaneous		AND
Device ID	Location Bus Name	Mfg.	Model #	Ratio	PU Ip	Curve Type	Time Dial	PU I>	Delay T	PU I>>	Delay T	PU Iep	Curve Type	Time Dial	PU Ie>	Delay T	PU Ie>>	Delay T	ADDITIONAL SETTINGS
51/51N BUS A	12.47kV BUS A	Siemens	7SJ601	PH 1200:5 GD 1200:5	1	ANSI/ Ex. Inv	5	4	0.25	-	-	-	-	-	0.1	0.4	-	-	Recommended Settings
51/51N BUS B	12.47kV BUS B	Siemens	7SJ601	PH 1200:5 GD 1200:5	1	ANSI/ Ex. Inv	5	4	0.25	-	-	-	-	-	0.1	0.4	-	-	Recommended Settings
50-1P	138kV BUS	Siemens	7SJ601	PH 2000:5	-	-	-	-	-	1.2	0	-	-	.	-	-	-	-	Recommended Settings
50-1B	138kV BUS	Siemens	7SJ601	PH 2000:5	-	-	-	-	-	1.2	0	-	-	.	-	-	-	-	Recommended Settings
50-2P	138kV BUS	Siemens	7SJ601	PH 2000:5	-	-	-	-	-	1.2	0	-	-	.	-	-	-	-	Recommended Settings
50-2B	138kV BUS	Siemens	7SJ601	PH 2000:5	-	-	-	-	-	1.2	0	-	-	.	-	-	-	-	Recommended Settings

5.2 RELAY SETTING RECORD (SIEMENS 7SJ602) FOR "SWGR-S" SIEMENS SWITCHGEAR

Date: 20-Mar-14

RELAY		RELAY DESCRIPTION		CT	PHASE SETTINGS							GROUND SETTINGS							COMMENTS AND ADDITIONAL SETTINGS
					Long Time			Short Time		Instantaneous		Long Time			Short Time		Instantaneous		
Device ID	Location Bus Name	Mfg.	Model #	Ratio	PU I>	Curve Type	Time Dial	PU I>>	Delay T>>	PU I>>>	Delay T>>>	PU Ie>	Curve Type	Time Dial	PU Ie>>	Delay T>>	PU Ie>>>	Delay T>>>	
50T/51T T1	CNP 138 kV	Siemens	7SJ602	PH 300:5	0.4	ANSI/ Ex. Inv	7	2.2	0.35	3.6	0	-	-	-	-	-	-	-	Recommended Settings
51NT-T1	T1 Neutral	Siemens	7SJ602	GD 600:5	-	-	-	-	-	-	-	0.1	ANSI/Mod. Inv	4	-	-	-	-	
50T/51T T2	CNP 138 kV	Siemens	7SJ602	PH 300:5	0.4	ANSI/ Ex. Inv	7	2.2	0.35	3.6	0	-	-	-	-	-	-	-	Recommended Settings
51NT-T2	T1 Neutral	Siemens	7SJ602	GD 600:5	-	-	-	-	-	-	-	0.1	ANSI/Mod. Inv	4	-	-	-	-	

5.3 RELAY SETTING RECORD (SIEMENS 7SJ62) FOR "SWGR-S" SIEMENS SWITCHGEAR

Date 20-Mar-14

RELAY		RELAY DESCRIPTION		CT	PHASE SETTINGS							GROUND SETTINGS							COMMENTS
					Long Time			Short Time		Instantaneous		Long Time			Short Time		Instantaneous		
Device ID	Location Bus Name	Mfg.	Model #	Ratio	PU 51	Curve Type	Time Dial	PU 50-1	Delay 50-1	PU 50-2	Delay 50-2	PU 51N	Curve Type	Time Dial	PU 50N-1	Delay 50N-1	PU 50N-2	Delay 50N-2	AND ADDITIONAL SETTINGS
50/51-T8A	12.47kV BUS-A	Siemens	7SJ62	PH 800:5 GD 800:5	6	ANSI/ V. Inv	6	25	0.15	40	0	-	-	-	0.25	0.25	-	-	Recommended Settings
50/51-T8B	12.47kV BUS-A	Siemens	7SJ62	PH 800:5 GD 800:5	6	ANSI/ V. Inv	6	25	0.15	40	0	-	-	-	0.25	0.25	-	-	Recommended Settings
50/51-T6A	12.47kV BUS A	Siemens	7SJ62	PH 200:5 GD 200:5	6	ANSI/ V. Inv	5	20	0.2	40	0	-	-	-	0.75	0.15	-	-	Recommended Settings
50/51-T6B	12.47kV BUS B	Siemens	7SJ62	PH 200:5 GD 200:5	6	ANSI/ V. Inv	5	20	0.2	40	0	-	-	-	0.75	0.15	-	-	Recommended Settings
50/51-T2A	12.47kV BUS A	Siemens	7SJ62	PH 200:5 GD 200:5	6	ANSI/ V. Inv	5	20	0.2	40	0	-	-	-	0.75	0.15	-	-	Recommended Settings
50/51-T2B	12.47kV BUS B	Siemens	7SJ62	PH 200:5 GD 200:5	6	ANSI/ V. Inv	5	20	0.2	40	0	-	-	-	0.75	0.15	-	-	Recommended Settings
50/51-T7A	12.47kV BUS A	Siemens	7SJ62	PH 200:5 GD 200:5	6	ANSI/ V. Inv	5	20	0.2	40	0	-	-	-	0.75	0.15	-	-	Recommended Settings
50/51-T7B	12.47kV BUS B	Siemens	7SJ62	PH 200:5 GD 200:5	6	ANSI/ V. Inv	5	20	0.2	40	0	-	-	-	0.75	0.15	-	-	Recommended Settings

5.4 RELAY SETTING RECORD (MULTILIN 850) FOR NEW HSPS1 SWITCHGEAR

Date 11-Oct-15

RELAY		RELAY DESCRIPTION		CT	PHASE SETTINGS							GROUND SETTINGS							COMMENTS
					Long Time			Short Time		Instantaneous		Long Time			Short Time		Instantaneous		
Device ID	ANSI DEVICE	Mfg.	Model Number	Ratio	OC PU	Curve Type	Time Dial	SDPU	SDT	PU	Delay	PU	Curve Type	Time	SDPU	SDT	PU	Delay	AND ADDITIONAL SETTINGS
					Set x CT Pri					Set x CT Pri		Set x CT Pri		Set x 0.1	Set x CT Pri		Set x CT Pn		
ML850 HSPS1-MA	50/51 51G	Multilin	850	PH 1200:5 GD 200:5	1.0	ANSI EX. INV	3	-	-	7	-	0.1	ANSI MOD INV	2	-	-	-	-	CT In Trans Neut See Note 1
	51N			1200:5	-	-	-	-	-	-	-	0.03	ANSI MOD INV	1.8	-	-	-	-	Sensitive Ground Input See Note 2
ML850 HSPS1-MB	50/51 51G	Multilin	850	PH 1200:5 GD 200:5	1.0	ANSI EX. INV	3	-	-	7	-	0.1	ANSI MOD INV	2	-	-	-	-	GND CT In Trans Neut See Note 1
	51N			1200:5	-	-	-	-	-	-	-	0.03	ANSI MOD INV	1.8	-	-	-	-	Sensitive Ground Input See Note 2
ML850 08-P-1	51 51G	Multilin	850	PH 150:5 GD 50:5	1.1	ANSI EX. INV	4	-	-	-	-	0.2	ANSI MOD INV	1	-	-	-	-	Feeder to ASD
ML850 08-P-2 Cap	51 51G	Multilin	850	PH 150:5 GD 50:5	0.4	ANSI EX. INV	2	-	-	-	-	0.2	ANSI EX. INV	1	-	-	-	-	Feeds to 250 kVAR Capacitor Bank
ML850 08-P-3	51 51G	Multilin	850	PH 150:5 GD 50:5	1.1	ANSI EX. INV	4	-	-	-	-	0.2	ANSI MOD INV	1	-	-	-	-	Feeder to ASD
ML850 08-P-4 Cap	51 51G	Multilin	850	PH 150:5 GD 50:5	0.4	ANSI EX. INV	2	-	-	-	-	0.2	ANSI EX. INV	1	-	-	-	-	Feeds 250 kVAR Capacitor Bank
ML850 08-P-6	51 51G	Multilin	850	PH 150:5 GD 50:5	1.1	ANSI EX. INV	4	-	-	-	-	0.2	ANSI MOD INV	1	-	-	-	-	Feeder to ASD
ML850 08-P-7 Cap	51 51G	Multilin	850	PH 150:5 GD 50:5	0.4	ANSI EX. INV	2	-	-	-	-	0.2	ANSI EX. INV	1	-	-	-	-	Feeds 250 kVAR Capacitor Bank
ML850 08-P-8	51 51G	Multilin	850	PH 150:5 GD 50:5	1.1	ANSI EX. INV	4	-	-	-	-	0.2	ANSI MOD INV	1	-	-	-	-	Feeder to ASD
ML850 T-HA	51 51G	Multilin	850	PH 150:5 GD 50:5	0.18	ANSI EX. INV	8	-	-	-	-	0.1	ANSI MOD INV	1	-	-	-	-	Feeds T-HA
ML850 T-HB	51 51G	Multilin	850	PH 150:5 GD 50:5	0.18	ANSI EX. INV	8	-	-	-	-	0.1	ANSI MOD INV	1	-	-	-	-	Feeds T-HB

Note 1. Ground CT is located in neutral of 7500 kVA transformers T8A and T8B
Note 2. Residually connected phase CTs. Connected to sensitive ground input of relay.
Note 3. 51G function of ML850 HSPS1-MA also trips 12.47 kV breaker in substation feeding T8A.
Note 4. 51G funciton of ML850 HSPS1-MB also trips 12.47 kV breaker in substation feeding T8B.

5.5 RELAY SETTING RECORD (MULTILIN MOTOR PROTECTION RELAYS) FOR NEW HSPS1 SWITCHGEAR

Date 11-Oct-15

RELAY		RELAY DESCRIPTION		CT					GROUND SETTINGS				COMMENTS
Device ID	Location Bus Name	Mfg.	Model Number	Ratio	OL		Instantaneous		Definite Time		Instantaneous		AND ADDITIONAL SETTINGS
					PU I>	Stand OL Curve #	PU I>>>	Time Delay	PU Ie>	Time Delay	PU Ie>>>	Time Delay	
ML869 08-P-2	HSPS1- BUSB	GE-MULTILIN	ML869	PH 150/5	1.1	4	-	-	-	-	-	-	Motor FLA =107
				GND 50/5	-	-	-	-	0.2	0.1	-	-	Est. Accel. Time ≤10 Sec
ML869 08-P-4	HSPS1- BUSB	GE-MULTILIN	ML869	PH 150/5	1.1	4	-	-	-	-	-	-	Motor FLA =107
				GND 50/5	-	-	-	-	0.2	0.1	-	-	Est. Accel. Time ≤10 Sec
ML869 08-P-7	HSPS1- BUSA	GE-MULTILIN	ML869	PH 150/5	1.1	4	-	-	-	-	-	-	Motor FLA =107
				GND 50/5	-	-	-	-	0.2	0.1	-	-	Est. Accel. Time ≤10 Sec

SECTION 16322
UNIT SUBSTATION TRANSFORMERS

PART 1 GENERAL

1.01 SCOPE

A. The **Electrical Contractor** shall furnish and install outdoor unit substation transformers as specified herein and as shown on the Contract Drawings.

1.02 UNIT PRICES

A. No separate payment will be made for unit substation transformers and other work performed under this Section. Include cost in lump sum price bid for work of which this is a component part.

1.03 RELATED SECTIONS

A. Specification Section 16195 – Electrical Identification

1.04 REFERENCES

A. The unit substation transformers shall be designed, manufactured and tested in accordance with the latest applicable standards of NEMA and ANSI. NEMA 201, 210; IEEE 100, ANSI C57

1.05 SUBMITTALS (FOR REVIEW/APPROVAL)

A. The following information shall be submitted:

1. Master drawing index
2. Front view elevation and weight with oil
3. Plan view
4. Schematic diagrams
5. Nameplate diagram
6. Component list
7. Conduit entry/exit locations
8. Ratings including:
   a. kVA
   b. Primary and secondary voltage
   c. Taps - Quantity and Configuration
   d. Primary and secondary continuous current
   e. Basic Impulse level - High and Low Voltage

f. Impedance
g. Insulation class and temperature rise
h. Sound level

9. Cable terminal sizes

10. Product data sheets.

11. Volume and weight of insulating liquid.

12. Calculated losses.

13. Connection diagrams.

1.06 SUBMITTALS (FOR RECORD PURPOSES)

A. The following information shall be submitted for record purposes:

1. Final as-built drawings and information for items listed in paragraph 1.05

2. Wiring diagrams

3. Certified production test reports, including document to guarantee losses.

4. Installation information

5. Seismic certification.

B. The final (as-built) drawings shall include the same drawings as the construction drawings and shall incorporate all changes made during the manufacturing process

1.07 QUALIFICATIONS

A. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of ten (10) years. When requested by the City Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.

1.08 DELIVERY, STORAGE AND HANDLING

A. Equipment shall be handled and stored in accordance with manufacturer's instructions. One (1) copy of these instructions shall be included with the equipment at time of shipment.

1.09 OPERATION AND MAINTENANCE MANUALS

A. Equipment operation and maintenance manuals shall be provided with each assembly shipped and shall include instruction leaflets, instruction bulletins and renewal parts lists where applicable, for the complete assembly and each major component. See Specifications 01782 and 01782S.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Eaton

B. General Electric

C. Square D Company

1. The listing of specific manufacturers above does not imply acceptance of products that do not meet the specified ratings, features and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety.

2.02 RATING

A. The rating of the transformer shall be as follows and as shown on the drawings:

kVA Rating(at 55degC)	As indicated on Contract Drawings
Impedance	As indicated on Contract Drawings
HV	12.47 kV Delta
HV BIL	95 kV
HV De-energized Taps	+/-2-2-1/2% full capacity
LV	4.16 kV Low Resistance Grounded Wye
LV BIL	60 kV

2.03 CONSTRUCTION

A. The unit shall be filled with Envirotemp or Biotemp (vegetable oil based) insulating fluid.

B. The transformer shall carry its continuous rating with average winding temperature rise by resistance that shall not exceed 55 degrees C, based on average ambient of 30 degrees C over 24 hours with a maximum of 40 degrees C. The insulation system shall allow an additional 12% kVA output at 65 degrees C average winding temperature rise by resistance, on a continuous basis, without any decrease in normal transformer life.

C. The transformer shall be designed to carry short time emergency overloads in accordance with ANSI C57.12.92 as applicable. Duration and magnitude of designed withstand capability shall be as outlined in ANSI C57.12.90 and the latest draft of the IEEE short-circuit test code.

D. The transformer shall be designed to meet the sound level standards for liquid transformers as defined in NEMA TR1. The measurement procedure shall be as specified in ANSI C.57.12.90.

E. High-voltage and low-voltage windings shall be copper. Insulation between layers of the windings shall be Insuldur paper or equal.

F. The main transformer tank and attached components shall be designed to withstand pressures 25% greater than the required operating design value without permanent deformation.

Construction shall consist of carbon steel plate reinforced with external sidewall braces. All seams and joints shall be continuously welded.

G. Each radiator assembly shall be individually welded and receive a quality control pressurized check for leaks. The entire tank assembly shall receive a similar leak test before tanking. A final six-hour leak test shall be performed after the transformer is tanked, welded and completed to ensure that there are no leaks before shipment.

H. The transformer manufacturer shall certify that the transformer is Non-PCB containing (less than 50 PPM). Do not provide nonflammable transformer liquids including askarel and insulating liquids containing tetrachloreoethylene, perchloroethylene, chlorine compounds, or halogenated compounds.

2.04 ACCESSORIES

A. Transformer features and accessories shall include:

1. De-energized tap changer with cover mounted, externally operated, padlockable handle
2. Combination drain and filter valve and sampling device
3. Manual gas pressure test connection
4. Filling plug and filter press connection in cover
5. Dial-type top liquid thermometer
6. Magnetic liquid level gauge
7. Provisions for lifting, provisions for jacking, base designed for skidding or rolling in two directions
8. Ground pad, copper faced
9. Instruction nameplate – stainless steel
10. Pressure vacuum gauge
11. Welded-on main tank cover and hand hole in cover
12. Pressure relief device

2.05 FINISH

A. The paint shall be applied using an electrostatically deposited dry powder system to a minimum of three mils average thickness. Outdoor liquid transformer units shall include suitable outdoor paint finish. Units shall be painted ANSI 61 Grey. Coat the base and 6" up the sides (including the sides inside the terminal compartments) with 10 mils of coal tar epoxy.

2.06 TERMINAL COMPARTMENTS/FLANGE CONNECTIONS

A. The transformer unit supplied shall include a HV cable terminal compartment and a LV cable terminal compartment. Each transformer shall be cable connected on the primary and secondary.

B. The HV cable terminal compartment shall be full height and extend from the concrete pad upon which the transformer is installed to an adequate distance above the transformer bushings to allow for cable termination and connections. Provide a full height hinged padlockable door with three - point latching. Include 12.7 kV MCOV intermediate class polymer type surge arresters in the HV compartment.

C. The LV cable terminal compartment shall extend from the concrete pad upon which the transformer is installed to an adequate distance above the transformer bushings to allow for cable termination and connections. Provide a full height hinged padlockable door with three - point latching

D. Coat the base and 6" up the sides (including the sides inside the terminal compartments) with 10 mils of coal tar epoxy.

E. Provide silicon bronze hardware including Belleville washers, split lock washers, flat washers, bolts and nuts to connect cable lugs to transformer bushing terminal pads.

2.07 EFFICIENCY

A. Provide unit substation transformers with a minimum efficiency of 99.4% at full load.

2.08 WARNING LABELS

A. Place OSHA warning labels on each door or removable panel which allows access to energized parts. See Specification Section 16195 - Electrical Identification, for warning label requirements.

2.09 LOW RESISTANCE GROUNDING RESISTOR

A. Acceptable Manufacturer: Post Glover.

B. The neutral grounding resistors shall be designed and tested to IEEE Standard 32. Provide factory test reports.

C. The neutral grounding resistors shall have the ratings indicated on the contract drawings.

D. The neutral grounding resistors shall be designed to mount on top of the unit substation transformers in a way that will provide the least obstruction to handhole access covers and other devices on top of the unit substation transformers.

E. The neutral grounding resistors shall be provided with an outdoor safety enclosure. The enclosure shall have a solid top, screened bottom, ventilated side covers and top mounted eye

bolts for handling by a crane. The enclosure material shall be Type 316 stainless steel. The enclosure shall have legs of sufficient length for access to transformer devices mounted below the enclosure. The resistor shall consist of stainless steel (the type typically used by the resistor manufacturer) stamped grid elements with double insulation. The resistor terminals shall be stainless steel (the type typically used by the resistor manufacturer). All resistor end frames, hardware and non-current carrying spacers shall be stainless steel (the type typically used by the resistor manufacturer). If more than one resistor frame is required, series connections shall be tin or silver plated solid copper bar. The resistor bank shall be mounted on porcelain standoff insulators with a rating equal to or greater than the line to neutral voltage. Neutral grounding resistors shall be completely assembled when deliver to the project site for installation on top of the unit substation transformers.

F. Provide and install a stainless steel nameplate on one side of the enclosure where it can be seen from the ground.

G. Provide shop drawings and O&M Manuals for neutral grounding resistors.

H. Provide a G.E. ITI Model 780 ground CT inside the grounding resistor enclosure for connection to the 5 kV switchgear.

PART 3 EXECUTION

3.01 FACTORY TESTING

A. The following standard factory tests shall be performed on all equipment provided under this section. All tests shall be in accordance with the latest version of ANSI and NEMA standards.

1. Resistance measurements of all windings on the rated voltage connection of each unit and at the tap extremes of one unit only of a given rating on this project

2. Ratio tests on the rated voltage connection and on all tap connections

3. Polarity and phase-relation tests on the rated voltage connections

4. No-load loss at rated voltage on the rated voltage connection

5. Exciting current at rated voltage on the rated voltage connection

6. Impedance and load loss at rated current on the rated voltage connection of each unit and on the tap extremes of one unit only of a given rating on this project

7. Applied potential test

8. Induced potential tests

B. The manufacturer shall provide six (6) certified copies of factory test reports.

3.02 FIELD QUALITY CONTROL

A. Provide the services of a qualified factory-trained manufacturer's representative to assist the contractor in installation and start-up of the equipment specified under this section for a period of two (2) working days. The manufacturer's representative shall provide technical direction and assistance to the Contractor in general assembly of the equipment, connections and adjustments, and testing of the assembly and components contained herein.

B. The Contractor shall provide six (6) copies of the manufacturer's field start-up report.

3.03 MANUFACTURER'S CERTIFICATION

A. A qualified factory-trained manufacturer's representative shall certify in writing that the equipment has been installed, adjusted and tested in accordance with the manufacturer's recommendations.

B. The Contractor shall provide six (6) copies of the manufacturer's representative's certification.

3.04 TRAINING

A. Provide vendor training in accordance with Section 01782 for one hour. Repeat vendor training one time. A training video is not required for this equipment.

B. The training session shall be conducted by a manufacturer's qualified representative. Training program shall include instructions on the transformer, auxiliary devices and other major components.

3.05 INSTALLATION

A. The Contractor shall install all equipment per the manufacturer's recommendations and the Contract Drawings.

B. All necessary hardware to secure the assembly in place shall be provided by the Contractor.

3.06 FIELD ADJUSTMENTS

A. Adjust taps to deliver appropriate secondary voltage.

3.07 FIELD TESTING

A. Measure primary and secondary voltages for proper tap settings.

B. Megger primary and secondary windings

C. Test oil for dielectric strength.

D. Doble and perform TTR (transformer turns ratio) tests before energization.

3.08 WARNING LABELS

A. Verify that required OSHA warning labels have been installed.

END OF SECTION

SECTION 16340
SWITCHGEAR 125V DC BATTERY SYSTEM

PART 1 GENERAL

1.01 SECTION INCLUDES

A. This section specifies the furnishing of a battery system nominally rated 125 volts dc for use with switchgear. The system shall include VRLA (valve regulated lead acid) batteries and battery charger in a NEMA 1 ventilated metallic cabinet. The electrical contractor shall furnish the equipment addressed in this specification.

1.02 MEASUREMENT AND PAYMENT

A. No separate payment will be made for work performed under this Section. Include payment in the lump sum bid for work of which this is a component part.

1.03 RELATED WORK

A. Specification Sections 01782 and 01782S, Operations and Maintenance Data.

B. Specification Section 16195, Electrical Identification.

1.04 CODES AND STANDARDS

A. Provide equipment in full accordance with the latest applicable rules, regulations, and standards of:

1. ANSI/IEEE 480 – Storage Batteries.

2. ANSI/IEEE 485 – Recommended Practices for Sizing Large Lead Storage Batteries for Generating Stations and Substations.

3. NFPA 70 – National Electrical Code (NEC).

4. UL 1564 – Battery Chargers, Industrial.

5. UL 1989 – Standby Batteries.

1.05 SUBMITTALS (FOR REVIEW/APPROVAL)

A. Submit product data on batteries, battery charger, and cabinet, in accordance with Section 01330.

B. Include dimensions of batteries, battery charger, and cabinet; number of cells, unit weight and total weight; voltage, ratings, and capacities.

C. Electrical Diagrams. Submit schematic and wiring diagrams for the battery charger.

D. O&M Manuals. Provide six (6) copies of operation and maintenance manuals in 3-ring binders, in accordance with Sections 01782 and 01782S.

PART 2 PRODUCTS

2.01 BATTERY

A. Type. Valve regulated lead acid (VRLA) plate type, with short-period high-rate discharge capability for switchgear-control application. Provide an absorbed glass material (AGM) design with absorbed electrolyte. Gel-cell batteries or similar designs employing a gelled-electrolyte or electrolyte paste are not acceptable.

B. Capacity. Provide 170 Ampere-hours at the 8 hour discharge rate to 1.75 volts per cell. Capacity shall consider an end voltage of not less than 1.75 volts per cell at 77 F, starting from a fully charged cell.

C. Voltage. 125 volts nominal.

D. Containers. Flame retardant ABS plastic.

E. Number of Cells. 60

F. Caps. Flash arrestor self-sealing removable type.

G. Terminals. Provide a battery with terminals at one end of the battery for easy connection in a cabinet.

H. Connectors. Provide battery to battery connectors.

I. Warranty. 10 years

J. Acceptable Manufacturer

1. East Penn, Deka, Unigy Batteries – Contact Mark Batton or Mike Watts at 281-443-2080.

2.02 CHARGER

A. Type. Full-wave solid state, with fully automatic a-c voltage compensation, d-c voltage regulation, and d-c current limiting at not more than 110 percent of rated output current, suitable for the battery described above in this specification.

B. Rating

1. Input. 120 volts, 60 hertz, single phase.

2. Output. 25 Amperes d-c continuous at 125 volts (nominal).

C. Charging Voltage

1. Float Voltage. Adjustable 110.0 to 150.0 V DC.

2. Equalize Voltage. Adjustable 110.0 to 150.0 V DC.

D. Accessories. Provide following minimum accessories.

1. Incoming line circuit breaker, 25 KAIC rated.

2. "AC Power On" LED-type pilot light.

3. AC surge suppressor.

4. DC surge suppressor.

5. 1 % accuracy digital LED meter to display DC volts, DC amps, or equalization hours remaining.

6. Float and equalize voltage adjustments.

7. Manually operated 0 to 255 hour timer that will put charger on equalize charge for selected time and automatically return charger to float charge when it times out. Include "Float Charge" and "Equalize Charge" long-life LED-type indicating lights.

8. Alarm relays for local monitoring and remote monitoring of the following parameters:
   a. AC failure.
   b. DC failure.
   c. High DC voltage.
   d. Low DC voltage.
   e. Positive and negative ground fault.

9. Provide one summary alarm relay which operates for any alarm.

10. Output circuit breaker, 10 KAIC rated.

11. Output filter for reduction to 30 mVrms ripple.

12. Battery eliminator filter.

13. Ground pad terminal.

14. MODBUS communication module.

15. 19" rack mounted.

16. NEMA 1 enclosure.

E. Warranty. 5 years

F. Acceptable Manufacturers

1. Stored Energy Systems, LLC (SENS) – Contact Mark Batton or Mike Watts at 281-443-2080.

2.03 BATTERY CABINET

A. Cabinet features.

1. Freestanding NEMA 1 enclosure with approximate dimensions: 23" wide, 34"deep and 62" high.

2. Hinged front door with provisions for padlocking.

3. Ventilated side panels.

4. Ventilated top.

5. Equipment shall be accessible from the front by way of the hinged door.

6. Cabinet components shall be epoxy powder coat painted.

7. Cabinet designed to house one 125V DC battery string in the bottom of the cabinet with front accessible batteries.

8. Cabinet designed to house the battery charger and output 125V DC circuit breaker in the top of the cabinet.

9. Provide a two pole output circuit breaker with a 10 kA interrupting rating at 125V DC. The output circuit breaker current rating is indicated on the Contract Drawings.

PART 3 EXECUTION

3.01 FACTORY START-UP

A. Provide factory trained and certified personnel to place the batteries and charger in service. One week after placing batteries and charger in service, the same startup personnel shall return and check the installation for proper operation.

3.02 VENDOR TRAINING

A. Provide three hours of vendor training for 8 persons. Repeat the vendor training session for 8 additional persons on a different day. Vendor training shall include both classroom training at the Owner's facility and hands-on training on the Owner's equipment.

B. Vendor training session topics shall include safety, hardware layout and functions, power & control wiring, diagnostic indicators, keypad/display interface, setup, configuration, operational indicators, faults, diagnostic tools, troubleshooting, and preventive maintenance.

C. A training video shall be provided. A training video shall be professionally made of the three hour vendor training session or the vendor can assemble a training video from the vendor's factory training video library. The training video must be representative of the equipment furnished for this project. The training video shall be in DVD format as required by Specification 01782S.

D. Documentation for vendor training shall be provided to each participant which includes actual manuals for the equipment and drawings and schematics of equipment supplied for this project.

3.03 IDENTIFICATION

A. Field installed wiring shall comply with Specification 16195.

B. Provide an engraved nameplate with "125 VDC BATTERY SYSTEM", in accordance with Specification 16195.

END OF SECTION

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SECTION 16346
MEDIUM VOLTAGE METAL-CLAD SWITCHGEAR

PART 1 GENERAL

1.01 SCOPE

A. The **Electrical Contractor** shall purchase, install and coordinate all aspects of the medium voltage metal-clad switchgear as specified herein and as shown on the Contract Drawings. Qualifications for the switchgear manufacturer, the electrical contractor/switchgear installer and the electrical contractor's project manager are also included in this document.

1.02 MEASUREMENT AND PAYMENT

A. No separate payment will be made for work performed under this Section.

1.03 RELATED SECTIONS

A. Section 16195 – Electrical Identification

B. Section 16340 – Switchgear 125V DC Battery Systems

C. Section 16349 – Medium Voltage Motor Controller Switchgear

D. Section 16995 – Relay and Protective Device Settings

1.04 REFERENCES

A. The metal-clad switchgear and all components shall be designed, manufactured and tested in accordance with the latest applicable standards of ANSI/IEEE C37.20.2, C37.55, C37.100, NEMA SG-5, and CSA C22.2 No. 31-04.

1.05 SUBMITTALS

A. Submit the following under provisions of Section 01330 – Submittal Procedures:

1. Master drawing index
2. Front view elevation
3. Floor plan
4. Top view
5. Single line diagram
6. Schematic diagram
7. Nameplate schedule

8. Component list

9. Conduit entry/exit locations

10. Assembly ratings including:
    a. Switchgear assembly short-circuit withstand rating
    b. Enclosure internal arc short circuit rating
    c. Voltage
    d. Continuous current
    e. Basic impulse level for equipment over 600 volts

11. Major component ratings including:
    a. Voltage
    b. Continuous current
    c. Interrupting ratings

12. Cable terminal sizes.

13. Product data sheets.

14. Busway connection

15. Connection details between close-coupled assemblies

16. Composite floor plan of close-coupled assemblies

17. Key interlock scheme drawing and sequence of operations

18. Descriptive bulletins

B. The following information shall be submitted for record purposes:

1. Final as-built drawings and all information listed in the previous paragraph

2. Wiring diagrams

3. Certified production test reports

4. Installation information including equipment anchorage provisions

C. The final (as-built) drawings shall include the same drawings as the construction drawings and shall incorporate all changes made during the manufacturing process.

1.06 SWITCHGEAR MANUFACTURER'S QUALIFICATIONS

A. The manufacturer of the assembly shall be the manufacturer of the major components within the assembly.

B. For the equipment specified herein, the manufacturer shall be ISO 9001 or 9002 certified.

C. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of ten (10) years. When requested by the Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.

1.07 ELECTRICAL CONTRACTOR/SWITCHGEAR INSTALLER'S QUALIFICATIONS

A. The electrical contractor/switchgear installer shall have successfully installed a minimum of 10 lineups of medium voltage metal-clad switchgear. The successful electrical contractor/switchgear installer shall submit a list of 10 medium voltage metal-clad switchgear projects with project descriptions and the name of the owner's contact person and telephone number. Electrical contractors without the required project experience will be rejected.

1.08 ELECTRICAL CONTRACTOR'S PROJECT MANAGER QUALIFICATIONS

A. The electrical contractor's Project Manager shall have successfully managed the installation of a minimum of 5 lineups of medium voltage metal-clad switchgear. The Project Manager for the successful electrical contractor shall submit a list of 5 medium voltage metal-clad switchgear projects with project descriptions and the name of the owner's contact person and telephone number. Project Manager's without the required project experience will be rejected.

1.09 DELIVERY, STORAGE AND HANDLING

A. Equipment shall be handled and stored in accordance with manufacturer's instructions. One (1) copy of these instructions shall be included with the equipment at time of shipment.

B. Shipping groups shall be designed to be shipped by truck, rail, or ship. Indoor groups shall be bolted to skids. Breakers and accessories shall be packaged and shipped separately.

C. Contractor shall confirm shipping splits are properly sized to fit through doorways and be installable without risk of damage to equipment during installation.

D. Switchgear shall be equipped to be handled by crane. Where cranes are not available, switchgear shall be suitable for skidding in place on rollers using jacks to raise and lower the groups.

E. Switchgear being stored prior to installation shall be stored so as to maintain the equipment in a clean and dry condition. If stored outdoors, indoor gear shall be covered and heated, and outdoor gear shall be heated.

1.10 OPERATION AND MAINTENANCE MANUALS

A. Equipment operation and maintenance manuals shall be provided with each assembly shipped, and shall include instruction leaflets and instruction bulletins for the complete assembly and each major component. Operation and maintenance manuals shall comply with Sections 01782 and 01782S.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Eaton

B. A pre-approved vendor that complies with this Specification

C. The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features, functions and space limitations as indicated on the Contract Drawings. Manufacturers listed above are not relieved from meeting these specifications in their entirety. Products in compliance with the specification and manufactured by others not named will be considered only if pre-approved by the Engineer fourteen (14) days prior to bid date.

2.02 RATINGS

A. The switchgear described in this specification shall be designed for operation on a 4.16 kV, three-phase, 3 wire, low impedance grounded, 60-hertz system.

B. Each circuit breaker shall have the following ratings:

Maximum Voltage	4.76 kV
BIL Rated	60 kV Peak
Continuous Current (5/15 kV)	see Drawings
Short-Circuit Current at rated Maximum kV	40 kA RMS SYM, 64 kA RMS ASYM
Rated Voltage Range Factor K	1.0
Closing and Latching Capability	139 kA Peak
Maximum Symmetrical Interrupting and 2-Second Rating	40 kA RMS SYM
Rated Interrupting Time	3 Cycles

C. The switchgear assembly short-time and momentary current withstand ratings shall be the same as that of the circuit breaker.

2.03 CONSTRUCTION

A. The switchgear assembly shall consist of individual vertical sections housing various combinations of circuit breakers and auxiliaries, bolted to form a rigid metal-clad switchgear assembly. Metal side sheets shall provide grounded barriers between adjacent structures and solid removable metal barriers shall isolate the major primary sections of each circuit. The 5 kV switchgear shall be arranged in a 1-high configuration, with two hinged rear covers furnished for each vertical section for circuit isolation and ease of handling.

B. Shipping splits shall be determined by the electrical contractor but in no case shall shipping splits contain more than three cubicles.

C. The stationary primary contacts shall be silver-plated and recessed within insulating tubes. A steel shutter shall automatically cover the stationary primary disconnecting contacts when the breaker is in the disconnected position or out of the cell. The 5 kV circuit breakers shall be drawout with stab-in connections to the bus and capable of being withdrawn on rails.

D. Space heaters shall be provided in each vertical section to prevent condensation. A thermostatically controlled heater bus, protected by a properly sized molded case circuit breaker shall be provided in each switchgear assembly to provide control power to space heaters. AC control voltage for space heaters shall be derived from a control power transformer supplied within the switchgear

2.04 BUS

A. The main bus shall be silver plated copper with fluidized bed epoxy flame-retardant and track-resistant insulation. The bus supports between units shall be flame-retardant, track-resistant, glass polyester or cycloaliphatic epoxy. The switchgear shall be constructed so that all buses, bus supports and connections shall withstand stresses that would be produced by currents equal to the momentary ratings of the circuit breakers. The main bus continuous current ratings shall be as indicated on the Contract Drawings. Insulated copper main bus shall be provided and have provisions for future extension. All bus joints shall be plated, bolted and insulated with easily installed boots. The bus shall be braced to withstand fault currents equal to the close and latch rating of the breakers. The temperature rise of the bus and connections shall be in accordance with ANSI standards and documented by design tests.

B. A copper ground bus shall extend the entire length of the switchgear.

2.05 WIRING/TERMINATIONS

A. The switchgear manufacturer shall provide suitable terminal blocks for secondary wire terminations and a minimum of 10% spare terminals shall be provided. One control circuit cutout device shall be provided in each circuit breaker housing. Switchgear secondary wire shall be #14 AWG, Type SIS rated 600 volt, 90 degrees C, furnished with heat shrink sleeve type wire markers at each termination. Wiring for CT circuits shall be a minimum of # 10 AWG, Type SIS rated 600 volts, 90 degrees C. Wires shall terminate on terminal blocks with marker strips numbered in agreement with detailed connection diagrams. Wire markers shall be heat shrink and shall comply with Specification 16195.

B. Incoming line and feeder cable lugs shall be 2- hole mounting, long barrel, copper compression lugs.

2.06 CIRCUIT BREAKERS

A. The circuit breakers shall be horizontal drawout type with stab-in connections to the bus, capable of being withdrawn on rails. The breakers shall be operated by a motor-charged stored energy spring mechanism, charged normally by a universal electric motor and in an emergency by a manual handle. The primary disconnecting contacts shall be silver-plated copper.

B. Each circuit breaker shall contain three vacuum interrupters separately mounted in a self-contained, self-aligning pole unit, which can be removed easily. The vacuum interrupter pole unit shall be mounted on glass polyester supports or cycloaliphatic epoxy supports. A contact wear gap indicator for each vacuum interrupter, which requires no tools to indicate available contact life, shall be easily visible when the breaker is removed from its compartment. The current transfer from the vacuum interrupter moving stem to the breaker main conductor shall be a non-sliding design. The breaker front panel shall be removable when the breaker is withdrawn for ease of inspection and maintenance.

C. The secondary contacts shall be silver-plated and shall automatically engage in the breaker operating position, which can be manually engaged in the breaker test position.

D. Interlocks shall be provided to prevent closing of a breaker between operating and test positions, to trip breakers upon insertion or removal from housing and to discharge stored energy mechanisms upon insertion or removal from the housing. The breaker shall be secured positively in the housing between and including the operating and test positions.

E. The circuit breaker compartment door shall be mechanically interlocked with the breaker levering mechanism to prevent opening of the door unless the breaker is first Opened and withdrawn to Test/Disconnected position with the door closed.

F. The design shall allow normal circuit breaker functions to be carried out with the door closed. Those functions include: manual open and close, manual levering to and from connected position, and manual charging of the circuit breaker closing springs. Shatter proof viewing windows shall be provided on the door to enable viewing of circuit breaker position inside the compartment, circuit breaker contact status (open/closed), and spring charged/discharged indication.

G. Circuit breaker shutters shall have large text to identify line side and load side. Tie circuit breaker shutters shall be labeled to identify what is connected to stabs behind shutters.

H. When a remote operable electrical levering device is specified under the accessories, the design shall allow levering of the circuit breaker using such a device with the door closed.

I. The breakers shall be electrically operated by 125 volt DC (close and trip). Each breaker shall be complete with control switch and red (closed) and green (open) LED indicating lights to indicate breaker contact position.

J. The Breakers shall have remote operation as indicated in the Contract Drawings. Each switchgear lineup shall have a standalone PLC with OIT (Operator Interface Terminal) as described later in this specification.

K. DC control voltage shall be supplied by the Contractor.

2.07 PROTECTIVE RELAYS

A. The switchgear manufacturer shall furnish and install, in the metal-clad switchgear, GE Multilin 850 relays, No. 850-E-P5-S5-H-A-N-G-S-S-B-B-S-E-N-N-B (Switchgear manufacturer to

verify this is the correct relay number for the application). Relays shall be mounted in a separate low voltage compartment metal barriered from medium voltage.

B. Wire circuit breaker auxiliary contacts to the Multilin relays so that circuit breaker status (red closed or green open) is illuminated on the face of the relay.

2.08 CURRENT TRANSFORMERS

A. All current transformers for phase and zero sequence applications shall be ITI (Instrument Transformer, Inc., a GE Company) Model 780.

2.09 AUXILIARY DEVICES

A. Low voltage type current transformers shall be furnished as indicated on the Contract Drawings. The thermal and mechanical ratings of the current transformers shall be coordinated with the circuit breakers. Their accuracy rating shall be equal to or higher than ANSI standard requirements. The standard location for the current transformers on the bus side and line side of the 5 kV breaker units shall be front accessible to permit adding or changing current transformers without removing high-voltage insulation connections. Shorting terminal blocks shall be furnished on the secondary of all the current transformers. Specific current transformer requirements are identified above in this specification.

B. Voltage and control power transformers of the quantity and ratings indicated in the detail specification shall be supplied. Voltage transformers shall be mounted in drawout drawers contained in an enclosed auxiliary compartment. Control power transformers up to 15 kVA, single-phase shall be mounted in drawout drawers. Rails shall be provided for 5 kV auxiliary drawers to permit easy inspection, testing and fuse replacement. Shutters shall isolate primary bus stabs when drawers are withdrawn.

C. A mechanical interlock shall be provided to require the secondary breaker to be open before the CPT drawer or CPT primary fuse drawer can be withdrawn.

2.10 METERING

A. Multilin relays will be used for metering functions where shown on the Contract Drawings. Include associated current transformers.

B. Provide current transformers for each Multilin relay. Current transformers shall be wired to shorting type terminal blocks.

C. Provide potential transformers including primary and secondary fuses with disconnecting means for metering as shown on the drawings.

2.11 ENCLOSURES

A. The switchgear described in these specifications shall be indoor construction, with devices arranged as shown on the Contract Drawings.

2.12 NAMEPLATES

A. Engraved nameplates, mounted on the face of the assembly, shall be furnished for all main and feeder circuits as indicated on the drawings. Nameplates shall be 3-ply laminated plastic, black characters on white background, and secured with screws. Characters shall be 3/16-inch high, minimum. Furnish master nameplate for each switchgear lineup giving information in accordance with IEEE Std C37.20.2-1999, section 7.4.1 and IEEE C37.20.7, section 6.3. Circuit nameplates shall be provided with circuit designations as shown on purchaser's single-line diagrams.

B. Control components mounted within the assembly, such as fuse blocks, relays, pushbuttons, switches, etc., shall be suitably marked for identification corresponding to appropriate designations on manufacturer's wiring diagrams.

2.13 FINISH

A. The finish shall consist of a coat of gray (ANSI-61), thermosetting, polyester powder paint applied electrostatically to pre-cleaned and phosphatized steel and aluminum for internal and external parts. The coating shall have corrosion resistance of 600 hours to 5% salt spray.

2.14 ACCESSORIES

A. The switchgear manufacturer shall furnish accessories for test, inspection, maintenance, and operation, including:

1. One – Maintenance tool for manually charging the breaker closing spring and manually opening the shutter

2. One – Levering crank for moving the breaker between test and connected positions

3. One – Test jumper for electrically operating the breaker while out of its compartment

4. One – Breaker lifting yoke used for attachment to breaker for lifting breaker on or off compartment rails, when applicable

5. One – Set of rail extensions, when applicable

6. One – Portable lifting device for lifting the breaker on or off the rails

7. One – Ramp for rolling breaker mounted in lower compartment directly onto the floor

8. One – "Dockable" transport dolly for moving breaker about outside its compartment

9. One –Universal Remote Power Racking Device, RPR-2

2.15 CORONA FREE DESIGN

A. The switchgear shall be corona free by design and shall be tested for partial discharges in accordance with EEMAC standard G11-1. The corona discharges measured during the tests shall be less than 100 picocoulombs.

2.16 NAMEPLATES ON SIEMENS METAL-CLAD SWITCHGEAR

A. Two circuit breakers in the City of Houston's existing Siemens metal-clad switchgear, designated "SWGR-S" on the Contract Drawings, will be used to power the two 7500 kVA transformers being added in this project. Change the nameplates on the outside of the Siemens circuit breaker cubicles to read, "Feeder T8A (Line 1), 7500 kVA Transformer (Line 2), HSPS1 (Line 3)" or "Feeder T8B (Line 1), 7500 kVA Transformer (Line 2), HSPS1 (Line 3)".

2.17 PLC FOR REMOTE CIRCUIT BREAKER OPERATION

A. A PLC is required to allow circuit breakers to be remotely operated. Remote operation will be connected in parallel with the circuit breaker control switch located on the front of the switchgear enclosure. At all times it shall be possible to control a circuit breaker from the control switch or from the operator interface panel associated with the PLC. The PLC shall be located in the metal-clad switchgear. In addition to remotely controlling circuit breakers, the PLC shall control medium voltage motor controller (Ampgard) contactors located in switchgear connected to the metal-clad switchgear. See Contract Drawing E-28 for additional information. Programming for this PLC shall be performed by Automation Nation, Inc. (Contact Person is Rich Kendall at 713-906-7115)

PART 3 EXECUTION

3.01 FACTORY TESTING

A. The following standard factory tests shall be performed on the circuit breaker element provided under this section. All tests shall be in accordance with the latest version of ANSI standards.

1. Alignment test with master cell to verify all interfaces and interchangeability
2. Circuit breakers operated over the range of minimum to maximum control voltage
3. Factory setting of contact gap
4. One-minute dielectric test per ANSI standards
5. Final inspections and quality checks

B. The following production test shall be performed on each breaker housing:

1. Alignment test with master breaker to verify interfaces
2. One-minute dielectric test per ANSI standards on primary and secondary circuits

3. Partial discharge tests, when applicable.

4. Operation of wiring, relays and other devices verified by an operational sequence test

5. Final inspection and quality check.

3.02 FIELD QUALITY CONTROL

A. Provide the services of a qualified factory-trained manufacturer's representative to assist the Contractor in installation and start-up of the equipment specified under this section for a period of 10 working days. The manufacturer's representative shall provide technical direction and assistance to the contractor in general assembly of the equipment, connections and adjustments, and testing of the assembly and components contained therein.

B. The Contractor shall provide six (6) copies of the manufacturer's field start-up report.

3.03 MANUFACTURER'S CERTIFICATION

A. A qualified factory-trained manufacturer's representative shall certify in writing that the equipment has been installed, adjusted, tested and programmed in accordance with the manufacturer's recommendations.

B. The Contractor shall provide six (6) copies of the manufacturer's representative's certification.

3.04 VENDOR TRAINING

A. Provide four hours of vendor training for 8 persons. Repeat the vendor training session for 8 additional persons on a different day. Vendor training shall include both classroom training at the Owner's facility and hands-on training on the Owner's equipment.

B. Vendor training session topics shall include safety, hardware layout and functions, power & control wiring, diagnostic indicators, software mapping, programming, setup, configuration, control loop tuning, operational indicators, faults, diagnostic tools, troubleshooting, and preventive maintenance.

C. A training video shall be provided. A training video shall be professionally made of the four hour vendor training session or the vendor can assemble a training video from the vendor's factory training video library. The training video must be representative of the equipment furnished for this project. The training video shall be in DVD format as required by Specification 01782S.

D. Documentation for vendor training shall be provided to each participant which includes actual manuals for the equipment and drawings and schematics of equipment supplied for this project.

3.05 INSTALLATION

A. The Contractor shall install all equipment per the manufacturer's recommendations and contract drawings.

B. All necessary hardware to secure the assembly in place shall be provided by the contractor. Switchgear cubicles shall be bolted to the floor with Type 316 SS hardware.

3.06 GE MULTILIN RELAY SETTINGS

A. Settings for the GE Multilin relays are provided in Specification 16995. Switchgear vendor to program all relays listed in Specification 16995.

END OF SECTION

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SECTION 16349
MEDIUM VOLTAGE MOTOR CONTROLLER SWITCHGEAR

PART 1 GENERAL

1.01 SCOPE

A. The **Electrical Contractor** shall furnish and install medium voltage motor controllers with vacuum contactors as specified herein and as shown on the Contract Drawings.

1.02 MEASUREMENT AND PAYMENT

A. No separate payment will be made for work performed under this Section.

1.03 RELATED SECTIONS

A. Section 16195 – Electrical Identification

B. Section 16280 – 5 KV Capacitor Bank

C. Section 16340 – Switchgear 125V DC Battery System

D. Section 16346 – Medium Voltage Metal-Clad Switchgear

E. Section 16995 – Relay and Protective Device Settings

1.04 REFERENCES

A. Medium Voltage Motor Controllers shall be designed, manufactured, assembled and tested in accordance with the following standards:

1. ANSI/NEMA ICS-3- Part 2

2. UL 347

1.05 SUBMITTALS

A. Submit the following under provisions of Section 01330 – Submittal Procedures:

1. Master drawing index

2. Front view elevation

3. Floor plan

4. Top view

5. Schematic diagram

6. Nameplate schedule

7. Component list

8. Conduit entry/exit locations

9. Assembly ratings including:
   a. Short circuit rating
   b. Voltage
   c. Continuous current
   d. Basic impulse level

10. Major component ratings including:
    a. Voltage
    b. Continuous current
    c. Interrupting ratings

11. Cable terminal sizes.

12. Product data sheets.

B. The following information shall be submitted for record purposes:

1. Final as-built drawings and all information listed in the previous paragraph including all changes made during the manufacturing process.

2. Wiring diagrams

3. Certified production test reports

4. Installation information including equipment anchorage provisions

C. The final (as-built) drawings shall include the same drawings as the construction drawings and shall incorporate all changes made during the manufacturing process.

1.06 QUALIFICATIONS

A. The manufacturer of the assembly shall be the manufacturer of the major components within the assembly.

B. For the equipment specified herein, the manufacturer shall be ISO 9001 or 9002 certified.

C. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of five (5) years. When requested by the Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.

1.07 REGULATORY REQUIREMENTS

A. Equipment shall be provided with UL labels where UL labels are available.

1.08 DELIVERY, STORAGE AND HANDLING

A. Equipment shall be handled and stored in accordance with manufacturer's instructions. One (1) copy of these instructions shall be included with the equipment at time of shipment.

1.09 OPERATION AND MAINTENANCE MANUALS

A. Equipment operation and maintenance manuals shall be provided with each assembly shipped, and shall include instruction leaflets and instruction bulletins for the complete assembly and each major component. Operation and maintenance manuals shall comply with Sections 01782 and 01782S.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Eaton

B. A pre-approved vendor that complies with this Specification.

C. The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety. Products in compliance with the specification and manufactured by others not named will be considered only if pre-approved by the Engineer fourteen (14) days prior to bid date.

2.02 RATINGS

A. Motor Controllers shall have an integrated interrupting rating with current limiting fuses of 400 MVA.

B. When Motor Controllers are grouped together in a lineup, the entire assembly shall be suitable for application on a power system having a short-circuit capacity of 400 MVA.

C. Vacuum contactors shall have the following ratings:

7200V Max.	400 Amperes
Max. Interrupting Current (3 Operations)	8500 Amperes
Interrupting Rating	50 kA RMS Sym
Rated Current – Enclosed	360 Amperes
Rated Current – Open	400 Amperes
Short-Time Current 30 Sec.	2400 Amperes

1 Sec.	6000 Amperes
8.7 ms (0.5 Cycle)	63 kA Peak
Mechanical Life	2.5 Million
Electrical Life at rated current	300,000
Impulse Withstand (BIL)	60 kV (1.2 x 50 Micro Sec.)

2.03 CONSTRUCTION

A. Isolating switch and contactor assemblies, including current limiting fuses, shall be of the component-to-component design with a minimum amount of interconnecting cables. The isolating switch shall be easily removed from the enclosure by removing the pin securing the operating rod to the switch and then removing two bolts securing the removable portion of the switch. Line and load cable terminations shall be completely accessible from the front.

B. The isolating switch shall be an externally operated manual three-pole drawout type, such that in the open position it grounds and isolates the starter from the line connectors with an isolating shutter leaving no exposed high-voltage components. Integral mechanical interlocks shall prevent entry into the high-voltage areas while the starter is energized and shall block accidental opening or closing of the isolating switch when the door is open or the contactor is closed. The isolating switch handle shall have provisions for padlocking in the open position. The isolating switch shall have a mechanical blown fuse indicating device. The isolation switch shall be designed for a minimum of 10,000 operations.

C. Current limiting power fuses shall be provided with special fatigue proof elements that allow the elements to absorb the expansions and contractions created by the heating and cooling associated with severe cycling as is typical with motor starting. The fuses will include visible fuse condition indicators. The fuses shall incorporate special time/current characteristics for all possible fuse sizes to eliminate contactor racing. The power fuses shall be vertically mounted permitting easy inspection and replacement without starter disassembly.

D. The vacuum contactor shall use a stab connection and be magnetically-held or use a latched design. The vacuum contactor shall be rated 400 amperes with single-break high-pressure type main contacts with weld-resistant alloy contact faces. The vacuum contactor contact wear shall be easily checked with the use of a "go/no-go" feeler gauge.

E. A built-in test circuit shall be included to permit checking of the starter control and pilot circuit, with the high voltage de-energized and isolated, and the contactor in its normal position or in the drawout position. The control circuit shall be capable of being energized through a polarized plug connector from an external 115-volt supply while in the test mode.

F. The low voltage control compartment shall be isolated and barriered from the high voltage area and mounted on a panel with a separate low voltage access door. The low voltage compartment shall be painted white to increase visibility of components mounted inside the compartment.

G. Each contactor cell shall contain a vertical and horizontal low voltage wireway.

2.04 BUS

A. The horizontal main bus shall be located in its own separate 12-inch high top mounted enclosure and isolated from the starters. To allow for ease of maintenance or extension of lineups without disassembling starters, the main bus shall be front, top and side accessible.

B. Starters shall be connected by an insulated vertical bus.

C. All bus bars shall be copper silver-plated and insulated. Bus shall be rated for a minimum 1200A continuous current.

D. Provide a 1/4 x 2-inch ground bus in each cubicle. Ground bus shall also be supplied in upper compartments of 2-high starters and be bus connected to the ground bus supplied in the lower compartments.

2.05 WIRING/TERMINATIONS

A. All control wire shall be UL/CSA approved.

B. Standard control wire shall be 14GA, stranded, tin-plated, red, dual-rated type XLPE (3173) 125 degrees C, SIS 90 degrees C.

C. Current transformer circuits shall utilize #12 wire with the same characteristics as above. Provide shorting blocks for all current transformers.

D. Provide "plug-in" terminal blocks, rated 600 V, 50A with "clamping collar."

E. Wire markers shall be heat shrink sleeve type as indicated in Specification 16195.

F. "Clamping-collar" type terminals shall be used to terminate control wiring. Current transformer circuits shall be provided with ring-type terminals.

2.06 MOTOR CONTROLLERS

A. Non-reversing magnetically-held motor controllers shall be designed to accommodate induction motors and power factor correction capacitors of the size and type as shown on the Contract Drawings. Latched motor controllers shall be used as feeders to transformers and ASDS (Adjustable Speed Drives).

B. The following equipment shall be provided for the controller type indicated.

1. Each induction motor full voltage controller shall include:
   a. Medium Voltage Section
      1) One – Mechanical non-loadbreak isolating switch
      2) Three – Bolt-in current-limiting power fuses with pop up blown fuse indication
      3) One – Stab-in three-pole vacuum contactor assembly with wheels
      4) One – Control circuit transformer 2 kVA minimum size at 4.16 kV
      5) Two – Control circuit primary current limiting fuses

6) One – Control circuit secondary fuse
7) One – Run-test circuit
8) Four – Electrical interlocks
9) Three – Current transformers, GE ITI Model 780
10) One – Zero sequence ground fault current transformer, GE ITI Model 780

b. Low Voltage Compartment and Door
1) One – GE Multilin 869 Relay No. 869-E-P5-NN-S5-H-R-R-A-N-N-G-S-S-B-S-E-N-N-B (Switchgear manufacturer to verify this catalog number is compatible with the application in the Contract Drawings). 869 relay to be powered at 125V DC.
2) Interposing control relays as required
3) Control circuit terminal blocks as required
4) Metering/monitoring voltage to 869 relay to be from VTs in metal-clad switchgear
5) Isolation switch viewing window to verify switch position
6) CT shorting terminal blocks
7) Control switches and indicating lights as necessary and as indicated in Contract Drawings
8) All provisions for remote contactor operation as indicated on Contract Drawing E-28
9) Siemens S7-1214C PLC with appropriate modules for high service pump discharge valve control

2. Each capacitor switching contactor shall include:
a. Medium Voltage Section
1) One – Mechanical non-loadbreak isolating switch
2) Three – Bolt-in current-limiting power fuseswith pop up blown fuse indication
3) One – Stab-in three-pole vacuum contactor assembly with wheels
4) One – Control circuit transformer 2 kVA minimum size at 4.16 kV
5) Two – Control circuit primary current limiting fuses
6) One – Control circuit secondary fuse
7) One – Run-test circuit
8) Four – Electrical interlocks
9) Three – Current transformers, GE ITI Model 780
10) One – Zero sequence ground fault current transformer, GE ITI Model 780

b. Low Voltage Compartment and Door
1) One – GE Multilin 850 Relay No. 850-E-P5-S5-H-A-N-G-S-S-B-B-S-E-N-N-B (Switchgear manufacturer to verify this catalog number is compatible with the application in the Contract Drawings). 850 relay to be powered at 125V DC.
2) Interposing control relays as necessary
3) Control circuit terminal blocks as necessary
4) Metering/monitoring voltage to 850 relay to be from VTs in the metal-clad switchgear
5) Isolation switch viewing window to verify switch position
6) CT shorting terminal blocks
7) One time closed delay timer to delay capacitor switching until the motor associated with the power factor correction capacitor is running at full speed

8) Control switches and indicating lights as necessary and as indicated on Contract Drawings
9) All provisions for remote contactor operation as indicated on Contract Drawing E-28.

3. Each latched contactor shall include:
   a. Medium Voltage Section
      1) One – Mechanical non-loadbreak isolating switch
      2) Three – Bolt-in current-limiting power fuses with pop up blown fuse indication
      3) One – Stab-in three-pole vacuum contactor assembly with wheels
      4) One – Control circuit transformer 2 kVA minimum size at 4.16 kV
      5) Two – Control circuit primary current limiting fuses
      6) One – Control circuit secondary fuse
      7) One – Run-test circuit
      8) Four – Electrical interlocks
      9) Three – Current transformers, GE ITI Model 780
      10) One – Zero sequence ground fault current transformer, GE ITI Model 780
   b. Low Voltage Compartment and Door
      1) One – GE Multilin 850 Relay No. 850-E-P5-S5-H-A-N-G-S-S-B-B-S-E-N-N-B (Switchgear manufacturer to verify this catalog number is compatible with the application in the Contract Drawings). 850 relay to be powered at 125 v DC.
      2) Interposing control relays as required.
      3) Control circuit terminal blocks as required
      4) Metering/monitoring voltage to 850 relay to be from VTs in metal-clad switchgear
      5) Isolation switch viewing window to verify switch position
      6) CT shorting terminal blocks
      7) Control switches and indicating lights as necessary and as indicated in the Contract Drawings.
      8) All provisions for remote contactor operation as indicated on Contract Drawing E-28.

2.07 ENCLOSURES

A. The controllers described in these specifications shall be indoor construction with devices arranged as shown on Contract Drawings. The minimum width of contactor cubicles shall be 36".

B. Enclosure shall be completely front accessible, allowing for free-standing, against a wall, or back-to-back mounting.

C. Motor Controller Switchgear shall connect to metal-clad switchgear by means of a transition section..

D. Structures shall be welded steel frame, formed steel doors and side sheets, flat steel top and rear covers.

E. Standard switchgear manufacturer's hardware shall be used.

2.08 NAMEPLATES

A. Nameplates shall be a minimum of 2-inches high x 3-inches wide, 3-ply laminated, white background with black letters.

B. Unit nameplate and device marker lettering shall be 3/16-inch high.

2.09 FINISH

A. The finish for internal and external parts shall consist of a coat of ANSI 61 (gray) thermosetting, polyester, powder paint applied electrostatically to pre-cleaned phosphatized steel and aluminum surfaces. The interior of the low voltage compartment shall be white.

2.10 ACCESSORIES

A. Provide a portable lifting device for transporting contactors outside contactor compartments.

2.11 HIGH SERVICE PUMP DISCHARGE VALVE PROGRAMMABLE LOGIC CONTROLLER (PLC)

A. Manufacturer and Product: Siemens Model S7-1214C; (with integral Ethernet and appropriate modules); must be the latest version of the indicated model.

B. Communication Interface

1. Ethernet

C. Programming, Software and Programming Equipment

1. Configure the system and program for operation as specified in Division 13 specifications.

2. Provide software and a software license.

2.12 PLC FOR REMOTE OPERATION

A. See Paragraph 2.17 in Specification 16346 for description of operation.

PART 3 EXECUTION

3.01 FACTORY TESTING

A. The following standard factory tests shall be performed on the equipment provided under this section. All tests shall be in accordance with the latest version of ANSI and NEMA standards.

1. Wiring check

2. Sequence of control circuits

2.15 CORONA FREE DESIGN

A. The switchgear shall be corona free by design and shall be tested for partial discharges in accordance with EEMAC standard G11-1. The corona discharges measured during the tests shall be less than 100 picocoulombs.

2.16 NAMEPLATES ON SIEMENS METAL-CLAD SWITCHGEAR

A. Two circuit breakers in the City of Houston's existing Siemens metal-clad switchgear, designated "SWGR-S" on the Contract Drawings, will be used to power the two 7500 kVA transformers being added in this project. Change the nameplates on the outside of the Siemens circuit breaker cubicles to read, "Feeder T8A (Line 1), 7500 kVA Transformer (Line 2), HSPS1 (Line 3)" or "Feeder T8B (Line 1), 7500 kVA Transformer (Line 2), HSPS1 (Line 3)".

2.17 PLC FOR REMOTE CIRCUIT BREAKER OPERATION

A. A PLC is required to allow circuit breakers to be remotely operated. Remote operation will be connected in parallel with the circuit breaker control switch located on the front of the switchgear enclosure. At all times it shall be possible to control a circuit breaker from the control switch or from the operator interface panel associated with the PLC. The PLC shall be located in the metal-clad switchgear. In addition to remotely controlling circuit breakers, the PLC shall control medium voltage motor controller (Ampgard) contactors located in switchgear connected to the metal-clad switchgear. See Contract Drawing E-28 for additional information. Programming for this PLC shall be performed by Automation Nation, Inc. (Contact Person is Rich Kendall at 713-906-7115)

PART 3 EXECUTION

3.01 FACTORY TESTING

A. The following standard factory tests shall be performed on the circuit breaker element provided under this section. All tests shall be in accordance with the latest version of ANSI standards.

1. Alignment test with master cell to verify all interfaces and interchangeability
2. Circuit breakers operated over the range of minimum to maximum control voltage
3. Factory setting of contact gap
4. One-minute dielectric test per ANSI standards
5. Final inspections and quality checks

B. The following production test shall be performed on each breaker housing:

1. Alignment test with master breaker to verify interfaces
2. One-minute dielectric test per ANSI standards on primary and secondary circuits

3. Partial discharge tests, when applicable.

4. Operation of wiring, relays and other devices verified by an operational sequence test

5. Final inspection and quality check.

3.02 FIELD QUALITY CONTROL

A. Provide the services of a qualified factory-trained manufacturer's representative to assist the Contractor in installation and start-up of the equipment specified under this section for a period of 10 working days. The manufacturer's representative shall provide technical direction and assistance to the contractor in general assembly of the equipment, connections and adjustments, and testing of the assembly and components contained therein.

B. The Contractor shall provide six (6) copies of the manufacturer's field start-up report.

3.03 MANUFACTURER'S CERTIFICATION

A. A qualified factory-trained manufacturer's representative shall certify in writing that the equipment has been installed, adjusted, tested and programmed in accordance with the manufacturer's recommendations.

B. The Contractor shall provide six (6) copies of the manufacturer's representative's certification.

3.04 VENDOR TRAINING

A. Provide four hours of vendor training for 8 persons. Repeat the vendor training session for 8 additional persons on a different day. Vendor training shall include both classroom training at the Owner's facility and hands-on training on the Owner's equipment.

B. Vendor training session topics shall include safety, hardware layout and functions, power & control wiring, diagnostic indicators, software mapping, programming, setup, configuration, control loop tuning, operational indicators, faults, diagnostic tools, troubleshooting, and preventive maintenance.

C. A training video shall be provided. A training video shall be professionally made of the four hour vendor training session or the vendor can assemble a training video from the vendor's factory training video library. The training video must be representative of the equipment furnished for this project. The training video shall be in DVD format as required by Specification 01782S.

D. Documentation for vendor training shall be provided to each participant which includes actual manuals for the equipment and drawings and schematics of equipment supplied for this project.

3.05 INSTALLATION

A. The Contractor shall install all equipment per the manufacturer's recommendations and contract drawings.

SECTION 16402
UNDERGROUND DUCT BANKS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Underground electrical duct banks.

1.02 MEASUREMENT AND PAYMENT

A. No separate payment will be provided for work performed under this Section. Include the cost for this work in the lump sum Base Bid.

B. Payment for extra unit price work shall be as defined in the extra unit price schedule.

1.03 RELATED WORK

A. Section 16111 – Conduit, Fittings and Bodies.

B. Section 16195 – Electrical Identification.

1.04 REFERENCES

A. National Fire Protection Association (NFPA): No. 70 - National Electrical Code (NEC) Appendix B.

1.05 SUBMITTALS

A. Catalog cut sheets of the ducts and spacers.

1.06 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.

1.07 DEFINITION

A. A duct bank is one or more electrical conduits grouped together and surrounded by a common encasement of concrete.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Thomas and Betts.

B. Underground Devices Inc.

C. Walker Division, Butler Manufacturing Company.

2.02 MATERIALS AND EQUIPMENT

A. Conduit. Construct ducts using Schedule 40 rigid PVC conduit for straight horizontal runs and for bends less than 15 degrees. For horizontal bends 15 degrees and greater and all stub-ups, use epoxy fiberglass conduit. Refer to Section 16111 - Conduit, Fittings and Bodies for additional requirements.

B. Spacers. Secure conduit with non-magnetic, universal, interlocking-type spacers for both horizontal and vertical duct arrangements.

C. Concrete. Use Grade 40 steel reinforced, Class A red concrete as duct encasement. Single conduit duct banks do not require steel reinforcement, but do require Class A red concrete encasement.

PART 3 EXECUTION

3.01 PREPARATION

A. Verify from Contract Drawings and field survey that the location of duct banks 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 City Engineer and the Local Code Inspector for cover-up inspection before pouring electrical conduit ductbanks.

3.02 INSTALLATION

A. Use the size conduit indicated on the Contract Drawings for the various duct banks required for the project. Conduit type is indicated in Section 16111 – Conduit, Fittings and Bodies. Install duct banks in accordance with the "Typical Duct Bank Installation" details in the Contract Documents.

B. Provide 12 inch minimum spacing between Instrumentation ducts containing low voltage (below 50VAC) or signal (4-20ma and 0-10V) conductors and ducts containing power or control voltages (120VAC and above).

C. Make duct bank installations and penetrations through foundation walls watertight.

D. 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.

E. Provide a 3-inch minimum structural 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.

F. Firmly fix ducts in place during pouring of concrete. Carefully spade and vibrate the concrete to ensure filling of spaces between ducts.

G. Make bends with sweeps of radius not less than 12 times the smallest diameter of the raceway.

H. Make a transition from Schedule 40 PVC to epoxy fiberglass conduit where duct banks enter structures or turn upward for continuation above grade. Transition from PVC riser or fiberglass 90 degree elbow to above ground conduit shall be concrete encased.

I. Make bends of 15 degrees or more using epoxy fiberglass conduit.

J. Reinforce all duct banks with two or more ducts. Single conduit duct banks do not require steel reinforcement, however duct bank marker tape is required.

   1. Unless otherwise noted on the Contract 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. 4 stirrups transversely placed at 36-inch maximum longitudinal intervals.

   2. Maintain a maximum clearance of 2 inches from bars to the edge of the concrete encasement.

K. Where ducts enter structures such as handholes, manholes, pull boxes, or buildings, terminate the ducts in suitable end bells, insulated L-bushings, Meyers (or approved equal) hubs or couplings on steel conduits. Tag conduit entering pull boxes and manholes with stamped, stainless steel tags. Identify as designated in cable and conduit schedule or on the plans in the Contract Drawings.

L. 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.

M. Install a bare stranded 4/0 copper duct bank ground in each duct bank envelope where a duct contains a circuit above 200 Amp or Voltage exceeds 600. Make ground electrically continuous with the source and destination grounding provision. Connect duct bank ground to manhole

ground ring, where applicable, switchgear ground bus (if available) or equipment support frame if no bus exist.

N. After completion of the duct bank and prior to pulling cable, pull a mandrel, not less than 12 inches long and with a cross section approximately one-fourth inch less than the inside cross section of the duct, through each duct. Then pull a rag swab or sponge through to remove any particles of earth, sand or gravel that may have been left in the duct. Re-pull the rag or sponge swab until the swab emerges clean.

O. Use hemp rope to pull conductors into PVC conduit. Do not use nylon or wire cable for this purpose.

P. Install a warning ribbon approximately 12 inches below finished grade over underground duct banks. Refer to Section 16195 - Electrical Identification.

Q. For manholes and pull boxes below grade, install a non-metallic cable rack system to support cables properly around the perimeter of the manholes or pull box. Cables shall be supported on a maximum of 18 inch spacing and shall not be allowed to contact manhole or pull box bottom surface.

END OF SECTION

SECTION 16461
DRY TYPE TRANSFORMERS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. General purpose, dry type transformers.
2. Drive isolation transformers.
3. Control and signal transformers.

1.02 MEASUREMENT AND PAYMENT

A. No separate payment will be made for work performed under this Section.

1.03 RELATED SECTIONS

A. Specification 16195, Electrical Identification.

1.04 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.

1.05 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.

1.06 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.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Cutler Hammer

B. General Electric

C. Square D

2.02 TRANSFORMERS, GENERAL

A. Transformers:

1. Factory-assembled and tested, air-cooled units of types specified, having characteristics and ratings as indicated.

2. Design unit for 60 Hz service.

B. Cores: Grain-oriented, non-aging silicon steel.

C. Coils: Continuous windings without splices, except for taps.

D. Internal Coil Connections: Brazed or pressure type.

E. Bolt coil/core to bottom of enclosure for transformers larger than 15 kVA.

1. Isolated by rubber, vibration-absorbing mounts.

2. Metal-to-metal contact between coil/core and enclosure not allowed.

F. Provide copper windings, aluminum windings are not acceptable.

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.

2.03 GENERAL PURPOSE, DRY TYPE TRANSFORMERS

A. Comply with NEMA ST 20.

B. Windings: 2-winding type. 3-phase transformers shall use 1 coil/ phase in primary and secondary.

C. Transformers shall have following features and ratings.

1. Enclosure: Indoor, ventilated unless otherwise shown on Contract 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: 80oC maximum rise above 40oC 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 Contract 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.

2.04 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.

PART 3 EXECUTION

3.01 INSTALLATION

A. Arrange equipment to provide adequate spacing for cooling air circulation.

B. Install Mini Power Center with Load center cover hinge at 72" above finish grade or floor.

C. All transformer termination lugs shall be copper, aluminum is not acceptable. All termination hardware shall be 316 SS.

D. 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.

E. Install wall-mounted transformers on prefabricated brackets, designed for purpose, with a minimum of ¼" spacing from wall.

F. Install floor-mounted transformers on vibration pads on 3-1/2-inch concrete housekeeping pad.

G. Touch up scratched or marred surfaces to match original finish.

H. Identify transformers as specified herein.

3.02 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.

3.03 ADJUSTING

A. Adjust transformer taps to provide optimum voltage conditions at utilization equipment.

3.04 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.

3.05 PROTECTION

A. Temporary Heating: Comply with manufacturer's written recommendations within enclosure of each transformer throughout periods during which equipment is not in a space continuously under normal control of temperature and humidity.

END OF SECTION

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SECTION 16475
OVERCURRENT PROTECTIVE DEVICES

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Overcurrent protective devices (OCPDs) rated 600 V and below and switching devices commonly associated with OCPDs.

B. Circuit breakers installed in panelboards are specified in Section 16161 – Panelboards.

1.02 MEASUREMENT AND PAYMENT

A. No separate payment will be made for work performed under this Section.

1.03 RELATED SECTIONS

A. Specification 16195, Electrical Identification.

1.04 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.

1.05 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.

1.06 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 indicated to be provided in the project documents.

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.

1.07 QUALITY ASSURANCE

A. Items provided under this section shall be listed and labeled by UL or other Nationally Recognized Testing Laboratory (NRTL).

1. Term "NRTL" shall be as defined in OSHA Regulation 1910.7.

2. Terms "listed" and "labeled" shall be as defined in National Electrical Code, Article 100.

B. Regulatory Requirements:

1. Components and Installation:
   a. NFPA 70 "National Electrical Code (NEC)."
   b. Local codes and ordinances.

C. Single-Source Responsibility: Obtain similar OCPDs from single manufacturer.

D. Coordinate OCPD sizes with characteristics of motors supplied for this project. Pay special attention to high efficiency motors.

1.08 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.

PART 2 PRODUCTS

2.01 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.

2.02 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.

2.03 FUSIBLE SWITCHES

A. Acceptable Manufacturers:

1. Cutler Hammer

2. General Electric

3. Square D Co.

B. UL 98 and NEMA KS 1 quick-make, quick-break heavy-duty units.

C. Rating: Load-breaking capacity in excess of normal horsepower rating for switch.

D. Withstand Capability: In excess of let through current permitted by its fuse when subject to faults up to 100,000 RMS symmetrical amperes.

E. Operation: By means of external handle.

F. Interlock: Prevents access to switch interior except when in "off" position.

G. Fuse Clips: Rejection type.

H. Padlocking Provisions: For 2 padlocks, whether open or closed.

I. Enclosure for Switchboard or Panelboard Mounting: Suitable for panel mounting where indicated.

J. Enclosure for Switchboard Mounting: Provide individual mounting where indicated.

K. Enclosure for Independent Mounting: NEMA type as indicated or required to suit environment where located.

2.04 MOLDED-CASE CIRCUIT BREAKERS

A. Acceptable Manufacturers:

1. Cutler Hammer

2. General Electric

3. Square D Co.

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 enclosure, as indicated or required to suit environment where located.

2.05 INSULATED-CASE CIRCUIT BREAKERS

A. Acceptable Manufacturers:

1. Cutler Hammer

2. General Electric

3. Siemens Energy and Automation

4. Square D Co.

B. UL 489 and NEMA AB 1.

C. Ratings: Continuous-current, interrupting, and short-time-current ratings, and voltage and frequency ratings as indicated.

D. Operating Mechanism: Mechanically and electrically trip-free, stored-energy operating mechanism with following features:

1. Moving Contacts Closing Speed: Independent of both control and operator.

E. Circuit-Breaker Features and Accessories: Include following:

1. Operating Handle: Provide 1 for each manually operated breaker. No handle ties are permitted.

PART 3 EXECUTION

3.01 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.

D. Coordinate size overcurrent protective devices with each motor and equipment manufacturer to assure correct size devices and provide accordingly.

3.02 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.

C. Combination Starters: Class J or RK1, time delay.

3.03 IDENTIFICATION

A. Identify with components as specified in Section 16195.

3.04 CONTROL WIRING INSTALLATION

A. Install wiring between OCPDs and control/indication devices as specified in Section 16120 for hard wired connections.

3.05 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.

3.06 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 16170.

3.07 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 ½ 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 man day for Instructional Services.
   b. 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.

2. 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.

3. Visual and mechanical inspection: Include following inspections and related work.
   a. Overcurrent-Protective-Device Ratings and Settings: Verify indicated ratings and settings to be appropriate for final system arrangement and parameters. Where discrepancies are found, test organization shall recommend final protective device ratings and settings. Use accepted revised ratings or settings to make final system adjustments.
   b. Inspect for defects and physical damage, NRTL labeling, and nameplate compliance with current single line diagram.
   c. Exercise and perform operational tests of mechanical components and other operable devices in accordance with manufacturer's instruction manual.

d. Check tightness of electrical connections of OCPDs with calibrated torque wrench. Refer to manufacturer's instructions for proper torque values.
e. Clean OCPDs using manufacturer's approved methods and materials.
f. Verify installation of proper fuse types and ratings in fusible OCPDs.

3.08 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.

END OF SECTION

SECTION 16476
DISCONNECTS AND CIRCUIT BREAKERS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Service disconnects.
2. Feeder and equipment disconnects.
3. Enclosed circuit breakers.

1.02 MEASUREMENT AND PAYMENT

A. No separate payment will be made for work performed under this Section.

1.03 RELATED SECTIONS

A. Specification 16195, Electrical Identification.

1.04 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.

1.05 QUALITY ASSURANCE

A. Items provided under this section shall be listed or labeled by UL or other Nationally Recognized Testing Laboratory (NRTL).

1. Term "NRTL" shall be as defined in OSHA Regulation 1910.7.

2. Terms "listed" and "labeled" shall be as defined in National Electrical Code, Article 100.

B. Regulatory Requirements:

1. National Electrical Code (NEC): Components and installation shall comply with National Fire Protection Association (NFPA) 70.

C. Single Source Responsibility: Enclosed switches and circuit breakers shall be product of a single manufacturer.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Fusible Switches:

1. Cutler Hammer

2. General Electric

3. Square D

B. Molded Case Circuit Breakers:

1. Cutler Hammer

2. General Electric.

C. Square D

2.02 ENCLOSED SWITCHES

A. Enclosed Non-fusible Switch: NEMA KS 1, Type HD handle lockable with 2 padlocks.

B. Enclosed Fusible Switch, 800 Amperes and Smaller: NEMA KS 1, Type HD, clips to accommodate specified fuses, enclosure consistent with environment where located, handle lockable with 2 padlocks, and interlocked with cover in CLOSED position.

2.03 ENCLOSED CIRCUIT BREAKERS

A. Enclosed Molded Case Circuit Breaker: NEMA AB 1, handle lockable with 2 padlocks.

B. Characteristics:

1. Frame size, trip rating, number of poles, and auxiliary devices as indicated

2. Interrupting capacity rating to meet available fault current, 10,000 symmetrical rms amperes minimum

3. Appropriate application listing when used for switching fluorescent lighting loads or heating, air conditioning, and refrigeration equipment.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install enclosed switches and circuit breakers in locations as indicated, according to manufacturer's written instructions.

B. Install enclosed switches and circuit breakers level and plumb.

C. Install wiring between enclosed switches and circuit breakers and control/indication devices.

D. Connect enclosed switches and circuit breakers and components to wiring system and to ground as indicated and instructed by manufacturer. Tighten connectors and terminals, including screws and bolts according to equipment manufacturer's published torque tightening values for equipment connectors. Where manufacturer's torqueing requirements are not indicated, tighten connectors and terminals according to tightening torques specified in UL Standard 486A.

3.02 FIELD QUALITY CONTROL

A. Manufacturer's Field Services:

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.

3.03 ADJUSTING

A. Set field adjustable enclosed switches and circuit breaker trip ranges as indicated.

3.04 CLEANING

A. After completing system installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finish including chips, scratches, and abrasions.

END OF SECTION

SECTION 16481
MOTOR CONTROLLERS

PART 1 GENERAL

1.01 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.

1.02 MEASUREMENT AND PAYMENT

A. No separate payment will be made for work performed under this Section.

1.03 RELATED SECTIONS

A. Specification 16195, Electrical Identification.

1.04 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.

1.05 SUBMITTALS

A. Submit all products covered under this section for Engineer's 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.

1.06 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.

1.07 COORDINATION

A. Coordinate features of controllers and control devices with pilot devices and control circuits provided under other sections of Specifications covering control systems.

B. Coordinate motor controls, starters and overcurrent devices with motor manufacturer's data. Provide motor manufacturer's data sheets to motor control manufacturer at time of order.

1.08 MAINTENANCE

A. Extra Materials:

1. Spare Fuses, Indicating Lamps and Lenses: Furnish one spare for every 5 installed units, but not less than one set of 3 of each kind.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Manual and Magnetic Motor Controllers:

1. EATON

2. General Electric

3. Square D Company

2.02 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. Overload devices to require manual reset after tripping occurs.

3. Enhanced Protection Overload Relay: Provide overload relays with NEMA Class 10 tripping characteristics for submersible equipment or where indicated on the contract drawings. 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.

2.03 MANUAL MOTOR CONTROLLERS

A. Quick-make, quick-break toggle action.

B. Doublebreak silver alloy contacts.

C. Pilot light.

D. Padlocking provision.

2.04 MAGNETIC MOTOR CONTROLLERS

A. Full voltage, non-reversing, across-the-line, magnetic controller, except where another type indicated.

B. Control Circuit: 120V. 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: 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.

2.05 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: Heavy duty industrial type auxiliary and adjustable time-delay relays.

F. Elapsed Time Meters: Heavy duty with digital readout in hrs.

G. Current Sensors: Rated to suit application.

H. Pilot Lights: High intensity LED type lamp.

PART 3 EXECUTION

3.01 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 rack, hot dip galvanized after fabrication with 316 SS strut for cross support. Use feet consisting of min. 3/8 in. thick steel plates, 8 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.

3.02 IDENTIFICATION

A. Comply with Section 16195.

3.03 CONTROL WIRING INSTALLATION

A. Install wiring as specified in Section 16120.

B. Install wiring in enclosures bundled, trained, and supported.

3.04 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.

3.05 FIELD QUALITY CONTROL

A. Manufacturer's Field Services:

1. Supplier's or manufacturer's technician for equipment specified herein shall be present at job site or classroom designated by Owner for minimum man-days indicated, travel time excluded, for equipment adjustment, and training of Owner's personnel for plant operation. Include minimum of:
   a. 1/2 man day for Instructional Services.

B. Testing:

1. Reports: Notify Engineer in writing indicating defective materials and workmanship and unsatisfactory test results. Include records of repairs and adjustments made.

2. On completing installation of system, perform following tests.
   a. Make insulation resistance tests of conducting parts of motor control components; and of connecting supply, feeder, and control circuits. For devices containing solid-state components, use test equipment and methods recommended by manufacturer.
   b. Make continuity tests of circuits.
   c. Review updating of final system configuration and parameters where they supplement or differ from those indicated in original Contract Documents.
   d. Review manufacturer's written instructions for installation and testing of motor control devices.

3. Visual and Mechanical Inspection: Include following inspections and related work.
   a. Motor Control Device Ratings and Settings: Verify ratings and settings as installed are appropriate for final loads and final system arrangement and parameters. Recommend final protective device ratings and settings where differences found. Use accepted revised ratings or settings to make final system adjustments.
   b. Inspect for defects and physical damage and nameplate compliance with Drawings.
   c. Exercise and perform operational tests of mechanical components and other operable devices in accordance with manufacturer's written instructions.
   d. Check tightness of electrical connections of devices with calibrated torque wrench. Use manufacturers 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 30V unacceptable.

5. Correct deficiencies and retest motor control devices. Verify by system tests that specified requirements are met.

3.06 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.

END OF SECTION

SECTION 16485
MEDIUM VOLTAGE ADJUSTABLE SPEED DRIVES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. This specification covers the complete labor, materials, equipment and incidentals required to place into operation integrated 4.16 kV medium voltage adjustable speed drive (ASD) systems each with redundant cell bypass for the following existing High Service Pump Motors: 08-P-01, 08-P-03, 08-P-06 and 08-P-08. The **Electrical Contractor** shall furnish the equipment addressed in this specification.

B. Every adjustable speed drive system shall consist of all system components required to meet the performance, protection, safety, testing, and certification criteria of this specification. These components may include incoming harmonic filter / power factor correction unit, input isolation transformer, ASD converter/DC-link/inverter, and output filter.

C. The ASD system shall:

1. Represent a fully integrated and serviceable package.

2. Include all material necessary to interconnect any ASD system elements, even if shipped separately.

D. Any modifications to a standard product provided to meet this specification shall be performed by the ASD manufacturer only.

E. The ASD system, as defined in Paragraphs 1.01.B and 1.01.C above, shall be completely factory pre-wired, assembled and then tested as a complete package by the ASD manufacturer, to assure a properly coordinated, fully integrated drive system.

F. Any third party certification, safety or protection requirements shall be applied to the ASD system as a whole. Certification or protection of system elements or individual components by themselves alone is not acceptable.

1.02 MEASUREMENT AND PAYMENT

A. No separate payment will be made for work performed under this Section. Include the cost for this work in the lump sum base bid.

1.03 CODES AND STANDARDS

A. Provide equipment in full accordance with the latest applicable rules, regulations, and standards of:

1. National Electric Code (NEC)

2. Underwriters' Laboratories (UL)

3. American National Standards Institute (ANSI)

4. National Electrical Manufacturers Association (NEMA)

5. Institute of Electrical and Electronics Engineers (IEEE)

6. Federal Communications Commission (FCC)

B. ASD systems shall be manufactured, assembled, tested and provided with a UL label for the integrated ASD systems.

1.04 RELATED SECTIONS

A. Specifications 01782 and 01782S – Operations and Maintenance Data

B. Specification 16195 – Electrical Identification

1.05 QUALITY STANDARDS

A. Adjustable frequency drives shall be manufactured by the ASD supplier at its own facility which has a quality assurance program that is certified in conformance with ISO Standard 9001.

1.06 ASD MANUFACTURER'S QUALIFICATIONS

A. The ASD manufacturer shall be able to demonstrate at least ten years of experience in manufacturing ASD's at medium voltage, and to demonstrate their capability to provide parts and service support. A user's list of similar design equipment, complete with contact names and telephone numbers, shall be furnished upon request.

B. It is the intention of this specification to purchase dependable and reliable equipment offering the best performance available from currently proven technology. All equipment furnished under this contract must, therefore, have documentation showing proof of actual operation for a minimum of three years in similar service. New components or design topologies that have less than ten years of actual operating experience will not be acceptable.

1.07 SUBMITTALS (FOR REVIEW/APPROVAL)

A. Submit the following under the provisions of Section 01330 – Submittal Procedures:

1. Master drawing index

2. Front view elevation

3. Floor plan

4. Top view

5. One line diagram and three line diagrams

6. Controls diagrams

7. External interconnection diagrams showing all power, control, and protection cabling required to connect the ASD System at the project site.

8. Nameplate schedule

9. Components list

10. Conduit entry/exit locations

11. Assembly ratings, including:
    a. Short circuit rating
    b. Input voltage range
    c. Nominal input voltage
    d. Maximum continuous input current and voltage ratings
    e. Maximum continuous output current
    f. Maximum continuous output current for one minute
    g. Basic Impulse Level (BIL)

12. Major component ratings, including:
    a. Voltage
    b. Continuous Current

13. Overall physical size and weight

14. Physical size and weight of each shipping section

15. Cable terminal sizes

16. Input current at 100%, 75%, 50% and 25% load

17. Efficiency and power factor at 100%, 75%, 50% and 25% load.

18. Sound level at one meter from equipment in all directions.

19. Current and Voltage Harmonic Distortion Analyses

20. Descriptive bulletins

21. Product data sheets

22. Installation information

1.08 SUBMITTALS (FOR RECORD PURPOSES)

A. The following information shall be submitted for record purposes, in accordance with Section 01330:

1. Final as–built drawings and information listed in the previous paragraph in this specification.

2. Wiring diagrams

3. Certified test reports

1.09 HANDLING, STORAGE, DELIVEY

A. Equipment shall be handled in accordance with the manufacturer's instructions. Use manufacturer recommended lifting devices and rollers to move equipment to final position.

1.10 OPERATION AND MAINTENANCE MANUALS

A. Provide Operation and Maintenance manuals in accordance with Sections 01782 and 01782S.

B. One copy of the Operation and Maintenance manuals shall be shipped with the equipment. Operation and Maintenance manuals shall include all items listed under above paragraphs titled, "SUBMITTALS (FOR REVIEW/APPROVAL)" and "SUBMITTALS (FOR RECORD PURPOSES)".

C. Provide additional copies of Operation and Maintenance manuals as indicated in Section 01782 – Operation and Maintenance Data.

1.11 COMPLETE SYSTEM

A. Provide a complete system which adjusts the speed of a pump motor during normal operating conditions. Provide all components required for a functional, operational system.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Siemens LDR (Robicon) Perfect Harmony Series

B. An approved equal product by another ASD manufacturers if submitted to the engineer and formally approved no later than 14 days prior to the bid date.

C. The listing of a specific manufacturer does not imply acceptance of products that do not meet the specified ratings, features and functions.

2.02 PERFORMANCE

A. Operating Envelope

1. ASD shall meet the following speed and torque requirements:

2. The ASD shall be capable of producing a variable AC voltage/frequency output to provide continuous operation over the normal system 30-100% speed range. The ASD must be capable of sustained operation at 1/10 speed to facilitate checkout and maintenance of the driven equipment. As a commissioning and troubleshooting feature, the ASD power circuit shall be capable of operating without a motor connected to the ASD output.

3. ASD shall be capable of operating any standard AC motor of equivalent rating (horsepower and speed) over the specified speed range.

4. For variable torque loads, the ASD shall be capable of a momentary overload of 110% of rated motor current for one minute out of any ten minutes.

5. The ASD shall be able to produce full rated torque at any speed in the operating range.

6. If high breakaway/starting torque is required, the ASD shall provide full rated torque at standstill and be capable of sustaining that level of torque indefinitely.

B. Input Harmonics

1. ASD's shall comply with the latest edition of IEEE 519 for total harmonic voltage and current distortion calculation and measurement and meet the following distortion limits:

2. Voltage Harmonics: Individual or simultaneous operation of ASD's shall not add more than 3% total harmonic voltage distortion while operating from the utility source.

3. Current Harmonics: Maximum allowable total harmonic current distortion limits for each ASD shall not exceed 5% as calculated and measured at the point of common coupling.

4. The ASD converter section shall be 18 or more pulse (or equivalent harmonic performance without filters) to eliminate the need for harmonic filters. Harmonic filters are undesirable due to the necessity to modify the filters to avoid resonance problems and correct tuning whenever other inductive/capacitive loads are placed on the system or when the power system changes.

5. Compliance shall be verified by the ASD manufacturer with field measurements of harmonic distortion differences at point of common coupling with and without ASD's operating. The point of common coupling (PCC) for all harmonic calculations and field measurements for both voltage and current distortion shall be defined as the primary connection of each ASD input transformer.

6. Power quality metering shall be installed in the ASD system to continuously monitor and display input and output power quality. This will allow easy customer verification of

power quality and efficiency for the ASD system. The power quality data shall include the following:

a. Input voltage (average rms value)
b. Input current (individual phase rms values and average rms value)
c. Input frequency
d. Power factor
e. Input kW, kVAr
f. Input kWHr
g. Input current THD (average of three phases)
h. Calculation of total input current or voltage harmonic demand distortion
i. Drive efficiency
j. Motor voltage (rms)
k. Motor current (rms)
l. Motor speed (in RPM or %)
m. Motor flux (%)
n. Motor torque (%)
o. Drive output power (kW)
p. Output kWHr

C. Motor Compatibility

1. ASD system shall provide an output waveform that will allow utilization of standard motors, without need of any special insulation or derating. Motor life expectancy shall not be compromised in any way by operation with the ASD system. The system must comply with all elements of the Output Harmonics section of this specification. The ASD must provide motor overload protection in any operating condition.

2. ASD output waveform shall be suitable for operating a squirrel cage induction motor without derating or requiring additional service factor. To ensure that there are no problems with motor heating, ASD output current waveform, as measured at the motor, shall be inherently sinusoidal at all speeds, with a total harmonic current distortion not exceeding 3% referenced to the full load output current fundamental between 10% and 100% speed. ASD's utilizing output transformers are not acceptable.

3. The system design shall not have any inherent output harmonic resonance in the operating speed range.

4. The ASD output shall produce no electrically induced pulsating torque to the output shaft of the mechanical system eliminating the possibility of exciting a resonance caused by ASD induced torque pulsations. ASD systems, or other types, which produce torque pulsations in excess of 1%, will require a torsional analysis to be supplied by the ASD manufacturer as part of the scope of supply. The cost of the torsional analysis shall be included in the base price of the ASD.

5. ASD shall inherently protect motor from high-voltage dv/dt stress, independent of cable length to motor. ASD shall not require nonstandard insulation systems or insulation ratings above the ASD output voltage rating. The ASD system shall be designed to produce no standing waves or over-voltage conditions based on a cable length of at least

2000 ft. This is a typical length which will cover most application requirements and allow for potential future cable run changes from ASD to motor. If the ASD requires an output filter to meet this requirement, it shall be an integral part of the ASD system and included within the ASD enclosure.

6. An input transformer shall be included to provide common mode voltage protection and allow the use of a standard motor. Special high-voltage motor insulation is not an acceptable method for protection against common mode voltages.

D. ASD System Efficiency

1. Guaranteed minimum total ASD system efficiency shall be a minimum 96% at 100% load and minimum 95% at 50% load. Efficiency evaluation shall include input transformer, harmonic filter, ASD converter, and output filter. Auxiliary controls, such as internal ASD control boards, cooling fans or pumps, shall be included in all loss calculations.

2. A factory test shall be performed at the ASD manufacturer's facility certifying that efficiencies have been met.

E. System Input Power Factor

1. ASD system shall maintain a 95% minimum true power factor from 30% to 100% of rated speed. ASD system including harmonic filter shall never have a leading power factor under utility or generator operation. ASD manufacturer shall not supply a power factor correction system to meet this requirement.

F. Speed Regulation

1. ASD speed regulation shall be ±0.5% without encoder or tachometer feedback.

G. Sound Level

1. Maximum allowable audible noise from the ASD system will be 75 dB(A) at a distance of one meter at any speed or load condition. ASD systems with audible noise in excess of this limit must be provided with sufficient noise abatement treatment to reduce the sound pressure level below 75 dB(A).

2.03 DESIGN CALCULATIONS

A. Torsional Analysis

1. If a torsional analysis is required, as defined by the output waveform section (paragraph 2.02.C.4.), a torsional analysis shall be included as part of the ASD system. The total rotating system shall be analyzed to determine its natural resonant frequencies. Stresses are to be calculated for elements of the rotating system, utilizing torsional excitation data from the drive and driven system, taking into account potential fault conditions, and appropriate amplification and damping factors of the rotating system. A written report on the analysis shall detail the procedures used and the assumptions that were considered shall

be provided. The results of the analysis must be presented in both detailed and summary form. Specific data presented shall include the following: a) a diagram of the frequencies of the torque pulsations and the mechanical resonant frequencies showing their coincident points; b) a plot of total shaft stress versus operating speed for the most highly stressed areas of the rotating system; c) a diagram of the rotating system model and mode shapes for resonance(s) of interest; d) Tables summarizing total calculated stresses for each element of the rotating system at operating speeds where interference(s) exist between torsional excitations and torsional resonance; e) details of the rotating system used in the analysis, including the specified or a recommended alternate coupling; f) recommendations for any modifications to the proposed system, if indicated by the analysis to be advisable, which cost shall be borne by the ASD system supplier.

2.04 ADDITIONAL FEATURES

A. Firing Signals

1. All internal firing signals, and other communications (which link operational controls with power components such as status and diagnostic signals) must meet noise immunity and safety requirements as defined by applicable IEEE Standards.

B. Failed Power Switching Device – Continued Operation Capability

1. The failure of any single power switching device (SCR, GTO, diode, IGBT, IGCT, etc.) or any single switching device control shall not result in a process trip and shall continue operation of the ASD system at full (100%) motor load. In the event of a device or device control failure, the ASD shall annunciate and identify the specific location of the failed device and shall continue operation at full motor (100%) load until such time as repairs can be scheduled.

C. Power Interrupt Ride-Through

1. The ASD system must be capable of continuous operation in the event of a power loss of 5 cycles or less.

2. The ASD system must be capable of automatically restarting in the event of a momentary loss of power. The ASD system shall provide the user with the choice of automatically restarting or not. The user shall be able to selectively apply this feature and have the ability to set the allowable restart time applicable to some (but not necessarily all) conditions as determined by the user to be appropriate for the specific application.

D. Power Sag Ride-Through

1. The ASD system shall be capable of continuous operation with a thirty (30) percent voltage sag on the input power line.

E. "Catch-A-Spinning-Load" Capability

1. The ASD system must be able to catch and take control of a spinning load if started while rotating equipment is already spinning. Appropriate safeguards must be included in this operation to prevent damaging torque(s), voltages or currents from impacting any of the equipment. The user shall have the option of employing this feature or disabling it.

F. Auto-Restart Capability

1. The ASD system must be capable of automatically restarting in the event of a process or drive trip. The ASD system shall provide the user with the choice of automatically restarting or not. The user shall be able to selectively apply this feature to some (but not necessarily all) conditions as determined by the user to be appropriate for the specific application.

G. Ground Faults

1. In the event of an input or output ground fault, the ASD shall be capable of annunciating the ground fault condition, safely operating and, by user selection, either trip or continue operation. As a result of a ground fault trip, the ASD shall be capable of being reset and operating normally. There shall be no risk of fire or electric shock as a result of the ground fault.

H. Redundant Cell Bypass

1. Redundant cell bypass is required so that up to 4 cells can be automatically bypassed and the ASD will continue to run up to 100% speed without interruption.

2.05 SERVICEABILITY/MAINTAINABILITY

A. Front Access

1. ASD system should be designed for front access only. Manufacturer shall state in his proposal if rear or side access is required. An explanation of the reason for any required rear or side access shall be given.

B. Power Component Accessibility

1. All power components in the converter sections shall be designed for rack-out accessibility for ease of maintenance and to minimize repair downtime.

2. Those systems that employ a single integrated power conversion module that is not site repairable or easily accessible by maintenance personnel are not acceptable.

C. Voltage Isolation

1. All low voltage components, circuits and wiring shall be separated with physical barriers from any sources of medium voltage.

D. Remote Diagnostics

1. The ASD system shall be provided with the capability for remote diagnostics via Ethernet link.

E. Marking/Labeling

1. Sleeve type wire marker tags shall be applied to each end of each power, control and data wire/cable. Individual labels shall be provided for all major components of the ASD system. Wire marker tags and component labels shall comply with Specification 16195 – Electrical Identification.

F. Mean Time To Repair (MTTR)

1. The ASD design must demonstrate an actual mean time to repair of less than 15 minutes, in the event of any power switching component failure.

G. Site Voltage Exposure Requirements

1. ASD system shall be designed with provisions to allow for qualified service personnel to perform the necessary fault resets without accessing the interior of the ASD cabinets with power applied.

2.06 PHYSICAL REQUIREMENTS

A. Environmental Requirements

1. The ASD system shall be capable of continuous operation in an average ambient temperature between 0°C and 40°C at an elevation up to 3300 feet (1000 meters) above MSL without derating. The ASD system shall also be simultaneously suitable for continuous operation in a maximum humidity between 0 and 95% non-condensing.

B. Heat Dissipation/Cooling System

1. The ASD system shall be air-cooled by an integral fan system.

C. Air-Cooling Requirements

1. Air-cooled ASDs shall be provided with fan redundancy and automatic switchover in the event of a fan failure for enhanced reliability. If a fan fails, the system must automatically switch to the alternate fan and generate an alarm to notify operator of initial fan system failure. Drive must have ability to detect failed operation of the cooling system (using temperature detectors as the only protection against loss of fan system is not acceptable). During normal operation, the system must periodically cycle between the two fan systems to "exercise" them and prevent drying out of bearings, seals, etc., and to ensure availability of all systems. ASD system manufacturer shall provide heat dissipation data necessary to design HVAC systems for rooms which house ASDs.

D. Enclosure

1. All ASD system components including the transformer shall be mounted and wired by the ASD system manufacturer in a grounded enclosure meeting the following requirements without exception:

2. Input filters, transformer, power conversion, output filters and auxiliary equipment enclosure sections shall be NEMA 1 Ventilated, IP-21 or better degree of protection, with gasketed doors. Units shall have clean-able filter media covering all air inlets. Inlet air filters shall be 100% washable, with a progressively structured, corrosion-free media. Filters shall be front replaceable (for cleaning) while the ASD is in operation without exposing maintenance personnel to any of the power components. Cabinet color shall be ANSI 61 Gray. Paint procedures and materials shall be manufacturer's system designed and proven for resistance to chemical attack in industrial environments.

3. Microprocessor and control logic boards and their power supplies shall be safely accessible without exposure to high voltages and without drive shutdown. All low voltage wiring shall be fully isolated from medium voltage compartments by metal barriers.

4. Cabinets and doors shall be fabricated using heavy gauge formed or structural steel for sturdy construction for dimensional integrity to assure long-term fit and function. All doors shall be gasketed to provide environmental protection and secure fits.

5. Enclosures must be designed to avoid harmonic and inductive heating effects.

E. Cabling

1. All ASD system wiring (power, control & protection) shall be located internally within the ASD system enclosure. All external power conductors shall be insulated. Power wiring shall be isolated by voltage class. Control and protection wiring shall be isolated from power wiring.

F. Space Limitations – Footprint

1. The ASD system must fit in the space indicated on project drawings.

G. Interlocks

1. Mechanical key interlocks shall be provided on all ASD enclosure doors. Interlocking shall be fully coordinated to prevent access to all high voltage compartments, including transformer and filters when line power is applied to the ASD system. Interlocks must be mechanical to provide positive lock-out prevention and safety. Electrical interlock switches alone are not acceptable, due to the possibility of inadvertent shutdown and the ease with which such switches could be bypassed.

H. Auxiliary and Control Power

1. Auxiliary power for ASD internal cooling shall be provided at 480 volts, three phase, three wire by the installing contractor. A circuit breaker shall be provided in the ASD to disconnect 480 volt power.

2. Control power for ASD internal controls shall be provided at 120 volts, single phase, three wire by the installing contractor. A circuit breaker shall be provided in the ASD to disconnect 120 volt power.

3. Provide red warning signs with white letters on the outside of the ASD to warn personnel that external power sources exist within the ASD.

2.07 PROTECTIVE DEVICES / DIAGNOSTICS

A. Power Component Protection

1. ASD system shall include intermediate class surge arresters to protect input transformer and ASD against voltage surges.

2. The ASD system shall include power fuses on the input to the converter rectifier devices to protect the secondary of the transformer from any potentially harmful fault currents.

B. Protective Features and Circuits

1. The controller shall include the following alarms and protective features:
   a. Static instantaneous over-current and over-voltage trip.
   b. Under-voltage and power loss protection.
   c. Over-temperature protection.
   d. Electronic motor inverse time overload protection.
   e. Responsive action to motor winding temperature detectors or thermostatic switches. A dry contact (NC) input to the ASD is required.
   f. When power is restored after a complete power outage, the ASD shall be capable of catching the motor while it is still spinning and restoring it to proper operating speed without the use of an encoder.

2. The ASD system shall be protected from damage due to the following, without requiring an output contactor:
   a. Single-phase fault or three-phase short circuit on ASD system output terminals.
   b. Failure to commutate inverter thyristor due to severe overload or other conditions.
   c. Loss of input power due to opening of ASD input disconnect device or utility power failure during ASD operation.
   d. Loss of one (1) phase of input power.
   e. Motor regeneration due to backspin or loss of ASD input power.

3. The ASD shall be able to withstand the following fault conditions without damage to the power circuit components:
   a. Failure to connect a motor to the ASD output.

b. ASD output open circuit that may occur during operation.

4. The ASD shall include a customer selectable automatic restart feature. When enabled, the ASD shall automatically attempt to restart after a trip condition resulting from over-current, over-voltage, under-voltage, or over-temperature.

C. Data Displays

1. A door-mounted LCD display shall be furnished, capable of displaying the ASD operational status and drive parameters. The digital display must present all diagnostic message and parameter values in plain English.

2. As a minimum, the following door mounted digital indications shall be supplied:
   a. Speed demand in percent
   b. Input current in amperes
   c. Output current in amperes
   d. Output Frequency in hertz
   e. Input voltage
   f. Output voltage
   g. Total 3-phase KW output
   h. Kilowatt hour meter
   i. Elapsed time running meter

D. Diagnostics & Fault Recording

1. The control logic section shall be fully digital and not require analog adjustment pots or fixed selector resistors.

2. Fault log data storage memory shall be stored in non-volatile memory or be supported by a UPS sized to provide a minimum of 48 hour data retention.

3. The ASD shall include a comprehensive microprocessor based digital diagnostic system which monitors its own control functions and displays faults and operating conditions.

4. A "FAULT LOG" shall record, store, display and print upon demand, the following for the 50 most recent events:
   a. ASD mode (Auto/Manual)
   b. Date and time of day
   c. Type of fault
   d. Reset mode (Auto/Manual)

5. A "HISTORIC LOG" shall record, store, display and print upon demand, the following control variables at an adjustable time interval for the 50 intervals immediately preceding a fault trip and 100 intervals following such trip:
   a. ASD mode (manual/auto/inhibited/tripped/etc.)
   b. Speed demand
   c. ASD output frequency
   d. Demand (output) Amps

e. Feedback (motor) Amps
f. ASD output volts
g. Type of fault:
h. Drive inhibit (On/Off)
i. The fault log record shall be accessible via a RS232 serial link as well as line by line on the keypad display.

6. A "Windows-based" graphical tool suite shall be available with the ASD. This graphical PC tool shall be able to plot and display up to 8 different ASD parameters and have the ability to freeze plotting and print hard-copy versions of the plots. Capability to display at least 8 different ASD system parameters is required and all parameters displayed on the PC tool shall be synchronized with the standard keypad display.

2.08 PROGRAMMING & COMMUNICATIONS

A. User Input/Keypad

1. The door of each ASD power unit shall include a manual speed device, a mode selector marked "Manual/Automatic", a "POWER ON" light, an ASD "FAULT" light, a ASD "RUNNING" light, start pushbutton, stop pushbutton and reset pushbutton.

2. A door-mounted keypad with integral digital LCD display shall be furnished, capable of controlling the ASD and setting drive parameters. The display must present all diagnostic message and parameter values in standard engineering units when accessed, without the use of codes. The keypad shall allow the operator to enter exact numerical settings in standard engineering units. A plain English user menu (rather than codes) shall be provided in software as a guide to parameter settings.

3. Drive parameters shall be factory set in non-volatile EEPROM registers and re-settable in the field through the keypad. A minimum of six (6) levels of password security shall be available to protect drive parameters from unauthorized personnel. The EEPROM stored drive variables must be able to be transferred for programming of new or spare boards.

4. The keypad module shall contain a "self-test" software program that can be activated to verify proper keypad operations.

5. The ASD system shall have the user selectable option of programming up to three speed avoidance bands. This gives the user the ability to block out and prevent operation at any undesirable speed, such as one that may be coincident with a mechanical resonance condition.

B. Hard-wire Communication

1. Additional analog input and output signals and additional digital inputs and outputs shall be accommodated.

C. Serial Communication/Protocols / Modem or Cable

1. The ASD shall be capable of digital communication for setup of parameters, fault diagnostics, trending and diagnostic log downloading. An Ethernet port shall be door mounted.

2. The ASD shall be provided with digital communication capability to allow direct control and status communication with a Siemens S7-1214C PLC located in a compartment in the ASD. The communication protocol shall be Ethernet. Provide any additional modules required for Ethernet communication.

2.09 COMPONENT REQUIREMENTS

A. Printed Circuit Boards

1. All printed circuit boards shall be new and shall be conformally coated for moisture and chemical resistance, in addition to any dielectric coating properties. All printed circuit boards must be tested as addressed later in this specification.

B. Power Bus and Wiring

1. Main power bus shall be high-conductivity copper and plated for chemical and corrosion resistance and low losses. Bus shall be appropriately sized for the ASD continuous current rating and braced to withstand the mechanical forces caused by a momentary short circuit current of 40 kA expected at the bus. All connections shall be bolted or continuously welded. Main grounding of the ASD system shall have a common loop consisting of copper cable placed in the enclosure base. This cable will ground the base and will be attached to stainless steel grounding pads welded to the base on two locations, one at each end of the enclosure.

2. All control wiring shall be physically separated from the power wiring. Low and high voltage cables shall be physically isolated from each other. The ASD system shall be pre-wired within the enclosure. Spade type connectors are not acceptable. No soldering shall be used in connection with any wiring. Wiring shall be adequately supported to avoid tension on conductors and terminations. All wiring shall be run in surface mounted conduit or wireways. Any section of wiring outside of conduit or wireways shall be securely tied with cable ties at intervals not exceeding six inches. No cables shall be tied off to or in any way supported from power busses. Wherever wiring passes metal edges or through holes, suitable guards or grommets shall be provided to prevent cutting or chafing of the insulation.

3. All wiring shall be tagged with permanent heat shrink labels at each termination, junction box, and device. Labels shall correspond to the schematic and wiring diagrams. See Specification 16195 for wire tag labeling requirements.

C. Ground Connection

1. Corrosion resistant grounding pads shall be provided in each power cubicle. A copper ground bus shall be provided for grounding of control circuits.

D. Input Isolation Transformer

1. The ASD system is to be supplied with a drive isolation transformer to provide common mode voltage protection and phase shifting. ASD systems utilizing input three phase AC line reactors which require motors equipped with special higher voltage rated insulation systems are not acceptable.

2. Transformer design to be a rectifier grade isolation type with a K-Factor of 12 for variable torque loads or a K-Factor of 20 for constant torque loads when applied to a SCR converter, in accordance with current EPRI recommendations and ANSI/IEEE Standard C57.110. A K-Factor of 6 is required for diode rectifier converters. Transformers shall have a BIL rating in accordance with the requirements of ANSI/IEEE Standard C57.12.01.

3. Drive isolation transformers shall be dry-type, with a maximum temperature rise of 115°C over a 40°C ambient and insulation rated for 220°C and over-temperature protection.

E. DC Link Inductors

1. DC link inductors if required shall be air core type to prevent saturation. Separate inductors (split dual winding type) shall be provided in the positive and negative leg of the DC link to minimize stray magnetic fields. Maximum temperature rise shall not exceed 115°C with minimum 220°C insulation and over-temperature protection. To minimize cabling costs the inductors shall be integral to the ASD system lineup. If it is not possible to integrate the inductors into the ASD system enclosure, the cabling and connecting must be entirely supplied and/or contracted by the ASD system supplier, and approved by the City Engineer. Inductors shall meet the requirements of ANSI C57.16 and shall be designed to prevent saturation under maximum fault current conditions.

F. DC Link Capacitors

1. Capacitors used in the converter DC link shall be integral to the ASD system lineup to minimize cabling costs.

2. Capacitors used in the converter DC link shall contain discharge resistors and be capable of reducing the residual charge to 50 volts or less within five minutes after the capacitor is disconnected from the source of supply.

G. Input Harmonic Filters

1. If, after complying with paragraph 2.02.B.4., harmonic filters are still required to meet power factor requirements, stricter local requirements, or telephone interference factor restrictions, the ASD manufacturer must provide the filter, upstream filter isolation, protection and protection coordination. As harmonic filters are power system dependent,

the ASD supplier is responsible for maintaining and providing any required upgrades required for the first ten years of operation at zero cost to the City of Houston. To minimize cabling costs the harmonic filter components shall be integral to the ASD system lineup, but isolated from other components, such that they can be disconnected from the power source and accessed for maintenance/repair while the ASD is in operation. If it is not possible to integrate the filters into the ASD system enclosure, the cabling and connecting must be entirely supplied and/or contracted by the ASD system supplier, and approved by the City of Houston's Engineer. Harmonic filters must be located on the primary side of the input isolation transformer and must be switchable with the ASD, to prevent their remaining on the power line in the event of a ASD trip which could create a damaging leading power factor condition. The complete filter must have independent protection for over-current, phase differential and ground fault.

2. Any inductors used shall be iron-core or air-core with a maximum temperature rise of 115°C with minimum 220°C insulation and over-temperature protection. Reactors shall be designed to prevent saturation under maximum fault current conditions. Reactors shall meet the requirements of ANSI C57.16.

3. Capacitors used in the harmonic filter banks shall meet the requirements of IEEE 18 and IEEE 1036 for shunt power capacitors. Capacitors used in any harmonic filter banks shall be dry type and shall be provided with a method of shorting the phases to ground once power has been removed and the capacitors have been discharged to a safe voltage level.

H. Output Filters

1. If an output filter is required to meet the output harmonics requirements of this specification, or to meet any special requirements of the application, they must be fully incorporated into the ASD system design. To minimize cabling costs the output filter components shall be integral to the ASD system lineup. If it is not possible to integrate the output filters into the ASD system enclosure, the cabling and connecting must be entirely supplied and/or contracted by the ASD system supplier, and approved by the City of Houston's Engineer.

2. Any inductors used shall be iron-core with a maximum temperature rise of 115°C with minimum 220°C insulation and over-temperature protection. Reactors shall be designed to prevent saturation under maximum fault current conditions. Reactors shall meet the requirements of IEEE C57.16.

3. Capacitors used in the harmonic filter banks shall meet the requirements of IEEE 18 and IEEE 1036 for shunt power capacitors.

4. Where potential exists for self-excitation between the output filter and the motor system, a fully (voltage and current) rated output contactor shall be provided by the ASD supplier as part of the ASD system delivery.

I. Input Power Terminations

1. Input and output power connections shall be made to isolated, supported and plated bus strap connections. Sufficient space shall be provided for termination connections from the top or the bottom of the ASD cubicle. Space provisions shall be provided for application of standard stress cones, and provisions shall be provided for grounding of shielded cabling.

2. An additional cabinet shall be installed on the left side of the ASD to allow termination of incoming 5 kV power cables and outgoing 5 kV power cables to the motor from the front of the ASD. All 5 kV power cables will enter the cabinet from underground and will be terminated with standard stress cones. The upper portion of the additional cabinet shall contain a Siemens S7-1214C PLC for pump motor and discharge valve control.

2.10 FACTORY TESTING

A. Subassembly Tests

1. Printed circuit boards shall be visually inspected and functionally tested. All boards must be tested individually prior to assembly to minimize any impact faulty boards may have on delivery schedules and system reliability. Each board shall be load and temperature cycled from no load to full load and from ambient to +60°C during a 48-hour burn-in test. Any boards that exhibit drift during the test must be replaced with boards that have successfully completed the burn-in without drift.

2. Power assemblies shall be visually inspected and then HIPOT tested. Complete diagnostics and logic shall be tested. The complete power conversion circuit shall be thoroughly tested at 100% load for a minimum of one hour and then tested for one minute at momentary overload rating, to reduce potential problems in advance of final system testing.

B. System Level Tests

1. The ASD system shall be given preliminary checks including verification of electrical connections including ground connections, power and control wiring shall be resistance checked point-to-point. E-prom and EE-prom shall be checked for correct revision level. Visual check shall be performed to verify: degree of protection for cabinets, input isolation is lockable in the off-position, marking of terminals and wiring, space availability for cable termination, accessibility of components and ease of maintenance and repair. The ASD system shall be fully checked against the approved drawings for compliance and correct physical dimensions.

2. Power circuit and all control circuits shall be HIPOT tested to ground.

3. All control voltage levels are to be checked and verified.

4. A no load test is to be performed on the system. Drive is to be connected to an unloaded motor and feedback signals shall be verified. Output voltage shall be calibrated. All logic and interlocks including customer logic and instrumentation shall be tested.

5. Drive shall be given a full power test at rated current and rated voltage (simultaneously) for a minimum of four hours on a dynamometer or reactor load. This test shall be performed as an integrated system including all supplied input switchgear, input transformer, input filter (if supplied), power section and output filter (if supplied). The ASD manufacturer shall perform the factory system test to verify that total system efficiency, power factor and harmonic distortion limits are met as specified. Total system efficiency shall be measured using a Multilin PQMII or approved equivalent meters on both the input and the output of the complete system. System shall not be shipped unless specified performance criteria are met. Certified test data of all tests conducted shall be provided with final documentation.

2.11 WARRANTY

A. All equipment furnished under this specification shall have a 60 month warranty from the date of certified start-up. The warranty shall include all parts, labor, travel time and expenses to perform necessary work to return the ASD to service. Warranty activities shall commence within 48 hours of notification. Warranty activities shall be performed by the ASD vendor's service technicians.

2.12 SPARE PARTS

A. The following minimum spare parts shall be furnished:

1. Three of each type of power and control fuse.

2. Four of each type of power semiconductor (SCR, SGCT, IGBT, IGCT, power diode, etc.) used in the converter/rectifier or inverter.

3. Eight of each type or size of DC link capacitor.

4. Two of each type or size of input and output filter capacitor.

5. Five of each type of panel lamp.

6. One keypad

7. One fiber optic connector of each type

8. One set of replacement air filters

9. Two of each control printed circuit board, two of each type gate firing boards, include all diagnostic system printed circuit boards.

B. All parts supplied with the equipment shall be properly labeled for ease of identification and to permit the shortest possible time to repair. Any parts that come from a sub-supplier shall be

labeled with that manufacturer's name and part number. Manufacturer shall state closest point where spare parts are stocked and where service can be obtained. Minimum response time for trouble calls shall be two hours. A qualified service technician shall be on site within twenty-four hours of a qualified request. Manufacturer shall warrant that all parts shall be available for a minimum of ten years.

2.13 MAINTENANCE CONTRACT

A. Provide a 60 month maintenance contract. The maintenance contract shall commence on the date of certified start-up. The maintenance contract shall include periodic field inspection and cleaning at maximum six (6) month intervals plus repair of ASDs for the duration of the maintenance contract period. ASDs shall be repaired and back in operation within 48 hours of notification that repair is needed. The maintenance contract shall include all labor, materials and expenses so there is no additional costs for ASD maintenance and repair for the duration of the maintenance contract.

2.14 PILOT LIGHTS

A. Provide heavy duty high intensity 30mm LED type pilot lights by Eaton Electrical or Square D Company.

2.15 COORDINATION WITH DRAWINGS

A. The ASD manufacturer shall coordinate with the Contract Drawings for the required controls.

2.16 MULTILIN RELAY

A. Install a Multilin 869 relay on the output of the ASD as indicated in the diagram on contract drawing E-15. Develop and program all necessary settings into the Multilin relay.

PART 3 EXECUTION

3.01 VENDOR TRAINING

A. Provide six hours of vendor training for 8 persons. Repeat the vendor training session for 8 additional persons on a different day. Vendor training shall include both classroom training at the Owner's facility and hands-on training on the Owner's equipment.

B. Vendor training session topics shall include safety, hardware layout and functions, power & control wiring, diagnostic indicators, keypad/display interface, software mapping, programming, setup, configuration, control loop tuning, operational indicators, faults, diagnostic tools, troubleshooting, and preventive maintenance.

C. A training video shall be provided. A training video shall be professionally made of the six hour vendor training session or the vendor can assemble a training video from the vendor's factory training video library. The training video must be representative of the equipment furnished for this project. The training video shall be in DVD format as required by Specification 01782S.

D. Documentation for vendor training shall be provided to each participant which includes actual manuals for the equipment and drawings and schematics of equipment supplied for this project.

3.02 DEVICE SETTINGS AND PROGRAMMING

A. Settings for electronic devices and controllers in ASDs shall be determined by the ASD vendor. All programming of electronic devices and controllers in ASDs shall be performed by the ASD vendor. Programming of the S7-1214C PLC shall be by Division 13.

3.03 START-UP

A. The ASD system vendor shall provide the field services of factory technicians to supervise/inspect the installation plus test and start-up all equipment. All equipment required for testing, start-up and performance verification shall be provided by the start-up technician.

B. Verification of ASD input harmonic voltage and current distortion limits specified must be verified at rated speed and rated power as part of final startup and acceptance. A recording type Fluke, Multilin PQMII, BMI or equivalent harmonic analyzer displaying individual and total harmonic currents and voltages must be utilized.

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SECTION 16670
LIGHTNING PROTECTION SYSTEM

PART 1 GENERAL

1.01 SECTION INCLUDES

A. A lightning protection system, including design, installation and materials is required for all new buildings and structures.

1.02 MEASUREMENT AND PAYMENT

A. No separate payment will be made for work performed under this Section.

1.03 RELATED SECTION

A. Section 16170, Grounding and Bonding.

1.04 REFERENCES

A. American National Standards Institute/National Fire Protection Association (ANSI/NFPA)

1. NFPA No: 780 – Standard for the Installation of Lightning Protection Systems

2. NFPA No: 70 - National Electrical Code
   a. Section 250-106 – Lightning Protection Systems

B. American National Standards Institute/Underwriters Laboratories (ANSI/UL)

1. UL 96 - Lightning Protection Components

2. UL 96A - Safety Installation Requirements for Lightning Protection System

3. Lightning Protection Institute (LPI) - LPI 175 - Installation Standards

1.05 SUBMITTALS

A. Submittals the following Section 01330 - Submittal Procedures.

1. Outline dimensions and weights

2. Installation and maintenance manual

3. Catalog data

4. Complete design and construction drawings in the latest version of AutoCAD

5. Underwriters Laboratories, Inc. Master Label Certification

6. Lightning protection institute certified system certification.

1.06 QUALITY ASSURANCE

A. See Part 3.02 – INSTALLATION

1.07 PREPARATION FOR SHIPPING

A. Pack and crate materials to permit ease of handling and provide protection from damage during shipping, handling and storage.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Advanced Lightning Technology

B. East Coast Lightning Equipment

C. Harger Lightning Protection

D. Thompson Lightning Protection

2.02 DESIGN, CONSTRUCTION AND MATERIALS

A. System Design: Provide a functional and unobtrusive lightning protection system. Departures from the Drawings or submittals shall be submitted to the City Engineer for approval.

B. Repair and improvement to the existing connected structures as required to achieve the required UL Certification.

C. Lightning Protection Equipment: Materials shall be copper and bronze and of the size, weight, and construction to suit the application and used in accordance with PLI, UL, and NFPA code requirements. Use bolt type connectors and splicers for Class I and Class II structures. Pressure squeeze clamps are not acceptable. Use stainless steel mounting hardware to prevent corrosion. Air terminals shall have bullet point tips for personnel safety. All ground rods in the lightning protection system shall be 3/4" x 20'.

D. Aluminum Components: Aluminum materials may not be used except on roofs that utilize aluminum roofing components. On aluminum roofs or where aluminum parapet caps are used, utilize aluminum components for roof lightning protection equipment to ensure compatibility. However, use copper down leads and grounding with the bimetal transition occurring at the through roof assembly with an approved bimetal through roof assembly.

E. Use equipment which is UL listed and properly UL labeled. Equipment shall be new, and of a design and construction to suit the application in accordance with accepted industry standards and LPI, UL, NFPA, and NEC code requirements.

PART 3 EXECUTION

3.01 PREPARATION

A. The Contractor is responsible for all coordination between the project subcontractors, including, but not limited to, the following:

1. The lightning protection installer shall install a correct, neat and unobtrusive installation in cooperation with other trades.

2. The roofing contractor shall seal and flash protection roof lightning penetrations conforming to the roof manufacturer's recommendations. However, the lightning protection contractor shall designate locations of through roofs and submit details of through roof penetrations, as required.

3. Should the roofing manufacturer require any special walk pads, membrane patches or pavers under the components of the lightning protection system, the lightning protection installer shall install such items with the roofing materials (patches, pads, pavers, adhesive) supplied by the roofing manufacturer at no additional cost to the lightning protection installer.

4. The roofing contractor shall instruct the lightning protection installer of the proper installation procedures of the roof pads, patches, and pavers, if required.

3.02 INSTALLATION

A. Have the system installed by an experienced installation company that is UL listed, a member of the Lightning Protection Institute and an employer of Certified Master Installers of lightning protection systems.

B. A Certified Master Installer shall directly supervise the work. Provide and install a complete conductor network at the roof and include air terminals, connectors, splicers, bonds, copper down leads, and proper ground terminals.

C. Use copper down lead conductors even when aluminum is required on the roof. Do not bring down lead conductors in conduit directly through the roof. Use through roof assemblies with solid brass or stainless steel rods for this purpose. Structural steel may not be utilized for down lead conductor.

D. Upon completion of the installation, the lightning protection installer shall secure and deliver to the Contractor for submittal to the City Engineer, the Underwriters Laboratories, Inc., Letter of Findings and Lightning Protection Institute Certified System certification. The system will not be accepted without the UL Letter and the LPI certification certificate in a wall mount frame.

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SECTION 16995
RELAY AND PROTECTIVE DEVICE SETTINGS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. The City of Houston will provide protective function settings for protective relays associated with equipment protection. Protective relays also require settings for non-protective functions. Settings for non-protective functions shall be the responsibility of the Contractor. The following is a description of the type of information that will be supplied by the City of Houston as well as the type of relay settings to be provided by the Contractor. The City of Houston provided "Relay and Protective Device Settings" document is attached to the end of this Section.

1.02 MEASUREMENT AND PAYMENT

A. No separate payment will be made for work performed under this Section. Include payment in lump sum bid for work of which this is a component part.

B. Refer to Section 01270 – Measurement and Payment for unit procedures.

PART 2 EXECUTION

2.01 DESCRIPTION OF INFORMATION TO BE SUPPLIED BY THE CITY OF HOUSTON

A. Suggested protective function relay settings for specifically identified existing devices and identified new devices are included in the City of Houston list of supplied settings. Also included in the City of Houston list of supplied settings will be the relay alarm functions associated with equipment protection, such as an over-current alarm. After notice-to-proceed the successful Contractor will be loaned a complete system coordination study and associated single line diagrams for reference purposes only.

B. The "City of Houston supplied settings" document will incorporate power system and equipment information for respective devices as listed below :

1. CT ratio
2. PT ratio
3. bus voltage at breaker location
4. medium voltage breaker continuous current rating
5. low voltage breaker integral power fuse rating, where applicable
6. identification of circuit load for feeder breaker
7. transformer main secondary breaker, where applicable including transformer KVA rating

8. tie breaker, where applicable

9. proper identification of solid state relay type and model

10. identification of trip contact for micro-processor based relays

11. when required, identification of alarm contact for micro-processor based relays

2.02 PROTECTIVE DEVICES REQUIRING CITY OF HOUSTON PROTECTIVE RELAY SETTINGS

A. The following is a list of the type of devices that will be supported by the "City of Houston supplied settings" document.

1. New and existing solid state protective relays for medium voltage breakers and medium voltage motor controllers.

B. Reference the identification of the protective relays listed below in this document.

2.03 INSTALLATION OF PROTECTIVE DEVICE SETTINGS AND COMMISSIONING OF PROTECTIVE DEVICES

A. The Contactor shall install all appropriate settings in the protective relay involved in this effort. The Contractor shall build all necessary computer based data files for the micro-processor based relays, before downloading settings into the relays. The Contractor shall completely commission all protective devices and field test all protective devices in line with the manufacturer's instruction book.

B. The Contractor shall prove by documented field test each protective function and alarm function for all protective devices.

2.04 CONTRACTOR VERIFICATION OF POWER SYSTEM DATA AND EQUIPMENT DATA ASSOCIATED WITH CITY OF HOUSTON SUPPLIED SETTINGS

A. BASIC POWER SYSTEM DATA: The Contractor shall verify the "basic power system data" before installation of settings for protective relay units. This verification effort shall include such items as the respective unit PT ratios as well as primary and secondary rated voltage, phase and ground CT ratios, system phase rotation, cable size, circuit load, motor horsepower rating when applicable, and circuit transformer KVA when applicable.

B. Identification of solid state relay type and model, and proper micro-processor based relay firmware version.

C. DATA DISCREPANCIES: If there are any discrepancies in the actual "basic power system data" compared to the "City of Houston supplied settings" documentation, the City of Houston representative shall be properly notified by the Contactor. The City of Houston will advise the Contractor if any of the "City of Houston supplied settings" requires modification due to such a discrepancy.

D. To prevent possible field commissioning delays, the Contractor shall submit the "City of Houston supplied settings" for the protective relay units to the qualified technicians responsible for protective device field commissioning for a complete review before settings installation and field test begin. If there is missing or conflicting information in the "City of Houston supplied settings" for the protective relay units that becomes apparent during this preliminary review or during the installation and field test phase of the project, the Contractor shall notify the City of Houston representative immediately.

E. MODIFIED SETTINGS: If modified settings are provided by the City of Houston, as a result of the entire process described above, the Contractor shall be responsible for accepting the modified settings from the City of Houston and verifying that the modified settings meet the basic requirement that was defined by the initial discovery of a discrepancy. The Contractor shall then continue with commissioning and field testing of protective devices utilizing the latest data provided by the City of Houston. The implementation of modified settings shall be at no additional cost to the City of Houston.

F. INPUT DATA VERIFICATION: Before downloading the Contractor prepared data files into the micro-processor based protective relays the Contractor shall submit the completed data files to the City of Houston representative for review. The City of Houston will not be responsible for the portions of the data files that are not associated with equipment protection.

PART 3 RELAY AND PROTECTIVE DEVICE SETTINGS

3.01 IMPLEMENTATION

A. Implementation of "Relay and Protective Device Settings" is the responsibility of the Contractor.

B. See "Relay and Protective Device Settings" document which is attached to this section.

END OF SECTION

START OF

"RELAY AND PROTECTIVE DEVICE SETTINGS"

DOCUMENT

5.1 RELAY SETTING RECORD (SIEMENS 7SJ601)

Date 20-Mar-14

RELAY		RELAY DESCRIPTION		CT	PHASE SETTINGS							GROUND SETTINGS							COMMENTS AND ADDITIONAL SETTINGS
					Long Time			Short Time		Instantaneous		Long Time			Short Time		Instantaneous		
Device ID	Location Bus Name	Mfg.	Model Number	Ratio	PU Ip	Curve Type	Time Dial	PU I>	Delay T	PU I>>	Delay T	PU Iep	Curve Type	Time Dial	PU Ie>	Delay T	PU Ie>>	Delay T	
51/51N BUS A	12.47kV BUS A	Siemens	7SJ601	PH 1200:5 GD 1200:5	1	ANSI/ V. Inv.	5	-	-	-	-	0.09	ANSI/ Ex. Inv	3.2	-	-	-	-	Existing Settings
51/51N BUS A	12.47kV BUS A	Siemens	7SJ601	PH 1200:5 GD 1200:5	1	ANSI/ Ex. Inv	5	4	0.25	-	-	-	-	-	0.1	0.4	-	-	Recommended Settings
51/51N BUS B	12.47kV BUS B	Siemens	7SJ601	PH 1200:5 GD 1200:5	1	ANSI/ Very Inv.	5	-	-	-	-	0.09	ANSI/ Ex. Inv	3.2	-	-	-	-	Existing Settings
51/51N BUS B	12.47kV BUS B	Siemens	7SJ601	PH 1200:5 GD 1200:5	1	ANSI/ Ex. Inv	5	4	0.25	-	-	-	-	-	0.1	0.4	-	-	Recommended Settings
50-1P	138kV BUS	Siemens	7SJ601	PH 2000:5	-	-	-	-	-	1.2	0	-	-	.	-	-	-	-	Existing Settings
50-1P	138kV BUS	Siemens	7SJ601	PH 2000:5	-	-	-	-	-	1.2	0	-	-	.	-	-	-	-	Recommended Settings
50-1B	138kV BUS	Siemens	7SJ601	PH 2000:5	-	-	-	-	-	1.2	0	-	-	.	-	-	-	-	Existing Settings
50-1B	138kV BUS	Siemens	7SJ601	PH 2000:5	-	-	-	-	-	1.2	0	-	-	.	-	-	-	-	Recommended Settings
50-2P	138kV BUS	Siemens	7SJ601	PH 2000:5	-	-	-	-	-	1.2	0	-	-	.	-	-	-	-	Existing Settings
50-2P	138kV BUS	Siemens	7SJ601	PH 2000:5	-	-	-	-	-	1.2	0	-	-	.	-	-	-	-	Recommended Settings
50-2B	138kV BUS	Siemens	7SJ601	PH 2000:5	-	-	-	-	-	1.2	0	-	-	.	-	-	-	-	Existing Settings
50-2B	138kV BUS	Siemens	7SJ601	PH 2000:5	-	-	-	-	-	1.2	0	-	-	.	-	-	-	-	Recommended Settings

5.2 RELAY SETTING RECORD (SIEMENS 7SJ602)

Date: 20-Mar-14

RELAY		RELAY DESCRIPTION		CT	PHASE SETTINGS							GROUND SETTINGS							COMMENTS AND ADDITIONAL SETTINGS
					Long Time			Short Time		Instantaneous		Long Time			Short Time		Instantaneous		
Device ID	Location Bus Name	Mfg.	Model Number	Ratio	PU I>	Curve Type	Time Dial	PU I>>	Delay T>>	PU I>>>	Delay T>>>	PU Ie>	Curve Type	Time Dial	PU Ie>>	Delay T>>	PU Ie>>>	Delay T>>>	
50T/51T T1	CNP 138 kV	Siemens	7SJ602	PH 300:5	0.4	ANSI/ Ex. Inv	5.8	3.1	0,0	-	-						-	-	Existing Settings
51NT T1	T1 Neutral	Siemens	7SJ602	GD 600:5	-	-	-	-	-	-	-	0.2	ANSI/Ex. Inv	3.4	-	-	-	-	
50T/51T T1	CNP 138 kV	Siemens	7SJ602	PH 300:5	0.4	ANSI/ Ex. Inv	7	2.2	0.35	3.6	0	-	-	-	-	-	-	-	Recommended Settings
51NT-T1	T1 Neutral	Siemens	7SJ602	GD 600:5	-	-	-	-	-	-	-	0.1	ANSI/Mod. Inv	4	-	-	-	-	
50T/51T2	CNP 138 kV	Siemens	7SJ602	PH 300:5	0.4	ANSI/ Ex. Inv	5.8	3.1	0,0	-	-						-	-	Existing Settings
51NT T2	T1 Neutral	Siemens	7SJ602	GD 600:5	-	-	-	-	-	-	-	0.2	ANSI/Ex. Inv	3.4	-	-	-	-	
50T/51T T2	CNP 138 kV	Siemens	7SJ602	PH 300:5	0.4	ANSI/ Ex. Inv	7	2.2	0.35	3.6	0	-	-	-	-	-	-	-	Recommended Settings
51NT-T2	T1 Neutral	Siemens	7SJ602	GD 600:5	-	-	-	-	-	-	-	0.1	ANSI/Mod. Inv	4	-	-	-	-	

5.3 RELAY SETTING RECORD (SIEMENS 7SJ62)

Date 20-Mar-14

RELAY		RELAY DESCRIPTION		CT	PHASE SETTINGS							GROUND SETTINGS							COMMENTS
					Long Time			Short Time		Instantaneous		Long Time			Short Time		Instantaneous		AND
Device ID	Location Bus Name	Mfg.	Model Number	Ratio	PU 51	Curve Type	Time Dial	PU 50-1	Delay 50-1	PU 50-2	Delay 50-2	PU 51N	Curve Type	Time Dial	PU 50N-1	Delay 50N-1	PU 50N-2	Delay 50N-2	ADDITIONAL SETTINGS
50/51-T8A	12.47kV BUS-A	Siemens	7SJ62	PH 800:5 GD 800:5	6	ANSI/ Ex. Inv	8	20	0.2	40	0	0.5	ANSI/Ex. Inv.	5.20	0.25	0.25	-	-	Existing Settings
50/51-T8A	12.47kV BUS-A	Siemens	7SJ62	PH 800:5 GD 800:5	6	ANSI/ V. Inv	6	25	0.15	40	0	-	-	-	0.25	0.25	-	-	Recommended Settings
50/51-T8B	12.47kV BUS-A	Siemens	7SJ62	PH 800:5 GD 800:5	6	ANSI/ Ex. Inv	8	20	0.2	40	0	0.5	ANSI/Ex. Inv.	5.20	0.25	0.25	-	-	Existing Settings
50/51-T8B	12.47kV BUS-A	Siemens	7SJ62	PH 800:5 GD 800:5	6	ANSI/ V. Inv	6	25	0.15	40	0	-	-	-	0.25	0.25	-	-	Recommended Settings
50/51-T6A	12.47kV BUS A	Siemens	7SJ62	PH 200:5 GD 200:5	5	ANSI/ V. Inv	5	25	0.5	100	0.1	0.25	ANSI V. Inv	-	0.75	0.15	-	-	Existing Settings
50/51-T6A	12.47kV BUS A	Siemens	7SJ62	PH 200:5 GD 200:5	6	ANSI/ V. Inv	5	20	0.2	40	0	-	-	-	0.75	0.15	-	-	Recommended Settings
50/51-T6B	12.47kV BUS B	Siemens	7SJ62	PH 200:5 GD 200:5	5	ANSI/ V. Inv	5	25	0.5	100	0.1	0.25	ANSI Ex./ Inv.	-	0.75	0.15	-	-	Existing Settings
50/51-T6B	12.47kV BUS B	Siemens	7SJ62	PH 200:5 GD 200:5	6	ANSI/ V. Inv	5	20	0.2	40	0	-	-	-	0.75	0.15	-	-	Recommended Settings
50/51-T2A	12.47kV BUS A	Siemens	7SJ62	PH 300:5 GD 300:5	3.92	ANSI/ Ex. Inv	5	45	0	45	0	5	ANSI/ V. Inv	1.0	-	-	-	-	Existing Settings
50/51-T2A	12.47kV BUS A	Siemens	7SJ62	PH 300:5 GD 300:5	------	-------	-------	------	------	------	------	------	-------	------	------	------	------	------	See Note Below
50/51-T2B	12.47kV BUS B	Siemens	7SJ62	PH 200:5 GD 200:5	9	ANSI/ V. Inv	5	25	0.5	40	0	1	ANSI/ V. Inv	-	0.75	0.15	-	-	Existing Settings
50/51-T2B	12.47kV BUS B	Siemens	7SJ62	PH 200:5 GD 200:5	6	ANSI/ V. Inv	5	20	0.2	40	0	-	-	-	0.75	0.15	-	-	Recommended Settings
50/51-T7A	12.47kV BUS A	Siemens	7SJ62	PH 200:5 GD 200:5	9	ANSI/ V. Inv	5	25	0.3	45	0	1	ANSI/ V. Inv	00	0.75	0.15	0.25	00	Existing Settings
50/51-T7A	12.47kV BUS A	Siemens	7SJ62	PH 200:5 GD 200:5	6	ANSI/ V. Inv	5	20	0.2	40	0	-	-	-	0.75	0.15	-	-	Recommended Settings
50/51-T7B	12.47kV BUS B	Siemens	7SJ62	PH 200:5 GD 200:5	9	ANSI/ V. Inv	5	25	0.3	45	0	1	ANSI/ V. Inv	00	0.75	0.15	-	-	Existing Settings
50/51-T7B	12.47kV BUS B	Siemens	7SJ62	PH 200:5 GD 200:5	6	ANSI/ V. Inv	5	20	0.2	40	0	-	-	-	0.75	0.15	-	-	Recommended Settings

Note: We understand that several emergency diesel generators are connected to the plant via feeder T2A. At this time we do not have any information on diesel generators and associated protective equipment. It is our understand that Feeder T2A becomes main source of power upon loss of power from Center Point. Without intimate knowledge of all equipment connected to feeder T2A we can not drive settings for Siemens relay associated wth feeder T2A.

5.4 RELAY SETTING RECORD (MULTILIN 850)

Date 20-Mar-14

RELAY		RELAY DESCRIPTION		CT Ratio	PHASE SETTINGS							GROUND SETTINGS							COMMENTS AND ADDITIONAL SETTINGS
					Long Time			Short Time		Instantaneous		Long Time			Short Time		Instantaneous		
Device ID	Location Bus Name	Mfg.	Model Number		PU	Curve Type	Time Dial	SDPU	SDT	PU	Delay	PU	Curve Type	Time	SDPU	SDT	PU	Delay	
					Set x CT Prl					Set x CT Prl		Set x CT Prl		Set x 0.1	Set x CT Prl		Set x CT Pri		
50/51-HSPS1-BUSB	HSPS1-BUSA T8 Neutral	Multilin	750	PH 2000:5 GD 400:5	1.2	ANSI/ Ex. Inv	4	-	-	5	-	0.1	Definite Time	1.5	-	-	-	-	
50/51-HSPS1-BUSB	HSPS1-BUSB T8 Neutral	Multilin	750	PH 2000:5 GD 400:5	1.2	ANSI/ Ex. Inv	4	-	-	5	-	0.1	Definite Time	1.5	-	-	-	-	

5.5 ML869 MOTOR PROTECTION RELAY SETTINGS

				Phase Settings						Ground Settings			20-Mar-14
Prot Dev	Func Name	Manufacturer	Relay Type	Phase CT Ratio	FLA	O/L Pickup (PU of FLA)	O/L Curve	S/C Trip (Tap x CT Prl.)	S/C Delay (Seconds)	Ground CT Ratio	GFPU (Tap x CT Pri)	GFD (Sec.)	Comments
ML369 08-P-3	Motor Prot	Multilin	369	150/5	107	1.10	4	-	-	50/5	0.20	0.10	
ML369 08-P-4	Motor Prot	Multilin	369	150/5	107	1.10	4	-	-	50/5	0.20	0.10	
ML369 08-P-6	Motor Prot	Multilin	369	150/5	107	1.10	4	-	-	50/5	0.20	0.10	
ML369 08-P-7	Motor Prot	Multilin	369	150/5	107	1.10	4	-	-	50/5	0.20	0.10	