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

PROJECT MANUAL
NORTHWEST WASTEWATER TREATMENT PLANT IMPROVEMENTS
WBS No. R-000265-0095-4

VOLUME 1 of 2

Divisions 00 through 10

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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://documents.publicworks.houstontx.gov/document-center/cat_view/88-engineering-and-construction/92-specifications/208-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 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.

F. Bidder may decrease 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.

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 for examination by appointment, under admission by Ali Khairandish at (832) 395-5459; only during the following periods:

   a. 8:00 A.M. – 4:00 P.M.

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 March 26, 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, March 10, 2015, in 15th Floor, Conference Room No. 1546 at 611 Walker Street, Houston, Texas 77002.

END OF DOCUMENT

Document 00220

REQUEST FOR BID INFORMATION

PROJECT: Northwest Wastewater Treatment Plant Improvements

PROJECT No.: WBS No. R-000265-0095-4

TO: Bill Zod, P.E.
15th Floor
611 Walker, Houston, Texas 77002

Phone No. (832) 395-2306
Fax No. (832) 395-2344
Email Addr. bill.zod@houstontx.gov

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

This request relates to _____ (Drawing / Detail No.) and/or _____ (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.: G128-12_ Prepared by (Firm Name):_Aviles Engineering Corp.; Title: Geotechnical Investigation City of Houston for Northwest WWTP Improvements 5423 Mangum Rd. WBS No. R-000265-0095-3 Houston Texas;_Report Date: _April 2013; No. of Pages: 65

   B. Report No.: G178-13 Prepared by (Firm Name): Aviles Engineering Corp.; Title: Geotechnical Investigation Northwest Wastewater Treatment Plant Improvements WBS no. R-000265-0095-4; Report Date: March 2014; No. of Pages: 53

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 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: Northwest Wastewater Treatment Plant Improvements
Project No.: WBS No. R-000265-0095-4
Bidder: _____
(Print or type full name of business entity, such as corporation, LLC, etc)

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 MWSBE 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] Document 00460 – (POP 1) Pay or Play Acknowledgement Form

[X] Document 00470 – Bidder's MWSBE Participation Plan *(required unless no MWSBE participation goal is provided in Document 00800* (the "Goal")).

[X] Document 00471 – Pre-bid Good Faith Efforts *(required if the goal in Bidder's Participation Plan–Document 00470 is lower than the Goal).*

[X] Document 00472 – Bidder's Goal Deviation Request *(required if the goal in Bidder's Participation Plan–Document 00470 is lower than the Goal).*

[X] Others as listed: Valid official letter from OBO with your designation as a City or Local Business *(Bidder's Participation Hire Houston First)*

CONTRACT TIME

A. If offer is accepted, Contractor shall achieve Date of Substantial Completion within 570 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 Short Title	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	01110	Construction of Odor Control System Improvements as shown on the contract drawings and specified including all permits, site preparation, demolition, installation of a fan, pre-cast concrete building with ventilation, and lighting,18", 24", and 36" diameter fiberglass piping for the fan inlet and discharge lines, add a 4th biotrickling filter with control panel and foundation, duct work for the inlet and outlet lines, and dual bed granular activated carbon system, replace mist eliminators in the exhaust of the biotrickling filters, electrical, instrumentation and controls for the existing odor control system.	LS	1		
3	01110	Construction of Non-Potable Water System (NPWS) as shown on the contract drawings and specified including all permits, site preparation, demolition and installation of pumps, strainers, horizontal hydro pneumatic tank, and electrical, instrumentation and controls complete in place.	LS	1		

Bidder's Initials [ ]

4	01110	Construction of improvements to Aeration System Basins 1,2,3,4,5 and Influent Channel as shown on the contract drawings and specified including site preparation, demolition, installation of new air drops and air drop isolation valves, new coarse bubble diffusers in aeration basins 1-5 and the west side of the influent channel, new 8", 24", and 36" air main isolation butterfly valves, replacement of damaged and missing guardrails/handrails, repair cracked and damaged aeration basin beam, and implementation of Maintenance of Plant Operations, start-up, testing and site restoration complete in place. Non-rubber compressed flange and valve gaskets shall be considered to be asbestos-containing and abated during renovation/demolition activities. No notifications are required.	LS	1		
5	01110	All works related to removal and disposal of accumulated grit, scum, and solids from the entire influent channel, RAS channel, Mixed Liquor Channel, Clarifier Feed Channels, Clarifier Return Channels and Aeration Basins 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 and 11. Contractor is responsible for testing and disposal of sludge or solid waste at a waste disposal facility in accordance with local state and federal regulations.	CY	5,000		

6	01110	Construction of Sluice Gate Improvements as shown on the contract drawings and specified including site preparation, demolition, installation of gates, motorized actuators on specified gates, and electrical conduit required from MCC-8 to each gate shown on the electrical drawings complete in place.	LS	1		
7	01110	Replacement of Clarifier Drain Valve as shown on the contract drawings and specified including, demolition, excavation, protection of existing structures, trench protection, backfill, compaction, pavement replacement, sidewalk replacement, maintenance of plant operations, 12-inch plug valves, 8-inch plug valves, pipe, fittings, valve boxes, extension stems, site restoration for a complete and operating system.	LS	1		

8	01110	Construction of Scum Separation System Improvements including, but not limited to furnishing all labor and materials for the installation of equipment for the scum handling system consisting of ductile iron piping; check and plug valves; vertical mixer; submersible chopper pumps; static screen; screw conveyor; motor control center (MCC), MCC enclosure, instrumentation; electrical; plumbing; painting; concrete slab; granular paving; yard piping; sitework and revegetating all disturbed areas; selective demolition of piping, valves and associated accessories; existing vertical mixer; and scum pumps, together with related subsidiary and incidental work in accordance with the plans and specifications.	LS	1		
9	01110	Construction of Clarifier No. 6 Distribution Weir Modifications as shown on the contract drawings and specified including, maintenance of plant operations, removal of existing weir and installation of new weir plate, complete in place.	LS	1		
10	01110	Installation of Air Lift Pump Pressure Gauge Addition as shown on the contract drawings and specified including, maintenance of plant operations, demolition, and installation of pressure gauges, fittings, and appurtenances.	LS	1		

11	01110	Building Repairs as shown on the contract drawings and specified including, permits. Chemical Building repairs: demolition, removal and re-installation of bleach tanks during replacement of walkways and tank pads, cosmetic building crack repairs, and site restoration. Blower and Maintenance Building: cosmetic building crack repairs. Maintenance and Admin Building: replacement of the HVAC system, demolition and replacement of ductwork, circuit breakers, disconnects for all three units, and conduits and wiring, complete in place.	LS	1		
12	01110	Construction of Chlorine Contact Basin Improvements as shown on the contract drawings and specified including all permits, site preparation, demolition and installation of non-potable water piping and hydrants for basin cleaning, and the placement of pea-gravel concrete to slope the basin floors toward the trench drain complete in place.	LS	1		
TOTAL BASE UNIT PRICES						

C. EXTRA UNIT PRICE TABLE:

Item No.	Spec Ref.	Extra Unit Short Title	Unit of Measure	Estimated Quantity	Unit Price (this column controls)	Total in figures
1	02136	Extra removal and disposal of accumulated grit, scum, and solids from the Aerations Basins and other Channels	CY	1,000	$197.65[3]	$197,650[3]
2	05520	Extra Aluminum Guardrail Complete in Place	LF	100	$48.00[2]	$4,800[2]
3	11280	Slide Gate (54"x54")	EA	5	$30,600[2]	$153,000[2]
4	11280	Slide Gate (60"x60")	EA	3	$33,600[2]	$100,800[2]
5	02318	Extra Hand Excavation	CY	100	$15.00[3]	$1,5000[3]
6	02318	Extra Machine Excavation	CY	200	$30.00[3]	$6,000[3]
7	02318/ 02321	Extra Cement Stabilized Sand	CY	100	$50.00[3]	$5,000[3]
8	16120	Copper No. 1/0 AWG conductor with XHHW-2 insulation, installed.	LF	200	$5.00[2]	$1,000[2]
9	16120	Copper No. 4/0 AWG conductor with XHHW-2 insulation, installed.	LF	200	$10.00[2]	$2,000[2]
10	16402	2" PVC Schedule 80 Conduit installed in underground duct bank	LF	200	$3.00[2]	$600[2]
11	16402	4" PVC Schedule 80 Conduit installed in underground duct bank	LF	200	$6.00[2]	$1,200[2]
12	16402	Duct bank trenching, rebar, concrete encasement and backfill for ductbanks.	LF	100	$45.00[2]	$4,500[2]
TOTAL EXTRA UNIT PRICES						$478,050[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		Building Permits	$25,000[(1)]
TOTAL CASH ALLOWANCES			$25,000

REST OF PAGE INTENTIONALLY LEFT BLANK

E. ALTERNATES TABLE:

Item No.	Spec Ref.	Alternate Short Title	Unit of Measure	Estimated Quantity	Unit Price (this column controls)	Total Price for Alternate in figures
1		N/A				
TOTAL ALTERNATES						$_____

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 by crossing out the Minimum and noting revised price on the line above.
(3) Maximum Bid Price determined prior to Bid. Can be decreased but not increased by Bidder by crossing out the Maximum and noting revised price on the line above. A Bid that increases the Maximum Bid Price may be found non-conforming and non-responsive.
(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 preference to resident bidders.
Bidder's resident state Does or Does Not

_____ _____
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.:** R-000265-0095-4

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.

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 00459

CONTRACTOR'S STATEMENT REGARDING PREVIOUS CONTRACTS SUBJECT TO EQUAL EMPLOYMENT OPPORTUNITY

Section 60-1.7(b) of the Regulations of the Secretary of Labor requires each bidder or prospective prime contractor and proposed subcontractor, where appropriate, to state in the bid or at the outset of negotiations for the contract whether it has participated in any previous contract or subcontract subject to the equal opportunity clause; and if so, whether it has filed with the Joint Reporting Committee, the Director, an agency, or the former President's Committee on Equal Employment Opportunity all reports due under the applicable filing requirements. In any case in which a bidder or prospective prime contractor or proposed subcontractor which participated in a previous contract subject to Executive Order 10925, 11114. or 11246 has not filed a report due under the applicable filing documents, no contract or subcontract shall be awarded unless such contractor submits a report covering the delinquent period or such other period specified by the FAA or the Director, OFCCP.

Contractor has __ has not __ participated in a previous contract subject to the equal opportunity clause prescribed by Executive Order 10925, or Executive Order 11114, or Executive Order 11246.

Contractor has __ has not __ submitted all compliance reports in connection with any such contract due under the applicable filing requirements; and that representations indicating submission of required compliance reports signed by proposed subcontractors will be obtained prior to award of subcontracts.

If Contractor has participated in a previous contract subject to the equal opportunity clause and has not submitted compliance reports due under applicable filing requirements, Contractor (Proposer) shall submit a compliance report on Standard Form 100, "Employee Information Report EEO-1" prior to the award of the Contract.

Standard Form 100 is normally furnished to contractors annually, based on a mailing list currently maintained by the Joint Reporting Committee. In the event Contractor has not received the form, Contractor may obtain it by writing to the following address:

Joint Reporting Committee
1800 G Street
Washington, DC 20506

_____
(Printed or typed Name of Signatory)

_____ _____
Signature Date

_____
Title

_____
Contractor's Firm Name

NOTE: The penalty for making false statements in offers is prescribed in 18 U.S.C. 1001.

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), and a Request for Deviation from the Goal (Document 00472), the 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.

Contract Goal	**MBEGoal %**	**WBEGoal %**
	11%	7%

Bidder's Participation Plan Percentage	**SBE**	**MBE**	**WBE**	**Total**

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: _____
Bidder: _____
(Print or type full name of business entity, such as corporation, LLC, etc)

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)	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: _____
Bidder: _____
(Print or type full name of business entity, such as corporation, LLC, etc)

*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 or Proposer Name: _____ **Project Name**_____

A Bidder or Proposer that may be unable to complete or follow a Participation Plan (Document CCD-00470) to meet the Contract Goal in the Supplemental Conditions (Document 00800), must submit this completed form as well as a Goal Deviation Request Form (Document 00472), and any other documentation of "Good Faith Efforts" with the bid (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	Method of Contact	Prime Contact Date	Certified Firm Response	Results of Contact (why suitable or not suitable for work)
					Phone ☐ E-mail ☐ Fax ☐			
					Phone ☐ E-mail ☐ Fax ☐			
					Phone ☐ E-mail ☐ Fax ☐			
					Phone ☐ E-mail ☐ Fax ☐			

Authorized Signature: _____ Date: _____ Phone: _____

Print Name: _____ Email Address: _____

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 Date	Certified Firm Response	Results of Contact (why suitable or not suitable for work)
					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 00472

BIDDER'S MWSBE GOAL DEVIATION REQUEST

Bidder or Proposer Name: _____

Project Name & Bid/Contract #: _____

	MBE	WBE	SBE	Total
Department Approved MWSBE Goals	%	%	%	%
Bidder's Proposed MWSBE Goals	%	%	%	%

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

_____

_____

_____

Good Faith Efforts: Please list any efforts not listed in the Bidder's Good Faith Effort Report (Form 00471).

_____

_____

_____

_____

Date: _____ Bidder: _____

Email: _____ By: _____

Phone Number: _____ Title: _____

FOR OFFICIAL USE ONLY: Approved ☐ Not Approved ☐

OBO Representative Date: _____

_____ Title: _____

Document 00495

POST-BID PROCEDURES

1.0 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

2.0 NOTICE OF INTENT TO AWARD

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

3.0 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: **Bill Zod, P.E.,**

4.0 REQUIREMENTS OF BIDDER

A. Within10 days of receipt of Notice of Intent to Award, Low Bidder shall execute and deliver to Bill Zod, 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 Bill Zod, 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, Bill Zod, 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 00500

FORM OF BUSINESS

Please mark the box describing your firm's form of business, fill in the requested information, and include the relevant attachments.

[ ] **Corporation**
Corporate Name: _____
State of Incorporation: _____
Mailing Address: _____, _____
Type of Corporation: _____

Certificate of Assumed Name, if operating under a name different than that on the corporate charter (the Certificate must have been issued within the past 10 years to be valid)

*Certificate of Good Standing

*Certificate of Existence (if non-Texas corporation, Certificate of Authority)

[ ] **Partnership/Joint Venture**
Partnership/Joint Venture Name: _____
Mailing Address: _____, _____
Type of Partnership/Joint Venture: _____

Copy of the Partnership or Joint Venture Agreement, **or**
Affidavit with the name of the partnership or joint venture, the names of the individual partners or participants in the joint venture, and a statement that the partnership or joint venture is in existence

Certificate of Assumed Name, (the Certificate must have been issued within the past 10 years to be valid)

If firm is a limited partnership, the Certificate of Limited Partnership

If any partner or joint venturer is a corporation, the above information relating to corporation must be included as to each sum partner or joint venturer.

[ ] **Sole Proprietorship**

Name: _____
Mailing Address: _____

Certificate of Assumed Name, if operating under a name different than that of the sole proprietor (the Certificate must have been issued within the past 10 years to be valid)

** Must be furnished upon request of the Director and must be less than 90 days old.*

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: Northwest Wastewater Treatment Plant Improvements

Project Location: The Facility is located at 5423 Mangum Road, Houston, Texas(Key Map No. 451-C)

Project No: WBS No. R-000265-0095-4

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 **570** 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
[ ]	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: Northwest Wastewater Treatment Plant Improvements
TOTAL DBE AWARD: $ _____
ORIG. CONTRACT PRICE: $ _____
PROJECT NO.: WBS No. R-000265-0095-4
DATE OF REPORT: _____

TOTAL MWSBE AWARD: $ _____
TOTAL HUB AWARD: $ _____
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)

LIST OF PROPOSED SUBCONTRACTORS AND SUPPLIERS

Document 00600

Continuation Page

PROJECT NAME: Northwest Wastewater Treatment Plant Improvements
DATE OF REPORT: _____
PROJECT NO.: WBS No. R-000265-0095-4

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 00607

CERTIFICATION REGARDING DEBARMENT, SUSPENSION, AND OTHER RESPONSIBILITY MATTERS

Contractor certifies to the best of its knowledge and belief that it and its principals:

1. Are not presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from covered transactions by any Federal, State, or local department or agency;

2. Have not within a three-year period preceding this proposal been convicted of or had a civil judgment rendered against them for commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public (Federal, State, or local) transaction or contract under a public transaction: violation of Federal or State antitrust statutes or commission of embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements, or receiving stolen property;

3. Are not presently indicted for or otherwise criminally or civilly charged by a government entity (Federal, State, or local) with commission of any of the offenses enumerated in paragraph 2 of this certification; and

4. Have not within a three-year period preceding this application/proposal had one or more public transactions (Federal, State, or local) terminated for cause or default.

I understand that a false statement on this certification may be grounds for rejection of this proposal or termination of the award. In addition, under 18 USC Section 1001, a false statement may result in a fine of up to $10,000 or imprisonment for up to five years, or both.

Company:

_____
Typed Name & Title of Authorized Representative

_____ _____
Signature of Authorized Representative Date

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

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: _____
Expiratio

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: _____
Project Number/Description: _____
_____

POP Contact Person: _____
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

EQUAL EMPLOYMENT OPPORTUNITY CERTIFICATION BY MATERIAL SUPPLIERS

Document 00633

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 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)

****

List of Changes:

02-04-2005: Added new Paragraph 3.25.1.3 concerning strict liability. Edited Paragraph 3.25.1.1 accordingly. Edited Paragraph 9.6.1.4 to remove the words "retainage of".

08-15-2006: Revised many references to Section(s) to read Paragraph(s). Added Small Business Enterprise (SBE) requirement to Paragraphs 3.5.3, 3.5.3.1, 3.5.3.2 and 3.5.3.3.

08-17-2006: Added new Paragraphs 5.2.4, 5.2.5, 9.2.1 and 9.4.2 concerning prompt payment provisions.

10-10-2006: Added new Paragraphs 9.7.1.8, 9.7.1.9 concerning prompt payment provisions. Changed 9.8.1 to "20 days", and added language to 9.8.2 concerning "7 calendar days" and payment disputes.

03-10-2008: Revised Table 1 after 11.2.11 (Installation Floater), and expanded Paragraph 11.5.1 on Maintenance Bonds.

09-10-2008: Revised 5.2.5[sic] on page 17 to read 5.2.4.

10-24-2008: Revised many sections to include or amend numbering.

08-01-2009: Amended 1.1.6., definition of City Engineer. Amended 2.2 to say "Duties" and added 2.2.2 stating that the contract imposes no implied duty on City. Added 3.5.4 concerning Contractor Participation in the Pay or Play Program. Added 3.28 pertaining to Contractor Debt. Amended 4.1.2 to prohibit the City Engineer from delegating signature authority under 4.4. Amended 4.1.11 stating that City owes no duty to Contractor not stated in contract. Amended 4.3.2 to delete second sentence concerning City Engineers decision as a condition precedent to litigation. Amended 4.6 to require both parties to wave claims, attorney fees, and interest. Amended 11.2.6 to require Contractor to notify the City of any Insurance Policy cancelation or modification. Amended 11.2.8 to exempt Workers' Compensation coverage from certain documentation requirements. Amended Table 1 after 11.2.11 to specify automobile coverage requirements. Added 11.3.3 to address content requirements on Certificates of Insurance. Added 13.3.2 to extend joint and several liability to any series, affiliate, subsidiary, or successor to which Contractor assigns or transfers assets. Amended throughout to standardize references to Sections (x.x), Paragraphs (x.x.x), and Subparagraphs (x.x.x.x and below).

01-15-2010: Amended Sections 4.4 and 4.6 concerning written decisions, findings of fact, and hearings by the City engineer, precedent to litigation, and interest under Chapter 2251 of the Texas Local Government Code. Removed Section 4.5 NON-BONDING MEDIATION and renumbered and renamed Section 4.6 as 4.5 CONDITION PRECEDENT TO SUIT; WAIVER OF ATTORNEY FEES AND INTEREST.

05-01-2010: Amended Subsection 1.1.5 to change "municipal corporation" to "home rule municipality". Amended Subsection 3.9.1.1 to reflect change from Low Sulfur Deisel Fuel (500 ppm) to Ultra Low Sulfur Fuel (15 ppm).

12-07-2010: Amended Section 14.1.1.5 to mirror change in Section 3.9.1.1; Low Sulfur Diesel Fuel was changed to Ultra Low Sulfur Fuel.

12-09-2010: Amended Section 4.5 (and Table of Contents) by adding "Interim Payment Waiver & Release" language from Document 00850. Amended Subsection 11.3 to include new insurance requirements.

12-10-2010: Inserted phrase into definition of Claim (§1.1.7) defining what a Claim can constitute

01-14-2011: Insertion of terms "Business Enterprise" and "Business Enterprise Policy" into definition section (§1.1) and insertion of those terms in §3.5, as appropriate, and deletion of old §3.5.3

01-18-2011: Renaming of §4.5; renumbering of Table of Contents due to introduction of "Interim Payment Waiver & Release" as a separate section (§4.6)

01-31-2011: Edit of Section 4.6, Interim Payment Waiver & Release" to reflect language suggestions of Litigation Division of Legal Dept.

02-09-2011: Edit of language in definitions of "Business Enterprise" and "Business Enterprise Policy"

10-12-2011: Amended Section 8.2, related to delays and extensions of time, to strengthen language suggested in 2011 Construction Law CLE.

10-19-2011: General reformatting of entire document for consistency; updating of header re: date; insertion of "Mayor's Office of Business Opportunity", as appropriate, to refect name change

10-27-2011: Added a definition for "Mayor's Office of Business Opportunity"; amended Section 8.2.2 to refer to Section 4.3.6.2; replaced MWBE with "Business Enterprise", where appropriate; added "persons, or entities" to Section 5.1 to broaden applicable provisions; updated issue date to proposed Issue date of November 1, 2011.

10-31-2011: edited definition of "Business Enterprise"

07-01-2013: Edited Section 3.5.3 to remove the binding arbitration requirement for contractor and subcontractor claims, per change in Office of Business Opportunity policy.

07-25-2013: Removed Section 4.5.1, regarding conditions precedent to suit.

11-01-2014: Changed Section 3.5.2 to reflect a move away from arbitration to mediation to resolve subcontractor disputes; removed requirement for City Engineer's decision before a suit may be brought from Section 4.5.2; included language in Section 5.1.3 requiring submission of written contracts with Subcontractors within 30 days of Notice to Proceed issuance; changed Section 11.2 to reflect required insurance coverages updated for new fiscal year; added more explicit language regarding the City's Additional Insured status in Section 11.2.4 ("Insured Parties") and the City's waiver of subrogation requirement in Section11.2.7 ("Subrogation").

01-01-2015: Changed the Automobile Insurance requirement from $2,000,000 to $1,000,000.

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Document 00700

GENERAL CONDITIONS

January 1, 2015 EDITION

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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 a change in the Work;
.2 a change in Contract Price, if any; and
.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 whose value is greater than five percent of Original Contract Price,

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

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

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

1.1.28 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.

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

1.1.30 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.

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

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:

.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").

.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 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:

- .1 Federal Wage Rate General Decisions
  - .1 Highway Rates
  - .2 Building Rates
  - .3 Heavy Construction Rates
  - .4 Residential Rates
- .2 City Prevailing Wage Rates
  - .1 Building Construction Rates
  - .2 Engineering Construction Rates
  - .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:

- .1 contracts authorized by Emergency Purchase Orders,
- .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 contracts with companies that have fewer than 15 employees during any 20-week period during a calendar year and no safety impact positions,
- .4 contracts with non-profit organizations providing services at no cost or reduced cost to the public, and
- .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:

- .1 a Drug Policy Compliance Agreement form (Attachment "A" to the Executive Order), and
- .2 a copy of Contractor's drug free workplace policy, and
- .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:

.1 new, unless otherwise required or permitted by the Contract, and

.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:

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

.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:

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

.2 shall provide the same warranty for the substitution as for the specified Product;

.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;

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

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

.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:

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

.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:

.1 free of defects in title;

.2 of good quality; and

.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:

.1 improper or insufficient maintenance by the City;

.2 normal wear and tear under normal usage; or

.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:

.1 necessary for proper execution and completion of the Work; and

.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:

.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;

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

.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:

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

.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:

.1 a description of the indemnification event in reasonable detail,

.2 the basis on which indemnification may be due, and

.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:*

.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.

.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:

.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;

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

.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:

.1 those indicated by the Contract; or

.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:

.1 written interpretation of City Engineer;
.2 order by City Engineer to stop the Work when Contractor is not at fault;
.3 suspension of the Work by City Engineer;
.4 termination of the Contract by City Engineer; or
.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:

.1 submit a suggested time to meet and discuss the Claim with City Engineer;
.2 reject Claim, in whole or in part, stating reasons for rejection;
.3 recommend approval of the Claim by the other Party;
.4 suggest a compromise; or
.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:

.1 Change Order;
.2 Work Change Directive; or
.3 Minor Change in the Work.

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

.1 a single Change Order that exceeds five percent of Original Contract Price,
.2 a Change Order which, when added to previous Change Orders, exceeds five percent of Original Contract Price,
.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:

.1 mutual acceptance of fixed price, properly itemized and supported by sufficient data to permit evaluation;

.2 unit prices stated in the Contract or subsequently agreed upon;

.3 cost to be determined in a manner agreed upon by the Parties and mutually acceptable fixed or percentage fee; or

.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:

.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;

.1 the maximum labor burden applied to costs of labor for changes in the Work is 55 percent;

.2 costs of materials, supplies, and equipment, including cost of transportation, whether incorporated or consumed;

.3 rental costs of machinery and equipment, exclusive of hand tools, whether rented from Contractor or others, with prior approval of City Engineer;

.4 costs of premiums for Bonds and insurance and permit fees related to the change in the Work;

.5 additional costs of direct supervision of work and field office personnel directly attributable to the change; and

.6 allowances for overhead and profit as stated below.

.1 the maximum allowances for overhead and profit on increases due to Change Orders:

.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:

.1 acts of God or of the public enemy;
.2 acts of government in its sovereign capacity;
.3 fires;
.4 floods;
.5 epidemics;
.6 quarantine restrictions;
.7 strikes;
.8 freight embargoes;
.9 unusually severe weather; and
.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:

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

.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.

.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 Mayor's 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.

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 Mayor's Office of Business Opportunity. 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:

.1 that portion of Contract Price allocated to completed work as determined by:
  .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
  .2 multiplying Unit Price quantities Installed times the Unit Prices listed in the Contract;
.2 plus progress payments for completed work that has been properly authorized by Modifications;
.3 less retainage of five percent;
.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;
.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:

.1 nonconforming work has not been remedied;
.2 the Work cannot be completed for unpaid balance of Contract Price;
.3 there is damage to the City or another contractor;
.4 the Work will not be completed within Contract Time and that unpaid balance will not be adequate to cover actual and liquidated damages;

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

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

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

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

.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:

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

.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:

.1 Date of Substantial Completion;

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

.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:

.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:

.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;

.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;

.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;

.4 consent of Surety to final payment; and

.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:

.1 deduct liquidated damages accrued from monies held;

.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,

.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:

.1 employees performing work on-site, and other persons who may be affected thereby;

.2 work, including Products to be incorporated into the Work, whether in proper storage, under control of Contractor or Subcontractor; and

.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 provide at a minimum insurance coverage and limits of liability set out in Table 1.

11.2.1.1 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.

11.2.2 *Form of Policies:* Insurance may be in one or more policies of insurance, form of which is subject to approval by City Engineer. It is agreed, however, that nothing City Engineer does or fails to do with regard to insurance policies relieves Contractor from its duties to provide required coverage and City Engineer's actions or inactions will never be construed as waiving the City's rights.

11.2.3 *Issuers of Policies:* Issuer of any policy shall have:

.1 a Certificate of Authority to transact business in Texas, or

.2 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 edition of Best's Key Rating Guide, and the issuer must be an eligible nonadmitted insurer in the State of Texas.

Each insurer is subject to approval by City Engineer in City Engineer's sole discretion as to conformance with these requirements, pursuant to Paragraph 11.2.2.

11.2.4 *Insured Parties:* The City shall be an Additional Insured under this Contract. Each policy, except those for Workers' Compensation and Owner's and Contractor's Protective Liability, must name the City, its officers, agents, and employees as Additional Insured parties on original policy and all renewals or replacements during term of the Contract. The City's status as Additional Insured under Contractor's insurance does not extend to instances of sole negligence of the City unmixed with any fault of Contractor.

11.2.5 *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.

11.2.6 *Cancellation:* Contractor shall notify the Director in writing 30 days prior to any cancellation or material change to Contractor's insurance coverage. Within the 30 day period, Contractor shall provide other suitable policies in lieu of those about to be canceled or nonrenewed so as to maintain in effect the required coverage. If Contractor does not comply with this requirement, the City Engineer, at his or her sole discretion, may:

.1 immediately suspend Contractor from any further performance under this Contract and begin procedures to terminate for default, or

.2 purchase the required insurance with City funds and deduct the cost of the premiums from amounts due to Contractor under this Contract.

11.2.7 *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.

11.2.8 *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.

11.2.9 *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.

11.2.10 *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.

11.2.10.1 Definitions:

.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.

.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.

.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.

11.2.10.2 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.

11.2.10.3 Contractor shall provide a Certificate of Coverage to the City prior to being awarded the Contract.

11.2.10.4 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.

11.2.10.5 Contractor shall obtain from each person providing services on the Work, and provide to City Engineer:

.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

.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.

11.2.10.6 Contractor shall retain all required Certificates of Coverage for the duration of the Work and for one year thereafter.

11.2.10.7 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.

11.2.10.8 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.

11.2.10.9 Contractor shall contractually require each person with whom it contracts to provide services on the Work to:

.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;

.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;

.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;

.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.

.5 retain all required Certificates of Coverage on file for the duration of the Work and for one year thereafter;

.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

.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.

11.2.10.10 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.

11.2.10.11 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.

11.2.11 *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

.1 be less than 12 months old;

.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;

.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;

.4 include the Contractor's email address in the Certificate Holder Box;

.5 include the Project reference numbers on the City address so the Project reference number is visible in the envelope window; and

.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:

.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,

.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:

.1 the date the Notice is actually received;
.2 the third day following deposit in a United States Postal Service post office or receptacle; or
.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:

.1 inspections or tests covered by Paragraph 13.6.3;
.2 those otherwise specifically provided in the Contract; or
.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:

.1 Contractor refuses or fails to supply enough properly skilled workers or proper Products;

.2 Contractor disregards laws, ordinances, rules, regulations, or orders of a public authority having jurisdiction;

.3 Contractor is guilty of material breach of any duty or obligation of Contractor under the Contract;

.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

.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:

.1 request that Surety complete the Work; or

.2 take possession of the site and all materials, equipment, tools, and construction equipment and machinery on the site owned by Contractor; and

.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:

.1 stop the Work on the date and to the extent specified in the Notice of Termination;

.2 place no further orders or subcontracts for Products or services;

.3 terminate all orders and subcontracts to the extent that they relate to performance of work terminated;

.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;

.5 settle all outstanding liabilities and all claims arising out of the termination of supply orders and subcontracts with approval of City Engineer;

.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

.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:

.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.

.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:

.1 performance was, or would have been, suspended, delayed, or interrupted by another cause for which Contractor is responsible; or

.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:

.1 issuance of an order of a court or other public authority having jurisdiction;

.2 act of government, such as a declaration of national emergency which makes material unavailable; or

.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 November 1, 2014 edition of General Conditions. Unaltered portions of General Conditions remain in effect.

ARTICLE 1 - GENERAL PROVISIONS:

1.1 *DEFINITIONS*: *Insert the following Paragraph 1.1.23, and reorder the remaining definitions accordingly.*

1.1.23 *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 11% 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

9.1 *UNIT PRICE WORK*: *Delete Section 9.1 in its entirety and insert the following Section 9.1.*

9.1 References to Unit Prices in individual Specification sections are not applicable to the Contract. Include payment for portions of the Work required by these sections in the Stipulated Price for the Contract.

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 (management, architecture, financial costs, pre-opening costs, etc.), transit coverage, off-site storage).	100% of Contract Price, including change orders

Flood Hazard Insurance: Contractor shall apply for flood insurance on all insurable structures built under the Contract. A copy of the completed application must be provided to City Engineer before commencing construction of the Work. Contractor shall obtain flood hazard insurance as soon as possible and submit a copy of the policy to City Engineer.

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.

I. 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.

'ost–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

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 00910

ADDENDUM NO._____

Date of Addendum: _____
****Enter date by hand when signed for release****

PROJECT NAME: Northwest Wastewater Treatment Plant Improvements

PROJECT NO: WBS No. R-000265-0095-4

BID DATE: March 26, 2015 (There is no change to the Bid Date.)

FROM: J. Timothy Lincoln, P.E., City Engineer
City of Houston, Department of Public Works and Engineering
611 Walker Street, Houston, Texas 77002
Houston, Texas 77002
Attn: *Bill Zod, P.E.*, Project Manager

TO: Prospective Bidders

This Addendum forms a part of the Bidding Documents and will be incorporated into the Contract documents, as applicable. Insofar as the original Project Manual and Drawings are inconsistent, this Addendum governs.

****

Use the following heading and select the appropriate wording for postponement of the Bid Date. Delete the statement beside Bid Date above which indicates that the Bid Date is unchanged. If change in Bid Date, issue as separate addendum. Delete this section entirely if there is no change in Bid Date.

****

CHANGE IN BID DATE

The Bid Date for this Project has been changed from _____ (Date) to _____ (Date).

[Time of day and place for submittal of bid remains the same]. [Time of submittal has been changed from _____ (Time) to _____ (Time). The place for submittal remains the same].

The bid date for this project has been indefinitely postponed.

****

Delete the following paragraph if the sole purpose of the

Addendum is to postpone the Bid Date.
****

This Addendum uses the change page method: remove and replace or add pages, or Drawing sheets, as directed in the change instructions below. Change bars (|) are provided in the outside margins of pages from the Project Manual to indicate where changes have been made; no change bars are provided in added Sections. Reissued Drawing Sheets show the Addendum number below the title block and changes in the Drawing are noted by a revision mark and enclosed in a revision cloud.

****
Number each item of the Addendum beginning with 1 through the total number of change items in the Addendum. Sample entries are provided in brackets.
****

CHANGES TO PREVIOUS ADDENDA

****
Reference Addendum Number and item number to correct clarifications or make minor corrections of changes issued by previous Addenda.
****

ADDENDUM NO. _____

[1. Item 5. Change to read as follows:]

CHANGES TO PROJECT MANUAL

****
Follow this format to sequence changes to the Project Manual.
****

BIDDING REQUIREMENTS

****
Give the individual change instructions for each item of change by Document number and title. List changes in order of Document number.
****

[2. Document 00020 - Notice to Bidders. Replace page 00020-2.]

CONTRACT FORMS

[3. Document 00610 - Replace revised Performance Bond, page 00610-1.]

CONDITIONS OF THE CONTRACT

[4. Document 00800 - Supplementary Conditions. Replace page 00800-4 and add page 00800-5.]

SPECIFICATIONS

[5. Section 02050 - Demolition. Add section including pages 02050-1 through 02050-3.]

CHANGES TO DRAWINGS

[6. Delete Sheet S-9, Beam Schedule, and replace with Sheet S-9-A.]

CLARIFICATIONS

[7. Document 00210 - Supplementary Instructions to Bidders states that no substitutions will be considered during the bidding phase. Substitutions will be considered during the first 15 percent of the Contract Time or first 90 days of the Contract, whichever is less, as stated in Document 00700 - General Conditions.]

END OF ADDENDUM NO. _____

DATED: _____

Ravi Kaleyatodi, P.E., CPM
Senior Assistant Director
Department of Public Works and Engineering

RK:EN:BZ:AK:sdd

END OF DOCUMENT

Document 00911

NOTICE OF
ADDENDUM NO.

Date of Addendum: _____

PROJECT NAME: Northwest Wastewater Treatment Plant Improvements

PROJECT NO: R-000265-0095-4

BID DATE: _____ (There is no change to the Bid Date.)

FROM: J. Timothy Lincoln, P.E., City Engineer
City of Houston
Department of Public Works and Engineering
611 Walker, 15th Floor
Houston, Texas 77002
Attn: Bill Zod, P.E., Project Manager

TO: Prospective Bidders

The referenced Addendum forms a part of the Bidding Documents and will be incorporated into the Contract documents, as applicable.

Written questions regarding this Addendum may be submitted to the Project Manager following the procedures specified in Document 00200 – Instructions to Bidders. Immediately notify the City Engineer through the named Project Manager upon finding discrepancies or omissions in the Bid Documents.

_____
Ravi Kaleyatodi, P.E., CPM
Senior Assistant Director
Department of Public Works and Engineering

END OF DOCUMENT

Document 00931

REQUEST FOR INFORMATION

1. PROJECT No.: R-000265-0095-4
2. RFI No.: _____
3. PROJECT NAME: Northwest Wastewater Treatment Plant 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 G E N E R A L

1.01 SECTION INCLUDES

A. Summary of the Work including Work covered by the Contract Documents, Cash allowances, Work Sequence, Warranty, Contractor use of Premises, additional conditions for substantial completion and City occupancy.

B. This project is part of the City's program to renew/replace inefficient components of the existing wastewater treatment plant (WWTP) facilities. The scope of project covers the entire Northwest Wastewater Treatment Plant process areas. Contractor shall field review all process areas of the existing conditions for better understanding of the specified works prior to submitting bids.

C. The Pre-bid site visit for this project will be conducted on March 11, 2015 at 10:00am at Northwest WWTP. All visitors shall sign-in at the Administration Building.

1.02 WORK COVERED BY CONTRACT DOCUMENTS

A. The Work included in the Contract is for the Contractor to furnish all labor, materials, equipment, and incidentals required for construction of the Northwest Waste Water Treatment Plant Improvements as described below:

1. Mobilization as specified in Section 01502. Includes construction of temporary facilities as specified in Section 01504 and 01520 and costs for bonds and insurance.

2. Odor Control System Improvements as shown on the contract drawings and specified including all permits, site preparation, demolition, installation of a new fan, new precast concrete building with ventilation and lighting, new 18", 24", and 36" diameter fiberglass piping for the fan inlet and discharge lines. Install a new 4th biotrickling filter (BTF) with new foundation, new dual bed granular activated carbon (GAC) system, new electrical, instrumentation and controls for the odor control system. Retrofit existing BTFs #1, #2, and #3 to include media, irrigation spray bars, media, electrical controls, and all appurtenances to match new #4 BTF. Construct/rebuild all associated BTF and GAC system inlet and outlet piping. The control system shall be installed with Programmable Logic Controller (PLC) equipment using the latest Wastewater standard PLC platform and connected to the local SCADA

system via existing network switch at the chemical building disinfection system. The VFD blower shall be installed within the new prefabricated building and power and control shall be provided from lift station switchgear and control. The SCADA iFIX application shall be configured to view status and alarm points for the biotrickling system and blower at the lift station indicated on the drawings. The odor control fan building is in the 100-yr flood plain and considered to be a critical facility and must have all electrical panels and equipment set 1-ft above the 500-yr TSARP EL 73.

3. Limited Non-Potable Water System (NPWS) as shown on the contract drawings and specified including all permits, site preparation, demolition and installation of new pumps, strainers, horizontal hydropneumatic tank, and new electrical, instrumentation and controls complete in place. New MCC enclosure shall be installed within the chemical building to provide power to the NPW system. The control system shall be installed with PLC remote base equipment using the latest Wastewater standard PLC platform and connected to the local SCADA system via existing network switch at the chemical building disinfection system. The SCADA iFIX application shall be configured to view status and alarm points for the NPW system indicated on the drawings.

4. Improvements to Aeration System Basins 1,2,3,4,5 and Influent Channel as shown on the contract drawings and specified including site preparation, demolition, installation of new air drops and air drop isolation valves, new coarse bubble diffusers in aeration basins 1-5 and the west side of the influent channel, new 8”, 24”, and 36” air main isolation butterfly valves, replacement of damaged and missing guardrails/handrails, repair cracked and damaged aeration basin beam, and implementation of Maintenance of Plant Operations, start-up, testing and site restoration complete in place. Non-rubber compressed flange and valve gaskets shall be considered to be asbestos-containing and abated during renovation and demolition activates. Break airline pipe flanges; abate non-rubber compressed gaskets by standard wet methods, bag asbestos waste, and dispose of as asbestos containing waste. The General Contractor should coordinate with an abatement contractor to schedule abatement activities. The quantity of the potential asbestos containing material is not expected to meet reportable limits for this NESHAP facility and no notifications are required. Reference Asbestos and Lead Survey Northwest WWTP Improvements dated January 2014 provided with construction documents.

5. All works related to removal and disposal of accumulated grit, scum, and solids from the entire influent channel, RAS channel, Mixed Liquor Channel, Clarifier Feed Channels, Clarifier Return Channels and Aeration Basins 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 and 11. Contractor is responsible for testing and disposal of sludge or solid waste at a waste disposal facility in accordance with local state and federal regulations.

6. Sluice Gate Improvements as shown on the contract drawings and specified including site preparation, demolition, installation of new gates, new motorized actuators on specified gates, and new electrical conduit required from MCC-8 to each gate shown on the electrical drawings. The gates will be manually controlled and there will be no SCADA monitoring of the gate status.

7. Clarifier Drain Valve Replacement as shown on the contract drawings and specified including, demolition, excavation, protection of existing structures, trench protection, backfill, compaction, pavement replacement, sidewalk replacement, maintenance of plant operations, 12-inch plug valves, 8-inch plug valves, pipe, fittings, valve boxes, extension stems.

8. Scum Separation System Improvements. Furnish and install all labor, materials, and equipment for the construction of improvements to the scum handling system. Work includes but is not limited to selective demolition of: piping, valves and associated accessories; existing vertical mixer; and existing scum pumps. The proposed improvements include ductile iron piping; check and plug valves; one (1) vertical mixer; two (2) submersible chopper pumps; one (1) static screen; one (1) screw conveyor; one (1) instrumentation and controls panel; electrical; plumbing; painting; concrete slab; granular paving; yard piping; sitework and revegetating all disturbed areas; together with related subsidiary and incidental work in accordance with the plans and specifications. Contractor shall expect scum flowrate of 400-700 gpm and concentrations of <1% solids. Contractor may work with Operations to try to optimize these flows if possible.

    a. New MCC enclosure shall be installed within a new prefabricated building to provide power for scum system and existing WAS pump. The control system shall be installed with PLC equipment using the latest Wastewater standard PLC platform and connected to the local SCADA system via existing network switch at the lift station building control panel. The SCADA iFIX application shall be configured to view status and alarm points for the scum separation system indicated on the drawings.

9. Clarifier No. 6 Distribution Weir Modifications as shown on the contract drawings and specified including, maintenance of plant operations, removal of existing weir and installation of new weir plate.

10. Air Lift Pump Pressure Gauge Addition as shown on the contract drawings and specified including, maintenance of plant operations, demolition, and installation of pressure gauges, fittings, and appurtenances.

11. Building Repairs as shown on the contract drawings and specified including, permits, demolition, removal and re-installation of tanks during repair of tank pads, site restoration, replacement of walkways and tank pads at the Chemical Building, and repair of cracks at the Blower, Maintenance, and Chemical Buildings.

    Building Repairs include the replacement of the HVAC system in the Admin and Maintenance Buildings including demolition and replacement of ductwork, circuit breakers, disconnects for all three units, and conduits and wiring as described in Contract Documents.

12. Chlorine Contact Basin Improvements as shown on the contract drawings and specified including all permits, site preparation, demolition and installation of new non-potable water piping and hydrants for basin cleaning, and the placement of pea-gravel concrete to slope the basin floors toward the trench drain.

13. Extra Unit Price Items are included in Section 00410, Bid Form, to be used with extra work, if required.

1.03 CASH ALLOWANCES

A. Include the following specific Cash Allowances in Contract Price under provision of General Conditions Paragraph 3.11:

1. Permitting Fees: Obtain all applicable permits from the City of Houston

1.04 ALTERNATES

A. From the following list of Alternates, amount included in Contract Price for only those Alternates accepted by the City and listed in the fully executed Document 00520 – Agreement, Paragraph 3.2:

1. Alternative bids are not allowed.

1.05 CITY-FURNISHED PRODUCTS

A. There are no items to be provided by the City and installed by the Contractor in this project.

1.06 WORK SEQUENCE

A. The Contractor shall provide the Owner and Engineer with a schedule and sequencing of construction for approval 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 this section. Contractor shall comply with Maintenance of Plant Operations (MOPO) requirements approved by Wastewater Operations listed on the Plans and conditions listed below.

B. Improvements at the wastewater treatment plant require work to be done at main process units. The wastewater treatment plant will have to be in full operation at all times during construction. This will require installation of temporary facilities and pumps to bypass flows. It is recommended that the work requiring bypass be done during dry weather conditions. All work that modifies the daily operation of the wastewater treatment must follow a written notice and confirmation of understanding between the Contractor and the City of Houston Wastewater Operations Division. In addition, the contractor's activities that impact the daily operation must be done with the full knowledge and agreement of the plant's operator.

The suggested work sequence is as below. Contractor shall submit his sequence of work for review, if he chooses to revise this sequence.

1. Aeration System, Influent, RAS, Mixed Liquor ,Clarifier Feed and Return Channel Improvements

    a. Follow the approved MOPO Plan.

    b. Install electric gate actuators as required after all the above work is completed.

    c. This work shall be coordinated with Wastewater Operations.

2. Clarifier Drain Valve Replacement

    a. Follow the approved MOPO plan.

    b. Complete installation.

3. Scum Separation System Improvements.

a. The scum system improvements will require phasing to maintain operability during construction.

b. The existing Scum Accumulation Box (SAB) shall be maintained in operation during the construction of the Screen/Dewatering equipment. The contractor shall install the Screen/Dewatering equipment, construct new drain manhole, drain pipes, electrical, etc. and ensure that all these systems are operational. The contractor shall utilize this equipment with temporary pumping to allow bypassing of the SAB. The SAB may be isolated via a sluice gate on the 12" scum discharge line. There are manholes upstream from the SAB that shall be used to stage the pumping. One manhole is believed to be buried and the other is adjacent to the clarifier just north of the new Screen/Dewatering equipment. The pumped scum shall be temporarily piped to the new Static Screen for dewatering. Contractor is responsible for operation, overflows, cleanup, and maintenance of this system until substantial completion.

c. Run the static screen during construction operations when the Contractor can oversee the system. During times when construction is not occurring, divert the pumped scum to drain back to Lift Station No. 3.

d. Install the pump at each clarifier scum pit while the respective clarifier is out of service per the bypass plan for the Aeration Basin Improvements.

e. Remove existing scum pump and piping after the proposed scum transfer facilities are tested and started up. This work can be performed concurrently with the rest of the project work and shall be coordinated with Wastewater Operations.

4. Clarifier No.6 Distribution Weir Modifications.

a. Begin improvements at Clarifier No. 6 after it is taken out of service.

b. Follow the approved MOPO plan.

c. Clean clarifier, and remove all existing equipment.

d. Install all proposed components of the clarifier.

e. Place clarifier in service after testing and startup.

C. Coordination of the Work

1. Refer to Section 01312 -Coordination and Meetings

2. The Contractor shall make every effort to group work in similar areas or work that will affect similar operation together.

D. Contractor shall keep Construction Manager 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.

E. The Contractor is required to protect all equipment, buildings, structures, piping, electrical cables, tanks, underground utilities, and all associated appurtenances during construction.

F. Contractor shall coordinate with Construction Manager and City of Houston Wastewater Operations Division regarding the removal and re-installation of FRP Bleach tanks and associated piping during Chemical building repair works.

G. The Contractor is clearly 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 insure the safety and functionality of the piping and associated appurtenances during all phases of construction. 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 Manager for the duration of the project through Construction Closeout Activities. Contractor will be responsible for all utility connections and services.

1.07 CONTRACTOR USE OF PREMISES

A. Contractor is required to keep areas used for temporary storage parts and equipment clean and mow the grass around the area. Comply with procedures for access to the site and Contractor's use of rights-of-way as specified in Section 01145 - 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 48 hours notice to the City and private utility companies (when applicable), excluding weekends and holidays, in advance of required utility shutdown. 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.

1.08 WARRANTY

A. Comply with warranty requirements in accordance with Document 00700 - General Conditions.

B. The cosmetic crack and brick repair associated with paragraph 1.02.A.11 will not require any warranty.

1.09 ADDITIONAL 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 Project Manager to confirm, the following conditions must be met or completed:

1. Demonstrate the ability to receive and monitor video and Supervisory Control and Data Acquisition (SCADA) data from all locations. Demonstrate the ability to receive and monitor wastewater treatment operations and Supervisory Control Data Acquisition (SCADA) data from all PLC panels and equipment control panels, as applicable.

2. All testing shall be completed and accepted by Project Manager. All new equipment shall undergo a seven (7) consecutive day test monitored by the Wastewater Operations (WWO) Group. The test shall consist of running the equipment under normal operating conditions for seven consecutive days in full automatic without failure to qualify as acceptable. If there is a failure, the problem must be identified, corrected, and approved by the WWO before the test can be rescheduled. “Failure” is considered as any problem that requires correction by maintenance personnel, such as instrumentation or control failure or alarm, any motor alarm, power failure, phase failure, communication failure, PLC failure or UPS failure. This would exclude Center Point Energy power failures that last longer than the specified duration of the service from

the UPS. Uncontrollable situations would allow the 7- day test to continue as soon as conditions are restored and all parties are notified. Only after completion of the 7-day test, the WWO can then accept the equipment.

3. All applicable SCADA equipment shall be installed, accepted by and approved for operation.

4. Draft O&M manuals shall be delivered to Project Manager.

5. Training shall be conducted, utilizing draft O&M manuals.

B. All safety- related systems and equipment shall be installed, accepted by the manufacturer's representative and approved for use.

1. All pay items complete report.

2. Contractor shall contact Construction Project Manager to complete Texas Department of Licensing and Regulation Post Construction Inspection of pedestrian elements for Texas Accessibility Standards, if applicable.

3. Final O& M Manuals including as-built drawings, PLC program source code with documentation shall be provided in both paper copies and electronic copies that are approved by the Engineer. All electronic documentation submitted shall be provided in CD or DVD that is acceptable to the Engineer.

4. Other conditions as specified in each individual Technical Specifications that must be completed by Date of Substantial Completion.

C. All additional conditions in Paragraph 1.09 shall be completed prior to Substantial Completion. Contractor's punch list shall not include the additional conditions described in Paragraph 1.09.

1.10 LEAD AND ASBESTOS CONTAINING MATERIAL

A. Sluice gate lifts and scum separator gate activators were found to contain lead based paints. It is recommended to recycle all metal components.

1. OSHA Requirements: The U.S. Occupational Safety and Health Administration (OSHA) does not specify a minimum lead concentration in its lead standard. Rather, it requires all employers to determine an exposure level and provide prescribed training, personal protective equipment, medical surveillance, and record keeping. The ways and means of the contractor will determine requirements.

2. All paint which has a detectable level of lead is considered a lead--containing paint by OSHA and should be handled in the following ways:

   a. Notify any contractor cutting, abrading or disturbing lead containing paint that the paint contains the listed concentrations of lead.

   b. Metal components should be dismantled by unfastening bolts where possible. Cutting, abrading or welding on painted metal components should be discouraged.

   c. Disposal of painted metal components should be through a metal recycling company that accepts metal with lead paint.

   d. Demolished concrete structures with lead-containing paint should be tested by the TCLP method, as required by the U.S. Environmental Protection Agency (EPA), to characterize the waste for disposal.

B. Flange Gaskets in the Aeration Basins, Scum Separation Unit, and for Plug Valves were determined to have asbestos containing material with a 2-60% chrysotile content. It is recommended that non-rubber compressed gaskets shall be considered to be asbestos-containing and abated prior to or during renovation/demolition activities required. Break pipe flanges; abate non-rubber compressed gaskets by standard wet methods, bag asbestos waste, and dispose of as asbestos containing waste. The General Contractor should coordinate with an abatement contractor to schedule abatement activities. Contractor may opt to cut out flanges and have an abatement contractor dispose of them intact.

1.11 SALVAGED MATERIALS AND EQUIPMENT

A. City will designate materials and equipment to be salvaged prior to the demolition process. Items noted for salvage shall be removed, lightly cleaned, and delivered to a City designated facility by Contractor.

B. Contractor shall notify City 14 calendar days prior to demolition activities and request a list of the items to be salvaged.

1.12 INTERPRETATION OF CONFLICTS

A. Should conflicts occur in Contract Documents, request interpretation before proceeding with Work. Such requests shall first be preceded by a diligent investigation into Contract Documents.

1.13 GENERAL CONSTRUCTION NOTES

A. Notify the Utility Coordinating Committee at 1-800-669-8344 or (713) 223-4567, and the City of Houston Department of Public Works and Engineering, Civil Construction at (713) 837-7196, at least 48 hours prior to commencement of work.

B. Field verify existing underground utilities and process piping shown on the drawings by whatever means necessary (metal detection, probes, excavation, survey, others) prior to excavation. Field verification work and utility adjustments shall be completed prior to excavation and construction of proposed utilities. The construction documents were prepared from the City's Record Drawings. The accuracy of the existing utilities and infrastructure shown on these documents is not guaranteed, and the use of such information in no way relieves the Contractor or others of any responsibility for any loss due to inaccuracies. No separate pay item.

C. Comply with OSHA Regulations and State of Texas laws concerning excavation, trenching and shoring as specified in City of Houston Ordinance No. 87-1457.

D. 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.

E. Contractor shall be responsible for providing required security to protect his own property, equipment and work in progress as defined in Section 01560.

F. Contractor shall be responsible for adequately protecting existing structures, utilities, trees, shrubs, and other adjoining facilities as applicable and repair or replace due to damage caused by Contractor.

G. Contractor shall field verify all dimensions and conditions before commencing work. All landscaping features shall be field verified, if applicable. It shall be the Contractor's responsibility to report any discrepancies to the Construction Manager in a timely manner.

H. Contractor to keep access road to plant 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.

I. The Contractor to give notice to all authorized inspectors and other personnel, in charge of private and public utilities affected by his operations prior to commencement of work.

J. Identify and obtain all required construction permits prior to commencement of work.

K. Plant coordinates shown for proposed structure locations are referenced to outside face of exterior wall or to centerline of structure, unless otherwise noted on the Plans.

L. The finished grade elevations shown in general are intended to provide drainage away from plant facilities. Minor changes may be necessary to provide adequate drainage.

M. Maintain drainage of site during all phases of construction. Do not block drainage from adjacent areas or add flow to adjacent areas.

N. The Construction Contractor shall prepare or obtain the appropriate safety systems required by Federal, State, and local laws and regulations. The Drawings prepared by the Design Engineers for this project do not include designs or systems pertaining to the safety of the Construction Contractor or its employees or agents.

O. Contractor shall not operate existing valves plant appurtenances or plant equipment unless, in the presence of the City Construction Manager and/or City Waste Water Operations. Provide sufficient notification and lead time, in accordance with the requirements of Section 01114 and 01732, for Plant Operator where it becomes necessary to actuate or de-actuate valves, plant appurtenances, or plant equipment unless in the presence of City WWO personnel or Construction Manager.

P. Plant Manager and Construction Manager to be notified in advance of any existing process equipment "shutdown", as specified in Section 01114.

Q. 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 and applicable.

R. Contractor shall comply with all relevant Federal, State, and local laws and regulations of utility companies concerning safety and health practices.

S. Contractor shall sod all areas disturbed as a result of construction operations, if applicable, 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.

T. Yard piping locations shown are approximate. Field verify locations of existing pipe. Arrange new piping as necessary to avoid interference and provide clearances as noted. All changes in piping shown, to be documented on required "red line drawings."

U. 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.

V. The Contractor shall provide tape, fittings, plugs, and other devices for use in filling, flushing, testing, etc. (no separate pay).

W. The Contractor shall not operate any equipment or have any persons within 10 feet (vertical and horizontal) of electrical power lines.

1.14 EXISTING UTILITIES

A. Underground utilities exist in the vicinity of this project. While every effort has been made to show locations for existing utilities, they are approximate and other utilities may exist in the vicinity of this project, which are not shown on these plans. The location and grades of existing utilities are based on City as-built drawing information.

B. Coordinate with the proper utility company to relocate or divert any utility in conflict with proposed construction so as not to disrupt service of same. Restore relocated or diverted utility to its original condition and location upon completion of construction.

C. Maintain existing water service and sanitary sewer service within construction area until construction of the new system is complete.

1.15 WATER LINES

A. All utilities present on these drawings are shown at approximate locations based on the best available information. The contractor shall field determine the exact locations prior to commencing construction. Contractor shall be fully responsible for any and all damages caused by failure to locate and maintain these underground utilities at no additional cost to the City of Houston.

1.16 STORM SEWER

A. Adequate drainage shall be maintained at all times during construction and any drainage ditch or structure disturbed during construction shall be restored to the satisfaction of the owning authority. All construction storm runoff shall comply with the final draft of the Storm Water Management Handbook for construction activities,

as prepared by Harris County, HCFCD and the City of Houston in compliance with NPDES requirements.

1.17 POTENTIALLY PETROLEUM CONTAMINATED AREAS

A. During proposed Work, the Contractor is responsible to inform the Project Manager of any observed soil contaminations. Where soil contamination exists, test the soil and take proper action as described in Section 02105 and Section 02120.

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 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 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 Contractors 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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Section 01270

MEASUREMENT AND PAYMENT

PART 1 G E N E R A L

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 G E N E R A L

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 G E N E R A L

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 G E N E R A L

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 01326

CONSTRUCTION SCHEDULE (BAR CHART)

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Provide an initial Construction Schedule as required by this section for the Work. Do not start construction until Project Manager reviews the schedule.

1.02 FORM AND CONTENT OF INITIAL CONSTRUCTION SCHEDULE

A. Bar Chart:

1. Show major construction activities such as pipe laying, by traffic control phases or other approved key areas; tunnel construction, pavement removal, pavement replacement, pressure testing, chlorination, clean up and punch list as separate activities on the schedule.

2. Show week duration for each activity.

3. Show separate activities for each Shop Drawing and Product Data submittal critical to timely completion. Show submittal dates and dates Project Manager needs to provide approved submittals.

4. Provide separate horizontal bar for each activity. List start and finish date for each activity at left side of diagram.

5. Horizontal Time Scale: Identify first work day of each week.

6. Scale and Spacing: Notes must be legible. Allow space for notations and future revisions.

7. Order of Listings: Order bar chart listings by phases or other approved groups of activities that are contiguous. List activities in chronological order within each phase or group.

B. Narrative Description:

1. Submit narrative descriptions of anticipated work sequences as indicated by the sequence of activities presented in the schedule.

2. Discuss any activity that affects the public (such as phases of traffic control), interaction with specific forces of the City (such as valve operation, chlorination and testing) or other associated contractors.

1.03 PROGRESS REVISIONS

A. Submit progress revisions or necessary information to complete and process Payment Applications. When required, re-submittals for rejected revisions must be submitted and reviewed prior to the following month's processing of a Payment Application. The following month's Payment Application will not be processed until the re-submittal is reviewed and required progress revisions are received.

B. Provide a narrative report to describe:

1. Major changes in scope.

2. Revised projections in progress, completion, or changes in activity duration.

3. Other identifiable changes.

4. Problem areas, anticipated delays, and the impact on schedule.

5. Corrective action recommended and its effect.

6. Effect of changes on schedules or other contractors.

7. Product delivery lead times.

C. Include additional data with Bar Chart described in Paragraph 1.03A of this Section:

1. Show original dates for each activity in the approved initial progress schedule by narrow bar next to a wider bar for the current schedule.

2. Show date each activity actually started or finished when an event has occurred. Clearly identify actual dates in two right-most columns in left portion of an 11 by 17-inch chart.

3. Indicate the percentage progress to the date of submittal for each activity.

1.04 SUBMITTALS

A. Submit the initial progress schedule within 15 days after award of contract. Project Manager will review the schedule and return a reviewed copy within 21 days after receipt.

B. Cut-off dates for progress revisions may be as early as the 20th of the month to avoid delaying processing of Payment Applications. Use the cut-off date for the first approved revision for further revisions.

C. When required, re-submit within seven days after return of review copy.

D. Include connecting lines between bars in the schedule to indicate the sequence that activities will be accomplished. Connecting lines when the activity's start or finish is modified will identify impact of preceding or succeeding activities. Submit a minimum of six copies of the bar chart on 11 by 17-inch opaque reproductions. Project Manager will retain five copies and return the remaining copy.

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 G E N E R A L

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 G E N E R A L

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 01351

ENVIRONMENTAL SAFETY AND WORKER PROTECTION

PART 1 GENERAL

1.01 SECTION INCLUDES

Environmental Safety and Worker Protection including monitoring emissions and exposure to workers and providing an appropriate response. The role of the Certified Industrial Hygienist (CIH) is also defined.

1.02 MEASUREMENT AND PAYMENT

No separate measurement and payment for work performed under this Section. The Contractor shall include the cost for this work in the contract bid price for work of which this is a component part.

1.03 REFERENCES

The following is a list of applicable requirements to this project. It is not intended to be a complete listing of all laws and regulations to which the Contractor must comply.

A. Code of Federal Regulations

1. 29 CFR 1910, "Occupational Safety and Health Standards".

   a. 29 CFR 1910.146 "Permit-required confined spaces".

2. 29 CFR 1926, "Safety and Health Regulations for Construction" (Construction Industry Standards).

   a. 29 CFR 1926.33 "Access to Employee Exposure and Medical Records".

   b. 29 CFR 1926.51, "Sanitation Standard".

   c. 29 CFR 1926.59, "Hazard Communication".

   d. 29 CFR 1926.62, "Lead".

   e. 29 CFR 1926.103 "Respiratory Protection".

3. 40 CFR 50, "National Primary and Secondary Ambient Air Quality

Standards"

a. 40 CFR 50 Appendix B, "Reference Method for the Determination of Suspended Particulate Matter in the Atmosphere (High Volume Method)".

b. 40 CFR 50 Appendix G, "Reference Method for the Determination of Lead in Suspended Particulate Matter Collected from Ambient Air".

4. 40 CFR 58, "Ambient Air Quality Surveillance".

5. 40 CFR 60 Appendix A, "Visual Determination of Fugitive Emissions from Material Sources and Smoke Emissions from Fires".

6. 40 CFR 117, "Determination of Reportable Quantities for Hazardous Substances".

7. 40 CFR 122, "Administered Permit Program: The National Pollutant Discharge Elimination System".

B. National Institute for Occupational Health and Safety

NIOSH Method 7082, "Lead" (or equivalent).

C. American Society for Testing and Materials

ASTM D3335, "Test Method for Low Concentrations for Lead, Cadmium, and Cobalt in Paint by Atomic Absorption Spectroscopy."

D. EPA (Environmental Protection Agency) Publications

1. SW-846, "Test Methods for Evaluating Solid Waste - Physical/Chemical Methods".

2. EPA Method 3050, "Acid Digestion of Sediments, Sludges, and Soils".

E. SSPC Guide 6, "Guide for Containing Debris Generated During Paint Removal Operations".

F. SSPC Guide 7, "Guide for the Disposal of Lead Contaminated Surface Preparation Debris".

G. SSPC Publication 91-18, "Industrial Lead Paint Removal Handbook".

H. Texas Commission on Environmental Quality

1. Texas Administrative Code (TAC) 30, Chapter 101, "General Rules".

2. Texas Administrative Code (TAC) 30, Chapter 111, "Control of Air Pollution from Visible Emissions and Particulate Matter".

3. Texas Administrative Code (TAC) 30, Chapter 290, "Water Hygiene".

4. Texas Administrative Code (TAC) 30, Chapter 307, "Surface Water Quality Standards".

5. Texas Administrative Code (TAC) 30, Chapter 309, "Effluent Limitations".

6. Texas Administrative Code (TAC) 30, Chapter 335, "Industrial Solid Waste and Municipal Hazardous Waste".

1.04 SUBMITTALS

A. Submittals shall conform to requirements of Section 01330 – Submittal Procedures.

B. Submittals shall conform to appropriate codes for regulatory requirements.

1.05 DEFINITION

A. Acceptance Criteria: Minimum standards for the content of programs, plans, procedures, and designs required by this specification for the performance of this project. Acceptance criteria will be the basis for judging the responsiveness of Contractors' programs and will also be used as a basis for suspending work, if necessary.

B. Action Level: Employee exposure, without regard to the use of respirators, to an airborne concentration of lead of 30 micrograms per cubic meter of air (µg/m3) calculated as an eight hour time-weighted average (TWA).

C. CERCLA: Comprehensive Environmental Response, Compensation, and Liability Act; commonly called Superfund. Federal laws addressing the clean up of hazardous waste sites. Amended in 1986 by Superfund Amendments and Re-Authorization Act (SARA). EPA implementing regulations are contained in 40 CFR 300-373.

D. Competent Person: One who is capable of identifying existing and predictable lead hazards in the surroundings or working conditions and who has authorization to take prompt corrective measures to eliminate them.

E. Containment System: An enclosure built around lead paint removal areas designed to contain lead paint debris and prevent emissions to the environment.

F. Dust Collection: Mechanical ventilation system designed specifically for the containment, capture, and removal of airborne particulate from the containment. Dust collection systems shall include ductwork, plenums and/or hoppers, and dust collector(s) for the removal of leaded paint dust from the air stream prior to discharging to the atmosphere.

G. Emission: A release of material to the air, water, or ground.

H. Entry/Exit Airlock: An isolated enclosure located at the entrance of the containment in which the workers remove contaminated dust and debris from their work clothes.

I. EPA: The US. Environmental Protection Agency. Regulations are contained in Title 40 of the Code of Federal Regulations (40 CFR).

J. Hazardous Waste (lead paint debris): Waste that is classified as hazardous due to its concentrations of regulated hazardous substances. Paint debris is classified as hazardous waste if, after testing by the Toxicity Characteristic Leaching Procedure (TCLP), the leachate contains any of the 8 metals or other substances in concentrations at or above limits established in 40 CFR 261.

K. HEPA: A high efficiency particulate filter (HEPA) that is 99.97% efficient against particles of 0.3 microns in size or larger.

L. Lead Containing Dust and Debris: Dust and debris generated during the project which contains lead in any amount, including but not limited to pulverized paint, spent abrasive, filters (wet and dry), and containment materials upon which lead is still present.

M. NIOSH: National Institute of Occupational Safety and Health.

N. OSHA: Occupational Safety and Health Administration. Standards are contained in Title 29 of the Code of Federal Regulations, Parts 1910 and 1926 (29 CFR 1910 and 29 CFR 1926).

O. Owner: The City of Houston

P. PEL: Permissible Exposure Limit. An employee exposure, without regard to the use of respirators, to an airborne concentration of lead of 50 µg/m3 over an 8 hour TWA.

Q. POTW: Publicly Owned Treatment Works

R. RCRA: Resource Conservation and Recovery Act. Federal law pertaining to hazardous waste management. EPA implementing regulations are contained in 40 CFR 240-280.

S. Regulated Area: Area established by the Contractor to demarcate the zone(s) beyond which airborne concentrations of lead do not exceed the Action Level.

T. SSPC: Society for Protective Coatings. An independent, non-profit organization of engineers, technical specialists, and Contractors whose goal is research and development of new coatings and methods for removal, application, and disposal of existing coatings on industrial structures.

U. Tarpaulins: Flexible fabric, vinyl, plastic or canvas cover sheets, impenetrable to dust, wind, and water, used to enclose the cable and/or scaffold support system comprising the containment enclosure.

V. TCLP: Toxicity Characteristic Leaching Procedure. Laboratory tests conducted on wastes that determine the amount of hazardous materials that leach out into a test solution. The test is intended to simulate the properties of water as it leaches through a solid waste landfill. TCLP testing is defined in 40 CFR 261, Appendix II.

W. TSP: Total Suspended Particulate

PART 2 PRODUCTS

2.01 MATERIAL AND EQUIPMENT

A. The Contractor is to supply materials and equipment to insure the safety and protection of workers and the environment in accordance with these specifications.

PART 3 EXECUTION

3.01 ENVIRONMENTAL PROTECTION AND MONITORING

NOTE: Section 09971 "Painting and Protective Coatings", 2.04 "Containment System" specifically identifies containment system requirements.

A. Protection of Ambient Air: Visible emissions are to be controlled to meet, as a minimum, TAC 30 Chapter 111," Control of Air Pollution from Visible Emissions and Particulate Matter" requirements and SSPC-Guide 6I (CON), Level 1 Emissions. Air monitoring and analysis may be performed by the City during abrasive blast cleaning operations. Such monitoring will be in accordance with 40

CFR 50, Appendix B, "Reference Method for the Determination of Suspended Particulate Matter in the Atmosphere" and/or 40 CFR 50, Appendix G, "Reference Method for the Determination of Lead in Suspended Particulate Matter Collected from Ambient Air". The limits for down wind pollutant concentrations allowed during blasting operations are as follows:

PM-10: 450 micrograms/cubic meter/ 8 hr.. (40 CFR 50.6)

Lead (Pb): 13.5 micrograms/cubic meter/8 hr.. (40 CFR 50.12)

Visible emissions and/or monitored emissions for PM-10 and TSP lead in excess of the above levels shall be cause for shut down of the project until corrections to control/ containment system or paint removal/ surface preparation operations are made to comply with these requirements.

B. Protection of Surface and Storm Water: The Contractor shall take all necessary precautions to ensure lead contaminants do not enter surface waters or storm water drainage systems.

1. The Contractor shall protect the area around ditches and drainage inlets. Daily verification of proper protection to minimize the potential contaminants reaching the drainage system shall be performed.

2. The Contractor shall collect all potentially contaminated process waters for testing and, as appropriate, treatment. Process water from pressure washing, wet abrasive blast cleaning or hygiene facilities shall not be discharged to drainage systems or surface waters.

3. The Contractor may remove lead or other heavy metals from such waters through filtration, ion exchange or other approved means. Following treatment, water samples must be tested prior to disposal. Discharge to sanitary sewer lines requires authorization, in writing, from a POTW.

C. Protection of Soil and Grounds: The Contractor shall protect the soil around the structure to ensure that the soil does not become contaminated. Where lead is present in the coatings to be removed, as indicated in Section 02136 "Waste Material Handling and Disposal", the Contractor shall provide for the sampling and analysis of soil samples for total lead content.

1. Sampling and analysis shall be performed prior to commencement of paint removal operations to establish a background "base level". Soil samples shall be taken 3 feet from the base of the tank(s), at a distance of 6-10 feet beyond the proposed containment structure and at the property line.

2. Samples from each area shall be taken in a minimum of four directions, at

circular increments of 90^0, one of which shall include the direction of prevailing wind. Samples shall also be obtained, at the direction of the engineer, at the closest points of public access (i.e. housing, park, school).

3. The soil sampling procedure shall be as outlined in SSPC Guide 6 Section 5.5.5. Each sampling point shall be sufficiently identified on a site map to allow return to the exact location upon project completion.

4. Each sample shall be split in two portions, one for immediate analysis and the other sealed, preserved and furnished to the Engineer. The samples shall be analyzed in accordance with EPA Method 3050, "Acid Digestion of Sediments, Sludges and Soils", and shall be performed by a qualified laboratory approved by the Engineer.

5. Samples shall be obtained at the completion of work (post-construction samples) from all locations from which pre-construction samples were obtained. Samples shall be collected, handled and tested in the same manner as described above.

6. Upon completion of the work, soils found to be contaminated with lead in greater quantity than found in the background "base level", established at the start of the work, shall be removed by the Contractor to the depth necessary to achieve a lead content equivalent to, or below, the pre-construction back ground levels. Disposal shall be in accordance with applicable regulations.

7. The Contractor shall replace in-kind (i.e., topsoil, structural fill, etc.) with an equivalent amount of non-contaminated soil, compact in place and grade to pre-existing conditions. The Contractor shall also replace in-kind any surface improvements, such as grass, shrubs, etc. that were damaged or destroyed by the work. The soil removal, replacement and related work is to be performed by the Contractor at no additional cost to the Owner.

3.02 WORKER PROTECTION

A. The Contractor shall develop a written Compliance Program to establish and implement practices and procedures for assuring that no employee is exposed to lead at concentrations greater than 50 micrograms per cubic meter of air ($\mu g/m^3$), the OSHA permissible exposure limit (PEL). This program is in addition to other OSHA hazard communication and safety and health requirements of the project, and shall be revised and updated at least every six months.

1. The program shall establish methods for complying with this specification and the OSHA Construction Industry Lead Standard, 29 CFR 1926.62(e)(2)(ii). The Federal regulation is referred to as the "Lead

Standard" for the purpose of this specification.

2. The program shall apply to all Contractor employees associated with lead on the project, and to subcontractors working under the direct control of the Contractor who are associated with lead on the project.

3. The program shall assign the specific responsibility for implementation and enforcement of the program to the Contractors' company management. The Contractor's Competent Person(s) shall be identified, by name, and qualifications submitted. The Competent Person shall be on-site during any operations which involve the removal, handling or disturbing of lead containing materials.

4. The program shall contain a description of each activity in which lead is emitted (e.g. equipment used, material involved, controls in place, crew size, employee job responsibilities, operating procedures and maintenance practices).

5. The program shall contain a report of the technology considered in meeting the PEL and air monitoring data which documents the source of lead emissions.

6. The program shall contain a work practice program which includes items required in the lead standard such as protective clothing and equipment, housekeeping, and hygiene facilities and practices.

B. Exposure Monitoring: The Contractor shall be responsible for conducting and reporting worker exposure assessments in accordance with 29 CFR 1926.62.

1. Representative personal air samples shall be collected at the beginning of the lead removal work to determine employee lead exposures. Tasks involving potential lead exposure include, but are not limited to, paint removal operations, clean-up, and debris handling operations. Full shift (at least 7 hours) air samples shall be collected for each job classification in the exposure area. The range of exposures for lead removal and cleanup activities shall be determined.

2. During the initial monitoring, workers performing the following activities (or equivalent) shall be protected to the anticipated exposure levels which are dictated by the lead standard:

a. 500 $\mu g/m^3$: Manual demolition of structures containing lead-containing coatings or paint (e.g., dry wall), manual scraping, manual sanding, heat gun applications, power tool cleaning with dust collection systems, and spray painting with lead paint.

b. 2,500 µg/m^3 : Using lead-containing mortar, lead burning, or conducting the following activities where lead-containing coatings or paint are present: rivet busting, power tool cleaning without dust collection systems, clean-up activities where dry expendable abrasives are used, and the movement and removal of abrasive blasting enclosures.

c. More than 2,500 µg/m^3: Activities involving lead containing coatings or paint on structures disturbed by abrasive blasting, welding, cutting, and torch burning.

3. Protection requires compliance with the necessary respiratory protection, personal protective clothing and equipment, change areas and washing facilities, blood lead and zinc protoporphyrin monitoring, and employee training. The protection measures shall be modified, as necessary, after the exposure results are received.

4. Where initial monitoring indicates that lead exposures are below the Action Level, and where work activities and conditions remain the same as at the time of initial sampling, additional monitoring need not be repeated for that work activity.

5. Where the initial monitoring of a given work activity indicates that lead exposures are at or above the Action Level, additional exposure monitoring shall be conducted monthly. The monthly monitoring is more frequent than frequencies established in the lead standard which are at least every 6 months if above the Action Level, but below the PEL, or every 3 months if above the PEL.

6. All air samples shall be collected and analyzed according to NIOSH Method 7082, or equivalent. All samples shall be analyzed by laboratories accredited by the American Industrial Hygiene Association for metals analysis.

7. All exposed employees shall be notified in writing of the monitoring results within five (5) days after receiving the results.

8. The Action Level for airborne lead exposure is 30 µg/m^3, as an 8-hour time weighted average (TWA) concentration, without regard to the use of respirators. Whenever workers' airborne lead exposures exceed the Action Level, the Contractor shall implement the following:

   a. Periodic Exposure Monitoring
   b. Employee Information and Training

c. Employee Medical Surveillance and Medical Removal Protection
d. Housekeeping
e. Record keeping
f. Signs and Regulated Areas

9. The Permissible Exposure Limit (PEL) for airborne lead exposure is 50 µg/m^3, as an 8-hour TWA concentration. When the work area contains airborne lead levels above the PEL the Contractor shall implement the following in addition to those items listed in 3.02.B.8 of this section:

a. Compliance Program
b. Respiratory Protection
c. Protective Clothing and Equipment
d. Hygiene Facilities and Practices

C. Respiratory Protection: After feasible engineering controls and work practices have been implemented, respiratory protection shall be used to maintain employees' lead exposures below the PEL.

1. Respirators shall be worn by all employees, other Contractors, inspectors, or observers who enter regulated areas.

2. The Contractor shall develop a written Respiratory Protection Program in compliance with 29 CFR 1910.134, paragraphs (b), (d), (e), and (f), and the lead standard. The program shall address the selection, use, maintenance, and inspection of respirators, and qualifications for respirator users.

D. Protective Clothing and Equipment: The Contractor shall provide protective clothing and equipment and ensure they are worn by all employees whose lead exposures exceed the PEL, or who enter regulated areas.

1. Protective clothing shall include washable and/or disposable full body coveralls, gloves, foot coverings, and hoods. Other protective equipment shall include face shields, hard hats, eye protection, and hearing protection as appropriate.

2. Disposable protective clothing shall be used for no more than one work day. Such clothing may have to be disposed of as hazardous waste.

3. Reusable protective equipment shall be cleaned or replaced weekly if exposure levels are less than 200 µg/m^3, or daily if the exposure levels are greater than or equal to 200 µg/m^3.

4. Clothing shall not be removed or "cleaned" by any means which could reintroduce the lead dust into the ambient air. This includes brushing,

shaking, and blowing. Vacuums equipped with HEPA filters shall be used for this purpose.

5. Reusable coveralls shall be collected at the end of each work day in closed containers. The containers shall be labeled in accordance with the requirements of 29 CFR 1926.62(g)(2)(vii). Contaminated clothing shall be cleaned in accordance with all applicable Federal, State, or local regulations pertaining to lead-contaminated laundry and water discharge. Laundries shall be informed that the clothing contains lead. If the clothing is washed on site, the discharge water shall be filtered, containerized, and arrangements made with the local POTW or other approved means of proper disposal.

6. Protective clothing and equipment shall be removed in the contaminated section of the change area and shall not be worn into any clean areas.

7. The Contractor shall provide the necessary clothing and equipment for use by the Owner and its designated representatives.

E. Housekeeping: Accumulations of lead-containing dust and debris generated by work activities shall be removed and cleaned daily.

1. All persons doing the cleanup shall be trained in performing lead activities, respirator qualified, and participate in the medical surveillance program. Respirators and protective clothing shall be worn by all persons doing the cleanup.

2. Compressed air may be used for housekeeping if used within containment and in conjunction with a ventilation system designed to capture the dust. Otherwise, HEPA-filtered vacuum cleaners shall be employed.

3. All lead-containing dust and debris shall be collected in sealed containers. The waste shall be tested to determine whether it will be disposed of as hazardous waste.

F. Personal Hygiene Facilities and Practices

1. Clean change areas shall be provided when employees' lead exposures exceed the PEL. The change areas shall be equipped with storage facilities for street clothing and a separate area for the removal and storage of lead-contaminated clothing and equipment. They shall be designed and used so that contamination of street clothing does not occur. Employees shall not leave the project site wearing any clothing worn while performing lead activities. Airborne lead exposures in the change area shall be maintained below the Action Level.

2. Shower facilities shall be provided whenever employees' lead exposures exceed the PEL. Shower facilities shall comply with OSHA Sanitation Standard, 29 CFR 1929.51. All employees whose lead exposures exceed the PEL shall shower at the end of each work shift or before leaving the project area. The shower facilities shall be made available for use by the Owner and its representatives, such as inspectors or observers.

3. Arrangements shall be made with the local POTW for the proper disposal of the shower and wash water after filtration (e.g., through a three stage 100, 50, and 5 micron filtering system), ion exchange, or other approved treatment technology.

4. Clean lunch areas shall be provided for all employees whose lead exposures exceed the PEL. Employees shall remove or clean (by vacuuming) their protective clothing and wash their hands and face before entering the lunch area. Lead exposures in the lunch area shall be maintained as free as practicable from lead contamination.

5. An adequate number of clean lavatory and hand washing facilities shall be provided. These shall comply with the OSHA Sanitation Standard, 29 CFR 1929.51.

6. Eating, drinking, smoking, chewing of food or tobacco products, or the application of cosmetics shall not be permitted in any areas where the lead exposures exceed the PEL. Thorough washing of hands and face is required prior to undertaking any of these activities.

G. Medical Surveillance and Medical Removal Protection

1. All employees who are exposed to lead above the Action Level in a single day during this project shall be provided with initial and periodic medical examinations and blood lead tests as required by the lead standard. A final blood lead test shall be provided for each worker upon completion of the project, or at any time a worker's employment at the project ceases.

2. When blood lead levels over 50 µg/dl are encountered, the Contractor shall provide for the temporary removal of employees from lead exposure above the Action Level. The required medical surveillance and periodic blood lead tests shall be provided in strict accordance with the lead standard throughout the removal.

3. Employees who will be required to wear a respirator or who request one shall be provided with a respirator and the necessary medical examinations to determine their ability to wear a respirator.

4. All examinations shall be provided by the Contractor and shall be performed by or under the direct supervision of a licensed physician.

H. Employee Information and Training

1. The Contractor shall provide lead training for all employees who are exposed to lead above the Action Level for this project.

2. The content of lead training shall include, as a minimum, those items listed in the lead standard.

3. Training shall also include hazard communication in accordance with 29 CFR 1926.59.

4. The Contractor shall notify other employers at the project site of the nature of the lead exposure work, the need to remain out of exposure areas, the warning sign and labeling system in effect, and the potential need for them to take measures to protect their employees.

I. Signs and Regulated Areas

1. The Contractor shall establish a regulated area surrounding activities where lead exposures exceed the Action Level. This includes locations where lead-containing debris is handled or transferred to storage containers.

2. The regulated area shall be demarcated by ropes, tape, walls, or containment's with caution signs posted at all accessible sides. Signs shall contain the legend:

WARNING
LEAD WORK AREA
POISON
NO SMOKING OR EATING

3. The Contractor shall control access of persons into regulated areas. Access shall be limited to individuals with proper training and personal protective equipment, and medical surveillance testing.

4. All persons entering regulated areas shall wear protective clothing and respirators.

5. Eating, drinking, smoking, and chewing of food or tobacco products shall be prohibited in regulated areas and in any area where lead exposures exceed the Action Level.

J. Record keeping: All records relating to training, medical examinations, blood lead monitoring, and exposure monitoring shall be maintained by the Contractor as required by the lead standard. All records shall be available for review by the Owner or its representative upon request.

3.03 CERTIFIED INDUSTRIAL HYGIENIST (CIH)

A. The Contractor shall provide for the services of a Certified Industrial Hygienist (CIH) who must be certified by the American Board of Industrial Hygiene in comprehensive practice.

B. Duties of the CIH shall be as follows:

1. Conduct and/or verify training for contractor employees in accordance with 29 CFR 1926.62 (l).

2. Review and approve Contractor's Written Compliance Plan for conformance to 29 CFR 1926.62(e)(2)(ii) and this Specification.
3. Monitor and evaluate work weekly to assure conformance with the approved plan and that hazardous exposure is adequately controlled in accordance with worker safety and health requirements of these specifications

4. Provide monthly reports of work compliance with control requirements in regards to working in a lead environment.

C. Activities of the CIH shall include:

1. Meet with City to discuss details of Contractor's Written Compliance Plan for lead paint removal.

2. Ensure worker and area air monitoring, testing and reporting are conducted by or under the direction of the CIH.

3. Furnish a detailed worker and area air monitoring schedule coordinated with Contractor's proposed production schedule.

4. Directing, monitoring and inspecting lead paint removal work to ensure that the requirements of the Contract have been satisfied during the entire lead paint removal operation.

5. Report results of air monitoring samples to the Engineer, signed by the CIH within 48 hours after the air samples are taken.

6. The CIH shall review sampling data, collected on a day when lead paint

removal operations occur, to determine if conditions require any change in work methods. Removal work shall not continue until approval is given by the CIH.

7. The CIH shall verify in writing and submit monitoring data to verify that:

   a. Air borne lead levels at and beyond the lead control (regulated) area were and remained less than 30 mg/m^3 of air

   b. Contractor conformance to 29 CFR 1926.62 and Item 3.02, above

   c. There were no visible accumulations of lead contaminated paint, dust or debris on the work site. Adjacent areas that may have become contaminated were properly cleaned and inspected.

   d. The CIH shall verify that the work area and contractor's equipment have been adequately cleaned of lead contamination prior to demobilization from the work site.

3.04 DEMOBILIZATION

The Contractor shall not remove the lead control area, boundaries, warning signs, etc. prior to proper removal of all hazardous wastes, debris and materials from the site and the City's receipt and acceptance of the CIH's verification.

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, Expy, 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/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 G E N E R A L

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 G E N E R A L

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 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 01454

TESTING LABORATORY SERVICES

PART 1 G E N E R A L

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 E X E C U T I O N

3.01 CONDUCTING TESTING

A Conform to laboratory sampling and testing methods specified in individual Specification sections to the latest issues of ASTM standards, TxDOT methods, or other recognized test standards as approved by Project Manager.

B Requirements of this Section shall also apply to those tests for approval of materials, for mix designs, and for quality control of materials as performed by employed testing laboratories.

END OF SECTION

Section 01502

MOBILIZATION

PART 1 G E N E R A L

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 G E N E R A L

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 P R O D U C T S - NOT USED

PART 3 E X E C U T I O N

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.

END OF SECTION

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Section 01506

DIVERSION PUMPING

PART 1 G E N E R A L

1.01 DEFINITIONS

A. Diversion-pumping: Installation and operation of bulkheads, plugs, hoses, piping, and pumps required to maintain sewer flow and prevent backups and overflows.

1.02 SYSTEM DESCRIPTION

A. Provides continuous sewer service to users of sewer systems while maintenance or construction operations are in progress, by diverting flow around construction locations. Maintain sewer flow to prevent backup or overflow onto streets, yards and unpaved areas or into buildings, adjacent ditches, storm sewers, and waterways. Do not divert sewage outside of sanitary sewer system.

B When pumps are operating, have an experienced operator on site to monitor operation, adjust pumps, make minor repairs to system, and report problems.

1.03 SUBMITTALS

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

B. For systems that bypass sanitary sewer line segments of 42-inch diameter or larger, submit a Diversion Pumping Plan prior to installation. Show location, number and size of pumps, number, location, size and type of hoses or rigid piping, and location of downstream discharge; and special features where pipes or hoses cross roadways, temporary trenches, support bridges.

1.04 SCHEDULING

A. When the City operates or maintains diversion pumping in construction areas, coordinate construction activities with Project Manager.

B. Cease operation of diversion pumping when approved by Project Manager.

PART 2 P R O D U C T S

2.01 MATERIALS

A. Design piping, joints and accessories to withstand at least twice maximum system pressure or 50 psi, whichever is greater.

B. Use self-priming type or submersible electric pumps, with a working pressure gauge on the discharge. Pumps shall meet requirements of City of Houston Noise and Sound Level Regulations.

PART 3 E X E C U T I O N

3.01 FIELD QUALITY CONTROL

A. During diversion pumping, do not allow sewage to leak, dump, or spill into or onto areas outside of existing sanitary sewer systems.

B. In the event of an accidental spill or overflow, immediately stop discharge and take action to clean up and disinfect spill. Promptly notify Project Manager so required reporting can be made to the Texas Commission on Environmental Quality (TCEQ) and the Environmental Protection Agency (EPA).

3.02 CLEANING

A. When diversion-pumping operations are complete, drain sewage within piping into sanitary sewers prior to disassembly.

END OF SECTION

Section 01520

TEMPORARY FIELD OFFICE

PART 1 G E N E R A L

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 P R 0 DUCTS

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 G E N E R A L

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.

END OF SECTION

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Section 01562

TREE AND PLANT PROTECTION

PART 1 G E N E R A L

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 P R O D U C T S

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 E X E C U T I O N

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

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

E. Submit shop drawings for Drop Inlet Baskets.

PART 2 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 G E N E R A L

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 manufacturer's 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 P R O D U C T S

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

Section 01576

WASTE MATERIAL DISPOSAL

PART 1 G E N E R A L

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 P R O D U C T S - Not Used

PART 3 E X E C U T I O N

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 G E N E R A L

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 E X E C U T I O N

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 G E N E R A L

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 01581

EXCAVATION IN PUBLIC WAY PERMIT SIGNS

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Project sign installation.

B. Maintenance and removal of Project sign.

1.02 SYSTEM DESCRIPTION

A. Sign Construction: Construct signs of new materials.

B. Appearance: Maintain signs to present a clean and neat look throughout the Contract duration.

C. Sign Placement: Place signs at each street entrance to street cut excavation.

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 LAYOUT

A. Conform to Texas Manual on Uniform Traffic Control Devices. Minimum size: 36 inches by 36 inches.

B. Lettering: Uppercase Helvetica Regular lettering.

C. Composition: Include on sign copy of street cut permit, title “City of Houston”, contracting department’s name, address, and emergency telephone number and Contractor’s name. Project Manager will provide department name, address, and emergency telephone number for preparation of sign.

PART 3 E X E C U T I O N

3.01 INSTALLATION

A. Install Project signs before commencement of pavement excavation in Public Way.

B. Position sign so it is fully visible and readable to general public.

C. Erect sign level and plumb.

D. 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 depth of at least 2 feet upon completion of the Work. Restore area to condition equal to or better than before construction.

END OF SECTION

Section 01610

BASIC PRODUCT REQUIREMENTS

PART 1 G E N E R A L

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 G E N E R A L

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 G E N E R A L

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 G E N E R A L

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 #
Project Description	Superintendent's Office #/Mobile #/Pager #
Contractor (Company Name)	Name and Phone #/Mobile #/Pager #
Job Superintendent's Name	Name, Phone #/Mobile #/Pager #
Contractor's Emergency Information	
Inspector/Senior Inspector	
Date & Time assistance is requested	

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 P R O D U C T S

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 E X E C U T I O N

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 G E N E R A L

1.01 SECTION INCLUDES

A. Starting systems.

B. Demonstration and instructions.

C. Testing, adjusting and balancing.

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. 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 G E N E R A L

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

Section 01782

OPERATIONS AND MAINTENANCE DATA

PART 1 G E N E R A L

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

Section 01785

PROJECT RECORD DOCUMENTS

PART 1 G E N E R A L

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 02101

SLUDGE/SETTLED DEBRIS REMOVAL

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Removal and disposal of all debris and grit as necessary to accommodate work in structures/piping installation.

1.02 UNIT PRICES

A. Unless indicated in the Unit Price Schedule as a pay item, no separate payment will be made for work performed under this Section. Include cost of work performed under this Section in pay items for which this work is a component.

B. Dewatering of piping/structures and removal/disposal of all waste, sediment, and debris material is considered incidental to work described in this section, unless otherwise noted, and shall be performed at no additional cost to the City.

1.03 SUBMITTALS

A. Submittals shall conform to requirements of Section 01330 -Submittal Procedures.

B. Submit written work procedures that include the proposed methods, equipment, materials, construction phases, and operations sequence for cleaning.

C. Submit sketches showing the location, method, and phasing of construction for any temporary work platforms, scaffolds, temporary separation walls, temporary dams, and/or temporary diversion channels that are planned to be used to facilitate debris removal.

D. Submit work procedures and related sketches to the City for review at least 14 days prior to implementation.

E. Submit copies of OSHA confined space entry certificates, Category "C", for all workers that will be entering the structure/pipe during operating conditions.

F. Notify the City Engineer in writing at least 72 hours prior to initiating cleaning.

1.04 OWNERSHIP OF MATERIAL

A. All waste material and debris removed shall become the property of the Contractor.

1.05 ENVIRONMENTAL CONTROLS

A. Minimize spread of dust and flying particles. If required by governing regulations, use temporary enclosures and other suitable methods to prevent the spread of dust, dirt, and debris.

B. Use appropriate controls to limit noise to levels designated in City ordinances.

C. Do not use water where it can create dangerous or objectionable conditions, such as localized flooding, erosion, or sedimentation of nearby ditches or streams.

D. Contractor shall be responsible for testing equipment, materials, waste, sediment, and debris removed for classification prior to disposal. Contractor shall dispose of removed equipment, materials, waste, sediment, and debris in a manner conforming to applicable City, State, and Federal laws and regulations.

PART 2 P R O D U C T S

2.01 MATERIALS

A. Cleaning Agents: Use cleaning materials and agents recommended by the manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

B. Diversion Pumps & Piping Pumps shall be self-priming type or submersible electric, in good working order, with a w orking pressure gauge on t he discharge. Pumps shall meet the requirements of the City of Houston Noise and Sound Level Regulations. Design piping, joints, and accessories to withstand at least twice the maximum system pressure or 50 psi, whichever is greater.

PART 3 E X E C U T I O N

3.01 PERFORMANCE CRITERIA

A. Debris removal shall include the removal of all loose debris of all sizes, including any rubbish, litter, grit, sediments, and any other foreign substances that may be deposited within the structure/pipe.

B. Debris removal shall include low pressure washing of all surfaces that is sufficient to remove caked-on grit and sediments without causing damage to the existing surface coatings. Cleaning does not include the removal of grime or stains.

3.02 DISPOSAL

A. Collect and dispose of all debris and waste removed. Conform to requirements of Section 01576-Waste Material Disposal.

B. Trash and loose debris shall not be permitted to accumulate at the Project site. All waste materials removed shall be regularly removed and disposed of at an approved site. Follow methods of disposal as required by the applicable regulatory agencies.

3.03 PROTECTION OF PERSONS AND PROPERTY

A. Provide safe working conditions for employees throughout the cleaning and debris removal operations. Observe safety requirements for work within confined structures.

B. All persons entering the structure/pipe shall have the proper confined space entry certification.

C. The Contractor shall provide the necessary equipment (gas masks, supply air, forced ventilation, etc.) as required by OSHA Federal Regulations Part 29 CFR 1910.146 for entering and working in confined spaces with a hazardous atmosphere. All work performed shall be in accordance with OSHA.

D. Maintain safe access to adjacent property and buildings. Do not obstruct roadways, sidewalks, or passageways adjacent to the work.

E. Perform cleaning in a manner to prevent damage to adjacent property. Repair damage made to City property or adjacent property and facilities.

F. Erect and maintain enclosures, barriers, warning lights, and other required protective devices.

G. Schedule cleaning operations to minimize temporary disruption of utilities to existing facilities.

H. Construct temporary flow diversion channels, temporary separation walls, or temporary dams as necessary to facilitate debris removal.

I. In the event of accidental spill or overflow during cleaning operations, immediately take action to clean up and disinfect the spill. Promptly notify the City Engineer.

END OF SECTION

Section 02105

CHEMICAL SAMPLING AND ANALYSIS

PART 1 G E N E R A L

1.01 1.01 SECTION INCLUDES

A. Preparatory work related to site remediation and excavation in a Potentially Petroleum Contaminated Area (PPCA).

B. Sampling and analysis of site material.

1.02 MEASUREMENT AND PAYMENT

A. Unit Prices

1. Preparatory work is paid on a lump sum basis. Item includes hiring environmental consultants, preparing Environmental Health and Safety Plan, preparing Environmental Work Plan, training personnel, and obtaining permits and additional insurance.

2. Underground Utility Construction in PPCA.

a. Underground utility construction and appurtenances in areas identified within PPCA limits is on a linear foot basis, each basis, or lump sum basis, as shown in Document 00405 ¬Schedule of Unit Price Work.

b. Payment includes compensation for labor, equipment, and supervision for mobilization, environmental monitoring and field screening, handling, sampling, and testing of contaminated soil and ground water. Contaminated soil may be Category I or II. Contaminated groundwater will be that encountered during excavation for underground utilities and flowing at a rate not greater than 20 gallons per minute. Included in this pay item is incremental cost for upgraded piping, gaskets, and appurtenant materials.

c. Limits of measurement under this section are noted on Drawings as Begin PPCA Excavation and End PPCA Excavation, and

other areas determined by Project Manager during the course of the work.

d. Payment will be made upon receipt of field test reports from approved analytical laboratory.

3. A force account for Extra Work for PPCA Handling will be used to compensate for time and materials required for additional work associated with PPCA when directed by Project Manager to perform such work and for which there is no bid item. Authorization and compensation for this work will be in accordance with Document 00700 -General Conditions.

4. Refer to Section 01270 -Measurement and Payment for unit price procedures.

B. Stipulated Price (Lump Sum). If the Contract is a Stipulated Price Contract, payment for work in this Section is included in the total Stipulated Price.

1.03 1.03 REFERENCE STANDARDS

A. ASTM D 5092 -Practice for Design and Installation of Groundwater Monitoring Wells in Aquifers.

B. Code of Federal Regulation (CFR), Title 40, Section 261.24. -Protection of the Environment.

C. CFR, Title 29, Section 1910.120. -Occupational Safety and Health Administration, Department of Labor.

D. CFR, Title 29, Section 1926. -Occupational Safety and Health Administration, Department of Labor.

E. CFR, Title 40, Section 261, Appendix II. -Protection of the Environment.

F. Texas Administrative Code (TAC) , Title 30, Chapter 335. -Industrial Solid Waste & Municipal Hazardous Waste.

G. TAC, Title 30, Chapter 334. -Underground and Aboveground Storage Tanks.

H. TAC, Title 30, Chapter 106.533. -Exemptions from Permitting, Subchapter X. Waste Processes and Remediation.

I. U.S. Environmental Protection Agency (EPA), (SW-846) Test Methods for Evaluating Solid Waste, Office of Solid Waste and Emergency Response, Washington, D.C. (P1388-239223, November 1986).

J. Texas Commission on Environmental Quality (TCEQ) Interoffice Memo, dated 4/12/94, by Chris Chandler, RPR Section, PST Division, regarding Revised Procedures for Classifying and Assigning Waste Codes for Underground and Aboveground Petroleum Storage Tank Wastes (text attached following this section).

1.04 DEFINITIONS

A. Petroleum: Crude oil, natural gas, natural gas liquids, liquefied natural gas, and synthetic gas usable for fuel, as well as distillates of crude oil including gasoline, kerosene, diesel oil, motor oil, waste oil, jet fuels, and fuel oil.

B. Potentially Petroleum Contaminated Area (PPCA): An area within station-to-station locations identified on Drawings where petroleum contamination has been detected in the soil or groundwater. PPCA also includes areas where contamination is suspected or encountered during utility installation outside areas identified on Drawings, and such contamination has been verified by Project Manager.

C. Category I Soil: Soil containing visual or physical evidence of contamination, as described in paragraph 3.01, and that is not Category II Soil.

D. Category II Soil: Soil that contains petroleum contamination in excess of levels identified in paragraph 3.04, and is consistent with a classification as Special Waste-PST as defined by TCEQ in their interoffice memo dated 4/12/94, or soil that contains visible free product or is impacted with non¬petroleum compounds detected above Risk Reduction Standard Number 2 levels as defined in Texas Administrative Code, Title 30, Chapter 335.

E. Potentially Contaminated Groundwater: Water recovered in a groundwater control system located in PPCA or groundwater that contains visual or physical evidence of contamination, as described in paragraph 3.01, and such contamination has been verified by Project Manager.

1.05 SUBMITTALS

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

B. Submit an Environmental Work Plan within 30 days after issuance of Notice to Proceed.

1. The Environmental Work Plan shall be prepared by a Corrective Action Project Manager licensed in Texas, who has completed 40-hours of Health and Safety Training and the required annual refresher training, and in the employment of a registered Corrective Action Specialist firm.

2. The Environmental Work Plan shall include the following items. Compile and arrange in a format that can be reviewed by TCEQ.

   a. Proposed sequence of construction through PPCA;

   b. Procedures for screening soil in PPCA, identifying Category I or II Soil;

   c. Procedures for handling material from PPCA;

   d. Proposed location of stockpile areas;

   e. Proposed reuse of Category I Soil as trench backfill below depths of 30 inches;

   f. Proposed methods for disposal or recycling of Category I or II Soil;

   g. Proposed carriers of Category I or II Soil or potentially contaminated groundwater with verification each is properly licensed;

   h. Proposed recycle/disposal sites for Category I or II Soil or potentially contaminated groundwater with verification that each is properly licensed;

   i. Copy of permit required for discharge of potentially contaminated groundwater in sanitary sewer system, if to be disposed in sanitary sewer;

   j. Name and qualifications of Corrective Action Project Manager and professional environmental consultants for health, environmental, and safety issues regarding operations within PPCA; and,

k. Proposed analytical laboratory with verification it is accredited by A2LA or other recognized association, or it is a participant in the EPAs Performance Evaluation Program.

3. Do not commence work in PPCA until Environmental Work Plan has been reviewed and accepted by Project Manager.

C. Submit Environmental Health and Safety Plan within 30 days after issuance of Notice to Proceed.

1. The Health and Safety Plan shall be prepared by a Corrective Action Project Manager licensed in Texas, who has completed 40 hours of health and safety training, and required annual refresher training, or a Certified Industrial Hygienist.

2. Include methods and procedures for assuring work, which will be conducted under conditions expected in the field, is safe.

D. As work proceeds, submit field screening, monitoring and analytical laboratory test results on a weekly basis for soil and on a daily basis for groundwater. Summarize test results in tables together with applicable regulatory criteria.

E. Submit copies of correspondence, reports, permits and other documents provided to, or received from, regulatory agencies.

1.06 PERSONNEL REQUIREMENTS

A. Provide trained personnel who have completed minimum health and safety programs specified by the Occupational Safety and Health Administration in 29 CFR 1910.120. Before beginning work at the site, each employee that will work in PPCA is required to have completed 40 hours health and safety training and the required annual refresher training.

PART 2 P R O D U C T S

2.01 MATERIALS

A. Do not use polyvinyl chloride or other plastic material, unless approved by Project Manager.

B. Water Line Pipe Material.

1. Furnish ductile-iron pipe or steel pipe material within station-to-station locations identified as PPCA on Drawings.

2. Provide restrained joints for ductile-iron pipe or welded joints for steel pipe.

3. Provide pipe material conforming to Section 02501 -Ductile-Iron Pipe and Fittings or Section 02502 -Steel Pipe and Fittings.

C. Sanitary Sewer Pipe Material.

1. Furnish ductile-iron pipe, centrifugally cast fiberglass pipe, or equivalent protective materials approved by Project Manager.

2. Provide restrained joints.

3. Provide pipe material conforming to Section 02501 -Ductile-Iron Pipe and Fittings or Section 02504 - Fiberglass Reinforced Pipe. Use pipe with a minimum pressure rating of 150 psi.

D. Use Viton (FKM) type gaskets, or other material as recommended by the pipe manufacturer, for water lines, sanitary and storm sewer pipe, and appurtenances requiring gaskets.

PART 3 E X E C U T I O N

3.01 POTENTIALLY PETROLEUM CONTAMINATED AREAS

A. Conduct operations in PPCA in accordance with the accepted Environmental Work Plan and the Environmental Health and Safety Plan and to minimize the spread of contamination. In other areas which are either detected or suspected to be potentially petroleum contaminated areas, immediately notify Project Manager and proceed with work in accordance with this Section, unless otherwise directed by Project Manager.

B. Immediately notify Project Manager and TCEQ s Region 12 Field Office whenever Category I or II Soil or potentially contaminated groundwater are encountered.

1. Provide location, depth, type (soil or groundwater), source (if known), and evidence of suspected contamination.

2. Determine if Category I Soil or potentially contaminated groundwater is present by visual or physical evidence of contamination. Visual or physical evidence includes:

   a. Petroleum or chemical odor.

   b. Indication of levels of contamination by air monitoring devices employed as part of the Environmental Health and Safety Plan.

   c. Soil or groundwater discoloration.

   d. Material oozing/dripping into excavation.

   e. Liquid or oily sheen floating on groundwater.

   f. Buried containers or refuse.

   g. Field screening head-space results in excess of a 25 ppm reading on a photoionization detector (PID) or flame ionization detector (FID).

C. Install piping and gasket materials and appurtenances in conformance with appropriate section, except as modified in this Section.

D. Construct trench dams within a utility trench at each boundary of PPCA and laterals to minimize potential for contaminant transport within pipe bedding material. A trench dam shall consist of at least 24 inches of cement stabilized sand with 10 percent bentonite clay added, extending from 6 inches below bottom of trench to within 12 inches of limits of topsoil or pavement.

3.02 ENVIRONMENTAL MONITORING

A. An environmental consultant shall monitor conditions in PPCA, as specified in the Environmental Health and Safety Plan. Maintain safe working conditions in accordance with OSHA requirements (29 CFR 1926).

3.03 SCREENING PPCA SOILS

A. An environmental consultant shall perform field screening of soil removed from excavation or tunneling in PPCA.

B. Screening Procedures.

1. Place samples in a sealed plastic bag and place in a warm location for 15 minutes prior to screening.

2. Properly calibrate the PID/FID using a calibration gas. For PIO use 100 ppm isobutylene and for FID use 100 ppm methane.

3. Open bag just enough to insert instrument probe and take maximum headspace reading.

4. Screen at least twice per hour while removing soils in open cut areas or shafts.

5. During tunneling, screen once for each pipe length in pipe jacked tunnels or each advance of tunnel shield in primary-lined tunnels. Screen at least once per shift when excavating.

3.04 SAMPLING AND TESTING

A. Frequency.

1. 1 Sample soil in PPCA at a rate of not less than one composite sample for every 20 cubic yards of excavation or volume corresponding to every 50 linear feet of installed underground utility, whichever is more frequent.

2. 2 Sample water from PPCA to be discharged to a sanitary sewer one week prior to initiation of discharge, and at a rate of one grab sample once per day during discharge to sanitary sewer.

B. Analyze soil samples for parameters listed in Table 01160-1, Soil Criteria-Petroleum Only, and in accordance with SW-846. Handle as a Category II Soil if analytical results indicate anyone, or more, parameters exceed allowable Maximum Concentration listed in Table 01160-1. If benzene concentration from composite sample is greater than 5 milligrams per kilogram (mg/kg) or lead concentration is greater than 30 mg/kg, perform Toxicity Characteristic Leaching Procedure (TCLP) analysis of appropriate compound for that sample to determine if a more stringent disposal classification is warranted. If contaminants other than petroleum are suspected, immediately notify Project Manager who will determine the list of parameters to be analyzed. If such are encountered, compensation will be made under the Allowance for PPCA Handling. Use a 4-part representative composite sample for analysis of parameters, except when inconsistent with SW-846.

C. Analyze groundwater samples for discharge to sanitary sewers. Analyze samples for BTEX by EPA Method 602, 8020, or 8021; TPH by EPA Method 418.1 or Method TX 1005; and LEL in accordance with EPA Method 1010.

D. Conduct analyses by proposed analytical testing laboratory listed in Environmental Work Plan.

3.05 AIR MONITORING REQUIREMENTS

A. Ensure health and safety of workers at the construction site. Maintain air quality within the construction zone to conform to exposure limits specified in Code of Federal Regulations (CFR) Title 29, Section 1910.120 enforceable by OSHA.

B. Provide adequate shoring and sufficient escape ladders in accordance with applicable trench safety regulatory requirements.

C. In the trench, continuously operate a combustible gas indicator (CGI) with LELl02 meter to monitor vapor and oxygen levels. Properly calibrate CGI and provide an alarm that sounds if greater than or equal to 20 percent Lower Explosive Limit (LEL), less than or equal to 19.5 percent oxygen, or greater than or equal to 25 percent oxygen is reached. Record monitoring data from CGI every 15 minutes to ensure safe work conditions.

D. Take appropriate measures during construction to keep LEL levels below 20 percent in the trench. If vapor concentrations exceed 20 percent of LEL stop construction work, turn off equipment, and have workers immediately vacate the PPCA in an upwind direction.

E. Take readings with PID/FID 50 feet downwind of area during excavation or work in contaminated excavation areas and until one hour after cessation of such work. Take readings within breathing zone at approximately 4 feet above ground level. Record readings, date, time, initials of person taking reading, PID/FID serial number and last calibration date of PID/FID in bound field book.

END OF SECTION

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SECTION 02120

OFF-SITE TRANSPORTATION AND DISPOSAL

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Off-site disposal of non-hazardous and hazardous solid, liquid and resinous waste.

1.02 MEASUREMENT AND PAYMENT

A. Unit Prices

1. Payment for transportation and disposal of Class II Soil at approved facility is on a cubic yard basis.

2. Payment for transportation and disposal of Class I Soil at approved facility is on a cubic yard basis.

3. No separate payment will be made for soil reused as backfill material.

4. Payment for transportation and disposal of contaminated groundwater at approved facility is on a per gallon basis.

5. No separate payment for ground water discharged into a sanitary sewer.

6. Refer to Section 01270 - Measurement and Payment for unit price procedures.

B. Stipulated Price (Lump Sum). If the Contract is a Stipulated Price Contract, payment for work in this Section is included in the total Stipulated Price.

1.03 REFERENCES

A. CFR, Title 29, Section 1910.120.- Occupational Safety and Health Administration, Department of Labor.

B. Texas Administrative Code (TAC), Title 30, Chapter 335.- Industrial Solid Waste & Municipal Hazardous Waste.

C. TAC, Title 30, Chapter 334.- Underground and Aboveground Storage Tanks.

D. TAC, Title 30, Chapter 106.533.- Exemptions from Permitting, Subchapter X, Waste Processes and Remediation.
E. U.S. Environmental Protection Agency (EPA), (SW-846) Test Methods for Evaluating Solid Waste, Office of Solid Waste and Emergency Response, Washington, D.C. (P1388-239223, November 1986).

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 HANDLING CATEGORY I AND II SOILS

A. Do not place Category II Soil back into excavation. Properly dispose of Category II Soil at the facility listed in Environmental Work Plan. Category I Soil consistent with classification as Class II PST Waste as defined by Texas Commission on Environmental Quality (TCEQ) in their interoffice memo dated 4/12/94, and not Category II Soil (as demonstrated through laboratory testing) can be reused as backfill material, provided;

1. Soil is reused in the same area from which it originated at depths greater than 30 inches below top of pavement, finished grade or ditch flowline, whichever is lower.

2. Soil has suitable engineering properties for backfill material as specified in Section 02320 - Utility Backfill Material.

3. Does not have indications of impact by contaminants other than petroleum.

B. Do not spread Category I or II Soil on ground surface.

C. Place Category I or II Soil in covered roll-off box with a minimum 20-mil plastic liner or in a stockpile at temporary storage area, pending receipt of analytical results and receipt of authorization from TCEQ and the disposal site for final disposal; or, in trucks for transport directly to the disposal facility.

1. Do not commingle Category I or II Soil from different locations or with different sources.

2. Temporary storage area to meet following criteria:

a. Within 2 miles of project site, to allow access by City personnel, unless otherwise approved by Project Manager.

b. Outside the 100-year floodplain.

c. Outside of, and not adjacent to, an area known or suspected to be a wetland.

d. Acceptable to Project Manager.

3. Secure using temporary fencing or other means of controlling access.

4. Place stockpiled soils on an impervious membrane. Surround with a berm to prevent migration of soils or moisture either into or out of the stockpile, other than evaporation.

5. Protect and cover the stockpile with minimum 20-mil plastic or other approved waterproof membrane covering. Replace damaged covers.

6. Do not place soil over monitoring wells or piezometers, utility line manholes, or any other potential route for water to migrate to subsurface.

7. Handle runoff from the temporary storage area in accordance with paragraph 3.06, Handling Water.

8. Do not stockpile soil for greater than 30 days.

9. Remove remaining material, including excavated soil from construction site, from temporary storage area prior to completion of Work.

D. Remove, handle, transport, stockpile, and dispose of Category II Soil under direction of Corrective Action Project Manager. Dispose waste classified (i.e., meets characteristics or other definitions of) a hazardous waste consistent with Resource Conservation and Recovery Act (RCRA) and 30 TAC Chapter 335.

E. Transport Category I or II Soil in accordance with Department of Transportation (DOT) and TCEQ rules and regulations.

F. Dispose Category I Soil, not reused as backfill, under direction of Corrective Action Project Manager, at a properly licensed facility with prior approval of Project Manager.

G. Obtain signed manifests from the receiving facility and provide originals to Project Manager.

H. Decontaminate large equipment to prevent cross-contamination with clean material. Steam clean or pressure wash dump trucks, bulldozers, backhoes, and other large equipment prior to use in uncontaminated areas after being used in PPCA.

3.02 HANDLING WATER

A. Prior to discharging petroleum contaminated groundwater, obtain an Industrial Wastewater Discharge Permit (no cost) from the City for disposal directly to a sanitary sewer which discharges to a City-owned wastewater treatment plant.

B. Procedures.

1. Provide equipment sized to handle flows anticipated by dewatering operations.

2. Include commercially available oil/water separator unit as part of the treatment system for dewatering operation discharging to sanitary sewer.

3. Do not exceed limits listed in Table 01160-2, Potentially Contaminated Groundwater Discharge Limits for groundwater discharged to the sanitary sewer. Provide additional treatment systems as needed prior to discharge to sanitary sewers where groundwater contamination levels exceed those noted in Table 01160-2. Approval by Project Manager shall be obtained for proposed treatment system prior to initiation of treatment and discharge.

4. Comply with all applicable requirements of 30 TAC, Chapter 106.533, including submitting a PI-7 form to the TCEQ for a standard exemption of oil/water separator unit, and any additional treatment systems. Submit copy of PI-7 form to Project Manager.

5. Do not discharge treated water into sanitary sewer if water level is within one foot of the top of sanitary sewer manhole or would cause an overflow situation.

6. Recover free product collected in treatment equipment. Recycle for beneficial reuse or dispose of recovered contaminants in a manner acceptable to Project Manager and TCEQ.

7. Transport potentially contaminated groundwater and free product in accordance with DOT and TCEQ rules and regulations for flammable products. Use DOT-licensed carrier for transport.

8. Obtain signed manifests for potentially contaminated groundwater and free product from the receiving facility and provide originals to Project Manager.

9. Furnish laboratory reports to Project Manager within one week of sample date.

C. Install and operate groundwater control systems, as described in Section 01578 - Control of Groundwater and Surface Water. Design and operate groundwater control systems so water from PPCA is handled in a system separated and isolated from groundwater control systems outside PPCA.

D. Handle, test, treat, and discharge potentially contaminated groundwater to the sanitary sewer in accordance with City of Houston, Industrial Wastewater Discharge Permit requirements, or have water evacuated and hauled for off-site treatment and disposal at a TCEQ-permitted facility. Perform discharge under direction of Corrective Action Project Manager.

3.03 AIR MONITORING REQUIREMENTS

A. Ensure health and safety of workers at the construction site. Maintain air quality within the construction zone to conform to exposure limits specified in Code of Federal Regulations (CFR) Title 29, Section 1910.120 enforceable by OSHA.

B. Provide adequate shoring and sufficient escape ladders in accordance with applicable trench safety regulatory requirements.

C. In the trench, continuously operate a combustible gas indicator (CGI) with LEL/O_2 meter to monitor vapor and oxygen levels. Properly calibrate CGI and provide an alarm that sounds if greater than or equal to 20 percent Lower Explosive Limit (LEL), less than or equal to 19.5 percent oxygen, or greater than or equal to 25 percent oxygen is reached. Record monitoring data from CGI every 15 minutes to ensure safe work conditions.

D. Take appropriate measures during construction to keep LEL levels below 20 percent in the trench. If vapor concentrations exceed 20 percent of LEL stop construction work, turn off equipment, and have workers immediately vacate the PPCA in an upwind direction.

E. Take readings with PID/FID 50 feet downwind of area during excavation or work in contaminated excavation areas and until one hour after cessation of such work. Take readings within breathing zone at approximately 4 feet above ground level. Record readings, date, time, initials of person taking

reading, PID/FID serial number and last calibration date of PID/FID in bound field book.

3.04 DISPOSAL OF MATERIAL

A. Non-categorized Material. Dispose of excess or unsuitable excavated materials, not Category I or II Soil, off-site in accordance with Section 01576 - Waste Material Disposal.

B. Category I or II Soil. Dispose of excess or unsuitable excavated materials off-site at a state registered Treatment, Storage, or Disposal (TSD) facility. Obtain signed manifests from the receiving facility and provide originals to Project Manager.

TABLE 01160-1
SOIL CRITERIA - PETROLEUM ONLY

Contaminant	Maximum[a] Concentration (mg/kg)	Method
TPH	1500	EPA 418.1/TX 1005
Total BTEX[b]	150	EPA 8020/8021
Total Lead[c]	250	EPA 6000/6010/7000

Notes: [a] If any parameters exceed the maximum concentrations, then the soil shall be considered Category II Soil and a Special Waste-PST as defined by the TCEQ in their interoffice memo dated 4/12/94.
[b] If benzene is greater than 5.0 mg/kg then analyze TCLP benzene which should be <0.3 mg/l.
[c] If total lead is greater than 30 mg/kg then analyze TCLP lead which should be <1.5 mg/l.

Definitions: TCLP - toxicity characteristic leachate procedure (40 CFR 261, Appendix II)
BTEX - benzene, toluene, ethyl benzene, and total xylenes
TPH - total petroleum hydrocarbons
mg/kg - milligrams per kilogram
mg/l - milligrams per liter

TABLE 01160-2
POTENTIALLY CONTAMINATED GROUNDWATER DISCHARGE LIMITS

Parameter	Discharge to Sanitary Sewer	
	Limit	**Method**
TPH (mg/l)	30.0	EPA 418.1/TX 1005
Total BTEX (mg/l)	1.0	EPA 602/8020/8021
Lower Explosive Limit (%)	10	EPA 1010

Notes: See definitions above.

END OF SECTION

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SECTION 02220

DEMOLITION

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Demolishing and removing existing structures, equipment and materials.

B. Disposing of demolished materials and equipment.

1.02 MEASUREMENT AND PAYMENT

A. No separate payment will be made for work under this section. Include payment in the Lump Sum Base Bid Price.

1.03 SUBMITTALS

A. Submittals shall conform to requirements of Section 01330 - Submittals.

B. Submit proposed methods, equipment, materials and sequence of operations for demolition of structures. Describe coordination for shutting off, capping, and removing temporary utilities. Plan operations to minimize temporary disruption of utilities to existing facilities or adjacent property.

C. Submit proposed demolition and removal schedule for approval. Notify Project Manager in writing at least 48 hours before starting demolition.

D. Submit an approved copy of demolition schedule to Fire Department prior to commencement of demolition operations.

E. Obtain a permit for building demolition, as required.

1.04 OWNERSHIP OF MATERIAL AND EQUIPMENT

A. Materials and equipment designated for reuse or salvage are listed in Section 01110 - Summary of Work. Protect items designated for reuse or salvage from damage during demolition, handling and storage. Restore damaged items to satisfactory condition.

B. Materials and equipment not designated for reuse or salvage become the property of the Contractor.

1.05 STORAGE AND HANDLING

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

B. Deliver items to be salvaged to City property storage areas indicated on Drawings. Items will be unloaded by City personnel.

C. Remove equipment and materials not designated for reuse or salvage and all waste and debris resulting from demolition from site. Remove material as work progresses to avoid clutter.

1.06 ENVIRONMENTAL CONTROLS

A. Minimize spread of dust and flying particles. If required by governing regulations, use temporary enclosures and other suitable methods to prevent the spread of dust, dirt and debris.

B. Use appropriate controls to limit noise from demolition to levels designated in City ordinances.

C. Do not use water where it can create dangerous or objectionable conditions, such as localized flooding, erosion, or sedimentation of nearby ditches or streams.

D. Stop demolition and notify Project Manager if underground fuel storage tanks, asbestos, PCB's, contaminated soils, or other hazardous materials are encountered.

E. Dispose of removed equipment, materials, waste and debris in a manner conforming to applicable laws and regulations.

PART 2 P R O D U C T S

2.01 EQUIPMENT AND MATERIALS FOR DEMOLITION

A. Use equipment and materials approved under Paragraph 1.03, Submittals.

B. Fires are not permitted.

C. Do not use a "drop hammer" where the potential exists for damage to underground utilities, structures, or adjacent improvements.

PART 3 E X E C U T I O N

3.01 EXAMINATION

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

B. Project Manager will mark or list existing equipment to remain the property of the City.

C. Do not proceed with demolition or removal operations until after the joint

inspection and subsequent authorization by Project Manager.

3.02 PROTECTION OF PERSONS AND PROPERTY

A. Provide safe working conditions for employees throughout demolition and removal operations. Observe safety requirements for work below grade.

B. Maintain safe access to adjacent property and buildings. Do not obstruct roadways, sidewalks or passageways adjacent to the work.

C. Perform demolition in a manner to prevent damage to adjacent property. Repair damage to City property or adjacent property and facilities.

D. The Contractor shall be responsible for safety and integrity of adjacent structures and shall be liable for any damage due to movement or settlement. Provide proper framing and shoring necessary for support. Cease operations if an adjacent structure appears to be endangered. Resume demolition only after proper protective measures have been taken.

E. Erect and maintain enclosures, barriers, warning lights, and other required protective devices.

3.03 UTILITY SERVICES

A. Follow rules and regulations of authorities or companies having jurisdiction over communications, pipelines, and electrical distribution services.

B. Notify and coordinate with utility company and adjacent building occupants when temporary interruption of utility service is necessary.

3.04 BUILDING DEMOLITION

A. Demolish structure to the lines and grades shown on Drawings. Where no limits are shown, the limits shall be 4 inches outside new items to be installed. Removals beyond these limits shall be at the Contractor's expense; satisfactorily reconstruct excess removals.

B. Proceed with demolition from the top of the structure to the ground. Complete demolition work above each floor or tier before disturbing supporting members of lower levels.

C. Demolish concrete and masonry in small sections.

D. Carefully remove structural framing members and lower them to the ground by means of hoists, derricks or other suitable devices.

E. Do not overload existing roof or structures.

F. Provide temporary coverings for openings through walls and roof to prevent water damage to buildings and structures which are to remain.

G. Where existing concrete must be removed, but will be replaced subsequently:

1. Make initial cut with a concrete saw; do not cut reinforcement.

2. After removing concrete, cut cross bars at center of breakout and protect for subsequent concrete work.

H. Demolish structures to a minimum of 3 feet below finished grade, unless otherwise indicated on Drawings.

3.05 DISPOSAL

A. Remove from the site all items contained in or upon the structure not designated for reuse or salvage. Conform to requirements of Section 01504 - Temporary Facilities and Controls or Section 01576 - Waste Material Disposal.

B. Follow method of disposal as required by regulatory agencies.

3.06 BACKFILL

A. Backfill holes in accordance with specification sections governing materials indicated on Drawings. Where no material is indicated, backfill with approved borrow and compact to a density of 90 percent standard Proctor.

B. Do not backfill with material from demolition unless approved by Project Manager.

3.07 MECHANICAL WORK ITEMS

A. Mechanical removals consist of dismantling and removing existing piping, pumps, motors, water tanks, equipment and other appurtenances. It includes cutting, capping, and plugging required to restore use of existing utilities.

B. Remove existing process, water, chemical, gas, fuel oil and other piping indicated to be removed on Drawings. Take out piping to the limits shown. Piping not indicated on Drawings shall be removed to the nearest solid support, capped, and the remainder left in place even though it does not interfere with new work. Purge chemical and fuel lines and tanks. Verify that such lines are safe prior to removal or capping.

C. Where piping that is to be removed passes through existing walls, cut and cap piping on each side of the wall. Use cap appropriate for pipe material to be capped. Provide fire-rated sealant for walls classified as fire-rated.

D. When underground piping is to be altered or removed, cap the remaining piping. Abandoned underground piping may be left in place unless it interferes with new work or is shown or specified to be removed. Piping less than 15 inches in diameter may be plugged and abandoned in place. For

piping 15 inches in diameter and greater to be abandoned, fill with sand, pressure grout or other approved method and plug with concrete or brick masonry bulkhead.

E. Remove waste and vent piping to points shown. Plug pipe and cleanouts and plugs. Where vent stacks pass through an existing roof that is to remain, remove the stack and patch the hole in the roof, making it watertight. Comply with requirements of existing roof installer so as to maintain roof warranty.

F. Conform to applicable codes when making any changes to plumbing and heating systems.

G. For demolition of water line, refer to Section 02516 - Cut, Plug, and Abandonment of Mains.

3.08 ELECTRICAL WORK ITEMS

A. Electrical removals consist of disconnecting and removing existing switchgear, distribution switchboards, control panels, bus duct, conduits and wires, panelboards, lighting fixtures, and miscellaneous electrical equipment.

B. Remove existing electrical equipment and fixtures to prevent damage to allow continued operation of existing systems and to maintain the integrity of the grounding systems.

C. Remove poles and metering equipment, if designated for removal on the Drawings. Coordinate electrical removals with the power company, as necessary. Verify that power is properly de-energized and disconnected.

D. Where shown or otherwise required, remove wiring in underground duct systems. Verify function of wiring before disconnecting and removing. Plug ducts which are not to be reused at entry to buildings.

E. Changes to electrical systems shall conform to applicable codes.

END OF SECTION

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SECTION 02375

DRILLED CONCRETE PIERS

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. This Section includes cast-in-place concrete drilled piers.

1.02 MEASUREMENT AND PAYMENT

B. No separate payment will be made for work under this section. Include payment in the Lump Sum Base Bid Price.

1.03 SUBMITTALS

A. Product Data: For each type of product specified. Include reinforcement and admixtures.

B. Shop Drawings: For concrete reinforcement detailing fabricating, bending, and placing.

C. Design Mixes: For each class of concrete. Include revised mix proportions when characteristics of materials, project conditions, weather, test results, or other circumstances warrant adjustments.

1. Laboratory Test Reports: For evaluation of concrete materials and mix design test.

D. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

E. Record drawings at Project closeout according to Division 1 Section "Closeout Procedures."

F. Conform to requirements of Section 01330- Submittal Procedures

1.04 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced installer who has specialized in installing drilled piers similar to those required for this Project.

B. Drilled-Pier Standard: Comply with provisions of ACI 336.1, "Specification for the Construction of Drilled Piers," unless modified in this Section.

1. The slurry displacement method of installation will not be permitted.

C. Survey Work: Engage a registered surveyor or licensed professional engineer to perform surveys, layouts, and measurements for drilled piers. Lay out each drilled pier to lines and levels required before excavation and record actual measurements of each drilled pier's location, shaft diameter, bottom and top elevations, deviations from specified tolerances, and other specified data.

1. Record and maintain information pertinent to each drilled pier and cooperate with City's testing and inspecting agency to provide data for required reports.

D. Preinstallation Conference: Conduct conference at Project site to comply with requirements of Division 1 Section "Coordination and Meetings."

1.05 PROJECT CONDITIONS

A. Existing Utilities: Locate existing underground utilities before excavating drilled piers. If utilities are to remain in place, provide protection from damage during drilled-pier operations.

1. Should uncharted or incorrectly charted piping or other utilities be encountered during excavation, consult the City's representative immediately for directions as to procedure. Cooperate with City and utility companies in keeping services and facilities in operation. Repair damaged utilities to satisfaction of utility owner.

B. Site Information: A geotechnical report has been prepared for this Project and is available for information only. Neither the City nor Design Consultant is responsible for accuracy or completeness of any information or data.

PART 2 P R O D U C T S

2.01 REINFORCING MATERIALS

A. Reinforcing Bars: ASTM A 615, Grade 60 (ASTM A 615M, Grade 400), deformed.

B. Plain, Cold-Drawn Steel Wire: ASTM A 82.

2.02 CONCRETE MATERIALS

A. Portland Cement: ASTM C 150, Type I or II.

B. Fly Ash: ASTM C 618, Type Cor F.

C. Silica Fume: ASTM C 1240, amorphous silica.

D. Aggregates: ASTM C 33, 3/4-inch (19-mm) maximum aggregate size.

E. Water: Potable, complying with ASTM C 94 requirements.

F. Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and to contain not more than 0.1 percent chloride ions by mass of portland cement or cementitious material.

1. Air-Entraining Admixture: ASTM C 260.

2. Water-Reducing Admixture: ASTM C 494, Type A.

3. High-Range, Water-Reducing Admixture: ASTM C 494, Type F.

4. Water-Reducing and Accelerating Admixture: ASTM C 494, Type E.

5. Water-Reducing and Retarding Admixture: ASTM C 494, Type D.

G. Sand-Cement Grout: Portland cement, ASTM C 150, Type I; and clean, natural sand, ASTM C 404. Unless otherwise indicated, mix at ratio of 1 part cement to 2-1/2 parts sand, by volume, with sufficient water to permit flow during placement.

2.03 STEEL CASINGS

A. Steel Pipe Casings:

ASTM A 283 (ASTM A 283M), Grade C; or ASTM A 36

(ASTM A 36M) carbon-steel plate, with vertical joints full-penetration welded

according to AWS D1.1.

B. Corrugated-Steel Pipe Casings: ASTM A 929 (ASTM A 929M), steel sheet, zinc coated .

2.04 CONCRETE MIX

A. Prepare design mixes, according to ACI 301, for concrete by either laboratory trial batch or field experience method. For trial batch method, use a qualified independent testing and inspecting agency for preparing and reporting proposed mix designs.

1. Do not use City's independent testing and inspecting agency.

2. Limit use of fly ash and silica fume to not exceed 25 percent of weight of portland cement.

B. Proportion mixes according to ACI 211.1 and ACI 301 to provide normal-weight concrete with the following properties:

1. Compressive Strength (28 Day): 4000 psi (27.6 MPa).

2. Maximum Water-Cement Ratio at Point of Placement: 0.45.

3. Slump Limit: Capable of maintaining a slump of 4 inches (102 mm) for 2 hours after placement.

C. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content as follows with a tolerance of plus or minus 1.5 percent:

1. Air Content: 6.0 percent.

D. Concrete-mix design adjustments may be proposed when characteristics of materials, project conditions, weather, test results, or other circumstances warrant.

2.05 CONCRETE MIXING

A. Ready-Mixed Concrete: Comply with requirements and with ASTM C 94. Do not add water after mixing.

1. When air temperature is between 85 and 90 deg F (30 and 32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.

PART 3 E X E C U T I O N

3.01 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, vibration, and other hazards created by drilled-pier operations.

3.02 EXCAVATION

A. Unclassified Excavation: Excavation is unclassified and includes excavation to bearing elevations regardless of character of materials or obstructions encountered.

1. Obstructions: Unclassified excavation includes removal of unanticipated boulders, concrete, masonry, or other subsurface obstructions.

2. Obstructions: Removal of unanticipated boulders, concrete, masonry, or other unforeseen obstructions that cannot be removed by conventional augers fitted with soil or rock teeth, drilling buckets, or under-reaming tools attached to drilling equipment of size, power, torque, and down thrust necessary for the work, will be paid according to Contract provisions for changes in the Work.

B. Dewatering: Prevent surface and ground water from entering excavated shafts. Dewater excavated shafts before concreting. Conduct water to site drainage facilities.

C. Excavate shafts for drilled piers to indicated elevations.

1. Excavate bottom of drilled piers to level plane.

2. Remove loose material and water from bottom of excavation.

D. Notify and allow testing and inspecting agency to test and inspect bottom of excavation. If unsuitable bearing stratum is encountered, make adjustments to drilled piers as determined by the City.

1. Do not excavate shafts deeper than elevations indicated, unless approved by the City.

2. Additional excavation will be paid according to Contract provisions for changes in the Work.

E. Excavate shafts for closely spaced drilled piers and those occurring in fragile or sand strata, only after adjacent drilled piers are filled with concrete and allowed to set.

F. Temporary Casings: Install watertight steel casings of sufficient length and thickness to prevent water seepage into shaft; to withstand compressive, displacement, and withdrawal stresses; and to maintain stability of shaft walls.

1. Remove temporary casings during concrete placement.

G. Bells: Excavate bells for drilled piers to shape, base thickness, and slope angle indicated. Excavate bottom of bells to level plane and remove loose material before concrete is placed.

H. Tolerances: Construct drilled piers to remain within the following tolerances:

1. Maximum Variation from Location: Not more than the lesser of 4.2 percent of pier diameter or 3 inches (76 mm) from design center location.

2. Out-of-Plumb: Not more than 2 percent of pier length.

3. Concrete Cutoff Elevation: Plus 1 inch (25 mm), minus 3 inches (76 mm).

4. Bottom Area of Pier: Not less than 96 percent of pier area required.

5. Shaft Diameter: Not less than 98 percent or more than 110 percent of shaft diameter indicated.

I. If location or out-of-plumb tolerances are exceeded, provide corrective construction. Submit design and construction proposals to the City for review before proceeding.

J. Inspection: Each drilled pier must be inspected and tested before placing concrete.

1. Provide and maintain facilities with equipment required for testing and inspecting excavations. Cooperate with testing and inspecting personnel to expedite the Work.

2. Notify City and testing agency at least 6 hours before excavations are ready for tests and inspection.

3.03 REINFORCEMENT

A. Comply with recommendations of CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

B. Clean reinforcement of loose rust and mill scale, earth, and other materials that reduce or destroy bond with concrete.

C. Fabricate and install reinforcing cages symmetrically about axis of shafts in a single unit.

D. Accurately position, support, and secure reinforcement against displacement during concreting. Maintain minimum cover to reinforcement.

E. Use templates to set anchor bolts, leveling plates, and other accessories furnished in work of other Sections. Provide blocking and holding devices to maintain required position during final concrete placement.

F. Protect exposed ends of extended reinforcement, dowels, or anchor bolts from mechanical damage and exposure to weather.

3.04 CONCRETE P LACEMENT

A. Place concrete in a continuous operation and without segregation immediately after inspection and approval of the shaft by an independent testing and inspecting agency.

B. Place concrete by means of bottom discharge bucket, flexible drop chute, elephant-trunk hopper, or tremie. Use chutes or tremies for placing concrete where a drop of more than 25 feet (7.6 m) is required, or pump concrete into place.

C. Place concrete in a dry shaft, unless placement underwater or by slurry displacement is approved by City.

1. Place concrete in slurry-filled shafts or underwater by tremie method or pumping. Control placement operations to ensure tremie is embedded no less than 60 inches (1500 mm) into concrete, and the flow of tremied concrete is continuous from bottom to top of drilled pier.

2. Other methods of depositing concrete may be used, if approved by City.

D. Coordinate withdrawal of temporary casings with concrete placement operations to maintain a head of concrete no less than 60 inches (1500 mm) above casing bottom.

E. Screed concrete at cutoff elevation level and apply a scoured, rough finish.

F. Where cutoff elevation is above the ground elevation, form top section above grade and extend shaft to required elevation.

G. Construct a cold joint if concrete placement is delayed more than one hour.

H. Level top surface of concrete and insert joint dowel bars. Before placing remainder of concrete, clean surface laitance, roughen, and slush with a commercial bonding agent or with a sand-cement grout mixed at the ratio of 1:1.

I. Protect concrete work, according to ACI 301, from physical damage or reduced strength that could be caused by frost, freezing, or low temperatures.

1. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.

2. Do not use calcium chloride, salt, or other mineral-containing antifreeze agents or chemical accelerators.

J. When hot-weather conditions exist that would seriously impair quality and strength of concrete, place concrete according to ACI 301 to maintain delivered temperature of concrete without exceeding 90 deg F (32 deg C).

1. Place concrete immediately on delivery. Keep exposed concrete surfaces and formed shaft extensions moist by fog sprays, wet burlap, or other effective means for a minimum of 7 days.

3.05 FIELD QUALITY CONTROL

A. Testing Agency: The City will engage a qualified independent testing and inspecting agency to sample materials, perform tests, and submit test reports during excavation and concrete placement for drilled piers.

B. A drilled pier report will be prepared for each drilled pier as follows:

1. Actual top and bottom elevations.

2. Description of soil materials.

3. Description, location, and dimensions of obstructions.

4. Final top centerline location.

5. Variation of shaft from plumb.

6. Shaft excavating method.

7. Design and tested bearing capacity of bottom.

8. Levelness of bottom and adequacy of cleanout.

9. Ground-water conditions and water-infiltration rate, depth, and pumping.

10. Description, diameter, and top and bottom elevations of temporary casings.

11. Description of soil or water movement, sidewall stability, loss of ground, and means of control.

12. Bell dimensions and variations from original /design.

13. Date and time of starting and completing excavation.

14. Inspection report.

15. Position of reinforcing steel.

16. Concrete placing method, including elevation of consolidation and delays.

17. Elevation of concrete during removal of casings.

18. Location of construction joints.

19. Remarks, unusual conditions encountered, and deviations from requirements.

20. Concrete testing results.

C. Soil Testing: Bottom elevations, bearing capacities, and lengths of drilled piers indicated have been estimated from available soil data. Actual elevations and drilled-pier lengths, and bearing capacities will be determined by a qualified independent testing and inspecting agency on excavation. Final evaluations and approval of data will be determined by the City.

D. Concrete: Sampling and testing of concrete for quality control will include the following:

1. Sampling Fresh Concrete: ASTM C 172, except modified for slump to comply with ASTM C 94.

a. Slump: ASTM C 143; 1 test at point of placement for each compressive-strength test, but no less than 1 test for each concrete load.

b. Air Content: ASTM C 231, pressure method; 1 test for each compressive-strength test.

c. Concrete Temperature: ASTM C 1064; 1 test hourly when air temperature is 40 deg F (4.4 deg C) and below and when 80 deg F (27 deg C) and above, and 1 test for each set of compressive-strength specimens.

d. Compression Test Specimens: ASTM C 31; 1 set of 4 standard cylinders for each compressive-strength test, unless otherwise directed. Mold and store cylinders for laboratory-cured test specimens, unless field-cured test specimens are required.

e. Compressive-Strength Tests: ASTM C 39; 1 set for each drilled pier, but not more than 1 set for each truck load. One specimen will be tested at 7 days, 2 specimens will be tested at 28 days, and 1 specimen will be retained in reserve for later testing if required.

2. When frequency of testing will provide fewer than 5 strength tests for a given class of concrete, testing will be conducted from at least 5 randomly selected batches or from each batch if fewer than 5 are used.

3. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, evaluate current operations and provide corrective procedures for protecting and curing the in-place concrete.

4. Strength level of concrete will be considered satisfactory if averages of sets of 3 consecutive strength test results equal or exceed specified compressive strength and no individual strength test result falls below specified compressive strength by more than 500 psi (3.45 MPa).

5. Test results will be reported in writing to Architect, concrete manufacturer, and Contractor within 24 hours of testing. Reports of compressive- strength tests will contain Project identification name and number, date of concrete placement, name of concrete testing and

inspecting agency, concrete type and class, location of concrete batch in drilled pier, design compressive strength at 28 days, concrete mix proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.

6. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted but shall not be used as the sole basis for acceptance or rejection.

7. Additional Tests: Testing and inspecting agency will make additional tests of concrete when test results indicate concrete strengths or other requirements have not been met.

   a. Continuous coring of drilled piers may be required, at Contractor's expense, when temporary casings have not been withdrawn within specified time limits or where observations of placement operations indicate deficient concrete quality, presence of voids, segregation, or other possible defects.

3.06 DISPOSAL OF MATERIALS

E. Remove surplus excavated material and slurry and legally dispose of it off City's property.

END OF SECTION

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SECTION 02455

PRESTRESSED CONCRETE PILING

PART I G E N E R A L

1.01 SECTION INCLUDES

A. Prestressed concrete piling.

1.02 MEASUREMENT AND PAYMENT

A. No separate payment will be made for work under this section. Include payment in the Lump Sum Base Bid Price

1.03 SUBMITTALS

A. Submittals shall conform to the requirements of Section 01330 - Submittals Procedures.

B. Clean and legible shop drawings on sheets 24" x 36", showing the following information shall be submitted for approval, the margin at the left end shall be 1-1/2 inches wide and the others 1/2 inch wide. The sheets shall include a title in the lower right hand corner, sheet number, name of structure, name of Fabricator and name of the Contractor. Preparation and submittal of drawings may be on 11" x 18" inch sheets, or full size drawings may be reduced to one-half scale, provided they are completely clear and legible.

1. Fabrication Details. Complete information necessary for fabrication shall be submitted for approval. On projects requiring several sizes of piling, an index sheet shall include but not be limited to cast lengths, concrete strengths, and strand data, shall be furnished. Contractor shall submit 6 sets of prints for approval where fabrication is to be at one or more casting yard, 2 additional sets of prints shall be required for each additional casting location. Index sheets shall reflect the plant location where each piling is to be fabricated.

2. Prestressing Details. Complete prestressing details shall be submitted showing details of the piling, forms, devices for holding prestressed steel in place, methods and details of arranging strands, anchorage details, methods and details of prestressing the steel, elongations, jack pressures and all other features of proposed prestressing. Calculations shall be included to justify the system and method of prestressing to be

used. Fabricator shall submit 6 prints for handling. The submittal of prestressing details shall be a "one-time" action of each Fabricator.

3. Methods of Handling and Transportation.

   a. Details of handling and transporting need not be submitted for approval, except special devices used for pick up shall be shown on the shop drawings.

   b. Drawings and details shall be checked by the Fabricator before submittal for approval. Submission of drawings shall be in accordance with Section 01340 - Shop Drawings, Product Data, and Samples.

   c. Submit a casting schedule prepared on standard forms and submitted prior to stressing.

   d. Design of casting beds and facilities for pre-tensioned construction, including Drawings and Specifications, shall be prepared and sealed by a Professional Engineer Registered in the State of Texas. Fabricator shall furnish a signed certificate signed by officer of the company stating that the bed, facilities, and hardware have been constructed in accordance with the Drawings and Specifications.

   e. Fabricator shall specify the maximum loading of which the bed is to be used. Prior to approval for that loading, the facilities shall be proof loaded to a minimum 10 percent overload for 4 hours, if deemed necessary by Project Manager. Minor changes in facilities will not require proof loading, but will require submission of the details of changes accompanied with design calculations.

C. Contractor shall submit 6 prints of shop drawings, showing complete information necessary for fabrication, for approval by the City of Houston. Notations on Drawings shall include but not be limited to type of member, member lengths, dimensions, bevels, erection devices, details of reinforcement, type of concrete, and prestressing details.

1.04 QUALITY CONTROL

A. Proceed with Prestressed Concrete Piling only after approval of Shop Drawings.

B. Prior to beginning the casting of concrete piling, Contractor shall give Design Consultant and Project Manager ample notice as to the location of casting site and date on which work will begin.

C. An Inspector representing City Engineer must have free entry at all times, while work is being performed, to all parts of the manufacturer's works which concern the manufacture of the piling ordered.

PART 2 P R O D U C T S

2.01 MATERIALS

A. Materials for concrete and water for curing shall be in accordance with applicable portions of Section 03310 - Structural Concrete. Material for reinforcing steel (non-prestressed) shall be in accordance with Section 03211 - Reinforcing Steel. Other steel shall be in accordance with this Section.

B. Concrete materials and their preparation and placing shall be in accordance with Section 03310 - Structural Concrete, except that concrete shall be proportioned to develop a compressive strength of not less than 5,000 psi in 28 days. The following limitations shall also be complied with:

Minimum Cement Content	6.25 sacks per cubic yard
Maximum Cement Content	7 sacks per cubic yard
*Maximum Water	6 gallons per sack
Maximum Slump	4 inches or as approved by Project Manager
Minimum Compressive Strength	5,000 psi at 28 days
Minimum Compressive Strength	4,000 psi at Prestress Transfer

*Water per sack of cement shall be reduced to the minimum amount that the required workability will permit.

C. An admixture must be used with Type I or Type III Portland Cement, if used in lieu of air-entrained Portland Cement. Entrained air must not exceed four 4 percent. Admixtures shall be in accordance with Section 03310 - Structural Concrete, and must be approved by Project Manager prior to use.

D. When tested in accordance with ASTM C 136, coarse aggregate shall conform to the following grading requirements:

Retained on	Percent Retained, by Weight

1-1/2" screen	0
1" screen	0 - 5
3/4" screen	20 - 50
1/2" screen	50 - 75
No. 4 sieve	95 - 100
Loss by Decantation	0 - 1%

E. Fine aggregate shall consist of clean, hard, durable, uncoated grains of washed sand, free from soft or flaky particles and all other injurious materials. It shall be graded from coarse to fine and when tested by approved methods, shall meet the following grading requirements:

Retained on	Percent Retained, by Weight
3/8" screen	0
No. 4 sieve	0 - 5
No. 20 sieve.	15 -50
No. 100 sieve	85 - 100

When subjected to the color test for organic impurities, fine aggregate shall not show a color darker than the standard color.

F. Prestressing Cables: Cables used to apply the prestressing load to precast prestressed concrete piling shall be uncoated seven wire strand conforming to the requirements of ASTM A 416. The cables shall be of size and number shown on the Drawings. Cables shall be free of rust, dirt, oil or other injurious materials before placing concrete. Cables shall meet the following requirements as to strength:

Proportional Limit	180,000 psi
Ultimate Tensile Strength	250,000 psi

G. Materials and method of manufacture of precast concrete piling, shall be in accordance with the guidelines set out in the publication, Recommendations for the Design, Manufacture and Installation of Concrete Piles, prepared by ACI Committee 543.

2.02 QUALITY ASSURANCE

A. Concrete. Four standard 6-inch diameter by 12-inch concrete cylinders shall be made according to current ASTM Specifications for each lot of piling cast. Two cylinders shall be broken prior to transfer of prestress forces to ensure that concrete meets the requirements of 4,000 psi compressive stress at a stress transfer. The other 2 cylinders shall be tested at 28-days to ensure that

the minimum 28-day compressive stress of 5,000 psi is obtained. If cylinders fail to indicate this strength, the mix shall be adjusted.

B. Prestressing Cables. Tests on at least 2 samples, taken at random, shall be made to insure that minimum requirements are met. Test samples shall be 7 feet long. However, if a certificate from the manufacturer of the cable showing that the cable meets or exceeds the minimum requirements is furnished, tests need not be made.

PART 3 E X E C U T I O N

3.0l FABRICATION OF PILES

A. Concrete Placement. Consolidate concrete using mechanical vibrators. Use no less than 3 vibrators for concrete placement in any individual unit and provide at least one standby vibrator for emergency use to avoid delays. Use vibrators of the high frequency type of not less than 7,000 impulses per minute.

1. Concrete shall be handled and placed in accordance with the applicable requirements of Section 03310 - Structural Concrete.

2. Concrete piling shall be cast using steel side forms. Do not use any device that requires that it be left in the member. Construct and maintain bed for casting prestressed members that will provide not more than 1/4-inch vertical variation in any 50 foot length.

3. Side forms shall be kept in place for a minimum of 4 hours. Forms may be removed after this time, if concrete has reached sufficient strength to prevent physical damage to member. Forms shall be removed in such a manner that curing of any member is not interrupted for more than 30 minutes. Provide forms with an acceptable contraction device and joints to prevent cracking due to form restriction, or loosen forms from members at proper time to prevent such cracking. Cracking due to form restriction will be cause for rejection.

4. After form removal, rub surface of members which are not true or that have porous or honeycombed areas. Extend rubbing over sufficient areas around blemished portions to blend rubbed area discolorations and finish exposed surfaces of members reasonably uniform in color and texture.

5. Mat curing of concrete shall begin not later than 30 minutes after placement of concrete in forms. Steam curing may be started in 3 hours. Cure pretensioned members continuously, except as provided above for form removal, until concrete strength as indicated by compressive tests of cylinders has reached the required release strength. Curing may then be interrupted for a time interval of not more than 4 hours for removal of member from casting bed to curing area. Member shall be steam or water cured for 3 days after release of tension in member.

6. Air temperature surrounding the members shall be at 40^{O} F or above from the time placing of concrete commences until curing cycle is complete. If external heating is required, use precautions to provide saturated humidity at surface of members to prevent drying. When steam curing is used, concrete may be placed when air temperature is below freezing, provided that steam is introduced into the jacket immediately behind placement of concrete and the temperature of the air surrounding the concrete kept above 40^{O} F, until steam curing is begun.

7. When steam curing is used, members shall be kept in a condition of saturated humidity and at a temperature not to exceed 150^{O} F. If temperature charts indicate that temperature inside the curing jacket is in excess of that shown below, the beams shall not be accepted.

TABLE

Maximum Temperature Shown on Chart, Degrees F	Maximum Permissible Total Time in Excess of 150 Degrees F
151 to 160	1 Hour
161 to 170	30 Minutes
171 to 180	15 Minutes
Over 180	None

8. If temperature charts indicate that temperature inside the curing jacket has fallen below 50^{O} F, add 4 hours to the required curing time (at temperatures in excess of 50^{O} F) for each hour below 50^{O} F. Provide sufficient wet steam inside curing jacket so that surface of member is wet. Provide air space of not less than 6 inches between surfaces of member and covering material. Arrange steam outlets so that no live steam is directed at concrete or prestressing tendons. Apply steam slowly, so that the temperature rise inside the curing jacket is not more than 40^{O} F per hour. Do not start steam curing until concrete has been in place for a minimum of 3 hours.

9. Decrease temperature at end of curing at same rate as applied. Cut off steam and begin strand release operations when the temperature within the curing jacket has been reduced to within 30 ^{O} F of the outside ambient air temperature or to 90 ^{O} F, whichever is the lower temperature. Complete release of stress to concrete, while concrete is still warm and moist. Arrange location of steam lines, location of control points for output of steam into curing jacket, and number and type of openings for steam distribution inside curing jacket so that variation of temperature between any two points in the bed is no more than 20 ^{O} F. Curing at elevated temperatures using other than steam, is not permitted.

10. Curing of test cylinders to establish concrete strength for the release of tension, shall be in the same manner as members being prestressed. Test cylinders shall be placed at points where the most unfavorable curing conditions are offered. The average strength of two cylinders shall be considered a test.

3.02 PRETENSIONING

A. Initially bring tendons to be prestressed in a group to a uniform initial minimum tension of 1,000 pounds (plus or minus 50 pounds) per tendon prior to being given their full pretensioning. Measure this uniform tension by some suitable means such as a dynamometer so that its amount can be used as a check against elongation computed and measured.

B. After initial stressing, stress group to total tension as required by means of hydraulic jacks equipped with gauges graduated to read directly to one percent of total load to be applied and calibrated to measure accurately the stress induced in the steel. Measure the induced stress by elongation of tendons and check by gauge pressure. Results to be within 5 percent. Provide means for measuring elongation to an accuracy of 1/16 inch for each 100 feet of length between jacing heads. In the event of apparent discrepancies between stresses indicated by gauge pressure and elongation of more than 5 percent, check entire operation, determine source of error, and check before proceeding further. Establish independent references adjacent to each anchorage to indicate any yielding or slippage between time of initial stressing and final release of tendons.

C. With tendons stressed to full tension, as prescribed above, and with reinforcing in-place, cast members to necessary lengths to provide plan lengths after shrinkage and elastic shortening have occurred. Maintain tendon stress between anchorages until concrete has reached the compressive strength specified, as determined by compressive cylinder tests

made for each continuous pour. If all test cylinders for tension release are broken and the required release strength has not been attained, maintain the tendon stress and cure piling for an extended period of 24 hours for each 100 psi deficiency or fraction thereof before release of tension. After the above strength requirement is attained, gradually release tension in tendons and cut off tendons, using sequence to minimize shock and reduce premature tendon breakage.

3.03 HANDLING AND ERECTION

A. Exercise care when handling members. Handle in accordance with approved fabrication and erection plans which indicate method of handling so as to preclude the possibility of overstressing any part of member. Provide an adequate factor of safety in design to cover dynamic force or impact. Do not remove members from casting yard until after tensioning, curing and strength requirements have been attained. Members may be driven any time after curing and tensioning requirements have been fulfilled and the design strength cylinders indicate that the specified 28 day compressive strength has been attained. An adequate number of design strength test cylinders shall be cast to ensure that acceptance of members will be based on cylinder breaks. Design strength cylinder is to be cured initially with members. After release of stress of members, cylinder shall be cured in accordance with the standard procedure for cylinder curing. Precast piling should be handled and hauled in flat position. Piling, if so designed, may be picked up by either one or two point pickup.

3.04 DEFECTS AND BREAKAGE

A. If a member or portion thereof is broken at any time during construction, it will be rejected and replaced with a satisfactory member at no expense to the City of Houston. Fine hair cracks on the surface of member, which do not extend to the plane of nearest reinforcement, will not be cause for rejection unless such cracks are so numerous and extensive as to indicate inadequate curing, in which case, members will be rejected. Members having diagonal cracks on vertical surfaces, which indicates damage from torsion, will be rejected.

3.05 WORKMANSHIP AND TOLERANCES

A. The following tolerances shall apply for fabrication of piling units:

1. Variation from plan lengths - plus or minus 1 inch.

2. Variation from plan transverse dimensions - plus or minus 1/4 inch.

3. Maximum sweep - 1/8 inch per 10 feet.

4. Head out of square - Maximum 1/8 inch.

5. At any point in member, small areas of honeycomb which are purely surface in nature, not over 1/2 inch deep, may be repaired. Piling with honeycomb extending to plane of prestressed strands will not be acceptable.

6. Requirements not covered - conform to current Prestressed Concrete Institute standards.

7. Members not conforming to the above, shall be rejected, repaired and replaced at no cost to the City of Houston.

3.06 FINISHING

A. Exposed surfaces of concrete piles shall be finished as follows: Handling wires and/or other protrusions shall be removed and resulting chips or indentations shall be pointed up with grout. The surfaces shall then be painted with two coats of "Daraweld" masonry paint, or equal.

END OF SECTION

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SECTION 03100

CONCRETE FORMWORK

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Design, construction, erection and removal of structural concrete formwork.

1.02 UNIT PRICES

A. No separate payment will be made for concrete formwork under this Section. Include payment in unit price for structural concrete.

B. Refer to Section 01270 - Measurement and Payment for unit price procedures.

1.03 REFERENCE STANDARDS

A. ACI 117 - Standard Tolerances for Concrete Construction and Materials.

B. ACI 347 - Recommended Practice for Concrete Formwork.

C. U.S. Product Standard PS 1 Construction and Industrial Plywood.

D. U.S. Product Standard PS 20 American Softwood Lumber Standard.

1.04 SUBMITTALS

A. Conform to Section 01330 – Submittal Procedures.

B. Shop Drawings: Show location, member size and loading of shoring. When reshoring is permitted, submit plans showing locations and member size of reshoring.

C. Product Data and Samples:

1. Corrugated Fiberboard Carton Forms: Submit certification of compliance with design criteria, description of forms, and one-foot-long sample.

2. Form-coating Materials: Submit trade or brand names of manufacturers and complete description of products.

3. Form ties and related accessories, including taper tie plugs, if taper ties are used. Form gaskets.

D. Detailed Layout for Slip-forming: Submit detailed layout of proposed slipforming, including description of equipment, rate of progress, and other data to show suitability of method. Show provisions for ensuring attainment of required concrete surface finish.

PART 2 P R O D U C T S

2.01 MATERIAL

A. Smooth Forms: New plywood, metal, plastic, tempered concrete-form hardboard, dressed lumber faced with plywood or fiberboard lining, or metal-framed plywood-faced panel material, to provide continuous, straight, smooth surfaces. Form material shall be free of raised grain, torn surfaces, worn edges, patches, dents or other defects. Furnish material in largest practical sizes to minimize number of joints and, when indicated on Drawings, conform to joint system indicated. Form material shall have sufficient strength and thickness to withstand pressure of newly placed concrete without bow or deflection.

B. Rough Forms: Plywood, metal, dressed or undressed lumber free of knots, splits or other defects, or other material acceptable to Project Manager of sufficient strength and thickness to withstand pressure of newly placed concrete without bow or deflection.

C. Plywood: Conform to PS 1, Class 1.

D. Lumber: Conform to PS 20.

E. Edge Forms and Intermediate Screed Strips: Type and strength compatible with the screed equipment and methods used.

F. Plastic Forms: One-piece forms for domes, beams and pan joists. Single lengths for columns not exceeding height of 7 feet 6 inches. For columns over 7 feet 6 inches, use 7-foot 6-inch sections and filler sections as needed. To facilitate removal of pan joist forms, taper sides one inch per foot.

G. Metal Pan Joist Forms: Removable type; fabricated of minimum 14-gauge steel; one piece between end closures. Adjustable forms not allowed. Taper sides one inch per foot to facilitate removal.

H. Earth Cuts for Forms:

1. Use earth cuts for forming unexposed sides of grade beams cast monolithically with slabs on grade.

2. Where sides of excavations are stable enough to prevent caving or sloughing, following surfaces may be cast against neat-cut excavations:

   a. Sides of footings.

   b. Inside face of perimeter grade beams not monolithic with slab on grade. When inside face is cast against earth, increase beam width indicated on Drawings by one inch.

   c. Both faces of interior grade beams not monolithic with slab on grade. When grade beam is cast against earth, increase beam width indicated on Drawings by 2 inches.

I. Corrugated Fiberboard Carton Forms:

1. Corrugated fiberboard carton forms, when called for, are intended to form a void space beneath pile-supported and pier-supported slabs and other structural elements as shown.

2. Provide products of a reputable manufacturer regularly engaged in commercial production of double-faced corrugated fiberboard carton forms, constructed of waterproof paper and laminated with waterproof adhesive.

3. Fiberboard forms: Capable of supporting required dead load plus construction loads, and designed to lose their strength upon prolonged contact with moisture and soil bacteria.

4. Seal cuts and ends of each form section by dipping in waterproof wax, unless liners and flutes are completely impregnated with waterproofing.

5. Size forms as indicated on Drawings. Assemble as recommended by manufacturer, either with steel banding at 4 feet 0 inches maximum on centers, or, where liners and flutes are impregnated with waterproofing, with adequate stapling.

J. Circular Forms:

1. Form round-section members with paper or fiber tubes, constructed of laminated plies using water-resistant adhesive with wax-impregnated exterior for weather and moisture protection. Provide units with sufficient wall thickness to resist loads imposed by wet concrete without deformation. Provide manufacturer's seamless units to minimize spiral gaps and seams.

2. Fiberglass or steel forms may be used for round-section members.

K. Shores: Wood or adjustable metal, with bearing plates; with double wedges at lower end.

L. Form Ties:

1. Use commercially-manufactured ties, hangers and other accessories for embedding in concrete. Do not use wire not commercially fabricated for use as a form accessory.

2. Fabricate ties so ends or end fasteners can be removed without causing spalling of concrete faces. Depth from formed concrete face to the embedded portion: At least 1 inch, or twice the minimum dimension of tie, whichever is greater.

3. Provide waterstop feature for form ties used on liquid-containing structures and on concrete walls which will have earth backfill on one side.

4. Removable ties: Taper ties may be used when approved by the Project Manager. In the hole left by the removal of the taper tie, insert a preformed neoprene or polyurethane plug sized to seat at the center of the wall.

M. Form Coating: Commercial formulation of form oil or form-release agent having proven satisfactory performance. Coating shall not bond with, stain or otherwise adversely affect concrete surfaces, or impair their subsequent treatment, including application of bonding agents, curing compounds, paint, protective liners and membrane waterproofing.

N. Coating for Plastic Forms: Alkali-resistant gel-coat.

O. Chamfer Strips: Unless otherwise indicated on Drawings, provide 3/4-inch chamfer strips in corners of forms to produce beveled edges where required by Part 3, Execution.

P. Form Gaskets: Polyethylene rod, closed cell, one-inch diameter.

2.02 DESIGN OF FORMWORK

A. Conform to ACI 117, ACI 347 and City building codes, unless more restrictive requirements are specified or shown on Drawings. Contractor shall design and engineer concrete formwork, including shoring and bracing. Design formwork for applicable gravity loads, lateral pressure, wind loads and allowable stresses. Camber formwork to compensate for anticipated deflection during placement of concrete when required to maintain specified tolerances. Design formwork to be readily removed without impact, shock or damage to concrete surfaces and adjacent materials.

B. Slip Forming: Permitted on written approval of City Engineer. Contractor shall demonstrate suitability of method proposed.

PART 3 E X E C U T I O N

3.01 INSTALLATION

A. Formwork Construction

1. Construct and maintain formwork so that it will maintain correct sizes of members, shape, alignment, elevation and position during concrete placement and until concrete has gained sufficient strength. Provide for required openings, offsets, sinkages, keyways, recesses, moldings, anchorages and inserts.

2. Construct forms for easy removal without damage to concrete surfaces.

3. Make formwork sufficiently tight to prevent leakage of cement paste during concrete placement. Solidly butt joints and provide backup material at joints as required to prevent leakage and fins. Provide gaskets for wall forms to prevent concrete paste leakage at their base.

4. Place chamfer strips in forms to bevel edges and corners permanently exposed to view, except top edges of walls, and slabs which are indicated on Drawings to be tooled. Do not bevel edges of formed joints and interior corners unless indicated on Drawings. Form beveled edges for vertical and horizontal corners of equipment bases. Unless otherwise indicated on Drawings, make bevels 3/4 inch wide.

5. Provide temporary openings at bases of column and wall forms and other points as required for observation and cleaning immediately before concrete is placed.

6. Where runways are required for moving equipment, support runways directly on the formwork or structural members. Do not allow runways or supports to rest on reinforcing steel.

7. Use smooth forms on formed concrete surfaces required to have smooth form finish or rubbed finish as specified in Section 03350 - Concrete Finishing.

8. Rough forms may be used on formed concrete surfaces indicated to have rough form finish as specified in Section 03350 - Concrete Finishing.

B. Forms for Surfaces Requiring Smooth Form Finish:

1. Drill forms to suit ties used and to prevent leakage of concrete mortar around tie holes. Uniformly space form ties and align in horizontal and vertical rows. Install taper ties, if used, with the large end on the wet face of the wall.

2. Provide sharp, clean corners at intersecting planes, without visible edges or offsets. Back up joints with extra studs or girts to maintain true, square intersections.

3. Form molding shapes, recesses and projections with smooth-finish materials and install in forms with sealed joints to prevent displacement.

4. Form exposed corners of beams and columns to produce square, smooth, solid, unbroken lines.

5. Provide exterior exposed edges with 3/4-inch chamfer or 3/4-inch radius.

6. Arrange facing material in orderly and symmetrical fashion. Keep number of joints to practical minimum. Support facing material adequately to prevent deflection in excess of allowable tolerances.

7. For flush surfaces exposed to view in completed structure, overlap previously- placed hardened concrete with form sheathing by approximately 1 inch. Hold forms against hardened concrete to maintain true surfaces, preventing offsets or loss of mortar.

C. Forms for Surfaces Requiring Rubbed Finish: Provide forms as specified in Paragraph 3.01B, Smooth Form Finish. Use smooth plywood or fiberboard linings or forms, in as large sheets as practicable, and with smooth, even edges and close joints.

D. Edge Forms and Screed Strips for Slabs: Set edge forms or bulkheads and intermediate screed strips for slabs to obtain required elevations and contours in finished slab surface. Provide and secure supports for types of screeds required.

E. Circular Forms: Set forms in one piece for full height of member.

F. Surfaces to Receive Membrane Waterproofing: Coordinate surface finish, anchors, reglets and similar requirements with membrane waterproofing applicator.

G. Fireproofing Steel Member: Construct forms to provide not less than the concrete thickness necessary, measured from face of steel member, to provide the required fire rating. Forms for concealed surfaces may be unlined.

H. Tolerances:

1. Unless noted otherwise on Drawings, construct formwork so concrete surfaces will conform to tolerance limits listed in Tables 03100A and 03100B at end of this Section.

2. Establish sufficient control points and bench marks as references for tolerance checks. Maintain these references in undisturbed condition until final completion and acceptance of the Work.

I. Adjustment of Formwork:

1. Use wedges or jacks to provide positive adjustment of shores and struts. After final inspection and before concrete placement, fasten in position wedges used for final adjustment of forms.

2. Brace forms securely against lateral deflections. Prepare to compensate for settling during concrete placement.

3. For wall openings, construct wood forms that facilitate necessary loosening to counteract swelling of forms.

J. Corrugated Fiberboard Carton Forms:

1. Place on smooth firm bed of suitable material to prevent vertical displacement; set tight to prevent horizontal displacement. Exercise care to avoid buckling of forms. Install in accordance with manufacturer's directions and recommendations.

2. Fit carton forms tightly around piles and piers; completely fill the space between subgrade and concrete placement with carton forms to form a void space.

3. Protect carton forms from moisture and maintain in a dry condition until concrete is placed on them. If they become wet before placement of concrete, allow them to dry and carefully inspect for strength before concrete is placed.

4. Before concrete placement, replace damaged or deteriorated forms which are incapable of supporting concrete dead load plus construction live loads.

3.02 PREPARATION OF FORM SURFACES

A. Clean surfaces of forms and embedded materials before placing concrete. Remove accumulated mortar, grout, rust and other foreign matter.

B. Coat forms for exposed or painted concrete surfaces with form oil or form-release agent before placing reinforcement. Cover form surfaces with coating material in accordance with manufacturer's printed instructions. Do not allow excess coating material to accumulate in forms or to contact hardened concrete against which fresh concrete will be placed. Remove coating material from reinforcement before placing concrete.

C. Forms for unexposed surfaces, other than retained-in-place metal forms, may be wet with water immediately before concrete placement in lieu of coating. When possibility of freezing temperatures exists, however, the use of coating is mandatory.

3.03 REMOVAL OF FORMS

A. Time Limits:

1. When repair of surface defects or finishing is required before concrete is aged, forms on vertical surfaces may be removed as soon as concrete has hardened sufficiently to resist damage from removal operations.

2. Remove top forms on sloping surfaces of concrete as soon as concrete has attained sufficient stiffness to prevent sagging. Loosen wood forms for wall openings as soon as this can be accomplished without damage to concrete. Leave formwork for water-retaining structures in place for at least 2 days. Formwork for non-water-retaining columns, walls, sides of beams and other formwork components not supporting weight of concrete may be removed after 12 hours, provided concrete has hardened sufficiently to resist damage from removal operations, and provided removal of forms will not disturb members supporting weight of concrete.

3. Forms and shoring supporting weight of concrete or construction loads: Leave in place until concrete has reached minimum strength specified for removal of forms and shoring. Do not remove such forms in less than 4 days.

B. Circular Paper or Spiral Tube Forms: Follow manufacturer's directions for form removal. Take necessary precautions to prevent damage to concrete surface. When removal is done before completion of curing time, replace form, tie in place and seal to retard escape of moisture.

C. Removal Strength:

1. Control Tests: Suitable strength-control tests will be required as evidence that concrete has attained specified strength for removal of formwork or shoring supporting weight of concrete in beams, slabs and other structural members. Furnish test cylinders and data to verify strength for early form removal.

a. Field-cured Test Cylinders: When field-cured test cylinders reach specified removal strength, formwork or shoring may be removed from respective concrete placements.

b. Laboratory-cured Test Cylinders: When concrete has been cured as specified for structural concrete for same time period required by laboratory-cured cylinders to reach specified strength, formwork or shoring may be removed from respective concrete placements. Determine length of time that concrete has been cured by totaling the days or fractions of days, not necessarily consecutive, during which air temperature surrounding concrete is above 50 degrees F and concrete has been damp or thoroughly sealed against evaporation and loss of moisture.

2. Compressive Strengths: The minimum concrete compressive strength for removal of formwork supporting weight of concrete is 75 percent of specified minimum 28-day strength for class of concrete involved.

3.04 RESHORING

A. When reshoring is permitted, plan operations in advance and obtain City Engineer's approval of such operations. While reshoring is under way, keep live load off new construction. Do not permit concrete in any beam, slab, column or other structural member to be subjected to combined dead and construction loads in excess of loads permitted for developed concrete strength at time of reshoring.

B. Place reshores as soon as practicable after form-stripping operations are complete but in no case later than end of day on which stripping occurs. Tighten reshores to carry required loads without over stressing construction. Leave reshores in place until tests representative of concrete being supported have reached specified strength at time of removal of formwork supporting weight of concrete.

C. Floors supporting shores under newly-placed concrete: Leave original supporting shores in place, or re-shore. Locate reshores directly under shore position above. Extend reshoring over a sufficient number of stories to distribute weight of newly-placed concrete, forms and construction live loads in such manner that design superimposed loads of floors supporting shores are not exceeded.

3.05 FORM REUSE

A. Do not reuse forms that are worn or damaged beyond repair. Thoroughly clean and recoat forms before reuse. For wood and plywood forms to be used for exposed smooth finish, sand or otherwise dress concrete contact surface to original condition or provide form liner facing material. For metal forms, straighten, remove dents and clean to return forms to original condition.

Table 03100A

TOLERANCES FOR FORMED SURFACES CONCRETE IN BUILDINGS**				
VARIATION FROM	VARIATION IN	FOR ANY 10-FOOT LENGTH	FOR ANY 20-FOOT LENGTH OR ANY BAY	MAXIMUM FOR ENTIRE DIMENSION
PLUMB OR SPECIFIED BATTER	LINES AND SURFACES OF COLUMNS, PIERS, WALLS AND ARRISES	1/4"	---	1"
	EXPOSED CORNER COLUMNS, CONTROL JOINT GROOVES, AND OTHER CONSPICUOUS LINES	---	1/4"	1/2"
LEVEL OR SPECIFIED GRADE	SLAB SOFFITS, CEILINGS, BEAM SOFFITS, AND ARRISES (MEASURED BEFORE REMOVAL OF SHORES)	1/4"	3/8"	3/4"
	EXPOSED LINTELS, SILLS, PARAPETS, HORIZONTAL GROOVES AND OTHER CONSPICUOUS LINES	---	1/4"	1/2"
DRAWING DIMENSIONS	POSITION OF LINEAR BUILDING LINES, COLUMNS, WALLS, AND PARTITIONS	---	1/2"	1"
	SIZE AND LOCATION OF SLEEVES, FLOOR OPENINGS AND WALL OPENINGS	---	---	±1/4"
	CROSS SECTION OF COLUMNS, BEAMS, SLABS, AND WALLS	---	---	+1/2", -1/4"
	FOOTINGS* IN PLAN	---	---	+2", -1/2"
	FOOTING MISPLACEMENT OR ECCENTRICITY IN DIRECTION OF ERROR (THE LESSER OF)	---	---	2% OF WIDTH OR 2"
	FOOTING THICKNESS DECREASE	---	---	5%
	FOOTING THICKNESS INCREASE	---	---	NO LIMIT
	STEP RISE IN FLIGHT OF STAIRS	---	---	±1/8"
	STEP TREAD IN FLIGHT OF STAIRS	---	---	±1/4"
	CONSECUTIVE STEP RISE	---	---	±1/16"
	CONSECUTIVE STEP TREAD	---	---	±1/8"

*** Footing tolerances apply to concrete dimensions only, not to positioning of vertical reinforcing steel, dowels, or embedded items.**

**** Includes water and wastewater process structures.**

TABLE 03100B

TOLERANCES FOR FORMED SURFACES CONCRETE IN BRIDGES, WHARVES AND MARINE STRUCTURES		
VARIATION FROM	VARIATION IN	MAXIMUM
PLUMB OR SPECIFIED BATTER	SURFACES OF COLUMNS, PIERS AND WALLS	1/2" in 10'
LEVEL OR SPECIFIED GRADE	TOP SURFACES OF SLABS	See Section 03350
	TOP SURFACES OF CURBS AND RAILINGS	3/16" in 10'
DRAWING DIMENSIONS	CROSS SECTION OF COLUMNS, CAPS, WALLS, BEAMS AND SIMILAR MEMBERS	+1/2", -1/4"
	THICKNESS OF DECK SLABS	+1/4", - 1/8"
	SIZE AND LOCATION OF SLAB AND WALL OPENINGS	± 1/2"
	FOOTINGS IN PLAN	+2", -1/2"
	FOOTING MISPLACEMENT OR ECCENTRICITY IN DIRECTION OF ERROR (THE LESSER OF)	2% of WIDTH OR 2"
	FOOTING THICKNESS DECREASE	5%
	FOOTING THICKNESS INCREASE	NO LIMIT
	STEP RISE IN FLIGHT OF STAIRS	±1/8"
	STEP TREAD IN FLIGHT OF STAIRS	±1/4"
	CONSECUTIVE STEP RISE	±1/16"
	CONSECUTIVE STEP TREAD	±1/8"

END OF SECTION

SECTION 03151

JOINTS IN CONCRETE STRUCTURES

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Waterstops and similar joints in concrete structures intended to retain water or withstand hydrostatic pressure.

1.02 UNIT PRICES

A. No separate payment will be made for joints under this Section. Include payment in unit price for structural concrete.

B. Refer to Section 01270 - Measurement and Payment for unit price procedures.

1.03 REFERENCES

A. ASTM A 775 - Standard Specification for Epoxy-Coated Reinforcing Steel Bars.

B. ASTM C 920 - Specification for Elastomeric Joint Sealants.

C. ASTM D 412 - Test Methods for Rubber Properties in Tension.

D. ASTM D 624 - Test Method for Rubber Property - Tear Resistance.

E. ASTM D 638 - Test Method for Tensile Properties of Plastics.

F. ASTM D 746 - Test Method for Brittleness Temperature of Plastics and Elastomers by Impact.

G. ASTM D 747 - Test Method for Apparent Bending Modulus of Plastics by Means of a Cantilever Beam.

H. ASTM D 1056 - Specification for Flexible Cellular Materials - Sponge or Expanded Rubber.

I. ASTM D 1752 - Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.

J. ASTM D 2000 - Specification for Rubber Products in Automotive Applications.

K. ASTM D 2240 - Test Method for Rubber Property - Durometer Hardness.

L. ASTM D 2241 - Specification for PVC Tubing.

M. Federal Specification SS-S-210A - Sealing Compound, Preformed Plastic for Expansion Joints and Pipe Joints.

N. Federal Specification TT-S-0227E(3) Sealing Compound, Elastomeric Type, Multi-Component, for Caulking, Sealing, and Glazing Buildings and Other Structures.

O. U.S. Army Corps of Engineers Specification CRD-C 572 PVC Waterstop.

1.04 DEFINITIONS

A. The following definitions refer to concrete joints in water-retaining structures. Unless otherwise indicated, all such joints shall have a waterstop or sealant groove to prevent water penetration at the joint.

B. Construction Joint: The joint or surface between two concrete pours, produced by placing fresh concrete in contact with a hardened concrete surface.

1. A bond breaker may or may not be used, as indicated.

2. Reinforcing steel is continuous through the joint, unless otherwise indicated.

C. Contraction Joint: A joint similar to a construction joint, but intended to accommodate concrete shrinkage and similar movement.

1. A bond breaker is always used.

2. Reinforcing steel is held back 4-1/2 inches from the joint surface, and sleeved dowels are used so pours can move apart, unless otherwise indicated.

D. Expansion Joint: A joint similar to a construction or contraction joint, but intended to accommodate both expansion and contraction.

1. Compressible joint filler is placed against the hardened concrete, to form and separate the second pour so pours can move together or apart.

2. A centerbulb waterstop and joint sealant are used to fill the gap, unless otherwise indicated.

3. Reinforcing steel is held back, and sleeved dowels are used to allow and control movement, unless otherwise indicated.

E. Control Joint: A groove cut or formed in the face of a single pour, producing a weaker plane more likely to crack; used in an attempt to control locations of normal shrinkage cracks.

1. Joint sealant is used to fill the groove.

2. Reinforcing steel is continuous, since the pour is monolithic.

1.05 SUBMITTALS

A. Submit under provisions of Section 01330 – Submittal Procedures.

B. Product Data: Information sufficient to indicate compliance with Contract Documents, including manufacturer's descriptive literature and specifications.

C. Shop Drawings: Indicate type, size, and location of each joint in each structure, and installation details.

D. Samples: For extrusions, submit 6-inch lengths. For molded or fabricated items, submit whole items. Submit 6-inch beads for sealants and 6-inch square samples for coatings, on appropriate substrates.

E. Quality Control Submittals: Submit manufacturer's instructions and recommendations for storage, handling and installation including material safety data sheets, and, where specified, test reports certified by an independent testing laboratory or the manufacturer, and manufacturer's certification that products furnished comply with Contract Documents.

1.06 QUALITY ASSURANCE

A. Waterstop Inspection: Notify City Engineer to schedule inspection at least 24 hours prior to work involving waterstop installation or fabrication of waterstop field joints.

B. Defects include but are not limited to the following:

1. Offsets at joints greater at any point than 1/16 inch or 15 percent of material thickness, whichever is less.

2. Exterior cracks at joints due to incomplete bond, which are deeper at any point than 1/16 inch or 15 percent of material thickness, whichever is less.

3. At any point, any combination of offsets or exterior cracks resulting in a net reduction in the cross-sectional area of the waterstop greater than 1/16 inch or 15 percent of material thickness at any point, whichever is less.

4. Misalignment of joint resulting in misalignment of the waterstop in excess of 1/2 inch in 10 feet.

5. Porosity in the welded joint as evidenced by visual inspection.

6. Bubbles or inadequate bond which can be detected with a pen knife. If, while probing the joint with the point of a pen knife, the knife breaks through the outer portion of the weld into a bubble, the joint is defective.

C. Field Joint Samples: Prior to use of the waterstop material in the field, fabricate and submit for review a sample of a fabricated mitered cross and a tee constructed of each size or shape of material to be used. Fabricate samples so material and workmanship represent fittings to be furnished. Field samples of fabricated fittings (crosses, tees, etc.) will be selected at random by the City for testing by a laboratory at City's expense; they shall have a tensile strength across the joints equal to at least 600 psi when tested in accordance with ASTM D 638. Contractor shall pay cost of failed tests and retesting required by failures.

D. Construction Joint Sealant: Prepare adhesion and cohesion test specimens, as specified, at intervals of 5 working days while sealants are being installed.

E. Sealant material shall show no signs of adhesive or cohesive failure when tested in accordance with the following procedure in laboratory and field tests:

1. Prepare sealant specimen between 2 concrete blocks (1 inch by 2 inches by 3 inches); spacing between the blocks shall be 1 inch. Use coated spacers (2 inches by 1-1/2 inches by 1/2 inch) to ensure sealant cross-sections of 1/2 inch by 2 inches with a width of 1 inch.

2. Cast and cure sealant according to manufacturer's recommendations except that curing period shall be not less than 24 hours.

3. Following curing period, widen the gap between blocks to 1-1/2 inches. Use spacers to maintain this gap for 24 hours prior to inspection for failure.

F. Sealant Installer: A competent waterproofing specialty contractor, approved by sealant manufacturer, having a record of successful performance in similar installations. Before beginning work, sealant manufacturer's representative shall instruct installer's crew in proper method of application.

1.07 WARRANTY

A. Provide a written warranty covering entire sealant installation against faulty and incompatible materials and workmanship, and agreeing to repair or replace defective work at no additional cost to the City, for a period of 5 years.

1.08 DELIVERY, STORAGE AND HANDLING

A. Deliver, store and handle materials in accordance with manufacturer's printed instructions.

B. Store waterstops to permit free circulation of air around waterstop material.

PART 2 P R O D U C T S

2.01 EPA POTABLE CLASSIFICATION

A. All joint materials shall be materials that reach acceptability for use in potable water systems no later than 30 days after installation, as classified by the Environmental Protection Agency.

2.02 PVC WATERSTOPS

A. Extrude from virgin polyvinyl chloride elastomer. Use no reclaimed or scrap material. Submit waterstop manufacturer's current test reports and manufacturer's written certification that the material furnished meets or exceeds Corps of Engineers Specification CRD-C572 and other specified requirements.

B. Flat Strip and Center-Bulb Waterstops: As detailed, and as manufactured by: Kirkhill Rubber Co., Brea, California; Water Seals, Inc., Chicago, Illinois; Progress Unlimited, Inc., New York, New York; Greenstreak Plastic Products Co., St. Louis, Missouri; or equal acceptable to the City Engineer, provided that at no place shall waterstop thickness be less than 3/8 inch.

C. Multi-Rib Waterstops: As detailed, and as manufactured by Water Seals, Inc., Chicago, Illinois; Progress Unlimited, Inc., New York, New York; Greenstreak Plastic Products Co., St. Louis, Missouri; or equal acceptable to the City Engineer. Use prefabricated joint fittings at intersections of ribbed-type waterstops.

D. Other Waterstops: When types of waterstops not listed above are indicated on the Drawings, they are subject to these specifications.

E. Waterstop Properties: When tested in accordance with specified standards, waterstop material shall meet or exceed the following requirements:

Physical Property, Sheet Material	Value	ASTM Standard
Tensile Strength-min (psi):	1750	D638, Type IV
Ultimate Elongation-min (percent):	350	D638, Type IV
Low Temp Brittleness-max (degrees F):	-35	D746
Stiffness in Flexure-min (psi):	400	D747
Accelerated Extraction (CRD-C572) -		
Tensile Strength-min (psi):	1500	D638, Type IV
Ultimate Elongation-min (percent):	300	D638, Type IV
Effect of Alkalies (CRD-C572) -		
Change in Weight (percent):	+0.25/-0.10	------
Change in Durometer, Shore A:	+5	D2240
Finished Waterstop -		
Tensile Strength-min (psi):	1400	D638, Type IV
Ultimate Elongation-min (percent):	280	D638, Type IV

2.03 JOINT SEALANT

A. Material: Polyurethane polymer designed for bonding to concrete which is continuously submerged in water. Use no material with an unsatisfactory history of bond or durability when used in joints of liquid-retaining structures.

B. Sealant Properties at 73 degrees F, 50 percent relative humidity:

1.	Work Life:	45 - 180 minutes
2.	Time to Reach 20 Shore A Hardness (at 77 degrees F, 200 gr quantity):	24 hours, maximum
3.	Ultimate Hardness (ASTM D 2240):	20 - 45 Shore A
4.	Tensile Strength (ASTM D 412):	200 psi, minimum
5.	Ultimate Elongation (ASTM D 412):	400 percent, minimum
6.	Tear Resistance (Die C ASTM D 624):	75 pounds per inch of thickness, minimum
7.	Color:	Light Gray

C. Polyurethane Sealants for Waterstop Joints in Concrete:

1. Sealant: 2-part polyurethane; when cured, sealant shall meet or exceed ANSI/ASTM C 920 or Federal Specification TT-S-0227 E(3) for 2-part material.

2. Vertical and overhead horizontal joints: Use only "non-sag" compounds meeting ANSI/ASTM C 920, Class 25, Grade NS, or Federal Specification TT-S-0227 E(3), Type II, Class A.

3. Plane horizontal joints: Self-leveling compounds meeting ANSI/ASTM C 920, Class 25, Grade P, or Federal Specification TT-S-0227 E(3), Type I. For joints subject to either pedestrian or vehicular traffic, use a compound providing non-tracking characteristics and having a Shore A hardness range of 35 to 45.

4. Primer: Use only compatible materials manufactured or recommended for the application by the sealant manufacturer, in accordance with the printed instructions and recommendations of the sealant manufacturer.

D. Acceptable Products: Polymeric Systems Inc. "PSI-270"; Pacific Polymers "Elastothane 227R"; Sika Corporation "Sikaflex 2C", or equal acceptable to the City Engineer.

E. Sealants for non-waterstop joints: Conform to Section 07920 - Sealants and Caulking.

2.04 MISCELLANEOUS MATERIALS

A. Bearing Pad: ASTM D 2000 neoprene, Grade 2 or 3, Type BC, tensile strength 1450 psi, 60 durometer hardness, unless otherwise indicated.

B. Neoprene Sponge: ASTM D 1056, Type 2C3-E1 closed-cell expanded neoprene.

C. Preformed Joint Filler: ASTM D 1752 Type I non-extruding type; neoprene sponge or polyurethane of firm texture, except as otherwise specified. Bituminous fiber type will not be permitted.

D. Control Joint Former: Continuous plastic insert strips with anchorage ribs located at the bottom and an enlarged upper portion that is readily removable without damage to the concrete, and is sized to form sealant groove. Size to extend to at least 1/4 slab depth.

E. Backing Rod: Extruded closed-cell polyethylene foam rod, compatible with joint sealant materials used, with a tensile strength not less than 40 psi, and compression deflection approximately 25 percent at 8 psi. Size: 1/8-inch larger in diameter than joint width, except use one-inch diameter rod for 3/4-inch wide joints.

F. Bond Breaker: "Super Bond Breaker" manufactured by Burke Company, San Mateo, California; "Select Cure CRB", manufactured by Select Products Co., Upland, California, or equal acceptable to the City Engineer. Bond breaker shall contain a fugitive dye so areas of application will be readily distinguishable.

G. Slip Dowels: Smooth epoxy-coated bars conforming to ASTM A 775.

H. PVC Tubing: ASTM D 2241, Schedule SDR 13.5.

2.05 RESILIENT WATERSTOP

A. Resilient waterstop, where called for on the Drawings, shall be either a bentonite or adhesive type material.

B. Bentonite Waterstop:

1. Material: 75 percent bentonite, mixed with butyl rubber-hydrocarbon containing less than 1.0 percent volatile matter, and free of asbestos fibers or asphaltics.

2. Manufacturer's rated temperature ranges: For application, 5 to 125 degrees F; in service, -40 to 212 degrees F.

3. Cross-sectional dimensions, unexpanded waterstop: One inch by 3/4 inch.

4. Provide with adhesive backing capable of producing excellent adhesion to concrete surfaces.

C. Adhesive Waterstop:

1. Adhesive waterstop shall be at least 2 inches in diameter and shall be Synko-Flex preformed plastic adhesive waterstop by Synko-Flex Products, Inc., or equal. The waterstop shall meet or exceed requirements of Federal Specification SS-S-210A.

2. The adhesive waterstop shall be supplied wrapped completely by a two part protective paper.

3. The adhesive waterstop material shall have independent laboratory tests verifying that the material seals joints in concrete against leakage when subjected to a minimum of 30 psi water pressure for at least 72 hours.

4. Primer, to be used on hardened concrete surfaces, shall be provided by the same manufacturer as the waterstop material.

PART 3 E X E C U T I O N

3.01 INSTALLATION

A. Embed waterstops in concrete across joints as shown. Waterstops shall be continuous for the extent of the joint; make splices necessary to provide such continuity in accordance with manufacturer's instructions. Support and protect waterstops during construction operations; repair or replace waterstops damaged during construction.

B. Install waterstops in concrete on one side of joints, leaving other side exposed until the next pour. When a waterstop will remain exposed for 2

days or more, shade and protect the exposed waterstop from direct rays of the sun during the entire exposure and until the exposed portion of the waterstop is embedded in concrete.

3.02 SPLICES IN WATERSTOPS

A. Splice waterstops by heat-sealing adjacent waterstop sections in accordance with the manufacturer's printed instructions.

1. Do not damage material by heat sealing.

2. Splice tensile strength: At least 60 percent of unspliced material tensile strength.

3. Maintain continuity of waterstop ribs and tubular center axis.

B. Butt end-to-end joints of 2 identical waterstop sections may be made in the forms during placement of waterstop material.

C. Prior to placement in formwork, prefabricate all waterstop joints involving more than 2 ends to be joined together, an angle cut, an alignment change, or the joining of 2 dissimilar waterstop sections, allowing not less than 24-inch long strips of waterstop material beyond the joint. Upon inspection and approval by the City Engineer, install prefabricated waterstop joint assemblies in formwork, and butt-weld ends of the 24-inch strips to the straight-run portions of waterstop in the forms.

D. Where a centerbulb waterstop intersects and is joined to a non-centerbulb waterstop, take care to seal the end of the centerbulb, using additional PVC material if needed.

3.03 JOINT CONSTRUCTION

A. Setting Waterstops:

1. Correctly position waterstops during installation. Support and anchor waterstops during progress of the work to ensure proper embedment in concrete. Locate symmetrical halves of waterstops equally between concrete pours at joints, with center axis coincident with joint openings. Thoroughly work concrete in joint vicinity for maximum density and imperviousness.

2. Flat-strip waterstop: Prevent folding over by concrete during placement. Unless otherwise shown, hold waterstops in place with

wire ties on 12-inch centers passed through the waterstop edge and tied to reinforcing steel.

a. Horizontal waterstops (with flat face in vertical plane): Hold in place by fastening upper waterstop edge to continuous supports.

b. Horizontal waterstops (with flat face in horizontal plane): Work concrete under waterstops by hand to eliminate air and rock pockets.

3. Place centerbulb waterstops in expansion joints centered on joint filler material.

4. Where a waterstop in a vertical wall joint does not connect with any other waterstop, and is not intended to be connected to a waterstop in a future concrete placement, terminate the waterstop 6 inches below the top of the wall.

B. Joint Location: Unless specifically noted otherwise, provide construction joints at 25-foot maximum spacing for concrete construction. Where joints are shown spaced greater than 40 feet apart, provide additional joints to maintain the 25-foot maximum spacing. Submit joint locations for review by the City Engineer.

C. Joint Preparation: Prepare surfaces in accordance with Section 03310 - Structural Concrete. Unless otherwise indicated, bonding is required at horizontal concrete joints in walls. Except on horizontal wall construction joints, wall-to-slab joints, or where otherwise shown or specified, at joints where waterstops are required, coat the joint face of the first pour with bond breaker as specified.

D. Replacement of Defective Field Joints: Replace waterstop field joints showing evidence of misalignment, offset, porosity, cracks, bubbles, inadequate bond or other defects with products and joints complying with Contract Documents.

E. Construction Joint Sealant:

1. In water-bearing floor slabs and elsewhere where indicated, provide construction joints with tapered grooves filled with construction joint sealant. Leave groove- forming material in place until time grooves are cleaned and filled with joint sealant. After removing groove forms, remove laitance and fins and sand-blast the grooves. Allow grooves to dry thoroughly, then blow out, immediately prime surfaces, place bond-breaker tape in bottom of groove and fill with construction joint

sealant. Use no sealant without a primer. Completely fill sealant grooves. Thoroughly clean areas designated to receive sealant, as specified for tapered grooves, prior to sealant application.

2. Mix and install primer and sealant in accordance with manufacturer's printed instructions and recommendations. Do not coat sides of sealant groove with bond breaker, curing compound or other substance which would interfere with proper sealant bond. Allow at least 7 days for sealant to achieve final cure before filling structure with water.

3. Thoroughly and uniformly mix 2-part catalyst-cured material.

4. Remove and replace improperly cured sealants after the manufacturer's recommended curing time; thoroughly sandblast the groove to remove all traces of uncured or partially-cured sealant and primer, then re-prime and re-seal with specified sealant.

F. Resilient Waterstop:

1. Install resilient waterstop in accordance with manufacturer's instructions and recommendations except as otherwise indicated and specified.

2. When requested by the Project Manager, provide technical assistance by manufacturer's representative in the field at no additional cost to the City.

3. Use resilient waterstop only where complete confinement by concrete is provided; do not use in expansion or contraction joints.

4. Where resilient waterstop is used in combination with PVC waterstop, lap resilient waterstop over PVC waterstop a minimum of 6 inches and place in contact with the PVC waterstop. Where crossing PVC at right angles, melt PVC ribs to form a smooth joining surface.

5. At the free top of walls without connecting slabs, stop the resilient waterstop and grooves (where used) 6 inches from the top in vertical wall joints.

6. Bentonite Waterstop:

   a. Locate bentonite waterstop as near as possible to the center of the joint and extend continuous around the entire joint.

Minimum distance from edge of waterstop to face of member: 5 inches.

b. Where thickness of the concrete member to be placed on the bentonite waterstop is less than 12 inches, place waterstop in grooves at least 3/4 inch deep and 1-1/4 inches wide formed or ground into the concrete. Minimum distance from edge of waterstop placed in groove to face of member: 2.5 inches.

c. Do not place bentonite waterstop when waterstop material temperature is below 40 degrees F. Waterstop material may be warmed so that it remains above 40 degrees F during placement but means used to warm it shall in no way harm the material or its properties. Do not install waterstop where air temperature falls outside manufacturer's recommended range.

d. Place bentonite waterstop only on smooth and uniform surfaces; grind concrete smooth if necessary to produce satisfactory substrate, or bond waterstop to irregular surfaces using an epoxy grout which completely fills voids and irregularities beneath the waterstop material. Prior to installation, wire brush the concrete surface to remove laitance and other substances that may interfere with bonding of epoxy.

e. In addition to the adhesive backing provided with the waterstop, secure bentonite waterstop in place with concrete nails and washers at 12-inch maximum spacing.

7. Adhesive Waterstop:

a. Thoroughly clean the concrete surface on which the waterstop is to be placed with a wire brush and coat with primer.

b. If the surface is too rough to allow the waterstop to form a complete contact, grind to form an adequately smooth surface.

c. Install the waterstop with the top protective paper left in place. Overlap joints between strips a minimum of 1 inch and cover back over with the protective paper.

d. Do not remove protective paper until just before final formwork completion. Concrete shall be placed immediately. The time that the waterstop material is uncovered prior to concrete placement shall be minimized and shall not exceed 24 hours.

G. Control Joints:

1. Where indicated, form in slabs by sawcutting, preformed plastic inserts or other means acceptable to City Engineer. Minimum insert or sawcut: 1/4 slab depth.

2. Perform sawcutting during the curing period as soon as possible after concrete has reached its final set, has attained sufficient strength to support sawcutting operations without damage, and while it remains fully saturated.

3. Leave the removable portion of plastic inserts in place and protect sawcuts against damage and intrusion of foreign material until the end of the curing period and until concrete has dried sufficiently to allow sealant installation.

4. Sealant Installation: Blow foreign material from formed or sawcut space. Insert a foam backer rod to form a sealant depth equal to the width of the space but not less than 3/8 inch. Install sealant as specified elsewhere in the Contract Documents.

END OF SECTION

SECTION 03211

REINFORCING STEEL

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Structural concrete reinforcement and grouting of reinforcement dowel bars into hardened concrete.

1.02 UNIT PRICES

A. No separate payment will be made for reinforcing steel or grouting that is part of the Work as bid. Include payment in unit price for structural concrete.

B. Measurement for reinforcing steel installed as extra work is on a per-pound basis.

C. Refer to Section 01270 - Measurement and Payment for unit price procedures.

1.03 REFERENCES

A. ACI 315 - Details and Detailing of Concrete Reinforcement.

B. ACI 318 - Building Code Requirements for Reinforced Concrete.

C. ASTM A 36 - Standard Specification for Structural Steel.

D. ASTM A 82 - Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.

E. ASTM A 185 - Standard Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement.

F. ASTM A 497 - Standard Specification for Steel Welded Wire Fabric, Deformed, for Concrete Reinforcement.

G. ASTM A 615 - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.

H. ASTM A 675 - Standard Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality, Mechanical Properties.

I. ASTM A 775/A 775M - Standard Specification for Epoxy-Coated Reinforcing Steel Bars.

J. ASTM C 881 - Specification for Epoxy-Resin-Base Bonding Systems for Concrete.

K. AWS D 1.4 - Structural Welding Code - Reinforcing Steel.

L. WRI - Manual of Standard Practice for Welded Wire Fabric.

M. CRSI MSP-1 - Manual of Standard Practice.

1.04 SUBMITTALS

A. Conform to Section 01330 – Submittal Procedures.

B. Shop Drawings:

1. Submit shop drawings detailing reinforcement fabrication, bar placement location, splices, spacing, bar designation, bar type, length, size, bending, number of bars, bar support type and other pertinent information, including dimensions. Provide sufficient detail for placement of reinforcement without use of Contract Drawings. Information shall correspond directly to data listed on bill of materials.

2. Use of reproductions of Contract Drawings by Contractor, Subcontractor, erector, fabricator or material supplier in preparation of shop drawings (or in lieu of preparation of shop drawings) signifies acceptance by that party of information shown thereon as correct, and acceptance of obligation to pay for any job expense, real or implied, arising due to errors that may occur thereon. Remove references to Design Engineer, including seals, when reproductions of Contract Drawings are used as shop drawings.

3. Detail shop drawings in accordance with ACI 315, Figure 6.

4. Submit shop drawings showing location of proposed additional construction joints as required under Section 03301 - Joints in Concrete Structures, and obtain approval of City Engineer, prior to submitting reinforcing steel shop drawings.

C. Bill of Materials: Submit with shop drawings.

D. Product Data:

1. Mechanical Bar Splices: Submit manufacturer's technical literature, including specifications and installation instructions.

2. Epoxy grout proposed for anchoring reinforcing dowels to hardened concrete: Submit manufacturer's technical literature including recommended installation procedures.

E. Certificates:

1. Submit steel manufacturer's certificates of mill tests giving properties of steel proposed for use. List manufacturer's test number, heat number, chemical analysis, yield point, tensile strength and percentage of elongation. Identify proposed location of steel in work.

2. Foreign-manufactured reinforcing bars shall be tested for conformance to ASTM requirements by a certified independent testing laboratory located in United States. Certification from any other source is not acceptable. Submit test reports for review. Do not begin fabrication of reinforcement until material has been approved.

1.05 HANDLING AND STORAGE

A. Store steel reinforcement above ground on platforms, skids or other supports. Protect reinforcing from mechanical injury, surface deterioration and formation of excessive, loose or flaky rust caused by exposure to weather. Protect epoxy-coated reinforcing from formation of any amount of rust.

1.06 QUALITY ASSURANCE

A. Notify City Engineer at least 48 hours before concrete placement so that reinforcement may be inspected, and errors corrected, without delaying Work.

PART 2 P R O D U C T S

2.01 MATERIAL

A. Reinforcing Bars: Deformed bars conforming to ASTM A 615, grade as indicated on Drawings, except column spirals and those shown on

Drawings to be smooth bars. Where grade is not shown on Drawings, use Grade 60.

B. Smooth Bars: Where indicated on Drawings, use smooth bars conforming to ASTM A 36; ASTM A 615, Grade 60; or ASTM A 675, Grade 70.

C. Column Spirals: Bars conforming to ASTM A 615, Grade 60, or wire conforming to ASTM A 82.

D. Epoxy-Coated Deformed Bars, Column Spirals and Smooth Bars: Conform to ASTM A 775/A 775M.

E. Welded Wire Fabric:

1. Welded Smooth Wire Fabric: Conform to ASTM A 185.

2. Welded Deformed Wire Fabric: Conform to ASTM A 497.

3. Provide wire size, type and spacing as shown. Where type is not shown on Drawings, use welded smooth wire fabric.

4. Furnish welded wire fabric in flat sheets only.

F. Tie Wire: 16-1/2 gage or heavier annealed steel wire. Use plastic-coated tie wire with epoxy-coated reinforcing steel.

G. Bar Supports: Provide chairs, riser bars, ties and other accessories made of plastic or metal, except as otherwise specified. Use bar supports and accessories of sizes required to provide required concrete cover. Where concrete surfaces are exposed to weather, water or wastewater, provide plastic accessories only; do not use galvanized or plastic-tipped metal in such locations. Provide metal bar supports and accessories rated Class 1 or 2 conforming to CRSI MSP-1 Manual of Standard Practice. Use epoxy-coated bar supports with epoxy-coated reinforcing bars.

H. Slabs on Grade: Provide chairs with sheet metal bases or provide precast concrete bar supports 3 inches wide, 6 inches long, and thick enough to allow required cover. Embed tie wires in 3-inch by 6-inch side.

I. Mechanical Bar Splices:

1. Conform to ACI 318; use where indicated on Drawings.

a. Compression splices shall develop ultimate stress of reinforcing bar.

b. Tension splices shall develop 125 percent of minimum yield point stress of reinforcing bar.

2. Regardless of chemical composition of steel, any heat effect shall not adversely affect performance of reinforcing bar.

J. Welded Splices:

1. Provide welded splices where shown and where approved by the City Engineer. Welded splices of reinforcing steel shall develop a tensile strength exceeding 125 percent of the yield strength of the reinforcing bars connected.

2. Provide materials for welded splices conforming to AWS D1.4.

K. Epoxy Grout: High-strength rigid epoxy adhesive, conforming to ASTM C 881, Type IV, manufactured for purpose of anchoring dowels into hardened concrete and the moisture condition, application temperature and orientation of the hole to be filled. Unless otherwise shown, depth of embedment shall be as required to develop the full tensile strength (125 percent of yield strength) of dowel, but not less than 12 diameters.

2.02 FABRICATION

A. Bending: Fabricate bars to shapes indicated on Drawings by cold bending. Bends shall conform to minimum bend diameters specified in ACI 318. Do not straighten or rebend bars. Fabricate epoxy-coated reinforcing steel to required shapes in a manner that will not damage epoxy coating. Repair any damaged epoxy coating with patching material conforming to Item 4.4 of ASTM A 775/A 775M.

B. Splices:

1. Locate splices as indicated on Drawings. Do not locate splices at other locations without approval of City Engineer. Use minimum number of splices located at points of minimum stress.

Stagger splices in adjacent bars.

2. Length of lap splices: As shown on Drawings.

3. Prepare ends of bars at mechanical splices in accordance with splice manufacturer's requirements.

C. Construction Joints: Unless otherwise shown, continue reinforcing through construction joints.

D. Bar Fabrication Tolerances: Conform to tolerances listed in ACI 315, Figures 4 and 5.

E. Standard Hooks: Conform to the requirements of ACI 318.

F. Marking: Clearly mark bars with waterproof tags showing number of bars, size, mark, length and yield strength. Mark steel with same designation as member in which it occurs.

PART 3 E X E C U T I O N

3.01 PREPARATION

A. Clean reinforcement of scale, loose or flaky rust and other foreign material, including oil, mud or coating that will reduce bond to concrete.

3.02 INSTALLATION

A. Placement Tolerances: Place reinforcement within tolerances of Table 03210A at the end of this Section. Bend tie wire away from forms to maintain the specified concrete coverage.

B. Interferences: Maintain 2-inch clearance from embedded items. Where reinforcing interferes with location of other reinforcing steel, conduit or embedded items, bars may be moved within specified tolerances or one bar diameter, whichever is greater. Where greater movement of bars is required to avoid interference, notify City Engineer. Do not cut reinforcement to install inserts, conduit, mechanical openings or other items without approval of City Engineer.

C. Concrete Cover: Provide clear cover measured from reinforcement to face of concrete as listed in Table 03211B at the end of this Section, unless otherwise indicated on Drawings.

D. Placement in Forms: Use spacers, chairs, wire ties and other accessory items necessary to assemble, space and support reinforcing properly. Provide accessories of sufficient number, size and strength to prevent deflection or displacement of reinforcement due to construction loads or concrete placement. Use appropriate accessories to position and support bolts, anchors and other embedded items. Tie reinforcing bars at each intersection, and to accessories. Blocking reinforcement with concrete or masonry is prohibited.

E. Placement for Concrete on Ground: Support bar and wire reinforcement on chairs with sheet metal bases or precast concrete blocks spaced at approximately 3 feet on centers each way. Use minimum of one support for each 9 square feet. Tie supports to reinforcing bars and wires.

F. Vertical Reinforcement in Columns: Offset vertical bars by at least one bar diameter at splices. Provide accurate templates for column dowels to ensure proper placement.

G. Splices:

1. Do not splice bars, except at locations indicated on Drawings or reviewed shop drawings, without approval of City Engineer.

2. Lap Splices: Unless otherwise shown or noted, Class B, conforming to ACI 318-89, Section 12.15.1. Tie securely with wire prior to concrete placement, to prevent displacement of splices during concrete placement.

3. Mechanical Bar Splices: Use only where indicated on Drawings or approved by the City Engineer. Install in accordance with manufacturer's instructions.

   a. Couplers located at a joint face shall be of a type which can be set either flush or recessed from the face as shown. Seal couplers prior to concrete placement to completely eliminate concrete or cement paste from entering.

   b. Couplers intended for future connections: Recess 1/2 inch minimum from concrete surface. After concrete is placed, plug

coupler and fill recess with sealant to prevent contact with water or other corrosive materials.

c. Unless noted otherwise, match mechanical coupler spacing and capacity to that shown for the adjacent reinforcing.

H. Construction Joints: Place reinforcing continuous through construction joints, unless noted otherwise.

I. Welded Wire Fabric: Install wire fabric in as long lengths as practicable. Unless otherwise indicated on Drawings, lap adjoining pieces at least 6 inches or one full mesh plus 2 inches, whichever is larger. Lace splices with wire. Do not make end laps midway between supporting beams, or directly over beams of continuous structures. Offset end laps in adjacent widths to prevent continuous laps. Conform to WRI - Manual of Standard Practice for Welded Wire Fabric.

J. Field Bending: Shape reinforcing bent during construction operations to conform to Drawings. Bars shall be cold-bent; do not heat bars. Closely inspect reinforcing for breaks. When reinforcing is damaged, replace, Cadweld, or otherwise repair, as directed by City Engineer. Do not bend reinforcement after it is embedded in concrete.

K. Epoxy-coated Reinforcing Steel: Install in accordance with Paragraph 3.02J, Field Bending, and in a manner that will not damage epoxy coating. Repair damaged epoxy coating with patching material as specified in Paragraph 2.02A, Bending.

L. Field Cutting: Cut reinforcing bars by shearing or sawing. Do not cut bars with cutting torch.

M. Welding of reinforcing bars is prohibited, except where shown on Drawings.

3.03 GROUTING OF REINFORCING AND DOWEL BARS

A. Use epoxy grout for anchoring reinforcing and dowel steel to existing concrete in accordance with epoxy manufacturer's instructions. Drill hole not more than 1/4 inch larger than steel bar diameter (including height of deformations for deformed bars) in existing concrete. Just before installation of steel, blow hole clean of all debris using compressed air. Partially fill hole with epoxy, using enough epoxy so when steel bar is inserted, epoxy grout will completely fill hole around bar. Dip end of steel bar in epoxy and twist bar while inserting into partially-filled hole.

Table 03211A
REINFORCEMENT PLACEMENT TOLERANCES

PLACEMENT	TOLERANCE IN INCHES
Clear Distance -	
To formed soffit:	-1/4
To other formed surfaces:	±1/4
Minimum spacing between bars:	-1/4
Clear distance from unformed surface to top reinforcement -	
Members 8 inches deep or less:	±1/4
Members more than 8 inches deep but less than 24 inches deep:	
Members 24 inches deep or greater:	-1/4, +1/2
Uniform spacing of bars (but the required number of bars shall not be reduced):	-1/4, +1
Uniform spacing of stirrups and ties (but the required number of stirrups and ties shall not be reduced):	±2
	±1
Longitudinal locations of bends and ends of reinforcement -	
General:	±2
Discontinuous ends of members:	±1/2
Length of bar laps:	-1-1/2
Embedded length -	
For bar sizes No. 3 through 11:	-1
For bar sizes No. 14 and 18:	-2

Table 03211B
MINIMUM CONCRETE COVER FOR REINFORCEMENT

SURFACE	MINIMUM COVER IN INCHES
Slabs and Joists -	
Top and bottom bars for dry conditions -	
No. 14 and No. 18 bars:	1-1/2
No. 11 bars and smaller:	1
Formed concrete surfaces exposed to earth, water or weather; over, or in contact with, sewage; and for bottoms bearing on work mat, or slabs supporting earth cover -	
No. 5 bars and smaller:	1-1/2
No. 6 through No. 18 bars:	2
Beams and Columns -	
For dry conditions -	
Stirrups, spirals and ties:	1-1/2
Principal reinforcement:	2
Exposed to earth, water, sewage or weather -	
Stirrups and ties:	2
Principal reinforcement:	2-1/2
Walls -	
For dry conditions -	
No. 11 bars and smaller:	1
No. 14 and No. 18 bars:	1-1/2
Formed concrete surfaces exposed to earth, water, sewage or weather, or in contact with ground -	
Circular tanks with ring tension:	2
All others:	2
Footings and Base Slabs -	
At formed surfaces and bottoms bearing on concrete work mat:	
At unformed surfaces and bottoms in contact with earth:	2
Over top of piles:	3
Top of footings -- same as slabs	2

END OF SECTION

SECTION 03310

STRUCTURAL CONCRETE

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Cast-in-place normal-weight structural concrete and mass concrete.

1.02 UNIT PRICES

A. Measurement for structural concrete is on lump-sum basis for each structure as bid. Payment includes related work performed on these structures in accordance with related sections of these Specifications.

B. Measurement for extra structural concrete is on cubic-yard basis. Payment includes related work performed in accordance with related sections.

C. Refer to Section 01270 - Measurement and Payment for unit price procedures.

1.03 REFERENCES

A. ACI 301 - Specifications for Structural Concrete for Buildings.

B. ACI 304.2R - Placing Concrete by Pumping Methods

C. ACI 305R - Hot Weather Concreting.

D. ACI 306.1 - Standard Specification for Cold Weather Concreting.

E. ACI 309R - Guide for Consolidation of Concrete.

F. ACI 318 - Building Code Requirements for Reinforced Concrete.

G. ACI 350R - Environmental Engineering Concrete Structures.

H. ASTM C 31 - Standard Practice for Making and Curing Concrete Test Specimens in the Field.

I. ASTM C 33 - Standard Specification for Concrete Aggregates.

J. ASTM C 39 - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.

K. ASTM C 42 - Standard Method of Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.

L. ASTM C 88 - Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate.

M. ASTM C 94 - Standard Specifications for Ready-Mixed Concrete.

N. ASTM C 127 - Standard Test Method for Specific Gravity and Absorption of Coarse Aggregate.

O. ASTM C 131 - Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.

P. ASTM C 136 - Sieve Analyses of Fine and Coarse Aggregates.

Q. ASTM C 143 - Standard Test Method for Slump of Hydraulic Cement Concrete.

R. ASTM C 150 - Standard Specification for Portland Cement.

S. ASTM C 157 - Test Method for Length Change of Hardened Hydraulic Cement Mortar and Concrete.

T. ASTM C 172 - Standard Practice for Sampling Freshly Mixed Concrete.

U. ASTM C 173 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.

V. ASTM C 192 - Method of Making and Curing Concrete Test Specimens in the Laboratory.

W. ASTM C 231 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.

X. ASTM C 260 - Standard Specification for Air-Entraining Admixtures for Concrete.

Y. ASTM C 330 - Standard Specification for Lightweight Aggregates for Structural Concrete.

Z. ASTM C 494 - Standard Specification for Chemical Admixtures for Concrete.

AA. ASTM C 535 - Standard Test Method for Resistance to Degradation of Large-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.

AB. ASTM C 567 - Standard Test Method for Unit Weight of Structural Lightweight Concrete.

AC. ASTM C 1064 - Standard Test Method for Temperature of Freshly Mixed Portland Cement Concrete.

AD. Concrete Plant Manufacturer's Bureau (CPMB), Plant Mixer Manufacturers Division: Concrete Plant Mixer Standards.

AE. National Ready-Mixed Concrete Association (NRMCA): Certification of Ready-Mixed Concrete Production Facilities (checklist with instructions).

AF. John Wiley and Sons, Interscience Publishers Division, "Encyclopedia of Industrial Chemical Analysis," Vol. 15, Page 230 (alkalinity test procedure).

1.04 DEFINITIONS

A. Mass Concrete: Concrete sections 4 feet or more in least dimension.

B. Hot Weather: Any combination of high air temperature, low relative humidity and wind velocity tending to impair quality of fresh or hardened concrete or otherwise resulting in abnormal properties.

C. Cold Weather: Period when, for more than 2 successive days, mean daily temperature is below 40 degrees F.

1.05 SUBMITTALS

A. Conform to Section 01330 – Submittal Procedures.

B. Mill Certificates: Required for bulk cement.

C. Design Mixes:

Submit test data on proposed design mixes for each type of concrete in the Work, including each class, and variations in type, source or quantity of material. Include type, brand and amount of cementitious materials; type, brand and amount of each admixture; slump; air content; aggregate sources, gradations, specific gravity and absorption; total water (including moisture in aggregate); water/cement ratio;
compressive strength test results for 7 and 28 days; and shrinkage tests for Class C and D concrete at 21 or 28 days of drying.

1. Submit abrasion loss and soundness test results for limestone aggregate.

2. Testing of aggregates, including sieve analysis, shall be performed by a certified independent testing laboratory. Tests shall have been performed no earlier than 3 months before Notice to Proceed.

3. Provide standard deviation data for plant producing concrete. Data shall include copies of laboratory test results and standard deviation calculated in accordance with ACI 318, Item 5.3.1. Laboratory tests shall have been performed within past 12 months. When standard deviation data is not available, comply with ACI 318, Table 5.3.2.2.

4. Review and acceptance of mix design does not relieve Contractor of responsibility to provide concrete of quality and strength required by these Specifications.

D. Admixtures: Submit manufacturer's technical information, including following:

1. Air-Entraining Admixture: Give requirements to control air content under all conditions, including temperature variations and presence of other admixtures.

2. Chemical Admixtures: Give requirements for quantities and types to be used under various temperatures and job conditions to produce uniform, workable concrete mix. Submit evidence of compatibility with other admixtures and cementitious materials proposed for use in design mix.

E. High-range Water Reducer (Superplasticizer): When proposed for use, submit manufacturer's technical information and instructions for use of

superplasticizer. State whether superplasticizer will be added at ready-mix plant or job site. When superplasticizer will be added at job site, submit proposed plan for measuring and adding superplasticizer to concrete mix at job site, and establish dosing area on site with holding tanks and metering devices. When superplasticizer is to be added at ready-mix plant, submit contingency plans for adding additional superplasticizer at job site when required due to delay in placing concrete. Identify portions of Work on which superplasticizer is proposed for use.

F. Hot and Cold Weather Concreting: Submit, when applicable, proposed plans for hot and cold weather concreting. Review and acceptance of proposed

procedure will not relieve Contractor of responsibility for quality of finished product.

G. Project Record Drawings: Accurately record actual locations of embedded utilities and components which are concealed from view.

1.06 QUALITY ASSURANCE

A. Provide necessary controls during evaluation of materials, mix designs, production and delivery of concrete, placement and compaction to assure that the Work will be accomplished in accordance with Contract Documents. Maintain records of concrete placement. Record dates, locations, quantities, air temperatures, and test samples taken.

B. Code Requirements: Concrete construction for buildings shall conform to ACI 318. Concrete construction for water and wastewater treatment and conveying structures shall conform to ACI 318 with modifications by ACI 350R, Item 2.6. Where this Specification conflicts with ACI 318 or ACI 350R, this Specification governs.

C. Testing and Other Quality Control Services:

1. Concrete testing required in this section, except concrete mix design, limestone aggregate test data, and testing of deficient concrete, will be performed by an independent commercial testing laboratory employed and paid by the City in accordance with Section 01454 - Testing Laboratory Services.

2. Provide material for and cooperate fully with City's testing laboratory technician in obtaining samples for required tests.

3. Standard Services: The following testing and quality control services will be provided by City in accordance with Section 01454, Testing Laboratory Services:

   a. Verification that plant equipment and facilities conform to NRMCA "Certification of Ready-Mix Concrete Production Facilities".

   b. Testing of proposed materials for compliance with this Specification.

   c. Review of proposed mix design submitted by Contractor.

   d. Obtaining production samples of materials at plants or stockpiles during work progress and testing for compliance with this Specification.

   e. Strength testing of concrete according to following procedures:

      (1) Obtaining samples for field test cylinders from every 100 cubic yards and any portion less than 100 cubic yards for each mix design placed each day, according to ASTM C 172, with each sample obtained from a different batch of concrete on a representative, random basis. Selecting test batches by any means other than random numbers chosen before concrete placement begins is not allowed.

      (2) Molding four specimens from each sample according to ASTM C 31, and curing under standard moisture and temperature conditions as specified in Sections 7(a) and (b) of ASTM C 31.

      (3) Testing two specimens at 7 days and two specimens at 28 days according to ASTM C 39, reporting test results averaging strengths of two specimens. However, when one specimen evidences improper sampling, molding or testing, it will be discarded and remaining cylinder considered test result. When high-early-strength concrete is used, specimens will be tested at 3 and 7 days.

f. Air content: For each strength test, determination of air content of normal weight concrete according to ASTM C 231.

g. Slump: For each strength test, and whenever consistency of concrete appears to vary, conducting slump test in accordance with ASTM C 143.

h. Temperature: For each strength test, checking concrete temperature in accordance with ASTM C 1064.

i. Lightweight concrete: For each strength test, or more frequently when requested by Project Manager, determination of air content by ASTM C 567 and unit weight by ASTM C 567.

j. Monitoring of current and forecasted climatic conditions to determine when rate of evaporation, as determined by Figure 2.1.5 of ACI 305R, will produce loss of 0.2 pounds of water, or more, per square foot per hour. Testing lab representative will advise Contractor to use hot weather precautions when such

conditions will exist during concrete placement, and note on concrete test reports when Contractor has been advised that hot weather conditions will exist.

k. Class A and D Concrete Shrinkage Tests: Performance of drying shrinkage tests for trial batches as follows:

(1) Preparation and Testing of Specimens: Compression and drying shrinkage test specimens will be taken in each case from the same concrete sample; shrinkage tests will be considered a part of the normal compression tests for the project. 4-inch by 4-inch by 11-inch prisms with an effective gage length of 10 inches, fabricated, cured, dried and measured in accordance with ASTM C 157, modified as follows:

(a) Wet curing: Remove specimens from molds at an age of 23 hours ±1 hour after trial batching and immediately immerse in water at 70 degrees F ±3 degrees F for at least 30 minutes;

(b) Measure within 30 minutes after first 30 minutes of immersion to determine original length (not to be confused with "base length");

(c) Then submerge in saturated limewater, at 73 degrees F ±3 degrees F, for 7 days;

(d) Then measure at age 7 days to establish "base length" for drying shrinkage calculations ("zero" days drying age);

(e) Calculate expansion (base length expressed as a percentage of original length);

(f) Immediately store specimens in a temperature- and humidity-controlled room maintained at 73 degrees F, ±3 degrees F and 50 percent ±4 percent relative humidity, for the remainder of the test.

(g) Measure to determine shrinkage, expressed as percentage of base length. Compute the drying shrinkage deformation of each specimen as the difference between the base length (at “zero” days drying age) and the length after drying at each test age. Compute the average drying shrinkage deformation of the specimens to the nearest 0.0001 inch at each test age. If the drying shrinkage of any specimen departs from the average of that test age by more than 0.0004 inch, disregard the results obtained from that specimen. Report results of shrinkage tests to the nearest 0.001 percent of shrinkage.

(h) Report shrinkage separately for 7, 14, 21, and 28 days of drying after 7 days of moist curing.

4. Additional Testing and Quality Control Services: The following will be performed by an independent commercial testing laboratory employed and paid by the City in accordance with Section 01454, Testing Laboratory Services, when requested by City Engineer.

   a. Checking of batching and mixing operations.

b. Review of manufacturer's report of each cement shipment and conducting laboratory tests of cement.

c. Molding and testing reserve 7-day cylinders or field cylinders.

d. Conducting additional field tests for slump, concrete temperature and ambient temperature.

e. Alkalinity Tests: For concrete used in sanitary structures, one test for each structure. Perform alkalinity tests on concrete covering reinforcing steel on the inside of the pipe or structure in accordance with "Encyclopedia of Industrial Chemical Analysis," Vol. 15, page 230.

5. Contractor shall provide the following testing and quality control services:

a. Employ an independent commercial testing laboratory, acceptable to City, to prepare and test design mix for each class of concrete for which material source has been changed.

b. Notify commercial testing laboratory employed by City 24 hours prior to placing concrete.

6. Testing of deficient concrete in place:

a. When averages of three consecutive strength test results fail to equal or exceed specified strength, or when any individual strength test result falls below specified strength by more than 500 psi, strength of concrete shall be considered potentially deficient and core testing, structural analysis or load testing may be required by Project Manager.

b. When concrete in place proves to be deficient, Contractor shall pay costs, including costs due to delays, incurred in providing additional testing and analysis services provided by the City Engineer, or the independent commercial testing laboratory selected by the City.

c. Replace concrete work judged inadequate by core tests, structural analysis or load tests at no additional cost to the City.

d. Core Tests:

(1) Obtain and test cores in accordance with ASTM C 42. Where concrete in structure will be dry under service conditions, air dry cores (temperature 60 to 80 degrees F, relative humidity less than 60 percent) for 7 days before test; test dry. Where concrete in structure will be more than superficially wet under service conditions, test cores after moisture conditioning in accordance with ASTM C 42.

(2) Take at least three representative cores from each member or area of concrete in place that is considered potentially deficient. Location of cores shall be determined by Project Manager so as to least impair strength of structure. When, before testing, one or more cores shows evidence of having been damaged during or after removal from structure, replace the damaged cores.

(3) Concrete in area represented by core test will be considered adequate when average strength of cores is equal to at least 85 percent of specified strength, and when no single core is less than 75 percent of specified strength.

(4) Patch core holes in accordance with Section 03350 - Concrete Finishing.

e. Structural Analysis: When core tests are inconclusive or impractical to obtain, Project Manager may perform additional

structural analysis at Contractor's expense to confirm safety of structure.

f. Load Tests: When core tests and structural analysis do not confirm safety of structure, load tests may be required, and their results evaluated, in accordance with ACI 318.

g. Testing by impact hammer, sonoscope, probe penetration tests (Windsor probe), or other nondestructive device may be permitted by Project Manager to determine relative strengths at various locations in structure, to evaluate concrete strength in place, or for selecting areas to be cored. However, such tests,

unless properly calibrated and correlated with other test data, shall not be used as basis for acceptance or rejection of structure's safety.

1.07 STORAGE AND HANDLING OF MATERIALS

A. Cement: Store cement in weathertight buildings, bins or silos to provide protection from dampness and contamination and to minimize warehouse set. When there is any doubt as to expansive potential of shrinkage-compensating cements because of method or length of storage and exposure, laboratory test cement before use.

B. Aggregate: Arrange and use aggregate stockpiles to avoid excessive segregation or contamination with other materials or with other sizes of like aggregates. Build stockpiles in successive horizontal layers not exceeding 3 feet in thickness. Complete each layer before next is started.

C. Fine Aggregate: Before using, allow fine aggregate to drain until uniform moisture content is reached.

D. Admixtures: Store admixtures to avoid contamination, evaporation or damage. For those used in form of suspensions or nonstable solutions, provide suitable agitating equipment to assure uniform distribution of ingredients. Protect liquid admixtures from freezing and other temperature changes which would adversely affect their characteristics.

E. Lightweight Aggregates: Uniformly predampen lightweight aggregates as necessary to prevent excessive variations in moisture content. Allow predampened aggregates to remain in stockpiles, under continuous fog spray, for minimum of 24 hours before use. Provide adequate drainage in stockpile areas to eliminate excess water and accumulation of contaminated fines.

PART 2 P R O D U C T S

2.01 MATERIALS

A. Cement:

1. Use same brand of cement used in concrete mix design. Use only one brand of each type in each structure, unless otherwise indicated on Drawings.

2. Portland Cement: ASTM C 150, Type I or Type II, gray in color. Use Type III only when specifically authorized by City Engineer in writing. Use Type II, including the requirements of Table 2, in construction of liquid-containing structures and cooling towers, unless shown otherwise on Drawings.

B. Admixtures:

1. Do not use calcium chloride, thiocyanate or admixtures containing more than 0.05 percent chloride ions.

2. Air-Entraining Admixtures: ASTM C 260, compatible with other admixtures used.

3. Chemical Admixtures: Polymer type, nonstaining, chloride-free admixtures conforming to ASTM C 494, Type A, C, D or E.

4. High-Range Water Reducer (Superplasticizer): ASTM C 494, Type F or G, compatible with and by the same manufacturer as other admixtures.

C. Mixing Water: Use clean, potable water, free from harmful amounts of oils, acids, alkalis or other deleterious substances, meeting requirements of ASTM C 94.

D. Aggregates: Use coarse aggregate from only one source, and fine aggregate from only one source, for exposed concrete in any single structure.

1. Coarse Aggregate: Gravel, crushed gravel or crushed limestone conforming to ASTM C 33.

2. Fine Aggregate: Natural sand complying with ASTM C 33.

3. Limestone aggregate shall conform to ASTM C 33 and the following additional requirements: Clean, hard, strong and

   durable particles free of chemicals and coatings of silt, clay, or other fine materials that may affect hydration and bond of cement paste. Select crushed limestone: High-calcium limestone (minimum 95 percent $CaCO_3$ and maximum 3.5 percent $MgCO_3$) with maximum Los Angeles Abrasion loss of 38 percent, when tested in accordance with ASTM C 131 or ASTM C 535. Test aggregate for soundness in accordance with ASTM C 88; maximum loss shall not exceed 18 percent after 5 cycles of magnesium sulfate test.

4. Maximum size of coarse aggregate:

   a. Normal weight concrete, except as noted below: 1-1/2 inches.

   b. Formed members 6 inches or less in least dimension: 1/5 least dimension.

   c. Slabs: 1/3 depth of slab.

   d. Drilled shafts: 1/3 clearance between reinforcing steel, but not greater than 3/4 inch.

   e. Concrete fill, seal slabs and bonded concrete topping in clarifiers: 3/8 inch.

5. Coarse aggregate for lightweight concrete: ASTM C 330. Grading limits: 3/4 inch to No. 4.

6. Abrasive Aggregate: Conform to requirements of Section 03350 - Concrete Finishing.

E. Calcium Chloride: Not permitted.

F. Evaporation Retardant: Masterbuilders "Confilm", Euclid "Eucobar", or equal.

G. Miscellaneous Materials:

1. Bonding Agent: Two-component modified epoxy resin.

2. Vapor barrier: 6 mil clear polyethylene film of type recommended for below-grade aplication.

3. Non-shrink grout: premixed compound consisting of non-metallic aggregate, cement and water-reducing and plasticizing

agents; capable of developing minimum compressive strength of 2,400 psi in 48 hours and 7,000 psi in 28 days.

2.02 CONCRETE MIX

A. Objective: Select proportions of ingredients to produce concrete having proper placability, durability, strength, appearance, and other specified properties.

B. Mix Design: Employ and pay an independent commercial testing laboratory, acceptable to City, to prepare and test mix designs for each type of concrete specified. Proportion mix design ingredients by weight. Submit mix designs and test results for approval.

1. During the trial batches, aggregate proportions may be adjusted by the testing laboratory using two coarse aggregate size ranges to obtain the required properties. If one size range produces an acceptable mix, a second size range need not be used. Such adjustments shall be considered refinements to the mix design and shall not be the basis for extra compensation to the Contractor. Concrete shall conform to the requirements of this Section, whether the aggregate proportions are from the Contractor's preliminary mix design, or whether the proportions have been adjusted during the trial batch process. Prepare trial batches using the aggregates, cement and admixtures proposed for the project. Make trial batches large enough to obtain 3 drying shrinkage test specimens and 6 compression test specimens from each batch. Shrinkage testing is required only for Class A and D concrete.

2. Determine compressive strength by testing 6-inch diameter by 12-inch high cylinders, made, cured and tested in accordance with ASTM C 192 and ASTM C 39. Test 3 compression test

cylinders at 7 days and 3 at 28 days. Average compressive strength for the 3 cylinders tested at 28 days for any given trial batch shall be not less than 125 percent of the specified compressive strength.

3. Perform sieve analysis of the combined aggregate for each trial batch according to of ASTM C 136. Report percentage passing each sieve.
4. In mix designs for Class A and D concrete, fine aggregate shall not exceed 41 percent of total aggregate by weight.

C. Shrinkage Limitations, Class A and D Concrete

1. Maximum concrete shrinkage for specimens cast in the laboratory from the trial batch: 0.036 percent as measured at 21-day drying age, or 0.042 percent at 28-day drying age. Use for construction only mix designs that meet trial batch shrinkage requirements. Shrinkage limitations apply only to Class A and D concrete.

2. Maximum concrete shrinkage for specimens cast in the field shall not exceed the trial batch maximum shrinkage requirement by more than 25 percent.

3. If the required shrinkage limitation is not met during construction, take any or all of the following actions, at no additional cost to the City, for securing the specified shrinkage requirements: Changing the source or aggregates, cement or admixtures; reducing water content; washing of aggregate to reduce fines; increasing the number of construction joints; modifying the curing requirements; or other actions designed to minimize shrinkage or its effects.

D. Selecting Ingredient Proportions for Concrete:

1. Proportion concrete mix according to ACI 301, Chapter 3.

2. Establish concrete mix design by laboratory trial batches prepared by independent testing laboratory, or on basis of previous field experience in accordance with provisions of ACI

318, Item 5.3; however, minimum cement content for each class of concrete shall not be less than specified.

3. Concrete mix design data submitted for review shall have average 28-day compressive strength calculated in accordance with ACI 318, Item 5.3.2.1. When data is not available to determine standard deviation in accordance with ACI 318, Item 5.3.1, average 28-day strength of mix design shall conform to ACI 318, Table 5.3.2.2.

E. Water-Cement Ratios:

1. Maximum allowable water-cement ratios shall be as follows:

a. Concrete for liquid-containing structures: 0.45.

b. Concrete subjected to brackish water, salt spray or deicers: 0.40.

c. All other concrete: 0.55.

2. Superplasticizer may be added to maintain specified maximum water-cement ratios. Include free water in aggregate in water-cement ratio computations.

F. Adjustment of Mix Proportions: After sufficient data becomes available during construction, mix may be adjusted upon approval of Project Manager, in accordance with ACI 318, Item 5.5; however, minimum cement content for each class of concrete shall not be less than specified.

G. Entrained Air: Air-entrain all concrete except drilled shafts. Total air content in accordance with ASTM C 173: 4 to 6 percent.

H. Consistency, Workability, and Slump:

1. The quantity of water in a batch of concrete shall be just sufficient, with a normal mixing period, to produce concrete which can be worked properly into place without segregation, and which can be compacted by vibratory methods as specified, to give the desired strength, density, impermeability and smoothness of surface. Change the quantity of water as necessary, with variations in the nature or moisture content of the aggregates, to maintain uniform production of a desired

consistency. Determine the consistency of the concrete in successive batches by slump tests in accordance with ASTM C 143. Slumps shall be as follows:

Concrete Type	Minimum Slump	Maximum Slump
Portland Cement Concrete:	2"	4"
Concrete to be dosed with superplasticizer:	1"	3"
Normal Weight Concrete after dosing with superplasticizer:	4"	9"
Lightweight Concrete after dosing with superplasticizer:	4"	7"
Drilled Shaft Concrete:	4"*	8"

* Minimum slump where drilled shafts are cast in temporary casings: 5 inches.

2. Specified slump shall apply at time when concrete is discharged at job site. Perform slump tests to monitor uniformity and consistency of concrete delivered to job site; however, do not

3. use as basis for mix design. Do not exceed water-cement ratios specified.

I. Admixtures: Proportion admixtures according to manufacturer's recommendations. Use of accelerator is permitted when air temperature is less than 40 degrees F. Use of retarder is permitted when temperature of placed concrete exceeds 65 degrees F.

J. High-Range Water Reducers (Superplasticizers): Use superplasticizer to improve workability of concrete or delay hydration of cement, in accordance with requirements and recommendations of product manufacturer and approved submittals.

K. Concrete Classification and Strength:

1. Strength: Conform to values for class of concrete indicated on Drawings for each portion of Work. Requirements are based on 28-day compressive strength. If high early-strength concrete is allowed, requirements are based on 7-day compressive strength.

2. Classification:

Class (Normal-weight)	Minimum 28-Day Compressive Strength (psi)	Minimum Cement Content Pounds per Cubic Yard	
Concrete for Structures Containing Water or Wastewater			
A	4000	564	(6 Sacks)
B	1500	329	(3-1/2 Sacks)
C	3000	470	(5 Sacks)
D	5000	658	(7 Sacks)
H	3000	611	(6-1/2 Sacks)
Concrete for Buildings, Slabs on Grade and Miscellaneous Structures			
AB	4000	N	ot Applicable
BB	1500	N	ot Applicable
CB	3000	N	ot Applicable
DB	5000	N	ot Applicable

Class (Light-weight)	Minimum 28-Day Compressive Strength (psi)	Minimum Cement Content Pounds per Cubic Yard	
E	3000	N	ot Applicable
F	4000	N	ot Applicable
G	5000	N	ot Applicable

3. Maximum size aggregate for Class H concrete: 3/8 inch. Maximum size aggregate for all other normal-weight concrete: 1-1/2 inches, except as specified in Paragraph 2.01D.4.

4. When required strength is not obtained with minimum cement content as specified, add cement, lower water-cement ratio or provide other aggregates as necessary.

5. In addition to conforming to specified strength, lightweight concrete must be within specified unit weight limits. Maximum air-dry unit weight is 118 pounds per cubic foot; minimum is 110 pounds per cubic foot unless shown otherwise on Drawings. Determine air-dry unit weight in accordance with ASTM C 567. Correlate air-dry unit weight with fresh unit weight of the same concrete as a basis for acceptance during construction.

L. Use of Classes of Concrete:

1. Use classes of concrete as indicated on the Drawings and in other specifications.

2. Liquid-containing structures: If not otherwise indicated, use the following classes for structures containing water or wastewater and for utility applications in the locations described:

   a. Class A: All reinforced concrete and where not otherwise defined.

   b. Class B: Unreinforced concrete used for plugging pipes, seal slabs, thrust blocks and trench dams, unless indicated otherwise.

   c. Class H: Fill and topping. Where concrete fill thickness exceeds 3 inches in the majority of a placement and is not less than 1.5 inches thick, Class A concrete may be used.

3. All other structures: If not otherwise indicated, use the following classes in the locations described:

   a. Class AB: All reinforced concrete and where not otherwise defined.

   b. Class CB: Duct banks; see Section 16402 - Underground Duct Banks for additional requirements.

   c. Class BB: Unreinforced concrete fill under structures.

2.03 MIXING NORMAL WEIGHT CONCRETE

A. Conform to ACI 301, Chapter 7.

B. Ready-Mixed Concrete:

1. Measure, batch, mix and transport ready-mixed concrete according to ASTM C 94. Plant equipment and facilities shall conform to NRMCA "Certification of Ready Mixed Concrete Production Facilities".

2. Provide batch tickets with information specified in ASTM C 94. Deliver batch ticket with concrete and give to City's on-site testing laboratory representative.

C. Batch Mixing at Site:

1. Mix concrete in batch mixer conforming to requirements of CPMB "Concrete Plant Mixer Standards". Use mixer equipped with suitable charging hopper, water storage tank and water measuring device. Batch mixer shall be capable of mixing aggregates, cement and water into uniform mass within specified mixing time, and of discharging mix without segregation. Operate mixer according to rated capacity and recommended revolutions per minute printed on manufacturer's rating plate.

2. Charge batch into mixer so some water will enter before cement and aggregates. Keep water running until one-fourth of specified mixing time has elapsed. Provide controls to prevent discharging until required mixing time has elapsed. When concrete of normal weight is specified, provide controls to prevent addition of water during mixing. Discharge entire batch before mixer is recharged.

3. Mix each batch of 2 cubic yards or less for not less than 1 minute and 30 seconds. Increase minimum mixing time 15 seconds for each additional cubic yard or fraction of cubic yard.

4. Keep mixer clean. Replace pick-up and throw-over blades in drum when they have lost 10 percent of original depth.

D. Admixtures:

1. Charge air-entraining and chemical admixtures into mixer as solution using automatic dispenser or similar metering device. Measure

2. admixture to accuracy within ± 3 percent. Do not use admixtures in powdered form.

3. Two or more admixtures may be used in same concrete, provided that admixtures in combination retain full efficiency and have no deleterious effect on concrete or on properties of each other. Inject admixtures separately during batching sequence.

4. Add retarding admixtures as soon as practicable after addition of cement.

E. Temperature Control:

1. When ambient temperature falls below 40 degrees F, keep as-mixed temperature above 55 degrees F to maintain concrete above minimum placing temperature.

2. When water or aggregate has been heated, combine water with aggregate in mixer before cement is added. Do not add cement to mixtures of water and aggregate when temperature of mixture is greater than 100 degrees F.

3. In hot weather, maintain temperature of concrete below maximum placing temperature. When necessary, temperature may be lowered by cooling ingredients, cooling mixer drum by fog spray, using chilled water or well-crushed ice in whole or part for added water, or arranging delivery sequence so that time of transport and placement does not generate unacceptable temperatures.

4. Submit hot weather and cold weather concreting plans for approval.

2.04 MIXING LIGHTWEIGHT CONCRETE

A. Determining Absorption of Aggregates: Mixing procedures vary according to total absorption by weight of lightweight aggregates. Determine total absorption by weight before predamping in accordance with ASTM C 127.

B. Ten Percent or Less Absorption: Follow same requirements as for mixing normal-weight concrete when preparing concrete made with low-absorptive lightweight aggregates having 10 percent or less total absorption by weight. To be low-absorptive, aggregates must absorb less than 2 percent additional water in first hour after mixing.

C. More Than 10 Percent Absorption: Batch and mix concrete made with lightweight aggregates having more than 10 percent total absorption by weight, as follows:

1. Place approximately 80 percent of mixing water in mixer.

2. If aggregates are pre-dampened, add air-entraining admixture and all aggregates. Mix for minimum of 30 seconds, or 5 to 10 revolutions of truck mixer.

3. When aggregates have not been predampened, mix aggregates and water for minimum of 1 minute and 30 seconds, or 15 to 30 revolutions of truck mixer. Then add air-entraining admixture and mix for additional 30 seconds.

4. Then, in the following sequence, add specified or permitted admixtures (other than air-entraining agent), all cement, and mixing water previously withheld.

5. Complete mixing using procedures for normal-weight concrete.

2.05 MASS CONCRETE

A. Do not use high early-strength cement (Type III) or accelerating admixtures.

B. Use high-range water-reducing admixture (superplasticizer) to minimize water content and cement content.

C. Specified water-reducing retarding admixture may be required to prevent cold joints when placing large quantities of concrete, to permit revibration of concrete, to offset effects of high temperature in concrete or weather, and to reduce maximum temperature or rapid temperature rise.

2.06 EQUIPMENT

A. Select equipment of size and design to ensure continuous flow of concrete at delivery end. Conform to following equipment and operations requirements.

B. Truck mixers, agitators and manner of operation: Conform to ASTM C 94. Use of non-agitating equipment for transporting concrete is not permitted.

C. Belt conveyors: Configure horizontally, or at a slope causing no segregation or loss. Use approved arrangement at discharge end to prevent separation. Discharge long runs without separation into hopper.

D. Chutes: Metal or metal-lined (other than aluminum). Arrange for vertical-to-horizontal slopes not more than 1 to 2 nor less than 1 to 3. Chutes longer than 20 feet or not meeting slope requirements may be used if concrete is discharged into hopper before distribution.

E. Do not use aluminum or aluminum-alloy pipe or chutes for conveying concrete.

PART 3 E X E C U T I O N

3.01 SPECIAL CONSIDERATIONS

A. Concreting Under Water: Not permitted except where shown otherwise on Drawings or approved by City Engineer. When shown or permitted, deposit concrete under water by methods acceptable to the City Engineer so fresh concrete enters mass of previously-placed concrete from within, causing water to be displaced with minimum disturbance at surface of concrete.

B. Protection from Adverse Weather: Unless adequate protection is provided or City Engineer's approval is obtained, do not place concrete during rain, sleet, snow or freezing weather. Do not permit rainwater to increase mixing water or to damage surface finish. If rainfall occurs after placing operations begin, provide adequate covering to protect Work.

3.02 PREPARATION OF SURFACES FOR CONCRETING

A. Earth Surfaces:

1. Under interior slabs on grade, install vapor barrier. Lap joints at least 6 inches and seal watertight with tape, or sealant applied between overlapping edges and ends. repair vapor barrier damaged during placement of reinforcing and inserts with vapor barrier material; lap over damaged areas at least 6 inches and seal watertight.

2. Other Earth Surfaces: Thoroughly wet by sprinkling prior to placing concrete, and keep moist by frequent sprinkling up to time of placing concrete thereon. Remove standing water. Surfaces shall be free from standing water, mud and debris at the time of placing concrete.

B. Construction Joints:

1. Definition: Concrete surfaces upon or against which concrete is to be placed, where the placement of the concrete has been interrupted so that, in the judgment of the Project Manager, new concrete cannot be incorporated integrally with that previously placed.

2. Interruptions: When placing of concrete is to be interrupted long enough for the concrete to take a set, use forms or other means to shape the working face to secure proper union with subsequent work. Make construction joints only where acceptable to the Project Manager.

3. Preparation: Give horizontal joint surfaces a compacted, roughened surface for good bond. Except where the Drawings call for joint surfaces to be coated, clean joint surfaces of laitance, loose or defective concrete and foreign material by hydroblasting or sandblasting (exposing aggregate), roughen surface to expose aggregate to a depth of at least 1/4 inch and wash thoroughly. Remove standing water from the construction joint surface before new concrete is placed.

4. After surfaces have been prepared cover approximately horizontal construction joints with a 3-inch lift of a grout mix consisting of Class A concrete batched without coarse aggregate; place and spread grout uniformly. Place wall concrete on the grout mix immediately thereafter.

C. Set and secure reinforcement, anchor bolts, sleeves, inserts and similar embedded items in the forms where indicated on Contract Drawings, shop drawings and as otherwise required. Obtain Project Manager's acceptance before concrete is placed. Accuracy of placement is the sole responsibility of the Contractor.

D. Place no concrete until at least 4 hours after formwork, inserts, embedded items, reinforcement and surface preparation have been completed and accepted by the Project Manager. Clean surfaces of forms and embedded items that have become encrusted with grout or previously-placed concrete before placing adjacent concrete.

E. Casting New Concrete Against Old**:** Where concrete is to be cast against old concrete (any concrete which is greater than 60 days of age), thoroughly clean and roughen the surface of the old concrete by hydro-blasting or sandblasting (exposing aggregate). Coat joint surface with epoxy bonding

agent following manufacturer's written instructions, unless indicated otherwise. Unless noted otherwise, this provision does not apply to vertical wall joints where waterstop is installed.

F. Protection from Water: Place no concrete in any structure until water entering the space to be filled with concrete has been properly cut off or diverted and carried out of the forms, clear of the work. Deposit no concrete underwater. Do not allow still water to rise on any concrete until concrete has attained its initial set. Do not allow water to flow over the surface of any concrete in a manner and at a velocity that will damage the surface finish of the concrete. Pumping, dewatering and other necessary operations for removing ground water, if required, are subject to Project Manager's review.

G. Corrosion Protection**:** Position and support pipe, conduit, dowels and other ferrous items to be embedded in concrete construction prior to placement of concrete so there is at least a 2 inch clearance between them and any part of

the concrete reinforcement. Do not secure such items in position by wiring or welding them to the reinforcement.

H. Where practicable, provide for openings for pipes, inserts for pipe hangers and brackets, and setting of anchors during placing of concrete.

I. Accurately set anchor bolts and maintain in position with templates while they are being embedded in concrete.

J. Cleaning: Immediately before concrete is placed, thoroughly clean dirt, grease, grout, mortar, loose scale, rust and other foreign substances from surfaces of metalwork to be in contact with concrete.

3.03 HANDLING, TRANSPORTING AND PLACING CONCRETE

A. Conform to applicable requirements of Chapter 8 of ACI 301 and this Section. Use no aluminum materials in conveying concrete.

B. Rejected Work**:** Remove concrete found to be defective or non-conforming in materials or workmanship. Replace rejected concrete with concrete meeting requirements of Contract Documents, at no additional cost to the City.

C. Unauthorized Placement**:** Place no concrete except in the presence of the Project Manager. Notify the Project Manager in writing at least 24 hours before placement of concrete.

D. Placement in Wall Forms**:**

1. Do not drop concrete through reinforcing steel.

2. Do not place concrete in any form so as to leave an accumulation of mortar on form surfaces above the concrete.

3. Pump concrete or use hoppers and, if necessary, vertical ducts of canvas, rubber or metal (other than aluminum) for placing concrete in forms so it reaches the place of final deposit without separation. Free fall of concrete shall not exceed 4 feet below the ends of pump hoses, ducts, chutes or buggies. Uniformly distribute concrete during depositing.

4. Do not displace concrete in forms more than 6 feet in horizontal direction from place where it was originally deposited.

5. Deposit in uniform horizontal layers not deeper than 2 feet; take care to avoid inclined layers or inclined construction joints except where required for sloping members.

6. Place each layer while the previous layer is still soft. Rate of placement shall not exceed 5 feet of vertical rise per hour.

7. Provide sufficient illumination in form interior so concrete at places of deposit is visible from the deck or runway.

E. Conveyors and Chutes**:** Design and arrange ends of chutes, hopper gates and other points of concrete discharge in the conveying, hoisting and placing system so concrete passing from them will not fall separated into whatever receptacle immediately receives it. Conveyors, if used, shall be of a type acceptable to the City Engineer. Do not use chutes longer than 50 feet. Slope chutes so concrete of specified consistency will readily flow. If a conveyor is used, it shall be wiped clean by a device operated in such a manner that none of the mortar adhering to the belt will be wasted. All conveyors and chutes shall be covered.

F. Placement of Slabs**:** In hot or windy weather, conducive to plastic shrinkage cracks, apply evaporation retardant to slab after screeding in accordance with manufacturer's instructions and recommendations. Do not use evaporation retardant to increase water content of the surface cement paste. Place concrete for sloping slabs uniformly from the bottom of the slab to the top, for

the full width of the placement. As work progresses, vibrate and carefully work concrete around slab reinforcement. Screed the slab surface in an up-slope direction.

G. Concrete Temperature**:** When placed, not more than 90 degrees F nor less than 55 degrees F for sections less than 12 inches thick, nor less than 50 degrees for all other sections. Do not heat concrete ingredients to a temperature higher than that necessary to keep the temperature of the mixed concrete, as placed, from falling below the specified minimum temperature. When concrete temperature is 85 degrees F or above, do not exceed 60 minutes between introduction of cement to the aggregates and discharge. When the weather is such that the concrete temperature would exceed 90 degrees F, employ effective means, such as pre-cooling of aggregates and mixing water, using ice or placing at night, as necessary to maintain concrete temperature, as placed, below 90 degrees F.

H. Cold Weather Placement**:** Conform to ACI 306.1 - Standard Specification for Cold Weather Concreting, and the following.

1. Remove snow, ice and frost from surfaces, including reinforcement, against which concrete is to be placed. Before beginning concrete placement, thaw the subgrade to a minimum depth of 6 inches. Warm reinforcement and embedded items to above 32 degrees F prior to concrete placement.

2. Maintain concrete temperature above 50 degrees F for at least 3 days after placement.

3.04 PUMPING OF CONCRETE

A. If pumped concrete does not produce satisfactory results, in the judgment of the Project Manager, discontinue pumping operations and proceed with the placing of concrete using conventional methods.

B. Pumping Equipment**:** Use a 2-cylinder pump designed to operate with only one cylinder if one is not functioning, or have a standby pump on site during pumping.

C. The minimum hose (conduit) diameter: Comply with ACI 304.2R.

D. Replace pumping equipment and hoses (conduits) that do not function properly.

E. Do not use aluminum conduits for conveying concrete.

F. Field Control**:** Take samples for slump, air content and test cylinders at the placement (discharge) end of the line.

3.05 CONCRETE PLACEMENT SEQUENCE

A. Place concrete in a sequence acceptable to the Project Manager. To minimize effects of shrinkage, place concrete in units bounded by construction joints shown. Place alternate units so each unit placed has cured at least 7 days for hydraulic structures, or 3 days for other structures, before contiguous unit or units are placed, except do not place corner sections of vertical walls until the 2 adjacent wall panels have cured at least 14 days for hydraulic structures and 7 days for other structures.

B. Level the concrete surface whenever a run of concrete is stopped. To ensure straight and level joints on the exposed surface of walls, tack a wood strip at least 3/4-inch thick to the forms on these surfaces. Carry concrete about 1/2 inch above the underside of the strip. About one hour after concrete is placed, remove the strip, level irregularities in the edge formed by the strip with a trowel and remove laitance.

3.06 TAMPING AND VIBRATING

A. Thoroughly settle and compact concrete throughout the entire depth of the layer being consolidated, into a dense, homogeneous mass; fill corners and angles, thoroughly embed reinforcement, eliminate rock pockets and bring only a slight excess of water to the exposed surface of concrete during placement. Use ACI 309R Group 3 immersion-type high-speed power vibrators (8,000 to 12,000 rpm) in sufficient number and with sufficient (at least one) standby units. Use Group 2 vibrators only when accepted by the City Engineer for specific locations.

B. Use care in placing concrete around waterstops. Carefully work concrete by rodding and vibrating to make sure air and rock pockets have been eliminated. Where flat-strip type waterstops are placed horizontally, work concrete under waterstops by hand, making sure air and rock pockets have been eliminated. Give concrete surrounding the waterstops additional vibration beyond that used for adjacent concrete placement to assure complete embedment of waterstops in concrete.

C. Concrete in Walls: Internally vibrate, ram, stir, or work with suitable appliances, tamping bars, shovels or forked tools until concrete completely fills forms or excavations and closes snugly against all surfaces. Do not place subsequent layers of concrete until previously-placed layers have been so worked. Provide vibrators in sufficient numbers, with standby units as required, to accomplish the results specified within 15 minutes after concrete of specified consistency is placed in the forms. Keep vibrating heads from contact with form surfaces. Take care not to vibrate concrete excessively or to work it in any manner that causes segregation of its constituents.

3.07 PLACING MASS CONCRETE

A. Observe the following additional restrictions when placing mass concrete.

1. Use specified superplasticizer.

2. Maximum temperature of concrete when deposited: 70 degrees F.

3. Place in lifts approximately 18 inches thick. Extend vibrator heads into previously-placed layer.

3.08 REPAIRING SURFACE DEFECTS AND FINISHING

A. Conform to Section 03350 - Concrete Finishing.

3.09 CURING

A. Conform to Section 03390 - Concrete Curing.

3.10 PROTECTION

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

B. Protect fresh concrete from damage due to rain, hail, sleet or snow. Provide such protection while the concrete is still plastic and whenever such precipitation is imminent or occurring.

C. Do not backfill around concrete structures or subject them to design loadings until all components of the structure needed to resist the loading are complete and have reached the specified 28-day compressive strength, except as authorized otherwise by the City Engineer.

END OF SECTION

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SECTION 03350

CONCRETE FINISHING

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Repairing surface defects.

B. Finishing concrete surfaces including both formed and unformed surfaces.

C. Sealing concrete surfaces.

D. Installation of concrete fill and installation of concrete topping in bottoms of clarifiers and thickeners.

1.02 UNIT PRICES

A. No separate payment will be made for concrete finishing under this Section. Include payment in unit price for structural concrete.

1.03 REFERENCES

A. ASTM C 144 - Standard Specification for Aggregate for Masonry Mortar.

B. ASTM C 881 - Specification for Epoxy-Resin-Base Bonding Systems for Concrete.

C. ASTM C 1059 - Standard Specification for Latex Agents for Bonding Fresh to Hardened Concrete.

D. ASTM D 4587 - Conducting Tests on Paint and Related Coatings and Materials Using a Fluorescent UV-Condensation Light-and Water-Exposure Apparatus.

E. ASTM E 1155 - Standard Test Method for Determining Floor Flatness and Levelness Using the F Number System.

1.04 SUBMITTALS

A. Conform to Section 01330 - Submittal Procedures

B. Submit manufacturer's technical literature on the following products proposed for use. Include manufacturer's installation and application instructions and, where specified, manufacturer's certification of conformance to requirements and suitability for use in the applications indicated.

1. Floor hardener.

2. Sealer.

3. Epoxy floor topping.

4. Epoxy penetrating sealer.

5. Latex bonding agent.

6. Epoxy adhesive.

7. Abrasive aggregate.

8. Evaporation retardant.

PART 2 P R O D U C T S

2.01 MATERIALS

A. Sealer/Dustproofer (VOC Compliant): Water-based acrylic sealer; non-yellowing under ultraviolet light after 200-hour test in accordance with ASTM D 4587. Conform to local, state and federal solvent emission requirements.

B. Epoxy Floor Topping: Two-component epoxy resin meeting ASTM C 881 Type III, resistant to wear, staining and chemical attack, blended with granite, sand, trap rock or quartz aggregate, trowel-applied over concrete floor. Topping thickness, 1/8 inch; color, gray.

C. Abrasive Aggregate for Nonslip Finish: Fused aluminum oxide grit, or crushed emery aggregate containing not less than 40 percent aluminum oxide and not less than 25 percent ferric oxide. Material shall be factory graded, packaged, rustproof and nonglazing, and unaffected by freezing, moisture and cleaning materials.

D. Epoxy Penetrating Sealer: Low-viscosity, two-component epoxy system designed to give maximum penetration into concrete surfaces. Sealer shall completely seal concrete surfaces from penetration of water, oil and chemicals; prevent dusting and deterioration of concrete surfaces caused by heavy traffic; and be capable of adhering to floor surfaces subject to hydrostatic pressure from below. Color, transparent amber or gray; surface, nonslip.

E. Latex Bonding Agent: Non-redispersable latex base liquid conforming to ASTM C 1059. When used in water and wastewater treatment structures, bonding agent shall be suitable for use under continuously submerged conditions. Conformance and suitability certification by manufacturer is required.

F. Bonding Grout: Prepare bonding grout by mixing approximately one part cement to one part fine sand meeting ASTM C 144 but with 100 percent passing No. 30 mesh sieve. Mix with water to consistency of thick cream. At Contractor's option, a commercially-prepared bonding agent used in accordance with manufacturer's recommendations and instructions may be used. When used in water and wastewater treatment structures, bonding agent shall be suitable for use under continuously submerged conditions. Conformance and suitability certification by manufacturer is required. Submit manufacturer's technical information on proposed bonding agent.

G. Patching Mortar:

1. Make patching mortar of same materials and of approximately same proportions as concrete, except omit coarse aggregate. Substitute white Portland cement for part of gray Portland cement on exposed concrete in order to match color of surrounding concrete. Determine color by making trial patch. Use minimum amount of mixing water required for handling and placing. Mix patching mortar in advance and allow to stand. Mix frequently with trowel until it has reached stiffest consistency that will permit placing. Do not add water.

2. Proprietary compounds for adhesion or specially formulated cementitious repair mortars may be used in lieu of or in addition to foregoing patching materials provided that properties of bond and compressive strength meet or exceed the foregoing and color of surrounding concrete can be matched where required. Use such compounds according to manufacturer's recommendations. When used in water and wastewater treatment structures, material shall be

suitable for use under continuously submerged conditions. Conformance and suitability certification by manufacturer is required.

H. Epoxy Adhesive: Two-component, 100 percent solids, 100 percent reactive compound developing 100 percent of strength of concrete, suitable for use on dry or damp surfaces. Epoxy used to inject cracks and as a binder in epoxy mortar shall meet ASTM C 881, Type VI. Epoxy used as a bonding agent for fresh concrete shall meet ASTM C 881, Type V.

I. Non-shrink Grout: See Section 03600 - Structural Grout.

J. Spray-Applied Coating: Acceptable products are Thoro System Products "Thoroseal Plaster Mix" or equal. Color: Gray.

K. Concrete Topping: Class H concrete with 3/8-inch maximum coarse aggregate size, as specified in Section 03310 - Structural Concrete.

L. Concrete Fill: Class H concrete with 3/8-inch maximum coarse aggregate size, (Class C where fill thickness exceeds 3 inches throughout a placement), as specified in Section 03310 - Structural Concrete.

M. Evaporation Retardant: Confilm, manufactured by Master Builders; Eucobar, manufactured by Euclid Chemical Company; or equal.

PART 3 E X E C U T I O N

3.01 AGGREGATE CONCEALMENT

A. Unless indicated otherwise on Drawings or approved by City Engineer, all surfaces to be finished shall be free of exposed aggregate.

3.02 REPAIRING SURFACE DEFECTS

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

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

B. Tie Holes: Patch holes immediately after removal of forms. After cleaning and roughening with a wire brush on a rotary drill, thoroughly dampen tie hole and fill solid with patching mortar. Taper tie holes shall have the plug, specified in Section 03100 - Concrete Formwork, driven into the hole to the center of the wall before grouting. Completely fill taper tie holes with patching mortar except that non-shrink grout shall be used for all walls in contact with soil or liquid. On wall faces exposed to view, fill the outer 2 inches of the taper tie hole with patching mortar blended to match adjacent concrete.

C. Cracks: Repair cracks in excess of 0.01 inch by pressure injection of moisture-insensitive epoxy-resin system. Submit proposed material and method of repair for approval prior to making repairs.

D. Structural Repair: When required, make structural repairs after prior approval of City Engineer as to method and procedure, using specified epoxy adhesive or approved epoxy mortar.

3.03 FINISHING OF FORMED SURFACES

A. Unfinished Surfaces: Finish is not required on surfaces concealed from view in completed structure by earth, ceilings or similar cover, unless indicated otherwise on Drawings.

B. Rough Form Finish:

1. No form facing material is required on rough form finish surfaces.

2. Patch tie holes and defects. Chip off fins exceeding 1/4 inch in height.

3. Rough form finish may be used on concrete surfaces which will be concealed from view by earth in completed structure, except concealed surfaces required to have smooth form finish, as shown on Drawings.

C. Smooth Form Finish:

1. Form facing shall produce smooth, hard, uniform texture on concrete. Use plywood or fiberboard linings or forms in as large sheets as practicable, and with smooth, even edges and close joints.

2. Patch tie holes and defects. Rub fins and joint marks with wooden blocks to leave smooth, unmarred finished surface.

3. Provide smooth form finish on the wet face of formed surfaces of water-holding structures, and of other formed surfaces not concealed from view by earth in completed structure, except where otherwise indicated on Drawings. Walls that will be exposed after future construction, at locations indicated on Drawings, shall have smooth form finish. Smooth form finish on exterior face of exterior walls shall extend 2 feet below final top of ground elevation. Exterior face of all perimeter grade beams shall have smooth form finish for full depth of grade beam.

D. Rubbed Finish:

1. Use plywood or fiberboard linings or forms in as large sheets as practicable, and with smooth, even edges and close joints.

2. Remove forms as soon as practicable, repair defects, wet surfaces, and rub with No. 16 carborundum stone or similar abrasive. Continue rubbing sufficiently to bring surface paste, remove form marks and fins, and produce smooth, dense surface of uniform color and texture. Do not use cement paste other than that drawn from concrete itself. Spread paste uniformly over surface with brush. Allow paste to reset, then wash surface with clean water.

3. Use rubbed finish at locations indicated on Drawings, except where rubbed finish is indicated for a wall which will be containing a liquid, use spray-applied coating.

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

F. Related Unformed Surfaces: Tops of piers, walls, bent caps, and similar unformed surfaces occurring adjacent to formed surfaces shall be struck

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

3.04 HOT WEATHER FINISHING

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

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

A. Apply Class A, B, and C finishes at locations indicated on Drawings.

B. Shaping to Contour: Use strike-off templates or approved compacting-type screeds riding on screed strips or edge forms to bring concrete surface to proper contour. See Section 03100 - Concrete Formwork for edge forms and screeds.

C. Consolidation and Leveling: Concrete to be consolidated shall be as stiff as practicable. Thoroughly consolidate concrete in slabs and use internal vibration in beams and girders of framed slabs and along bulkheads of slabs on grade. Consolidate and level slabs and floors with vibrating bridge screeds, roller pipe screeds or other approved means. After consolidation and leveling, do not permit manipulation of surfaces prior to finishing operations.

D. Tolerances for Finished Surfaces: Check tolerances by placing straightedge of specified length anywhere on slab. Gap between slab and straightedge shall not exceed tolerance listed for specified class.

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

E. Raked Finish: After concrete has been placed, struck off, consolidated and leveled to Class C tolerance, roughen surface before final set. Roughen with stiff brushes or rakes to depth of approximately 1/4 inch. Notify City Engineer prior to placing concrete requiring initial raked surface finish so that acceptable raked finish standard may be established for project. Protect

raked, base-slab finish from contamination until time of topping. Provide raked finish for following:

1. Surfaces to receive bonded concrete topping or fill.

2. Steep ramps, as noted on Drawings.

3. Additional locations as noted on Drawings.

F. Float Finish:

1. After concrete has been placed, struck off, consolidated and leveled, do not work further until ready for floating. Begin floating when water sheen has disappeared, or when mix has stiffened sufficiently to permit proper operation of power-driven float. Consolidate surface with power-driven floats. Use hand floating with wood or cork-faced floats in locations inaccessible to power-driven machine and on small, isolated slabs.

2. After initial floating, re-check tolerance of surface with 10-foot straightedge applied at not less than two different angles. Cut down high spots and fill low spots to Class B tolerance. Immediately re-float slab to a uniform, smooth, granular texture.

3. Provide float finish at locations not otherwise specified and not otherwise indicated on Drawings.

G. Trowel Finish:

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

2. Produce finished surface free of trowel marks, uniform in texture and appearance and conforming to Class A tolerance. On surfaces intended to support floor coverings, remove defects which might show through covering by grinding.

3. Provide trowel finish for floors which will receive floor covering and additional locations indicated on Drawings.

H. Broom or Belt Finish:

1. Apply float finish as previously specified. Immediately after completing floated finish, draw broom or burlap belt across surface to give coarse transverse scored texture.

2. Provide broom or belt finish at locations indicated on Drawings.

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

A. Shaping to Contour: Use strike-off templates or approved compacting-type screeds riding on screed strips or edge forms to bring concrete surface to proper contour. Edge forms and screeds: Conform to Section 03100 - Concrete Formwork.

B. Consolidation and Leveling: Concrete to be consolidated shall be as dry as practicable. Thoroughly consolidate concrete in slabs and use internal vibration in beams and girders of framed slabs and along bulkheads of slabs on grade. Consolidate and level slabs and floors with vibrating bridge screeds, roller pipe screeds or other approved means. After consolidation and leveling, do not manipulate surfaces prior to finishing operations.

C. Tolerances for Finished Surfaces: Independent testing laboratory will check floor flatness and levelness in accordance with Paragraph 3.12, Field Quality Control.

D. Float Finish:

1. After concrete has been placed, struck off, consolidated and leveled, do not work further until ready for floating. Begin floating when water sheen has disappeared, or when mix has stiffened sufficiently to permit proper operation of power-driven float. Consolidate surface with power-driven floats. Use hand floating with wood or cork-faced floats in locations inaccessible to power-driven machine and on small, isolated slabs.

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

3. Provide "F-Number System" float finish at locations indicated on Drawings.

E. Trowel Finish:

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

2. Produce finished surface free of trowel marks, uniform in texture and appearance and conforming to an F_F25/F_L20 tolerance for slabs on grade and F_F25/F_L17 for elevated slabs, unless shown otherwise on Drawings. On surfaces intended to support floor coverings, remove defects, which might show through covering, by grinding.

3. Provide "F-Number System" trowel finish at locations indicated on Drawings.

3.07 BONDED CONCRETE TOPPING AND FILL

A. Surface Preparation:

1. Protect raked, base-slab finish from contamination until time of topping. Mechanically remove oil, grease, asphalt, paint, clay stains or other contaminants, leaving clean surface.

2. Prior to placement of topping or fill, thoroughly dampen roughened slab surface and leave free of standing water. Immediately before topping or fill is placed, scrub coat of bonding grout into surface. Do not allow grout to set or dry before topping or fill is placed.

B. Concrete Fill:

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

2. Apply wood float finish to surfaces of concrete fill.

3. Provide concrete fill at locations shown on Drawings.

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

1. Minimum thickness of concrete topping: 1 inch. Maximum thickness when swept in by clarifier and thickener equipment: 3 inches.

2. Compact topping and fill by rolling or tamping, bring to established grade, and float. Topping grout placed on sloping slabs shall proceed uniformly from the bottom of the slab to the top, for the full width of the placement. Coat surface with evaporation retardant as needed between finishing operations to prevent plastic shrinkage cracks.

3. Screed topping to true surface using installed equipment. Protect equipment from damage during sweeping-in process. Perform sweeping-in process under supervision of equipment manufacturer's factory representative. After topping has been screeded, apply wood float finish. During finishing, do not apply water, dry cement or mixture of dry cement and sand to the surface.

4. As soon as topping or fill finishing is completed, coat surface with curing compound. After the topping is set and sufficiently hard in clarifiers and where required by the City Engineer, fill the tank with sufficient water to cover the entire floor for 14 days.

5. Provide bonded concrete topping in bottom of all clarifiers and thickeners.

3.08 EPOXY PENETRATING SEALER

A. Surfaces to receive epoxy penetrating sealer: Apply wood float finish. Clean surface and apply sealer in compliance with manufacturer's instructions.

B. Rooms with concrete curbs or bases: Continue application of floor coating on curb or base to its juncture with masonry wall. Rooms with solid concrete walls or wainscots: Apply minimum 2-inch-high coverage of floor coating on vertical surface.

C. Mask walls, doors, frames and similar surface to prevent floor coating contact.

D. When coving floor coating up vertical concrete walls, curbs, bases or wainscots, use masking tape or other suitable material to keep a neat level edge at top of cove.

E. Provide epoxy penetrating sealer at locations indicated on Drawings.

3.09 EPOXY FLOOR TOPPING

A. Surfaces to receive epoxy floor topping: Apply wood float finish unless recommended otherwise by epoxy floor topping manufacturer. Clean surface and apply epoxy floor topping in compliance with manufacturer's recommendations and instructions. Thickness of topping: 1/8 inch.

B. Rooms with concrete curbs or bases: Continue application of floor coating on curb or base to its juncture with masonry wall. Rooms with solid concrete walls or wainscots: apply 2-inch-high coverage of floor coating on vertical surface.

C. Mask walls, doors, frames and similar surfaces to prevent floor coating contact.

D. When coving floor coating up vertical concrete walls, curbs, bases or wainscots, use masking tape or other suitable material to keep a neat level edge at top of cove.

E. Finished surface shall be free of trowel marks and dimples.

F. Provide epoxy floor topping at locations indicated on Drawings.

3.10 SEALER/DUSTPROOFER

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

3.11 NONSLIP FINISH

A. Apply float finish as specified. Apply two-thirds of required abrasive aggregate by method that ensures even coverage without segregation and re-float. Apply remainder of abrasive aggregate at right angles to first application, using heavier application of aggregate in areas not sufficiently covered by first application. Re-float after second application of aggregate

and complete operations with troweled finish. Perform finishing operations in a manner that will allow the abrasive aggregate to be exposed and not covered with cement paste.

B. Provide nonslip finish at locations indicated on Drawings.

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3.12 FIELD QUALITY CONTROL

A. Flatness and levelness of slabs and similar flat surfaces that are indicated on Drawings to receive "F-Number System" finish will be checked by independent testing laboratory employed by City in accordance with Section 01454 - Testing Laboratory Services.

B. Tolerances for "F-Number System" finished surfaces:

1. Floor tolerance shall be determined in accordance with ASTM E 1155.

2. Floor flatness and levelness tolerances:

a. F_F defines maximum floor curvature allowed over 24 inches. Computed on the basis of successive 12-inch elevation differentials, F_F is commonly referred to as the "flatness F-Number."

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

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

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

3. Achieve specified overall slab tolerance. Minimum local tolerance (1/2 bay, unless otherwise designated by City Engineer): 2/3 of specified tolerance.

4. Tolerance for floated finish: F_F20/F_L17, unless otherwise shown on Drawings.

5. Tolerance for troweled finish: F_F25/F_L20 for slabs on grade, and F_F25/F_L17 for elevated slabs, unless otherwise shown on Drawings.

3.13 CURING

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

END OF SECTION

Section 03390

CONCRETE CURING

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Curing of structural concrete.

1.02 UNIT PRICES

A. No separate payment will be made for concrete curing under this Section. Include payment in unit price for structural concrete.

1.03 REFERENCES

A. ACI 308 - Standard Practice for Curing Concrete.

B. ASTM C 171 - Standard Specifications for Sheet Materials for Curing Concrete.

C. ASTM C 309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.

D. ASTM D 44587 - Conducting Tests on Paint and Related Coatings and Materials Using a Fluorescent UV-Condensation Light-and Water-Exposure Apparatus.

1.04 DEFINITIONS

A. Mass Concrete: Concrete sections 4 feet or more in least dimension.

1.05 SUBMITTALS

A. Conform to Section 01330 - Submittal Procedures.

B. Product Data: Submit description of proposed curing method for concrete. When use of membrane-forming compound is proposed, submit manufacturer's technical information including material specifications, installation instructions and recommendations, and evidence that compound is satisfactory for intended application. State locations where curing compound will be used.

C. When membrane-forming compounds are to be used, submit certification by the manufacturer of compliance with specified requirements and compatibility with toppings, coatings, finishes, and adhesives to be applied.

PART 2 P R O D U C T S

2.01 MATERIALS

A. Membrane-forming Curing Compound: Conform to ASTM C 309, Type 1D, and following requirements.

1. Minimum solids content: 30 percent.

2. Compound shall not permanently discolor concrete. When used for liquid- containing structures, curing compound shall be white-pigmented.

3. When used in areas that are to be coated, or that will receive topping or floor covering, material shall not reduce bond of coating, topping, or floor covering to concrete. Curing compound manufacturer's technical information shall state conditions under which compound will not prevent bond.

4. Conform to local, state and federal solvent emission requirements.

B. Clear Curing and Sealing Compound (VOC Compliant): Conform to ASTM C 309, Type 1, Class B, and the following requirements: 30 percent solids content minimum; non-yellowing under ultraviolet light after 500-hour test in accordance with ASTM D 4587. Sodium silicate compounds are not permitted. Conform to local, state and federal solvent emission requirements.

C. Sheet Material for Curing Concrete: ASTM C 171; waterproof paper, polyethylene film or white burlap-polyethylene sheeting.

D. Curing Mats (for use in Curing Method 2): Heavy shag rugs or carpets, or cotton mats quilted at 4 inches on center; 12 ounce per square yard minimum weight when dry.

E. Water for curing: Clean and potable.

PART 3 E X E C U T I O N

3.01 CURING PROCEDURES

A. Comply with ACI 308 and the requirements specified herein. Protect freshly-deposited concrete from premature drying and excessively hot or cold temperatures. Maintain minimal moisture loss and relatively constant temperature during time necessary for hydration of cement and proper hardening of concrete.

B. Unformed Surfaces: For concrete surfaces not in contact with forms, use one of following procedures immediately after completion of placement and finishing.

1. Ponding or continuous sprinkling.

2. Absorptive mat or fabric kept continuously wet.

3. Sand or other covering kept continuously wet.

4. Continuous steam bath (not exceeding 150 degrees F at surface of concrete).

5. Vapor mist bath.

6. Membrane-forming curing compound applied according to manufacturer's recommendations. After the curing compound has dried, wet slab surfaces and cover with waterproof paper, polyethylene film, or white burlap-polyethylene sheeting after the application of the curing compound. Tape sheet seams together and provide sufficient weights to keep the sheeting in place. Wet the slab surface again if the sheeting becomes dislodged, and replace the sheeting.

7. Other moisture-retaining coverings as approved by City Engineer.

C. Restrictions on Use of Curing Compounds: Unless curing compound manufacturer certifies that curing compound will not prevent bond to cured surface, do not use curing compound on surfaces that will be rubbed or receive additional concrete, mortar, topping, terrazzo or other cementitious finishing materials, on slabs under resilient floors or built-up roofing, or on surfaces to be waterproofed, sealed, hardened or painted.

D. Curing and Sealing Compounds: At locations indicated, cure exposed interior slabs and troweled slabs receiving mastic-applied adhesives with specified clear curing and sealing compound in accordance with manufacturer's recommendations. Do not store materials directly on curing membranes. Use plywood to protect curing membrane from damage. Immediately repair membranes damaged by foot traffic or other operations.

E. Duration of Curing: Continue curing until cumulative number of days or fractions of days during which ambient temperature is above 50 degrees F has totaled 7. Continue curing of water-retaining structures for a total of 14 days. When high-early-strength concrete has been used, continue curing for total of 3 days. Prevent rapid drying at end of curing period.

F. Formed Surfaces: During the curing period keep wet steel forms heated by sun and wood forms in contact with concrete. When forms are to be removed during curing period, employ curing materials or methods immediately. Continue such curing for remainder of curing period.

G. Temperature:

1. Cold Weather. When mean daily temperature of atmosphere is less than 40 degrees F, maintain temperature of concrete between 50 and 70 degrees F for required curing period. When necessary, make arrangements for heating, covering, insulating or housing concrete work in advance of placement to maintain required temperature and moisture conditions. Prevent damage or injury due to concentration of heat. When combustion heaters are necessary in enclosed or protected area where concrete slabs are being placed, vent heaters.

2. Hot Weather. In advance of placement make arrangements for shading, fog spraying, sprinkling, ponding or installation of windbreaks or wet covering of light color. Take such protective measures as quickly as concrete hardening and finishing operations will allow.

3. Temperature Changes. Control so rate of change in temperature of concrete is as uniform as possible. Do not permit temperature change to exceed 5 degrees F in any one hour or 50 degrees F in any 24-hour period.

H. Protection from Mechanical Injury. During curing period, protect concrete from damaging mechanical disturbances, particularly load stresses, heavy shock, and excessive vibration. Protect finished concrete surfaces from damage caused by construction equipment, materials or methods, and by rain or running water. Do not load self-supporting structures in a way that over stresses concrete.

3.02 CURING MASS CONCRETE

A. Observe the following additional restrictions when curing mass concrete.

1. Minimum curing period: 2 weeks.

2. When ambient air temperature falls below 32 degrees F, protect surface of concrete against freezing.

3. Do not use steam or other curing methods that will add heat to concrete.

4. Keep forms and exposed concrete continuously wet for at least the first 48 hours after placing, and whenever surrounding air temperature is above 90 degrees F during final curing period.

5. During 2-week curing period, provide necessary controls to prevent ambient air temperature immediately adjacent to concrete from falling more than 30 degrees F in 24 hours.

END OF SECTION

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Section 03600

STRUCTURAL GROUT

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Non-shrink grout used wherever grout is shown in the Documents, unless another type is specifically referenced. Two classes of non-shrink grout (Class I and II) and areas of application are specified.

1.02 UNIT PRICES

A. Include the cost for grout in the lump sum for each structure in which it will be used. No separate payment will be made for grout.

B. Measurement for extra grout (Class I and II) is on cubic foot basis. Payment includes associated work performed in accordance with related sections included in the Contract Documents.

C. Refer to Section 01270 - Measurement and Payment for unit price procedures.

1.03 REFERENCES

A. CRD C 621 - Corps of Engineers Specification for Non-shrink Grout

B. ASTM C 109 - Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in or 50-mm Cube Specimens)

C. ASTM C 230 - Specifications for Flow Table for use in Tests of Hydraulic Cement

D. ASTM C 1107 - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Non-shrink)

1.04 SUBMITTALS

A. Conform to Section 01330 - Submittal Procedures.

B. Quality Control:

1. The Contractor shall submit manufacturer's literature certifying compliance with the specified properties for Class I and II grouts.

2. The Contractor shall submit manufacturer's literature containing instructions and recommendations on the mixing, handling, placement and appropriate uses for each type of grout used in the work.

C. The Contractor shall submit manufacturer's written warranty as specified.

1.05 QUALITY ASSURANCE

A. Field Tests:

1. Compression test specimens will be taken during construction from the first placement of each type of grout, and at intervals thereafter as selected by the Project Manager to ensure continued compliance with these Specifications. The specimens will be made by the Project Manager or its representative.

2. Compression tests and fabrication of specimens for non-shrink grout will be performed as specified in ASTM C 109 at intervals during construction as selected by the Project Manager. A set of three specimens will be made for testing at 7 days, 28 days, and each additional time period as appropriate.

3. Grout already placed which fails to meet the requirements of these Specifications is subject to removal and replacement no additional cost to the City.

4. The cost of laboratory tests on grout will be borne by the City, but the Contractor shall assist the Project Manager in obtaining specimens for testing. However, the Contractor shall be charged for the cost of any additional tests and investigation on work performed which does not meet the Specifications. The Contractor shall supply materials necessary for fabricating the test specimens.

B. Warranty:

1. Provide one-year warranty for work provided under this Section.

2. Manufacturer's warranty shall not contain a disclaimer limiting responsibility to only the purchase price of products or materials furnished.

3. Manufacturer shall warrant participation with Contractor in replacing or repairing grout found to be defective due to faulty materials, as determined by industry standard test methods.

PART 2 P R O D U C T S

2.01 APPLICATION

A. The following is a listing of typical applications and the corresponding type of grout which is to be used. Unless indicated otherwise, grouts shall be provided as listed below whether or not called for on the Drawings.

Application:	Type of Grout
Structural member base plates	Non-shrink Class II
Storage tanks and other equipment	
Filling blockout spaces for embedded items such as railing posts, gate guide frames, etc.	
Under precast concrete elements	
Toppings and concrete fill less than 3 inches thick	
Application:	Type of Grout
Toppings and concrete fill greater than 3 inches thick	Non-shrink Class II
Any application not listed above, where grout is called for on the Drawings	

Non-shrink Class I
Non-shrink Class II (Class I where placement time exceeds 15 minutes) Non-shrink Class I
Concrete Topping per Section 03310 and Section 03350

Type of Grout
Concrete Fill per Section 03310 and Section 03350
Non-shrink Class I, unless noted otherwise

2.02 PREPACKAGED GROUTS

A. Basic Requirements for Cementitious Non-Shrink Grout

1. Provide prepackaged non-shrink grout that is inorganic, flowable, non-gas-liberating, non-metallic, and cement-based, requiring only the addition of water.

2. Deliver grout in original packaging with manufacturer's instructions printed on each container.

3. Select the specific formulation for each class of non-shrink grout specified to conform to that recommended by the manufacturer for the particular application.

4. Compressive strength at 28 days: 7000 psi minimum.

5. Do not use a grout for which the non-shrink property is based on a chemically generated gas or gypsum expansion.

B. Class I Non-Shrink Grout:

1. Supply Class I Grout conforming to these specifications and to CRD C 621 and ASTM C 1107 Grade C and B (as modified below) when tested using the amount of water needed to achieve the following properties:

a. Fluid consistency (20 to 30 seconds) per CRD C 611 at initial testing.

b. Fluid consistency (45 seconds) per CRD C 611 at 30 minutes after mixing.

c. At temperatures of 45, 73.4, and 95 degrees F.

2. To satisfy non-shrink requirements, the length change from placement to time of final set shall not have a shrinkage greater than the amount of expansion measured after final set at 3 and 14 days. The expansion at 3 and 14 days shall not exceed the 28-day expansion.

3. Fluid grout shall pass through the flow cone, with a continuous flow, 1 hour after mixing.

4. Demonstrate in tests that grout maintains contact with the baseplate to provide an minimum effective bearing area of 95 percent of the gross contact area after final set.

5. The grout packaging shall list weight, maximum amount of mixing water to be used, maximum usable working time (pot life) at flowable consistency, and temperature restrictions for preparation and placement within which grout will meet specified requirements.

C. Class II Non-Shrink Grout:

1. Supply Class II Grout confirming to ASTM C 1107 and the following requirements when tested using the amount of water needed to achieve the following properties:

a. Flowable consistency: 140 percent flow on ASTM C 230, five drops in 30 seconds.

b. Fluid working time: 15 minutes, minimum.

c. Flowable duration: 30 minutes, minimum.

2. When tested, the grout shall not bleed at maximum allowed water.

2.03 CURING MATERIALS

A. Curing materials: As specified in Section 03390 - Concrete Curing and as recommended by the manufacturer of prepackaged grouts.

2.04 CONSISTENCY

A. Mix grouts to the consistency necessary to completely fill the space to be grouted. Dry pack consistency is such that the grout is plastic and moldable but will not flow. Where "dry pack" is called for in the Contract Documents, it shall mean a grout of that consistency; the type of grout to be used shall be as specified herein for the particular application.

PART 3 E X E C U T I O N

3.01 PREPARATION

A. Verify that base concrete or masonry has attained design strength before grout is placed.

B. When cementitious grouts are used on concrete surfaces, saturate the concrete surface with water for 24 hours prior to placement of cement-based grout. Upon completion of saturation period remove excess water prior to grouting.

3.02 GROUTING PROCEDURES

A. Prepackaged Grouts: Perform mixing, surface preparation, handling, placing, consolidation, curing, and other means of execution for prepackaged grouts according to the written instructions of the manufacturer. Use prepackaged materials in the quantities and proportions as directed by the manufacturer unless there is certified test data verifying that the specified properties are attained by modified mix.

3.03 CONSOLIDATION

A. Place grout in such a manner, for the consistency necessary for each application, so as to assure that the space to be grouted is completely filled.

END OF SECTION

SECTION 05060

METALS

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Where not otherwise shown, metals for general construction and fabricated products other than those for the building structure, mechanical, electrical products, services, and other operating or operable products referenced in other Sections.

1.02 MEASUREMENT AND PAYMENT

A. No separate payment will be made for work under this section. Include payment in the Lump Sum Base Bid Price.

1.03 TESTS REPORTS AND CERTIFICATIONS

A. Conform to requirements of Section 01330- Submittal Procedures

B. Where required, mill reports showing fulfillment of testing requirements of metals used or provided, or certifications of compliance therewith shall be provided with shipping documents for submittal. •

PART 2 P R 0 D U C T S

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 STEEL

A. Shall be size, shape, weight, or gauge shown, of material conforming to the following:

1. Rolled shapes, plates, sheet piling and bars - General Requirements, ASTMA6.

2. Shapes, plates and bars

a. For general use, ASTM A36;

b. For high strength applications, ASTM A572, grades 42, 50, 60 or 65 as shown.

c. Floor plate, ASTM AT86, pattern, gauge or thickness shown.

3. Concrete reinforcement -

d. Deformed bars, ASTM A615.

e. Galvanized bars - ASTM A767

f. Cold drawn wire - ASTM A82;

g. Deformed wire- ASTM A496;

h. Welded plain wire fabric- ASTM A 185;

4. Sheet and strip -

a. General requirements, ASTM A568.

b. Hot rolled sheet and strip- For structural uses, ASTM A570, grade 36; For general fabrication, commercial quality, ASTM A569.

c. Cold rolled sheet and strip- For structural uses, ASTM A611, grade C; For general fabrication, commercial quality, ASTM A366.

d. Galvanized sheet- General requirements, ASTM A525, hot dip. For general fabrication, ASTM A526 or 527, coated to 0.90 oz. PSF (G 90), mill phosphatized where required to be painted. For machine lock forming fabrication, ASTM A527 only.

e. Galvalumn sheet -Aluminum zinc alloy coated conforming to ASTM A792, .5 oz./sf. hot dip.

5. Pipe- For structural use and general fabrications, ASTM A53, welded or seamless, size and weight, black or galvanized as shown.

6. Hot formed tubing - For general fabrication, ASTM A501, weldeq or seamless, size and weight, square or round, black or galvanized, as shown.

7. Cold formed tubing- For general fabrication, ASTM A500, welded or seamless, size and weight, square or round, black or galvanized, as shown.

8. Wire- For general use, ASTM A510, grade required.

9. Galvanized wire - For general use, ASTM A641, coating Class 1, soft, medium or hard temper as shown or required.

10. Castings - For general use, ASTM A48 gray iron castings of tensile strength/test bar classes suited to the work; For weldable applications, ASTM A27, carbon steel castings, grade and class suited to the work.

B. Aluminum: Shall be shape, size, weight, alloy and temper shown, of material conforming to the following:

1. Extruded bars, rods, wire, shapes and tubes - For general fabrication ASTM 8221.

2. Sheet and Plate- For general fabrication, ASTM 209.

3. For color anodized finishes - Alloys and tempers shall be selected to produce the required colors and strength, matching in extrusions, sheet and plate.

C. Copper: Shall be thickness, weight, gauge, temper shown, of material conforming to the following:

1. Sheet and strip - For general fabrication, ASTM 8370.

D. Stainless steel: Shall be thickness, gauge, and alloy shown, of material conforming to the following:

1. Plate, sheet and strip- For general fabrications, ASTM A167;

2. Bars and shapes - for general fabrications, ASTM A276.

3. Tubing- for general fabrication, ASTM A554.

4. Where not otherwise shown, type 304 (18-8); For use in coastal areas, type 316.

PART 3 E X E C U T I 0 N- Not used.

END OF SECTION

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SECTION 05080

METAL FINISHES

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Where not otherwise shown, finishes for general construction and fabricated products, other than those for mechanical, electrical products, services, and other operable or operating products referenced in other sections. Products specified in this Section are to be coordinated with Section 09901 -Protective Coatings.

1.02 MEASUREMENT AND PAYMENT

A. No separate payment will be made for work under this section. Include payment in the Lump Sum Base Bid Price.

1.03 SUBMITTALS

A. Conform to requirements of Section 01330- Submittal Procedures

PART 2 P R 0 D U C T S

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 GALVANIZING

A. On steel sheet and wire products, as specified under METALS; On shapes, plates and bars - ASTM A 123;

2.03 ALUMINUM- ZINC ALLOY COATING (GALVALUME)

A. Aluminum zinc alloy Hot dip coating on sheet steel conforming to ASTM A792, class AZ50 (0:8 mil. thickness each side) for painted work, A255 Satin finish for natural finish, treated as required for following finishes, if any.

2.04 ZINC RICH COATING

A. For repair of galvanizing damage due to welding, burning, cutting, grinding, mishandling, etc., 2.50 DMT ASTM A780 and annex A2, zinc rich coating application over SP2 prepared base metal and onto undisturbed galvanizing.

2.05 SHOP PRIMING

A. Preparation - Shall be in accordance with Steel Structures Painting Coun.cil (SSPC) Specifications, short titled as follows: SP1 (solvent cleaning}, SP2 (hand tool cleaning), SP3 (power tool cleaning), SP4 (not used), SP5 (white metal blast cleaning), SP6 (commercial blast cleaning), SP7 (brush off blast cleaning), SP8 (pickling}, SP9 (not used), SP10 (near white blast cleaning). SP2 thru 10 include SP1. SP8 also includes SP2, 3,6 or 7.

B. On black steel products for concealed installations or for protected alkyd or latex field painting, Federal Spec. TT-P-636 iron oxide/zinc chromate paint over SP3 preparation.

C. On aluminum products for concealed installations or for protected alkyd or latex field painting- Fed. Spec. TT-P-645A zinc chromate primer over clean base metal.

D. HIPAC primer- For epoxy, polyurethane or other special finishes, finish manufacturer's compatible product over SP7 preparation.

E. Alkaline primer- For field painted exposed exterior installations, GSA Spec. 207-1B Alkaline Base Metal Paint over SP7 preparation.

F. Galvanized primer- for field painted exterior installations, Fed. Spec. TT- P-641 Type II, zinc oxide/alkyd paint.

G. Asphalt base paint- On concealed bar joists as an option, Federal Spec. TT-C-494 Type II, dipped or sprayed over SP2 preparation.

H. Apply primers by brush, roller, spray or dipping to a uniform coat of 1.5 dry mil. thickness.

I. Touch up- Provide matching touch up product for application under other sections to primed work not subject to field painting.

2.06 COLOR COATING:

A. On galvanized or aluminized steel and aluminum products - .80 dry mill thick (DMT) finish over .20 DMT primer for basic 2 coat system, with .80 DMT barrier coats and .50 DMT clear finishes added for higher level protection and/or Color Systems required in applicable Spec. sections, mill applied, baked coil or spray coating based on Kynar 500 or Hylar 5000 polyvinlidene flouride (PVDF) resin product produced under license from Elf Autochem, North America, Inc. or Ausimont USA Inc., applied by an approved applicator over manufacturer's compatible primer and specified preparation, in selected colors, with wash coated reverse surfaces. Provide matching field touch up system. Guarantee for 10 years against fading, chalking or color change.

B. Unless otherwise shown, shall include Duranar 2 coat and 3 coat XL Systems for color selection, including exotic colors in each.

2.07 BAKED ENAMEL

A. On fabricated steel and aluminum products - 1 dry mil total thickness, mill applied, baked polymer spray coating, applied over manufacturer's compatible prime coat, in selected colors, with wash-coated reverse surfaces. Provide field touch up system.

2.08 POWDER COAT

A. On fabricated products - 2 dry mil electrostatic baked epoxy powder primer, 2 dry mil electrostatic baked polyester powder finish.

1. Morton Powder Coatings - Carvel 3000 Series Polyester Powders

2.09 LACQUER

A. Protective coating for fabricated aluminum products- Water white methacrylate product, formulated to pass the Aluminum Association mortar test, spray coated to 1.0 dry mil. minimum thickness.

2.10 MECHANICAL FINISHES

A. On aluminum: Shall be produced in accordance with Aluminum Association (AA) designations as follows:

1. As fabricated -

a. M11, specular as fabricated

b. M12, non specular as fabricated

2. Buffed-

    a. M21, Smooth specular

    b. M22, Specular

3. Directional Textured-

    a. M31, Fine satin

    b. M32, Medium satin

    c. M33, Coarse satin

    d. M34, Hand rubbed

    e. M35, Brushed

4. Non-directional texture

    a. M41, Extra fine matte

    b. M42, Fine matte

    c. M43, Medium matte

    d. M44, Coarse matte

    e. M45, Fine shot blast

    f. M46, Medium shot blast

    g. M47, Coarse shot blast

B. On stainless steels: Shall be produced in accordance with American Iron and Steel Institute (AISI) designations as followed:

1. Unpolished finishes -

    a. No. 1 Rough and dull - as fabricated (hot rolled, annealed and descaled).

    b. No. 2D Dull- as fabricated (cold rolled, annealed and strip descaled). (No. 1 strip finish)

c. No. 2B Bright - No. 2D followed by final light pass on polished rolls. (No.2 strip finish)

d. No. 2B, Bright- cold rolled, final annealing in controlled atmosphere furnace. (Bright Annealed)

2. Polished Finishes -

a. No.3 Intermediate polish- finished with 100 grit abrasive.

b. No. 4 Polished - finished with 150 grit abrasive. _

c. No. 6 Dull Satin - No. 4 finish, tampico brushed in oil and abrasive.

d. No. 7 Reflective - finely ground surfaces buffed without completely removing grit lines.

e. No. 8 Highly reflective - finely ground surfaces buffed to complete removal of grit lines.

2.11 CHEMICAL FINISHES

A. On aluminum: Shall be produced in accordance with Aluminum Association (M) designations as follows:

1. Non-etched cleaned

a. C11, Degreased

b. C12, Chemically cleaned

2. Etched

c. C21, Fine matte

d. C22, Medium matte

e. C23, Coarse matte

3. Brightened Chemical

a. C31, Highly specular

b. C32, Defuse bright

4. Chemical Conversion Coatings

a. C41, Acid chromate - flouride

b. C42, Acid chromate - flouride phosphate

c. C43, Alkaline chromate

2.12 ANODIZING

A. On aluminum: Shall be electrolytically formed, clear or colored, over mechanical or chemical finishes as above, produced in accordance with Aluminum Association (AA) designations as follows:

1. Less than 0.4 mil thick

a. A21, Clear coating

b. A22, Integral color coating

2. 0.4 to 0.7 mil thick (Class II).

a. A31, Clear coating

b. A32, Integral color coating

3. 0.7 mil and thicker (Class 1).

a. A41, Clear coating

b. A42, Integral color coating

4. Unless otherwise shown, anodic coatings shall be Class I.

2.13 ALUMINUM F INISH CODES

A. Coatings shall be specified by codes selected from MECHANICAL and CHEMICAL FINISHES and ANODIZING above in sequence as, AA-M21C11A41, designating a Class I, clear anodic coating over a degreased, smooth specular, buffed surface.

PART 3 E X E C U T I 0 N - Not used.

END OF SECTION

SECTION 05090

FASTENINGS

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Where not otherwise shown, fastening of fixtures, fittings, equipment, etc. to floors, pavements, walls, ceilings and soffits and to building and site structures referenced in other sections.

1.02 MEASUREMENT AND PAYMENT

A. No separate payment will be made for work under this section. Include payment in the Lump Sum Base Bid Price.

1.03 SUBMITTALS

A. Conform to requirements of Section 01330 - Submittal Procedures

B. Product data, including test load results where specified or required.

PART 2 P R OD U C T S

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 HOLLOW WALL FASTENERS

A. 1/8 x 2 in. minimum, spring wing or swing T type, conforming to Fed. Spec. FF-B-588C, Type I, Class A, Style 1, or hollow wall bolts, equal to Molly Bolts conforming to FF-B-588C, Type lll.

2.03 EXPANSION A NCHORS

A. For 1/4 to 3/4 in. bolts, for solid masonry and concrete, steel sleeve and plug drop in anchor for machine bolts for flush or sub setting, conforming to Fed. Spec. FF-S-325, Group VIII, Type I.

B. For hollow masonry, units designed for engagement of spalled hole sides equal to Rawl Hollow Set Drop Ins.

2.04 ONE PIECE SLEEVE ANCHORS

A. For heavy loads and as required, in lieu of bolts in expansion anchors, one piece sleeve bolt anchors equal to Rawi-Bolts may be used where bolt anchors are required, Rawl Studs conforming to FF-S-325, Group II, Type 4, Class 1 or approved equal where stud anchors are allowed.

2.05 S SPIKES

A. Tempered drive pins with S shaped bottom end for hammer setting, equal to Rawl Spikes.

2.06 SHOT FASTENERS

A. 145 to .205 in. shank pins for penetration thru 1/4 to 1/2 in. steel, 3/4 to 2- 3/4 in. into concrete, headed or provided with 1/4 or 3/8 in. stud extensions as required, conforming to Fed. Spec. FF-P-3958.

2.07 SCREW ANCHORS

A. Fiber shield -lead lined braided jute plug for wood, sheetmetal or lag screws, conforming to FF-S-325, Group IV, Type 2.

B. Lead shield - expandable lead alloy tube for wood or sheetmetal screws conforming to FF-S-325, Group IV, Type I.

2.08 BOLTS

A. 1/4 x 1/2 in. minimum, hex head unless square head is permitted, conforming to Fed. Spec. FF-B-575.

2.09 MACHINE SCREWS

A. Size 0 x 1/8 in. minimum, conforming to Fed. Spec. FF-S-111.

2.10 SECURITY SCREWS

A. Size 0 x 1/8 in. minimum machine screws with torx head for limited distribution drivers only, unless one way, Torx Plus, spanner or hex heads are specified.

2.11 LAG BOLTS (SCREWS)

A. 1/4 x 1 in. minimum, hex head, conforming to Fed. Spec. FF-B-561.

2.12 WOOD SCREWS

A. Size 0 x 1/8 in. minimum, conforming to Fed. Spec. FF-S-111.

2.13 SCREWS, TAPPING AND DRILL

A. No.4 x 1/8 in. minimum, various head styles from flat to hex washer style as required, conforming to Fed. Spec. FF-S-107b.

2.14 NUTS

A. Hex unless square is permitted, or castle or wing where shown, matching the bolt and conforming to Fed. Specs. FF-N-845 and FF-N-836.

PART 3 E X E C U T I 0 N

3.01 SELECTION

A. Style: Fastener head selection shall be in accordance with the preparations provided, or requirements for coverage by following materials, otherwise oval or flush screw heads will be preferred over round heads for finish work, and screw or bolt anchorage over stud anchorage.

1. Screw head patterns - For general use, Phillips head; for vandalproof, one way slotted or spanner head; for detention work, allen head for sizes #6, #8 and #10, pinned allen head or pinned Torx head for sizes over #10.

B. Size: Size shall conform to the preparations provided or as recommended by product installation instructions. Pull out test values of at least 250 lb. for the total of all fasteners of a single item, or 125 lb. per lineal foot for continuous anchorage shall be provided for all friction fasteners. Toggle fasteners shall develop the full strength of the fastener or the support or the fixture, which ever governs.

C. Type:

1. In hollow masonry-

    a. For smaller than 1/4 in. fasteners, hollow wall fasteners in masonry hollows, lead or fiber shield screw anchors in masonry solids.

    b. For 1/4 in. and larger fasteners, hollow set expansion anchors in masonry hollows and solids.

2. In solid masonry or concrete -

    a. For smaller than 1/4 in. fasteners, lead or fiber shield screw anchors.

    b. For concealed locations, shot fasteners, and for light duty, S spikes except in soffits.

    c. For 1/4 in. and larger fasteners, bolts in steel expansion anchors or one piece sleeve anchors.

3. In wood-

    a. For smaller than 1/4 in. fasteners, wood screws.

    b. For 1/4 in. and larger fasteners, wood screws unless lag bolts are shown.

4. Thru wood - Bolts with nuts and washers.

5. Thru structural metal - bolts and nuts.

6. In structural metal - bolts and screws in tappings.

7. Thru sheet metal - Sheet metal screws, self tapping screws or drill screws.

8. Thru drywall or plaster on lath - hollow wall fasteners.

9. In plaster- lead or fiber screw anchors.

D. Materials: Where not otherwise shown, provide steel fasteners and anchors, galvanized or zinc plated for general use, stainless steel, brass or bronze to match fastened material in finish work.

E. Distribution: Provide a fastener for every opening prepared for fasteners in the support or fixture. Provide bolts at 2 ft. centers max. for semi structural work, screws or bolts 12 in. centers for non structural work where prepared openings are not provided, with fasteners each end of every fastened piece or item

1. In hollow supports adjust field determined distributions to locate all fasteners in the hollows and adjust location of items with prepared openings laterally and/or vertically to provide at least half the fasteners in the hollows. Where possible, redrill concealed fasteners locations to provide the maximum number of fasteners in the hollows.

3.02 APPLICATION

A. Preparation: P rovide holes sized for snug fit to bolts, for thread bite for screws, depth of penetration only for screws, size and depth recommended by manufacturer for anchors. Provide holes in support for spring wing toggle bolts, in fixture for bolt only, and disassemble, install bolt in fixture and reassemble before setting. Tap threads full depth of the fixture or hole. Countersink bolt heads and washers in wood.

B. Lengths: Size to leave head thickness minimum exposed thread on thru bolts, to provide at least 3/4 member thickness penetration of wood screws, 4-5 thread penetration of point of sheet metal and self tapping screws, as recommended by manufacturer for shot fasteners and bolts in anchors.

C. Installation: Take up on screws or bolts to bring members into uniformly solid contact and to develop the full strength of the fasteners, support or fixture which ever governs, or to measured torque where required.

END OF SECTION

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SECTION 05120

STRUCTURAL STEEL

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Furnishing all labor, materials, services, equipment and appliances required in conjunction with or properly incidental to the furnishing, fabrication, delivery, and erection of structural steel complete, including, but not limited to, the following:

1. Structural steel columns, girders, beams, angles, steel plates, miscellaneous deck support angles, connections and component parts.
2. Qualification of welders.
3. Shop prime coat of paint and field touch-up painting.
4. Temporary construction bracing.
5. Fabrication/erection inspection and testing.

B. Extent of structural steel work is shown on the Drawings, including, notes and details to show sizes and locations of members, typical connections and types of steel required.

C. All supplementary parts and members necessary to complete the structural steel work, regardless of whether all such parts are definitely shown or specified, and furnish all such bolts, gussets, plates, etc., as may be required for the proper assembly of all items.

1.02 QUALITY CONTROL:

A. Latest adopted edition of all standards referenced in this Section shall apply, unless noted otherwise. In case of conflict between these Contract Documents and a referenced standard, the Contract Documents shall govern. In case of conflict between these Contract Documents and the Building Code, the more stringent shall govern.

B. Contractor shall furnish fabrication/erection inspection and testing of all welds in accordance with AWS 01.1, Chapter 6. Submit records of inspections and tests to City's testing laboratory for their review.

C. Fabricator shall employ a competent technician, engineer or independent testing laboratory to inspect the fabrication work to ensure compliance with the Contract Documents and shall identify such inspector to City's testing laboratory. Inspector shall examine in the shop all welding, bolting, painting, galvanizing, and straightness and alignment of fabricated members.

D. All materials, fabrication procedures and field erection are subject to verification inspection and testing, by the City's testing laboratory, in both shop and field. Such inspections and tests will not relieve Contractor of his responsibility for providing materials and fabrication procedures in compliance with specified requirements. City reserves the right to use ultrasonic or radiographic inspection to verify the adequacy of all welds. Testing procedures and acceptance criteria shall be as specified in AWS 01.1. Promptly remove and replace materials or fabricated components which do not comply.

E. Qualifications for Welding Work: Contractor shall be responsible for qualifying welding operators in accordance with the AWS "Standard Qualification Procedure." Provide certification, to City's testing laboratory, that welders to be employed in work have satisfactorily passed AWS qualification tests within previous 12 months. If recertification of welders is required, retesting will be Contractor's responsibility.

F. Qualifications of Welding Procedures: Contractor shall provide the testing laboratory with welding procedures which are to be used in executing this work. Welding procedures shall be qualified prior to use in accordance with AWS 01.1, Part B.

G. Comply with provisions of the following codes, Specifications and standards, in addition to the Building Code:

1. AISC, "Code of Standard Practice for Steel Buildings and Bridges," except that the following sentence in paragraph 4.2.1 shall not apply to this project: "This approval constitutes the City's acceptance of all responsibility for the design adequacy of any detail configuration of

connections developed by the fabricator as part of his preparation of these shop drawings."

2. AISC, "Specification for Structural Steel Buildings,II including the "Commentary" and Supplements thereto, as issued.

3. AISC, "Specifications for Structural Joints using ASTM A 325 or A 490 Bolts," approved by the Research Council on Structural Connections of the Engineering Foundation.

4. AWS 01.1, "Structural Welding Code.II

5. ASTM A 6, "Specifications for General Requirements for Delivery of Rolled Steel Plates, Shapes, Sheet Piling, and Bars for Structural Use."

6. Industrial Fasteners Institute, "Handbook on Bolt, Nut, and Rivet Standards."

7. Steel Structure Painting Council:

   a. Painting Manual, Volume 1, Good Painting Practice.

   b. Painting Manual, Volume 2, Systems Specifications.

8. Qualifications:

   a. Structural steel fabricator shall have not less than five years experience in the fabrication of structural steel for buildings and shall be currently certified under the AISC Qualify Certification Program for fabrication of Category I or higher structures. An otherwise qualified fabricator who is not a member of the AISC Quality Certification Program will be accepted if satisfactory evidence of qualifications is submitted prior to contract award. For non-certified fabricators, contractor shall submit a resume describing plant size, equipment, quality control procedures and personnel, and experience on comparable work in the last three years.

   b. Structural steel erector shall have not less than five years experience in the erection of structural steel.

1.03 DESIGN:

A. Connections:

1. All structural steel beams, truss, and bracing connections not specifically detailed on the Drawings shall be designed by the Contractor, under the direct supervision of a Registered Professional Engineer, licensed in the State of Texas, to resist all the forces, and shall be shown in detail on the shop drawings.

2. Connections shall be designed in accordance with the requirements sin the AISC Manual of Steel Construction latest edition.

B. Substitutions: Substitutions of sections or modifications of details, or both, and the reasons therefore, shall be submitted with the shop drawings for approval. Submitted substitutions must be clearly identified and noted as such. Approved substitutions, modifications, and necessary changes in related portions of the work shall be coordinated by the fabricator and shall be accomplished at no additional cost to the City.

C. Responsibility for Errors: Fabricator shall be responsible for all errors of detailing, fabrications, and for the correct fitting of structural steel members.

D. Templates: Shall be furnished by fabricator with instructions for setting of anchor bolts and bearing plates.

1.04 SUBMITTALS:

A. Conform to requirements of Section 01330 - Submittal Procedures

B. Product Data: Submit producer's or manufacturer's specifications and installation instructions, including laboratory test reports and other data, to show compliance with Specifications for the following products.

1. Structural steel primer paint.

C. Mill Certificates: Submit for the City's record certificates of mill analysis showing compliance with Specifications for the following products:

1. Structural steel (each type).

2. High-strength bolts (each type), including nuts and washers.

D. Shop Drawings:

1. Submit shop drawings prepared under the supervision of a Registered Professional Engineer, licensed in the State of Texas, including complete details and schedules for fabrication and shop assembly of members, erection plans, details, procedures, and diagrams showing sequence of erection. Include details of cuts, connections, camber, holes, and other pertinent data. Indicate welds by standard AWS symbols, and.show size, length, and type of each weld. Shop drawings and erection drawings shall not be made by using reproductions of Contract Drawings.

2. Structural steel members for which shop drawings have not been reviewed shall not be fabricated. Architect's review shall cover general locations, spacings, and details of design. Omission from shop drawings of any materials required by the Contract Documents shall not relieve the Contractor of the responsibility of furnishing and installing such materials, even though such shop drawings may have been reviewed and returned.

3. Submit setting drawings, templates, and directions for installation of anchor bolts and other anchorages to be installed by other trades.

E. Certification: Submit evidence of current AISC plant certification (see "Qualifications").

1.05 PRODUCT DELIVERY, STORAGE, AND HANDLING:

A. Deliver anchor bolts and anchorage devices, which are to be embedded in cast-in-place concrete or masonry, in ample time to not delay that work.

B. Store materials to permit easy access for inspection and identification. Keep steel members off the ground, using pallets, platforms, or other supports. Protect steel members and packaged materials from corrosion and deterioration.

C. Do not store materials on structure in a manner that might cause distortion or damage to members or supporting structures. Repair or replace damaged materials or structures as directed.

D. Support cambered members during shipment and handling in a manner which will not result in loss of camber.

1.06 JOB CONDITIONS:

A. Coordinate erection of structural steel with work of other trades.

B. Do not install columns which have anchor bolts in concrete, until concrete members have attained their 28 day compressive strengths.

1.07 MEASUREMENT AND PAYMENT

A. No separate payment will be made for work under this section. Include payment in the Lump Sum Base Bid Price.

PART 2 P R O D U C T S

2.01 MATERIALS:

A. Metal Surfaces, General: For fabrication of work which will be exposed to view, use only materials which are smooth and free of surface blemishes including pitting, seam marks, roller marks, rolled trade names, and roughness. Remove such blemishes by grinding, or by welding and grinding, prior to cleaning, treating and application of surface finishes.

B. Steel:

1. Wide flange shapes ASTM A572-50 (50ksi yield).

2. Rolled Shapes, Plates, and Bars: ASTM A 36 (36 ksi yield).

3. Cold formed Steel Tubing: ASTM A 500, Grade B, (46,000 psi yield).

4. Steel Pipe: ASTM A 53, Type E or S, Grade B.

C. Bolts and Washers:

1. Bolts: Anchor bolts and erection bolts shall conform to ASTM A 307, and to the requirements for regular hexagon bolts and nuts of ANSI Standards B18.2.1 and B18.2.2.

2. High-strength bolts for connections shall conform to ASTM A 325 or ASTM A 490. Dimensions of bolt heads and nuts shall conform to requirements for heavy hexagon nuts of ANSI Standards B18.2.1 and B18.2.2.

3. Washers: Circular washers shall be flat and smooth, and shall conform to requirements of Type A washers in ANSI Standard B23.1. Beveled

washers for "S" shapes and channels shall be square or rectangular, shall taper in thickness, and shall be smooth. Washers for use with high-strength bolts shall be hardened.

4. Drilled anchor bolts shall be one of the following:

   Wej-it Bolt, Wej-it Corporation, Tulsa, Oklahoma Kwik Bolt, Hilti Fastening Systems, Tulsa, Oklahoma Trubolt, Ramset Fastening Systems, Paris, Kentucky

D. Welding electrodes shall conform to the requirements of the Specifications of the American Welding Society. Use E70 electrodes. For high-strength, low-alloy steel, provide electrodes, welding rods, and filler metals equal in strength and compatible in appearance with parent metal joined.

E. Primer Paint:

1. Standard shop coat of red oxide primer, meeting the requirements of "SSPC-Paint 13" or Federal Specification "TT-P-636," applied to a dry film thickness of 2.0 mils.

F. Zinc-coating: When galvanized steel is required, the zinc-coating shall conform to ASTM A 123. Zinc-coating for threaded products shall conform to ASTM A 153, Class C. Zinc-coating for sheet steel shall conform to ASTM A 591.

G. Cold galvanizing compound shall be "ZRC" cold galvanizing compound, as manufactured by ZRC Chemical Products, Quincy, Massachusetts.

2.02 FABRICATION:

A. Shop Fabrication and Assembly:

1. Fabricate and assemble structural assemblies in the shop to greatest extent possible. Fabricate items of structural steel in accordance with AISC Specifications and as indicated on final shop drawings.

2. Provide camber in members where indicated. Specified camber applies at jobsite, just prior to erection, lying down flat so that member weight has no effect. Contractor shall take necessary precautions to prevent or compensate for camber loss during shipment. Measured camber in members up to 50'-0" long shall be within a tolerance of minus 1/2" to plus zero from the amount specified. For members greater than 50'-0" long, both positive and negative tolerance may increase 1/8" for every

10'-0" of length in excess of 50'-0". Members with a field measured camber outside of the specified tolerance shall be returned to the shop.

3. Properly mark and match-mark materials for field assembly. Fabricate for delivery sequence which will expedite erection and minimize field handling of materials.

4. Where finishing is required, complete assembly, including welding of units, before start of finishing operations. Provide finish surfaces of members exposed in final structure free of markings, burrs, and other defects.

5. Splicing of structural steel members is prohibited without prior approval of the Architect. Any member having a splice not shown and detailed on approved shop drawings shall be rejected.

6. Members in compression joints which depend on contact bearing shall have the bearing surfaces milled to a common plane. Members to be milled shall be completely assembled before milling.

7. Plates shall be free of gross internal discontinuities such as ruptures and delaminations. Plates shall comply with ASTM A 578, Level 1.

8. Mill tolerances: Comply with ASTM A 6.

9. Fabrication tolerances: Comply with AISC Code of Standard Practice.

B. Connections:

1. Weld or bolt shop connections, as indicated on the Drawings.

2. Bolt field connections, except where welded connections or other connections are indicated. Provide specified threaded fasteners for all principle bolted connections. Holes for bolted constructions shall be drilled or punched at right angles to member. The slope of surfaces under the bolt head and nut shall not exceed 1:20. Provide beveled washers where slopes exceed 1:20. Bolt holes shall have a diameter not greater than 1/16" larger than the nominal bolt diameter. Do not flame cut holes or enlarge by burning. Provide washers over all slotted holes in an outer ply.

3. High-strength Bolted Construction: Install high-strength threaded fasteners in accordance with AISC, "Specifications for Structural Joints using ASTM A 325 or A 490 Bolts," (RCRBSJ).

4. Welded Construction: Comply with AWS Structural Welding Code for procedures, appearance and quality of welds, and methods used in correcting welding work. Assemble and weld built-up sections by methods which will produce true alignment of axes without warp. Welds not specified shall be continuous fillet welds designed to develop the full strength of member. No combination of bolts and welds shall be used for stress transmission at the same face of any connections.

5. Clean completed welds prior to inspection. Slag shall be removed from all completed welds and the weld and adjacent base metal shall be cleaned by brushing or other suitable means. Tightly adherent splatter remaining after the cleaning operation is acceptable unless its removal is required for the purpose of nondestructive testing.

6. Base Plates: Hole sizes for anchor bolts may be oversized to facilitate erection as follows:

   Bolts 3/4" to 7/8" Diameter - 5/16" oversize

   Bolts 1" to 2" Diameter - 1/2" oversize

   Bolts over 2" Diameter - 1" oversize

   Use oversize or plate washers under nut at all oversized holes in base plates. Washers must be large enough to cover the entire hole. Washer thickness shall be at least 1/8 of bolt diameter.

C. Holes for Other Work: Provide holes required for securing other work to structural steel framing and for passage of other work through steel framing members, as shown on final shop drawings. Provide threaded nuts welded to framing and other specialty items as indicated to receive other work. Cut, drill or punch holes perpendicular to metal surfaces. Do not flame cut holes or enlarge holes by burning. Drill holes in bearing plates.

D. Zinc-coating:

1. The Following Steel shall be Galvanized:

   a. As specified on drawings.

2.03 SHOP PAINTING:

A. General: Shop Painting shall be coordinated with Section 09901 - Protective Coatings. Shop paint structural steel, except those members or portions of members to receive a galvanized coating and those members to be embedded in concrete or mortar. Paint embedded steel which is partially exposed, on exposed portions and initial 2" of embedded areas only.

1. Do not paint surfaces which are to be welded.

2. Do not paint surfaces which are scheduled to receive sprayed-on fireproofing.

B. Surface Preparation: After inspection and before shipping, clean steel work to be painted. Remove loose rust, loose mill scale, spatter, and slag or flux deposits. Clean steel in accordance with Steel Structures Painting Council (SSPC) as follows:

1. SP-1, "Solvent Cleaning."

2. SP-2, "Hand Tool Cleaning."

3. SP-3, "Power Tool Cleaning."

C. Painting: Immediately after surface preparation, apply structural steel primer paint in accordance with manufacturer's instructions and at a rate to provide a uniform dry film thickness as specified. Use painting methods which result in full coverage of joints, corners, edges, and exposed surfaces.

PART 3 E X E C U T I O N

3.01 INSPECTION:

A. Erector must examine areas and conditions under which structural steel work is to be installed, and notify Contractor of conditions detrimental to proper and timely completion of work.

3.02 ERECTION:

A. General: Comply with AISC Specifications and Code of Standard Practice, and as herein specified.

B. Temporary Shoring and Bracing:

1. Provide adequate shoring and bracing to safely withstand all loads to which the structure may be subjected during the construction process, including wind loads, dead loads, construction material, and equipment loads. Such bracing shall remain in place as long as required for safety.

2. As the erection progresses, make a sufficient number of permanent welded or bolted connections to withstand erection stresses and maintain stability.

3. The design of temporary shoring and bracing shall be the responsibility of the Contractor.

C. C. Temporary Planking: Provide temporary planking and working platforms, as necessary, to effectively complete the work.

D. Anchor Bolts: Furnish anchor bolts and other connectors required for securing structural steel to foundations and other in-place work. Furnish templates and other devices as necessary for presetting bolts and other anchors in accurate locations.

E. Setting Bases and Bearing Plates: Clean concrete and masonry bearing surfaces of bond-reducing materials and roughen to improve bond to surfaces. Clean bottom surface of base and bearing plates.

1. Set loose and attached base plates and bearing plates, for structural members, on wedges or other adjusting devices.

2. Tighten anchor bolts after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of base or bearing plate prior to packing with grout.

F. Field Assembly:

1. Set structural frames accurately to lines and elevations indicated. Align and adjust various members forming a part of a complete frame or structure before permanently fastening. Clean bearing surfaces and other surfaces, which will be in permanent contact, before assembly. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.

2. Level and plumb individual members of structure within tolerances defined by AISC Code for Standard Practice, unless closer tolerances are required for proper fitting of adjoining or enclosing materials, in which case the most stringent shall apply.

3. Set horizontal members with their natural camber (or specified• camber) up.

4. Establish required leveling and plumbing measurements on mean operating temperature of structure. Make allowances for the difference between temperature at time of erection and mean temperature at which the structure will be when completed and in service.

5. Splice members only where indicated and accepted on final shop drawing.

6. Where parts cannot be assembled or fitted properly, as a result of errors in fabrication or of deformation due to handling or transportation, such condition shall be immediately reported to the Architect, along with proposed method of correction. The straightening of bends or warps shall be done by approved methods. Bent or damaged heat-treated parts will be rejected.

7. Fastening of splices in compression members shall be done after the abutting surfaces have been brought completely into contact.

G. Erection Bolts: On exposed welded construction, remove erection bolts, fill holes with plug welds and grind smooth at exposed surfaces. On non-exposed welded construction, erection bolts shall be tightened securely and left in place, or if removed, the holes shall be filled with plug welds.

H. Bolted Connections:

1. High-strength bolts shall be installed in conformance with the "Specifications for Structural Joints using ASTM A 325 or A 490 Bolts."

2. A 307 bolts and high-strength (A 325 and A 490) bolts noted to be "snug-tight" shall be tightened using a few impacts of an impact wrench or the full effort of a man using an ordinary spud wrench, bringing the plies into snug contact.

3. High-strength bolts which are not specifically designated to be "snug-tight" shall be tightened to provide at least the minimum tension shown in Table 4 of the "Specification for Structural Joints using ASTM A 325 and A 490 Bolts." Tightening shall be done by the turn-of-the-nut method, with direct tension indicators, or by properly calibrated wrenches.

4. Bolted parts shall fit solidly together when assembled. All joint surfaces shall be free of burrs, dirt and other foreign material that would prevent solid seating of the parts.

5. Bolts tightened by calibrated wrench or by torque control shall have a hardened washer under the element (nut or bolt head) turned in tightening.

6. Hardened washers shall be placed over slotted holes in an outer ply.

7. Hardened beveled washers shall be used where outer face of bolted parts has a slope greater than 1:20 with respect to bolt axis.

I. Field Welding: Comply with AWS Structural Welding Code and AISC Specification for Structural Steel Buildings. Pay particular attention to surface preparation, preheating, sequence, and continuity of welds. Where heavy shapes are to be welded, comply with all special requirements contained in the AISC Specification and the AWS Structural Welding Code.

J. Comply with AISC Specifications for bearing, adequacy of temporary connections, alignment, and removal of paint on surfaces adjacent to field welds.

K. Do not enlarge unfair holes in members, by burning or by use of drift pins, except in secondary bracing members. Ream holes that must be enlarged to admit bolts.

L. Gas Cutting: Do not use gas cutting torches in field for correcting fabrication errors in structural framing. Cutting will be permitted only on secondary members which are not under stress, as acceptable to City. Finish gas-cut sections equal to a sheared appearance when permitted.

M. Touch-up Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint. Apply paint to exposed areas with same materials as used for shop painting. Apply by brush or spray, to provide a minimum dry film thickness of 2.5 mils for each coat.

N. Touch-up Cold Galvanizing: Immediately after erection, touch-up areas of hot-dip galvanized members where galvanizing has been abraded during shipping and erection and areas where galvanizing has been removed or damaged due to welding. Apply specified cold galvanizing compound in accordance with the manufacturer's instructions, to a minimum dry film thickness of 2.0 mils.

3.03 CLEANUP:

A. Clean up all debris caused by the work of this Section, keeping the area clean and neat at all times.

END OF SECTION

SECTION 05510

PREFABRICATED MODULAR ALUMINUM PLATFORMS

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Prefabricated modular aluminum platforms including handrails, stairs, tower support and all structural members necessary for installation of a complete structure as shown on the drawings. All components shall be bolted together during installation in the field.

1.02 MEASUREMENT AND PAYMENT

A. Unit Prices

1. Payment for aluminum platforms is on a unit price basis for each platform installed.

2. Refer to Section 01270 - Measurement and Payment and Section 01292 - Schedule of Values.

B. Stipulated Price (Lump Sum). If the Contract is a Stipulated Price Contract, payment for work in this Section is included in the total Stipulated Price.

1.03 SUBMITTALS

A. Submit following Section 01330 - Submittal Procedures.

B. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable.

C. Indicate welded connections using standard AWS A 2.0 welding symbols. Indicate net weld lengths.

1.04 FIELD MEASUREMENTS

A. Verify that field measurements are as indicated on Drawings.

PART 2 P R O D U C T S

2.01 ACCEPTABLE MANUFACTURERS/PRODUCTS

A. Erectastep or approved equal.

2.02 MATERIALS

A. Modular Platform:
1. 36” x 36” square
2. Stamped from one piece of 5052 aluminum
3. Aluminum slip resistant safety tread walk surface
4. 50 PSF design load

B. Handrail:

1. 2” diameter round tubing handrail and midrail
2. 5” toeboard
3. Aluminum construction with powder coated ANSI Safety Yellow

C. Stair with Handrails:

1. Stair width shall be a minimum of 22 inches
2. Steps shall have 26 inches of slip resistant safety tread walk surface
3. Steps shall be of aluminum construction in 9” vertical increments
4. 2” diameter round tubing transition handrail, handrail and midrail
5. All handrails shall be aluminum construction with powder coated ANSI Safety Yellow.

D. Tower Support:

1. 4” x 4” square tube two leg design
2. Aluminum construction mill finish
3. All welded construction
4. Two baseplates for 5/8” anchor bolts

E. Bolts, Nuts, and Washers: ASTM A 307 galvanized to ASTM A 153 for galvanized components.

2.02 FABRICATION

A. All components shall be robot and laser cut and made from aluminum.

B. Fabricate components with same bolt hole pattern for installation and assembly.

C. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of component, except where specifically noted otherwise.

D. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

2.03 FINISHES

A. All handrails shall be finished with powder coated ANSI Safety Yellow.

PART 3 E X E C U T I O N

3.01 EXAMINATION

A. Verify that field conditions are acceptable and ready to receive work.

B. Beginning of installation means erector accepts existing conditions.

3.02 INSTALLATION

A. Install items plumb and level, accurately fitted, free from distortion or defects.

B. Allow for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.

C. Obtain Project Manager approval prior to cutting or making adjustments in the field.

D. No welding or fabrication of components shall be allowed in the field.

END OF SECTION

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SECTION 05520

ALUMINUM HANDRAILS AND GUARDRAILS

PART 1 G E N E R A L

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment, and incidentals required to provide complete handrails and guardrails as shown on the Drawings and as specified herein. Handrails and guardrails shall be the product of a company normally engaged in the manufacturing of pipe railing. This section includes Aluminum mechanical sub-assembled rails, posts, and fittings.

1.02 MEASUREMENT AND PAYMENT

A. Unless noted in the Bid Form, no separate payment will be made for work under this section. Include the cost for this work in the lump sum base bid.

B. Refer to Section 01270 – Measurement and Payment

1.03 REFERENCES

A. American Society for Testing and Materials (ASTM)

1. Standard Specifications as referenced.

2. ASTM E985: Permanent Metal Railing Systems and Rails for Buildings

3. ASTM E894: Test Method for Anchorage of Permanent Metal Railing Systems and Rails for Buildings.

4. ASTM E935: Test Methods for Performance of Permanent Metal Railing Systems and Rails for Buildings

B. Occupational Safety and Health Standards (OSHA)

1. Code of Federal Regulations, 29 CFR Part 1910.

C. 2006 International Building Code

D. Aluminum Association (AA): AA 30-86 Specifications for Aluminum Structures.

E. Where reference is made to one of the preceding standards, the revision in effect at the time of bid opening shall apply, unless otherwise noted.

1.04 DEFINITIONS

A. Guardrail: A system of building components located near the open sides of elevated walking surfaces for the purpose of minimizing the possibility of an accidental fall. A protective railing adjacent to a change in height in a structure. Used also at the open sides of stairways.

B. Handrail: A horizontal or sloping rail intended for grasping by the hand for guidance or support.

1.05 SUBMITTALS

A. Conform to requirements of Section 01330 – Submittal Procedures

B. Submit shop drawings for review prior to fabrication. Indicate rail layout, profiles, sizes of members, methods of assembly, attachments, anchorages, anchorage locations, sizes and types of fasteners, accessories, and locations of expansion joints.

C. Submit manufacturer's load tables and test data, or calculations sealed by a professional engineer registered in the State of Texas, demonstrating that the rails, guardrails, and their attachments including connections to concrete or steel will resist the loads specified in Paragraph 1.05 at the spacings provided.

D. Submit letter certifying that railing system is in compliance with local building code and OSHA requirements.

E. The manufacturer shall submit calculations for approval at the request of the Engineer.

1.06 SYSTEM DESCRIPTION

A. The railing assembly including rails, posts, attachments, and anchors shall be adequate to resist the following forces without damages or permanent set. Apply each load so as to produce the maximum stress in each of the railing components. The following loading conditions need not be applied simultaneously, but each shall be applied to produce the maximum stress in their respective components or any supporting components.

1. A uniform load of 50 pounds per lineal foot applied horizontally at the top rail, and a simultaneous load of 100 pounds per lineal foot applied vertically downward at the top rail.

1. A concentrated load of 200 pounds applied to the top rail at any point and in any direction.

2. A 200 pound concentrated horizontal load applied on a I-foot square area at any point in the railing system.

1.07 PROJECT/SITE REQUIREMENTS

A. Fully coordinate the work of this Section with that of other sections. Verify at the site, the dimensions and work of other trades adjoining or supporting the work of this Section prior to fabrication and installation.

B. Take field measurements at the site to confirm and supplement indicated dimensions and to ensure proper fit of all components.

C. Furnish to the appropriate trades all items specified under this Section, and installed under other sections.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Protect railings against scratching, splashes, mortar, paint, and other damage using paper wrap, an approved coating, or both. Provide such protection during transportation, storage, erection, and until adjacent work by other trades is complete.

1.09 WARRANTY

A. Provide warranty under provisions of Specification Section 00700 – General Conditions and 01770 – Closeout Procedures.

B. The manufacturer shall warrant that the product is free of defects in material and workmanship under normal use and service, and when properly installed.

C. The manufacturer shall provide written document to the City of Houston that warrants 100 percent of parts and labor for at least 24 months from the date of substantial completion as defined in the Contract Documents. Warranty shall be in printed form and previously published as the manufacturer’s standard warranty for the manufactured products.

PART 2 P R O D U C T S

2.01 RAILING SYSTEM

A. Railings shall be constructed 1-1/2 inch diameter aluminum pipe schedule 40 with anodized satin finish. Finish to be clear anodized (0.7 mil). All fittings shall be extruded aluminum pre-engineered for railing application.

B. All railing mounted to the side of walkway surfaces shall use 1/2 inch diameter stainless steel anchors. All hardware used on the railing system shall be stainless steel and shall be furnished by the handrail and guardrail manufacturer. Anchors for fastening aluminum guardrails to concrete shall be Type 316 stainless steel.

C. All railing surfaces in contact with concrete or dissimilar metals shall receive one coat of zinc chromate.

D. All fittings shall be secured to the post and railing with #17 x 1” 316 stainless steel set screws.

E. Railings shall be provided with at least two horizontal rails.

F. Non-shrink Non-metallic Grout Premixed , factory-packaged, non-staining, non-corrosive, nongaseous grout complying with CE CRD-C621. Provide grout specifically recommended by Manufacturer in this section.

G. Erosion Resistant Anchoring Cement: Factory pre-packaged, non-shrink, non-staining, hydraulic controlled expansion cement formulation for mixing with water at Project Site to create pourable anchoring, patching, and grouting compound. Provide formulation that is resistant to erosion from water exposure without need for protection by a sealer or waterproof coating and is recommended for exterior use by manufacturer.

H. Provide expansion joints at maximum 24 ft. centers using splice sleeves.

I. Openings in rail shall be provided for access to gates and valves. Provide double strand 3/16 inch diameter 316 stainless steel chain.

2.02 MANUFACTURERS

A. Acceptable manufacturers.

1. Hollaender Manufacturing Company.

2. Thompson Fabricating, LLC

3. Or equal.

PART 3 E X E C U T I O N

3.01 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive work prior to commencing installation.

3.02 PREPARATION

A. Supply items required to be cast into concrete, embedded in masonry, and/or placed in partitions with setting templates, to appropriate trades for installation under other sections of these Specifications.

3.03 INSTALLATION

A. Install railings in compliance with manufacturer's instructions and approved submittals.

B. Install components vertically plumb in all directions and in line, accurately fitted, free from distortion or defects, and securely anchored to the structure.

C. Provide anchors, plates, angles, etc. required for connecting railings to structure.

D. Where handrail or guardrail posts are set in concrete the posts shall be set into PVC sleeves cast in the concrete. Set in cored holes where shown. Firmly cement posts in place with 1651 epoxy resin such as Sikadur Hi mod Sika Corporation, Lindhurst, NJ; or equal. Place collars on the posts and fasten in place as detailed on approved shop drawings.

E. Where steel contacts a dissimilar metal, provide dielectric break material at the joint between the metals.

F. Field weld anchors if indicated on Drawings or shop drawings. Touch up welds with primer. Grind welds smooth.

G. Accurately cut rail to be field cut and attached to posts in full compliance with the manufacturer's instructions.

H. Side applied hand rails to have anchor plate and anchorage as shown and specified.

I. Curve handrails where shown and necessary to prevent hazardous conditions and corners.

3.04 ERECTION TOLERANCES

A. Maximum Variation from Vertical Plumb in two (2) directions shall be 11/4 inch.

B. Maximum Offset from True Alignment for every 50 foot length of railing shall be one inch, non cumulative.

3.05 REPAIR OF DEFECTIVE WORK

A. Remove stained or otherwise defective work and replace with material meeting specification requirements.

END OF SECTION

SECTION 06600

FIBERGLASS REINFORCED POLYMER (FRP) LADDER AND CAGE AND FABRICATIONS

PART 1 G E N E R A L

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification Sections, apply to work of this section.

1.02 MEASUREMENT AND PAYMENT

A. Unless noted in the Bid Form, no separate payment will be made for work under this section. Include the cost for this work in the lump sum base bid.

B. Refer to Section 01270 – Measurement and Payment

1.03 SUMMARY

A. This section includes the following FRP Products & Fabrications:

1. FRP Ladder and Cage

1.04 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals governed by this section necessary to install the fiberglass reinforced polymer (FRP) ladder and cage as specified herein.

1.05 QUALITY ASSURANCE

A. The material covered by these specifications shall be furnished by an ISO-9001:2008 certified manufacturer of proven ability who is regularly engaged in the manufacture, fabrication and installation of FRP systems.

B. Substitution of any component or modification of system shall be made only when approved by the Design Engineer.

C. Fabricator Qualifications: Firm experienced in successfully producing FRP fabrications similar to that indicated for this project, with sufficient production capacity to produce required units without causing delay in the work.

D. In addition to requirements of these specifications, comply with manufacturer's instructions and recommendations for work.

1.06 DESIGN CRITERIA

A. The design of FRP products including connections shall be in accordance with governing building codes and standards as applicable.

B. Structural members shall be designed to support all applied loads. Deflection in any direction shall not be more than L/180 of span for structural members unless specifically stated otherwise in drawings and/or supplementary conditions. Connections shall be designed to transfer the loads.

C. Temperature exposure is limited to 109°F (42.5°C) unless specifically stated otherwise in drawings and/or supplementary conditions.

1.07 SUBMITTALS

A. Shop drawings of all fabricated pultruded gratings and treads, structural shapes and plate, standard railings, ladders and cages, foam core building panels, building panel systems, planks, molded gratings and treads and appurtenances shall be submitted to the Design Engineer for approval in accordance with the requirements of Section 01340 - Shop Drawings, Product Data, and Samples. Fabrication shall not start until receipt of Design Engineer's approval marked "Approved As Submitted" or "Approved As Noted".

B. Manufacturer's catalog data showing

1. Materials of construction

2. Dimensions, spacing, and construction of ladder and cage.

C. Detail shop drawings showing

1. Dimensions

2. Sectional assembly

3. Location and identification mark

4. Size and type of supporting frames required

Samples of each type of product shall be submitted for approval in accordance with the requirements of Section 01340 - Shop Drawings, Product Data, and Samples.

1.08 WARRANTY

A. Warranties shall conform to requirements of 00700 – General Conditions.

1.09 SHIPPING AND STORAGE INSTRUCTIONS

B. All systems, sub-systems and structures shall be shop fabricated and assembled into the largest practical size suitable for transporting.

C. All materials and equipment necessary for the fabrication and installation of pultruded ladder and cage shall be stored before, during, and after shipment in a manner to prevent cracking, twisting, bending, breaking, chipping or damage of any kind to the materials or equipment, including damage due to over exposure to the sun. Any material which, in the opinion of the Design Engineer, has become damaged as to be unfit for use, shall be promptly removed from the site of work, and the Contractor shall receive no compensation for the damaged material or its removal.

D. Identify and match-mark all materials, items and fabrications for installation and field assembly.

PART 2 P R O D U C T S

2.01 GENERAL

A. Materials used in the manufacture of the FRP products shall be raw materials in conformance with the specification and certified as meeting the manufacturer's approved list of raw materials.

B. All raw materials shall be as specified by the contract.

C. The visual quality of the pultruded shapes shall conform to ASTM D4385.

D. With the exception of molded gratings and treads, all FRP products noted in 1.02 shall be manufactured using a pultruded process utilizing vinyl ester resin with flame retardant and ultraviolet (UV) inhibitor additives. A synthetic

surface veil fabric shall encase the glass reinforcement. FRP shapes shall achieve a flame spread rating of 25 or less in accordance with ASTM test method E-84, the flammability characteristics of UL 94 V0 and the self-extinguishing requirements of ASTM D635.

E. If required, after fabrication, all cut ends, holes and abrasions of FRP shapes shall be sealed with a compatible resin coating.

F. FRP products exposed to weather shall contain an ultraviolet inhibitor. Should additional ultraviolet protection be required, a one mil minimum UV coating can be applied.

G. All exposed surfaces shall be smooth and true to form, consistent with ASTM D4385.

H. Manufacturers:

1. Strongwell

2. Approved Equal

I. Pultruded FRP products shall be manufactured and fabricated in the USA. Manufacturer shall provide a written Certificate of Compliance.

J. The materials covered by these specifications shall be furnished by an ISO-9001:2008 and ISO-14001 certified manufacturer.

2.02 FRP STRUCTURAL SHAPES AND PLATE

A. Material

1. Structural shapes and plate shall be made from vinyl ester resin with fire retardant additives to meet a flame spread rating of less than 25 per ASTM E-84, the flammability characteristics of UL 94 V0 and meet the self-extinguishing requirements of ASTM D-635. All structural shapes shall contain a UV inhibitor.

2. Pultruded profiles shall satisfy the visual requirements of ASTM D4385.

3. Structural shapes shall be EXTREN® as manufactured by Strongwell.

B. Process

1. Manufactured by the pultrusion process.

2.03 Structural FRP members' composition shall consist of vinyl ester resin matrix and glass reinforcements. A synthetic surface veil fabric shall encase the glass reinforcement. Glass strand rovings shall be used internally for longitudinal strength. Continuous strand glass mats or stitched reinforcements shall be used internally for transverse strength.

A. Mechanical properties shall meet or exceed the values listed in Table 1.

Table 1 – Fiberglass Pultruded Material Properties

Minimum Ultimate Coupon Properties (UN)

PROPERTIES	ASTM TEST METHOD	UNITS/ VALUE	SERIES 625 SHAPES
MECHANICAL			
Tensile Stress, LW	D638	psi	30,000
		N/mm^2	207
Tensile Stress, CW	D638	psi	7,000
		N/mm^2	48.3
Tensile Modulus, LW	D638	10^6 psi	2.6
		$10^3 N/mm^2$	17.9
Tensile Modulus, CW	D638	10^6 psi	0.8
		$10^3 N/mm^2$	5.52
Compressive Stress, LW	D695	psi	30,000
		N/mm^2	207
Compressive Stress, CW	D695	psi	16,000
		N/mm^2	110
Compressive Modulus, LW③	D695	10^6 psi	2.6
		$10^3 N/mm^2$	17.9
Compressive Modulus, CW	D695	10^6 psi	0.8
		$10^3 N/mm^2$	5.52
Flexural Stress, LW	D790	psi	30,000
		N/mm^2	207
Flexural Stress, CW	D790	psi	10,000
		N/mm^2	68.9
Flexural Modulus, LW③	D790	10^6 psi	1.6
		$10^3 N/mm^2$	11
Flexural Modulus, CW	D790	10^6 psi	0.8
		$10^3 N/mm^2$	5.52
Modulus of Elasticity①	full section	10^6 psi	2.8
		$10^3 N/mm^2$	19.3
Modulus of Elasticity >4" ① >102 mm	full section	10^6 psi	2.5
		$10^3 N/mm^2$	17.2

PROPERTIES	ASTM TEST METHOD	UNITS/ VALUE	SERIES 625 SHAPES
Shear Modulus, LW②⑦	—	10^6 psi	0.425
		10^3N/mm^2	2.93
Short Beam Shear, LW⊕∅	D2344	psi	4,500
		N/mm^2	31
Ultimate Bearing Stress, LW	D953	psi	30,000
		N/mm^2	207
Poisson's Ratio, LW∅	D3039	in/in	0.33
		mm/mm	0.33
Notched Izod Impact, LW	D256	ft-lbs/in	25
		J/mm	1.33
Notched Izod Impact, CW	D256	ft-lbs/in	4
		J/mm	0.214
Barcol Hardness℘	D2583	—	45
24 HR Water Absorption⊗	D570	% Max by wt	0.6
Density	D792	lbs/in^3	.062-.070
		10^{-3}g/mm^3	1.72-1.94
Coefficient of Thermal	D696	10^{-6}in/in/^{o}F	7
Expansion, LW∅		10^{-5}mm/mm/^{o}C	1.2
Thermal Conductivity∅	C177	BTU-in/ft^2/hr/^{o}F	4
		W (m • ^{o}K)	0.58
ELECTRICAL			
Arc Resistance, LW∅	D495	seconds	120
Dielectric Strength, LW∅	D149	KV/in	35
		KV/mm	1.38
Dielectric Strength, PF∩	D149	volts/mil	200
FLAMMABILITY ℘			
Tunnel Test 1/8" thickness	E-84	25 Max	
NBS Smoke Chamber 1/8" thickness	E-662	650-700 (typical)	
Flammability 1/8" thickness	UL 94	V0	
Flammability	D635	Self Extinguishing	
UL Thermal Index	Generic	130^{o}C	
British Fire Test	BS 476-7	Class 1	

All values are minimum ultimate properties from coupon tests except as noted.
ℵ This value is determined from full section simple beam bending of EXTREN® structural shapes.
ℑ The Shear Modulus value has been determined from tests with full sections of EXTREN® structural shapes. (See the Strongwell *Design Manual* for further information.)
ℜ Plate compressive stress/modulus measured edgewise and flexural stress/modulus measured flatwise.
℘ Values apply to Series 525 and 625.
⊗ Measured as a percentage maximum by weight.
⊕ Span to depth ratio of 3:1; EXTREN® angles will have a minimum value of 4,000 psi and the I/W shapes are tested in the web.
∅ Typical values because these are shape and composite dependent tests.
∩ This is a typical value which varies with composite thickness.

LW = Lengthwise
CW = Crosswise
PF = Perpendicular to laminate face
N.T. = Not Tested

2.04 FRP LADDERS AND CAGES

A. Performance Requirements

1. Ladder and cage systems shall meet the requirements set forth in OSHA 1910.27.

B. Materials

1. The side rails and cage straps shall be fiberglass reinforced pultruded polyester with OSHA safety yellow pigment. As an option, an industrial grade polyurethane yellow coating may be applied to the finished ladder and cage. Other colors are available as an option.

2. The side rails shall be 2” (50.8mm) square tube with a wall thickness of .156” (3.81mm) or greater. The rungs shall be pultruded 1.25” (31.8mm) diameter FRP fluted tube.

3. Cage hoops shall be manufactured by the open mold hand lay-up process with a width of 3” (7.62mm) and thickness of 1/4” (6.4mm) minimum at the top and bottom and 2” (50.8mm) x 1/4” (6.4mm) at the intermediate hoops. The cage shall be interconnected with 2” (50.8mm) x 3/16” (4.76mm) pultruded straps spaced 9” (229mm) on center around the hoop.

4. Fiberglass pultruded rails, cage straps, fluted tube and cage hoops to be manufactured by Strongwell.

C. Fabrication Requirements

1. If required, all joints and rungs shall be epoxied and riveted. The hoops shall be attached to the rails in a manner which provides hand clearance throughout the length of the ladder.

2. Ladders shall be shop assembled, and as an option may be pre-drilled and prepared for field attachments of standoff clips.

3. The ladder cages shall be shipped assembled or as an option may be shipped unassembled for field assembly using rivets or bolts.

D. Workmanship

1. If required, all cut or machined edges, holes and abrasions shall be sealed with a resin compatible with the resin matrix used in the structural shape.

E. Approved Fabricators

1. Strongwell

2. Approved Equal

F. Installation

1. All FRP ladder sections shall be installed as shown on the approved shop drawings.

PART 3 E X E C U T I O N

3.01 PREPARATION

A. Coordinate and furnish anchorages, setting drawings, diagrams, templates, instructions and directions for installation of anchorages, including concrete inserts, sleeves, anchor bolts and miscellaneous items having integral anchors that are to be embedded in concrete or masonry construction. C oordinate delivery of such items to project site.

B. Set sleeves in concrete with tops flush with finish surface elevations; protect sleeves from infiltration of water and debris.

3.02 INSPECTION AND TESTING

A. The Design Engineer shall have the right to inspect and test all materials to be furnished under these specifications prior to their shipment from the point of manufacture.

B. All labor, power, materials, equipment and appurtenances required for testing shall be furnished by the Contractor at no cost to the Owner.

3.03 INSTALLATION, GENERAL

A. Fastening to in-place construction: Provide anchorage devices and fasteners where necessary for securing miscellaneous FRP fabrications to in-place construction; include threaded fasteners for concrete and masonry inserts,

toggle bolts, through-bolts, lag bolts and other connectors as determined by the Design Engineer.

B. Cutting, fitting and placement: Perform cutting, drilling and fitting required for installation of miscellaneous FRP fabrications. Set FRP fabrication accurately in location, alignment and elevation; with edges and surfaces level, plumb, true and free of rack; measured from established lines and levels.

C. Provide temporary bracing or anchors in form work for items that are to be built into concrete masonry or similar construction.

3.04 ALL FRP INSTALLATION

A. If required, all field cut and drilled edges, holes and abrasions shall be sealed with a catalyzed resin compatible with the original resin as recommended by the manufacturer.

B. Install items specified as indicated and in accordance with manufacturer's instructions.

END OF SECTION

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SECTION 09900

PAINTING

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Surface preparation and field painting application.

B. Shop preparation and shop prime coating when specified in other Sections of these Specifications.

C. A free choice of manufacturer's standard factory mixed or mechanically proportioned intermixed colors. A color schedule will be furnished after manufacturer of material has been selected.

1.02 UNIT PRICES

A. No separate payment will be made for Painting under this Section. Include payment in Lump Sum for Lift Station with price breakdown included in the Schedule of Values.

B. Refer to Section 01270 - Measurement and Payment and Section 01292 - Schedule of Values.

1.03 REFERENCES

A. ASTM D16 – Standard Terminology for Paint, Related Coatings, Materials and Applications. Definitions of Terms Rating to Paint, Varnish, Lacquer, and Related Products.

B. ASTM D2016 – Standard Test Methods for Moisture Content of Wood.

C. National Paint and Coatings Association (NPCA) - Guide to U.S. Government Paint Specifications.

D. Painting and Decorating Contractors of America (PDCA) - Painting - Architectural Specifications Manual.

1.04 DEFINITIONS

A. Conform to ASTM D16 for interpretation of terms used in this Section.

1.05 SUBMITTALS

A. Submit under provisions of Section 01330 - Submittal Procedures.

B. Product Data: Provide data on all finishing products.

C. Inspection Devices: Furnish inspection devices, in good working conditions for the detection of holidays, and the measurement of coating thickness (wet and dry).

D. Provide mask, gloves and other protective materials, and/or clothing recommended by the paint manufacturer.

E. Provide special, temporary, ventilation required by the paint manufacturer.

1.06 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum 10 years documented experience.

B. Applicator: Company specializing in performing the work of this section with minimum 5 years documented experience approved by manufacturer.

1.07 REGULATORY REQUIREMENTS

A. Conform to applicable locally adopted codes for flame and smoke rating requirements for finishes.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect, and handle products to site under provisions of Section 01610 - Basic Product Requirements.

B. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.

C. Container label to include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.

D. Store paint materials at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F in ventilated area, and as required by manufacturer's instructions.

1.09 ENVIRONMENTAL REQUIREMENTS

E. Do not apply material when surface and ambient temperature are outside the temperature ranges required by the paint product manufacturer.

F. Do not apply exterior coatings during rain or snow, or when relative humidity is outside the humidity ranges required by the paint product manufacturer.

G. Minimum Application Temperature for Latex Paints: 45 degrees F for interiors; 50 degrees F for exterior; unless required otherwise by manufacturer's instructions.

H. Minimum Application Temperature for Varnish Finishes: 65 degrees F for interior or exterior, unless required otherwise by manufacturer's instructions.

I. Provide lighting level of 80 ft candles measured mid-height at substrate surface.

1.10 EXTRA MATERIALS

A. Furnish under provisions of Section 01770 - Closeout Procedures.

B. Provide 3 gallons of each color of each coating of material specified for City's maintenance use. Provide in individual gallon quantities.

C. Label each container with manufacturer's name, product number, color number, date and name and number of building rooms where used, equipment or piping coated, etc.

PART 2 P R O D U C T S

2.01 MANUFACTURERS

A. See Schedule in Part 3 for manufacturers, types, surfaces by exposure to be painted, the paint system to use and minimum dry mil thickness.

B. The following manufacturers (with the abbreviated name used in the Painting Schedule) are approved for use. Use the products of only one manufacturer.

1. Devoe & Reynolds Co. (Devoe).

2. Pittsburgh Paints, (PPG).

3. Pratt and Lambert, Inc. (P&L).

4. The Valspar Corporation, (Valspar).

5. The Sherwin Williams Co.,(Sherwin).

C. Products of a manufacturer other than those named may be accepted if proof is submitted, prepared by an independent testing laboratory, that the products, item by item, are the same generic type and equal to those specified in composition, durability, utility, coverage, and appearance for the intended use.

2.02 MATERIALS

A. Coatings: Ready mixed, except field catalyzed coatings. Process pigments to a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating; good flow and brushing properties; capable of drying or curing free of streaks or sags.

B. Accessory Materials: Linseed oil, shellac, turpentine, paint thinners and other materials not specifically indicated but required to achieve the finishes specified, of commercial quality.

C. Patching Materials: Latex filler.

D. Fastener Head Cover Materials: Latex filler.

PART 3 E X E C U T I O N

3.01 EXAMINATION

A. Verify site conditions.

B. Verify that surfaces and substrate conditions are ready to receive work as instructed by the product manufacturer.

C. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.

D. Test shop applied primer for compatibility with subsequent cover materials.

E. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:

1. Plaster and Gypsum Wallboard: 12 percent.

2. Masonry, Concrete, and Concrete Unit Masonry: 12 percent.

3. Interior Wood: 15 percent, measured in accordance with ASTM D2016.

4. Exterior Wood: 15 percent, measured in accordance with ASTM D2016.

5. Starting work constitutes acceptance (on the Contractor's part) of conditions and substrates and full responsibilities for the quality and suitable for the finished work.

3.02 PREPARATION

A. Remove or mask electrical plates, hardware, light fixture trim, escutcheons, and fittings prior to preparing surfaces or finishing.

B. Correct defects and clean surfaces which affect work of this section. Remove existing coatings that exhibit loose surface defects.

C. Seal with shellac and seal marks which may bleed through surface finishes.

D. Impervious Surfaces: Remove mildew by scrubbing with solution of tri-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.

E. Gypsum Board Surfaces: Fill minor defects with filler compound. Spot prime defects after repair.

F. Concrete and Unit Masonry Surfaces Scheduled to Receive Paint Finish: Remove dirt, loose mortar, scale, salt or alkali powder, and other foreign matter. Remove oil and grease with a solution of tri-sodium phosphate; rinse well and allow to dry. Remove stains caused by weathering of corroding metals with a solution of sodium metasilicate after thoroughly wetting with water. Allow to dry.

G. Interior Wood Items Scheduled to Receive Paint Finish: Wipe off dust and grit prior to priming. Seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after primer has dried; sand between coats.

H. Exterior Wood Scheduled to Receive Paint Finish: Remove dust, grit, and foreign matter. Seal knots, pitch streaks, and sappy sections. Fill nail holes with tinted exterior caulking compound after prime coat has been applied.

3.03 APPLICATION

A. Apply products in accordance with manufacturer's instructions.

B. Do not apply finishes to surfaces that are not dry.

C. Apply each coat to uniform finish.

D. Apply each coat of paint slightly darker than preceding coat unless otherwise approved.

E. Sand surfaces required lightly between coats to achieve required finish.

F. Vacuum clean surfaces free of loose particles. Use tack cloth just prior to applying next coat.

G. Allow applied coat to dry before next coat is applied.

H. Prime concealed surfaces of interior and exterior woodwork with primer paint.

3.04 FIELD QUALITY CONTROL

A. Field inspection and testing will be performed under provisions of Section 01450 - Contractor's Quality Control.

B. Test questionable coated areas.

3.05 CLEANING

A. Clean work under provisions of 01770 - Closeout Procedures.

B. Collect waste material which may constitute a fire hazard, place in closed metal containers and remove daily from site.

3.06 DECORATIVE COATINGS SCHEDULE

A. Interior Concrete Masonry Units.

1. Step one: Remove dust, mortar drippings, and other foreign matter.

2. Step two: Apply one of following alkyd system with the block filler indicated in sufficient coats and mill thickness to provide a uniform smooth surface.

a. Devoe:

1) 52901 De-Vo-Ko Bloxfil Latex Block Filler, tinted.

2) One coat 23xx Velour Alkyd Eggshell Enamel, roller stippled, 1.7 mils.

b. PPG:

1) Masonry Block Filler No. 6-7.

2) One coat 50-65 Snolite Alkyd Stippling Eggshell, roller stippled, 1.9 mils.

c. P & L:

1) Primafil 200.

2) One coat Vitra-Shield, roller stripped,2.0 mils.

d. Valspar:

1) 79-W-8 Latex Block Filler, white or tinted if needed.

2) One coat 31 Series Semi-Gloss Enamel, 2.0 mils dry.

e. Sherwin:

1) Heavy Duty Block Filler, B42 W46, not tinted.

2) One coat Pro-Mar Alkyd Eg-Shel Enamel, B33 W100, 2 mils.

B. Drywall

1. Step one: Spackle all scratches, nail holes, dents, and other abrasions. When dry, sand sand surfaces smoothe and vacuum clean.

2. Step two: Apply one of the following alkyd systems.

a. Devoe: 4.8 mils system

1) One coat 50801 Devoe Vinyl Primer, 0.8 mil.

2) Two coats 21xx Velour Alkyd Flat Interior, 2 mils each.

C. Interior Wood Painted

1. Step One. Sand smooth, shellac knots and pitch streaks, fill holes, dents, joints, cracks, and irregularities with linseed oil putty. Sand smooth.

2. Step two: Apply one coat of one of the following primers.

a. Devoe: 51701 Wonder-Tones Acrylic Latex Enamel Undercoat, 1.5 mil.

b. PPG: 6-6 Quick Dry Enamel Undercoat, 1.4 mils.

c. P & L: Interior trim primer, 1 mil.

d. Valspar: Alkyd First Coater 17-W-4, 2 mils dry.

e. Sherwin: Wall and Wood Primer B49 W 2, 2 mils.

3. Step three: Apply two coats of same paint as adjacent walls.

D. Exterior Wood

1. Step one: Sand smooth, shellac knots and pitch streaks, fill holes, dents, joints, cracks, and irregularities with linseed oil putty. Sand smooth.

2. Step two: Apply one of the following alkyd enamel systems.

a. Devoe: 4.7 mils system

1) One coat 1102 All Weather Alkyd House Paint Primer, 2.3 mils.

2) Two coats 70xx Mirrolac Alkyd Urethane Gloss Enamel,1.2 mils each.

b. PPG: 6 mils system

1) One coat 6-9 Speedhide Wood Primer-Exterior, 2 mils.

2) Two coats Speedhide Exterior-Interior Alkyd Gloss Enamel, 2 mils each.

c. P & L: 4.75 mils system

1) One coat Permalize Exterior Primer, 2.25 mils.

2) Two Coats Effecto Enamel, 1.25 mils each.

d. Valspar: 5 mils system

1) One coat Alkyd First Coated 17-W-4, 2 mils dry.

2) Two coats 12 Series Alkyd Enamel, 1.5 mils dry per coat.

e. Sherwin: 6.2 mils system

1) One coat A-100 Exterior Wood Primer Y24 W20, 2.2 mils.

2) Two coats Industrial Enamel B54 Series, 2 mils each.

3.07 SCHEDULE COLORS

A. The City Engineer will prepare color schedule after award of Contract.

END OF SECTION

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SECTION 11206

HYDROPNEUMATIC TANK

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. All labor, materials, equipment and accessories to provide, install and test an aboveground protected steel, ASME, hydropneumatic tank and compressed air system for the in-plant non-potable water system (NPWS) as shown on the Drawings and specified herein.

1.02 MEASUREMENT AND PAYMENT

A. Unless noted in the Bidsheet, no separate payment will be made for work under this Section. Include payment for applicable work as noted on the Bidsheet.

B. Refer to Section 01270 – Measurement and Payment.

1.03 RELATED WORK

A. Section 00700 – General Conditions

B. Section 01330: Submittals

C. Section 01610: Basic Product Requirements

D. Section 03310: Structural Concrete

E. Section 05520 Aluminum Handrails and Guardrails

F. Section 09900: Painting

G. Electrical and Instrumentation Specification Sections as required

1.04 REFERENCES

A. ASTM SA516 GR 70, Carbon Steel.

B. ASTM SA106 GR B and SA105 for nozzle and flanges.

C. Underwriters Laboratories (UL) Standard 142, 1746.

D. NSF Standard 6.1.

E. ASME Section VIII, Division 1, 2010 Edition, 2011 Addenda.

F. National Fire Protection Association (NFPA) 22, Standard for Water Tanks for Private Fire Protection

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications

1. Manufacturer regularly engaged in manufacturing of hydropneumatic tanks and equipment in the United States for not less than 20 years.

2. The manufacturer of the tank shall have a quality management system in place and shall be ISO 9001 certified.

3. Provide materials that are new, of high grade and with properties best suited to the Work required.

4. All equipment, accessories and materials shall be supplied by the same manufacturer for equipment compatibility and complete functioning system responsibility.

1.06 WARRANTY

A. Provide warranty under provisions of Specification Section 00700 – General Conditions and 01770 – Closeout Procedures.

B. The manufacturer shall warrant that the equipment is free of defects in material and workmanship under normal use and service, and when properly installed. The manufacturer shall repair or replace such equipment or any part thereof furnished by the manufacturer and found defective after inspection by the manufacturer excepting only those items that are normally consumed in service.

C. The manufacturer shall provide written document to the City of Houston that warrants 100 percent of parts and labor for at least 24 months from the date of substantial completion as defined in the Contract Documents. Warranty shall be in printed form and previously published as the manufacturer's standard warranty for the manufactured products.

1.07 SUBMITTALS:

A. Conform to the requirements of Section 01330 – Submittal Procedures.

B. Submit shop drawings including plan and section views of the tank and associated features, product data and information required to establish compliance with the Section. The section view shall clearly identify elevations/clearances of all equipment, including all critical dimensions and show locations of all fittings and accessories including manways, vents, tank overflow lines, suction connection and piping, tank fill lines, test header refill lines, heaters, supervisory switches, float valves and access manway. Construction shall be governed by the drawings and specifications showing general dimensions and construction details. Where deviations from this specification are proposed, the manufacturer shall submit a list of deviations and provide a detailed description and explanation for each deviation.

C. Shop Drawings and Product Data: Submittals shall include the following:

1. Certified shop and working drawings
2. Descriptive literature, bulletins and/or catalog cuts of the equipment.
3. Operating and maintenance instructions and parts lists
4. Shop drawing data for accessory items including the compressed air system
5. Templates or certified setting plans, with tolerances for anchor bolts
6. Field inspection/testing reports
7. A list of the manufacturer's recommended spare parts
8. Recommendations for short and long term storage
9. Shop and field testing procedures and equipment to be used
10. Tag numbers for all equipment
11. Special tools

D. Operations and Maintenance Data

1. Furnish Operation & Maintenance (O&M) Manuals per Section 01782 prepared specifically for the supplied equipment. The O&M Manual shall include all required section drawings, approved Shop Drawings, parts lists, protective coatings, recommended spare parts, operation

instructions, maintenance instructions, etc., that are required to instruct operating and maintenance personnel unfamiliar with this equipment.

2. Provide two (2) preliminary copies of the O&M Manual in 3-ring binders including all required data.

3. Four (4) copies of the Final O&M Manuals bounded in D-ring binders shall be submitted for final acceptance of the installed system. One copy shall be submitted for review and returned with comments and three (3) copies shall be submitted as final. The Final O&M Manuals shall include all required data, as-built drawings with field modifications and/or corrections, and manufacturer's certifications including inspection, testing and start-up completion reports. Each Final O&M Manual shall include attached an electronic copy of all the O&M Manual data in portable document files (PDF) on a computer disc (CD) with the content bookmarked for easy search.

4. Exterior Aluminum Stairs, Platform and Railing Shop/Erection Drawings. Prior to purchase or fabrication, submit shop drawings and erection drawings for approval in accordance with the requirements of Section 01300 Submittals. Provide complete details of fabrication, assembly, and erection including at a minimum; sizes of all members, fastenings, supports and anchors, patterns, clearances, and all necessary connections to work of other trades. The Contractor shall provide the structural design, drawings and calculations, signed and sealed by a structural engineer registered in the state of Texas, for all aluminum exterior stair assemblies shown on the Contract Drawings unless otherwise noted. Stair design shall meet all applicable codes and regulations including but not limited to the Standard Building Code, O.S.H.A. and N.F.P.A. Live loads for stair treads shall be a minimum of 100 psf. Railings shall withstand a minimum 200 pound force from any direction. Fiber stress shall not exceed that allowed by the Aluminum Association. Quality of stairs, railings, grates, posts and caps, shall be equal to Thompson Fabricating Company.

PART 2 P R O D U C T S

2.01 SINGLE-WALL ABOVEGROUND ASME PRESSURE TANKS

A. Loading Conditions – Tank shall meet the following design criteria:

1. Maximum allowable working pressure shall be 100 psi @ 140° F with a 4:1 Safety factor.

2. Welds to Bigbee Steel Weld procedures and ASME Section XIII, Division I requirements with 5% joint efficiency. Butt weld design welded internal and externally. Circumferential and longitudinal weld seams shall be automatically sub-arc welded. Internal welds shall be ground to a smooth radius, free of any sharp edges or surfaces. Welds shall be hydrostatically tested.

3. Provide UL 142 rated saddles (2) engineered for the tank as specified on the drawings. Saddles shall provide 6” clearance under tank with 4-1 1/8” diameter 316 SS bolts holes to secure tank to hold down system.

B. Product Storage:

1. Tank shall be capable of storing chlorinated, non-potable effluent (reuse) water.

2. Tank shall be properly vented.

3. Tank shall be capable of storing products identified in the manufacturer’s current standard warranty.

2.02 MATERIALS:

A. Provide UL 142 rated saddles (2) engineered for the tank as specified on the drawings. Saddles shall provide 6-inch clearance under tank with 4-1 1/8-inch diameter 316 SS bolts holes to secure tank to hold down system.

B. Coatings: The Pressure Vessels coating system shall be in strict accordance with Underwriters Laboratories Inc. Subject UL-1746 Standard for External Corrosion Protection Systems for Steel Aboveground Storage Tanks.

1. External surfaces commercial grit blast SP-6, coated and sprayed with 15mils DFT self-reinforcing polyurethane primer and top coating.

2. Internal surfaces grit blasted to SSPC-SP10 white metal grade profile and vacuumed clean. Internal surfaces internally lined for HighDRO Liner Plus water service to a minimum dry film thickness of 15 mils after curing.

C. Tank Dimensions: Tank shall have nominal capacity of 5,000 gallons, a nominal outside diameter of 84-inches with steel thickness to be 3/8-inch shell and 3/8-inch head.

2.03 Accessories

A. UL Saddles: Saddles shall be protected steel, sized based on diameter of tank, as supplied by tank manufacturer. Number and location of saddles shall be specified in current literature by tank manufacturer.

B. Manways: Manways shall be protected steel, sized based on diameter of tank, as supplied by tank manufacturer. The number and location of saddles shall be specified in current literature by tank manufacturer.

C. Stairway and Platform: Provide an OSHA 0910 compliant stairway and platform as shown on the drawings and described herein.

D. Fill Tube/Return Line: Drop/fill tubes shall be coated carbon or stainless steel and shall terminate per Drawings. Size shall be as shown on Drawings.

E. Fittings Schedule: All fittings shall be raised face screw on type (RFSO). Nozzle and flange components shall be mild carbon steel to SA106 GR B, C and SA 105.

1. All flanged fittings shall conform to ANSI B16.5 150# bolting pattern. Fittings shall be called out on individual drawings and include but not limited to the following:

a. Side manway

b. Outlet/inlet

c. As shown on the Drawings

2.04 TANK MANUFACTURERS

A. Acceptable manufacturers:

1. Highland Tank

2. Or Approved Equal

2.05 COMPRESSED AIR TANK CHARGING SYSTEM

A. Contractor shall provide a tank mounted, self-contained compressed air charging system comprised of an oilless air compressor, encapsulated solid state liquid level switch with an isolated, stainless steel electrode circuit and integral time delay and pressure switch. The system shall be enclosed in a weatherproof, fiberglass cover and mounted where shown on the Drawings. The compressor motor shall be 115/230 V continuous duty with thermal protection. The assembly shall be installed on top of the hydropneumatic tank in accordance with the manufacturer's instructions. Acceptable manufacturer is Air Rite by Whitewater, Model 610 HP, or equal.

PART 3 E X E C U T I O N

3.01 INSTALLATION AND TESTING

A. Installation shall be in strict accordance with the manufacturer's instructions and recommendations in the locations shown on the Drawings. Installation shall include furnishing the required oil and grease for initial operation. The grades of oil and grease shall be in accordance with the manufacturer's recommendations. Anchor bolts shall be set in accordance with the manufacturer's recommendations.

3.02 FIELD PAINTING

A. Per Specification Section 09900.

B. Only touch up painting shall be performed in the field.

3.03 FIELD SERVICE

A. Provide the services of a tank manufacturer's factory trained representative for a total of one (1) trip of one (1) day to provide start up assistance and instruction on the proper operation of the equipment to the Owner's personnel.

3.04 TESTING AND INSTALLATION

A. The tank and compressor system shall be tested according to industry standards and manufacturers' procedures.

B. The tank and compressor shall be installed according to manufacturer's directions. Contractor shall be trained by the tank manufacturer, the state or other approved agency. Contractor shall make all adjustments necessary to provide for proper operation and full functionality.

3.05 CONTROLS INSTALLATION

A. Instrumentation, wiring and conduits for electrical power and controls shall be provided per specification under Division 13 – Special Construction and Division 16 – Electrical.

END OF SECTION

SECTION 11280

STAINLESS STEEL FABRICATED SLIDE GATES

PART 1 G E N E R A L

1.01 SUMMARY

A. The Contractor shall furnish all labor, materials, equipment and incidentals required to install and ready for operation stainless steel slide gates and operators as shown on the Contract Drawings and as specified herein. The equipment provided under this section shall be fabricated, assembled, erected and placed in proper operating condition in full conformity with the drawings, specifications, engineering data, instructions and recommendations of the equipment manufacturer unless exceptions are noted by the Engineer. All of the gates and operators shall be provided by the gate manufacturer.

1.02 MEASUREMENT AND PAYMENT

A. Unless noted in the Bid Form, no separate payment will be made for work under this section. Include the cost for this work in the lump sum base bid.

B. Refer to Section 01270 – Measurement and Payment

1.03 SUBMITTALS

A. The manufacturer shall submit for approval by the Engineer, drawings showing the principal dimensions, general construction and materials used in the gate and lift mechanism.

B. Conform to requirements of Section 01330 – Submittal Procedures

Submittals shall include as a minimum:

1. Shop Drawings
2. Manufacturer’s operation and maintenance manuals and information.
3. Manufacturer’s installation certificate.
4. Manufacturer’s equipment warranty.
5. Manufacturer’s performance affidavit.

1.04 WARRANTY

A. Warranties shall conform to requirements of 00700 – General Conditions.

1.05 QUALITY ASSURANCE

A. Qualifications

1. All of the equipment specified under this Section shall be furnished by a single manufacturer with a minimum of 20-years of experience designing and manufacturing slide gates. The manufacturer shall have manufactured stainless steel slide gates for the type described herein for a minimum of 100 projects. The manufacturer's shop welds, welding procedure and welders shall be qualified and certified in accordance with the requirement of the latest edition of ASME, Section IX.

2. The specification is based on the SS-250 Series (SS-250-1 or SS-251-1-Y) Fabricated Slide Gate as manufactured by Waterman Industries of Exeter, California or approved equal.

3. Gates shall be shop inspected for proper operation before shipping.

4. The manufacturer shall have a quality control process in place to ensure gates provided are in compliance with all applicable AWWA standards.

PART 2 EQUIPMENT

2.01 GENERAL

A. The gates shall be either self-contained with yoke and bench stand operators, or non-self-contained with separate stem guides and operator, in accordance with the requirements of these specifications and the gate schedule.

B. This gate is in compliance with the latest version of AWWA C 561.

C. Specific configurations shall be as noted on the gate schedule or as shown on the plans.

D. Materials:

Components	Materials
Frame, Cover Slides, Yokes	Stainless steel: ASTM A 276 and/or ASTM A 240, AISI Type 316L as specified or as shown on gate schedule
Stems	Stainless Steel: ASTM A 276, AISI Type 316L, as specified

Stem Cover	Polycarbonate ASTM D-3935
Fasteners and Anchor Bolts	Stainless Steel: ASTM F 593 and 594, Type 316 CW, as specified
Flush bottom Seals, Compression Cord	Rubber: A STM D 2000 BC 615/625 Grade BE 625
Seat/Seals , Stem Guide Liner	Ultra High Molecular Weight Polyethylene (UHMW)
Finish	Mill finish on all stainless steel surfaces.
Pedestal, hand wheel, crank	Tenzaloy aluminum fabricated steel or CI with a polyamide epoxy coating
Gasket (between frame and wall)	Non-shrink grout or Neoprene
Lift nut, couplings	Manganese bronze ASTM B584 UNS-C86500

2.02 FRAME AND GUIDES

A. The gate frame shall be constructed of structural members or formed plate welded to form a rigid one-piece frame. The frame shall be of the flange back design suitable for mounting on a concrete wall (CW), concrete wall with extra wide flange (CWX), or a standard flange (SF) as required to avoid conflicts with existing anchors.

B. The gate frame shall be composed of stainless steel guide rails with UHMW seat/seals upstream and downstream. The seat/seals shall form a tight seal between the frame and the slide (disc). The top seal shall be a wiper type seal equal to the Waterman Guardian Seal ™.

1. The UHMW seats will impinge on the slide (disc) by way of a continuous loop neoprene seal. Seal designs incorporating neoprene or other resilient side and top seals in direct contact with the slide are not acceptable.

2. The neoprene seal will perform the function of a seal between the frame and the UHMW as well as a spring force to maintain contact between the UHMW and the slide (disc).

3. The gates shall be substantially water tight under the design head conditions. This tight seal shall provide an allowable leakage rate of no more than .05 gallons per minute (GPM) per peripheral foot of perimeter opening for seating head and unseating heads.

4. The gates sealing system should have been tested through a cycle test in an abrasive environment and should show that the leakage requirements are still obtained after 25,000 cycles with a minimum deterioration.

C. Stainless steel retainer bars, cross bars and head rails (or yoke for self-contained gates only) shall be provided. The maximum deflection of the yoke shall not exceed 1/360 of the yoke span.

1. The clear opening shall be the same size as the waterway, unless otherwise specified.

2. The guides will be of sufficient length to support ½ of the height of the slide when in the full open position.

2.03 SLIDE COVER (DISC) AND STEM

A. The slide cover (disc) shall be stainless steel plate reinforced with structural shapes welded to the plate.

1. The slide cover shall not deflect more than 1/720th of the span, or 1/16” at the sealing surface of the gate under maximum specified head.

2. The stem connection shall be either the clevis type, with structural members welded to the slide and a bolt or bolts to act as a pivot pin, or a threaded and bolted (or keyed) thrust nut supported in a welded nut pocket.

3. The clevis or pocket and yoke of the gate shall be capable of taking, without damage, at least twice the rated thrust output of the operator at 40 pounds of pull on a hand wheel or hand crank. The stem shall have a slenderness ratio (L/r) less than 200. The threaded portion of the stem shall have machined cut thread of the Acme type. Where an electric operator is used, the stem design force shall not be less than 1.25 times the output thrust of the electric motor in the stalled condition.

4. Rising stem gates shall be provided with a clear polycarbonate stem cover. The stem cover shall have a cap and condensation vents and a clear mylar position indicating tape. The tape shall be field applied to the stem cover after the gate has been installed and positioned.

2.04 FLUSHBOTTOM CLOSURE

A. Gates shall be furnished with a flush seal arrangement. A resilient seal with a minimum width of exposed face of 1-3/8” shall be securely attached to the frame

along the invert, and shall extend to the depth of the guide groove. The resilient seal extrusion shall be constructed to be ribbed and self-retaining. Invert seal designs that require mechanical retention are not allowed.

2.05 ANCHOR BOLTS

A. Anchor hardware shall be provided by the slide gate manufacturer.

1. The size, quantity and location of the anchor hardware will be determined by the slide gate manufacturer.

2. Anchor hardware consisting of studs, nuts and w ashers shall be provided by the manufacturer.

PART 3 E X E C U T I O N

3.01 EXAMINATION

A. Installation of the slide gates shall be done in a workmanlike manner. It shall be the responsibility of the CONTRACTOR to handle, store, and install the equipment specified in this Section in strict accordance with the Manufacturer's recommendations.

B. The CONTRACTOR shall review the installation drawings and installation instructions prior to installing the slide gates.

C. The slide gate frames shall be installed in a true vertical plane, square and plumb, with no twist, convergence or divergence between the vertical legs of the guide frame.

D. The CONTRACTOR shall fill any void between the guide frames and the structure with non-shrink grout as shown on the installation drawing and in accordance with the grout manufacturer's recommendations.

3.02 FIELD TESTING

A. After installation, all slide gates will be field tested in the presence of the ENGINEER and OWNER to ensure that all items of equipment are in full compliance with this Section. Each slide gate assembly shall be water tested by the CONTRACTOR at the discretion of the ENGINEER and OWNER, to confirm that leakage does not exceed the specified allowed leakage.

B. Following the completion of each gate installation, the gates shall be operated through at least two complete open/close cycles. If an electric operator is used, limit switches shall be adjusted following the manufacturer's instructions.

END OF SECTION

SECTION 11285

FRP/ENGINEERED COMPOSITE SLIDE GATES

PART 1 G E N E R A L

1.01 SUMMARY

A. This Section includes all Slide Gates complete with all necessary parts and accessories required for the complete installation of the work. They shall be fabricated, assembled, and placed in proper operating condition in accordance with the plans and specifications, and in full conformity with installation instructions and recommendations of the equipment manufacturer. Equipment shall be the latest product design of a manufacturer regularly engaged in the production of equipment of this type.

1.02 MEASUREMENT AND PAYMENT

A. Unless noted in the Bid Form, no separate payment will be made for work under this section. Include the cost for this work in the lump sum base bid.

B. Refer to Section 01270 – Measurement and Payment

1.03 REFERENCES

A. Design, fabricate and test valves and materials in accordance with manufacturer's recommended procedures and the following codes and latest version of the standards:

1.	ASTM A193	-	Stainless Steel Anchor Bolts
2.	ASTM A276	-	Stainless Steel Bars
3.	ASTM B584	-	Alloy 865 Manganese Bronze
4.	ASTM D256	-	Izod Impact Strength
5.	ASTM D570	-	Water Absorption Rate
6.	ASTM D638	-	Tensile Strength
7.	ASTM D695	-	Compressive Properties of Rigid Plastic
8.	ASTM D696	-	Coefficient of Linear Expansion
9.	ASTM D790	-	Flexural Properties

10. ASTM D792 - Density and Specific Gravity at 230 C
11. ASTM D1056 - Polymer Grade
12. ASTM D2000 - Standard Elastomer Specification
13. ASTM D2563-0 - Visual Defects
14. ASTM D2583 - Indentation Hardness
15. ASTM D2584 - Resin, Glass & Filler Content
16. AWWA C-563 - Fabricated Composite Slide Gates
17. AWWA C-540 - Power Actuating Devices - Sluice Gates
18. NSF-61 - Potable Water

B. Composition of the slide gate laminate shall be in accordance with the recommendations shown in the Quality Assurance Report for Reinforced Thermoset Plastic (RTP) Corrosion Resistant Equipment prepared under the sponsorship of the Society of the Plastics Industry, Inc. (SPI), and the Material Technology Institute (MTI) of the Chemical Process Industry for "Hand Lay-UP Laminates," and shall meet the specifications for Type I, Grade 10 laminates shown in Appendix M-1 of said report.

C. Manufacturer shall be experienced in the design and manufacture of specific valves and accessories for a minimum period of 20 years.

D. Manufacturer must provide warranty for 25 years against corrosion.

1.04 SUBMITTALS

A. Submit the following as a minimum for acceptance:

1. Approval Drawings
    a. Showing all critical dimensions (Dimensional and Installation Shop Drawings).
    b. Showing principal parts and materials.
2. Spare parts list (when applicable).
3. Manufacturer's Operation and maintenance manuals and information.
4. Manufacturer's installation certificate

5. Manufacturer's equipment warranty.

6. Manufacturer's performance affidavit.

7. Quality Control Submittals include field leakage test reports, installation instructions and field performance test procedures.

1.05 WARRANTY

A. Warranties shall conform to requirements of 00700 – General Conditions

1.06 QUALITY DELIVERY, STORAGE AND HANDLING

A. Ship all gates with suitable packaging to protect products from damage.

B. Protect stems and operators from damage.

PART 2 P R O D U C T S

2.01 MATERIALS

A. Gate body shall be:

1. Engineered composite fiberglass reinforced plastic (FRP) completely encapsulating an internal steel reinforcing structure.

2. Molded to create a seamless corrosion barrier impervious to moisture.

3. FRP resin shall be polyester.

4. Internal Steel Reinforcing: Carbon Steel as needed for deflection requirements.

5. Internal Core Foam: 2lb (0.9kg) polyisocyanurate closed cell rigid foam.

B. Guide Frame

1. Head Frame: T-316L stainless steel

2. Guide Frame Rails: poly ester resin.

3. Operator Support Yoke: poly ester resin.

C. Stems and Gate Hardware

1. Stem: T-316L stainless steel

2. Gate Hardware: T-316L stainless steel.

D. Seals

1. Side, and Flush Bottom Seals: Hollow Bulb J Seal molded of extruded virgin neoprene / EPDM.

E. J-Seal Clamping Bar and Fasteners

1. Clamping Bar: T-316L stainless steel.

2. Fasteners: T-316L stainless steel.

F. Lift Nuts and Thrust Nuts

1. Manganese Bronze, ASTM B-584, Alloy 865.

G. Thrust Collar

1. T-316L stainless steel.

H. Hand wheel

1. Cast Iron, ASTM A-126, Class B.

I. Anchor Bolts

1. T-316L stainless steel

J. Stem Cover

1. Butyrate (manual hand wheel).

2. Clear PVC (Electric Motor Operators).

K. Stem Guides (When applicable)

1. UHMW-PE

2.02 SLIDE GATES

A. Acceptable Manufacturers:

1. Plasti-Fab Inc

a. Shall be Heavy Duty Tite Seal Slide Gates (HDTS) as shown on plans

2. Or approved equal. Pre-approved by Engineer at least 10 business days prior to bid date.

    a. Manufacturer must have a qualified Engineer on staff with at least 5 years experience with hydraulic control gates.

B. Performance Requirements

1. Leakage:

    a. Gates shall have a maximum leakage rate of 0.10 GPM per Wetted Foot (1.24 LPM/m) of wetted linear seal under seating and unseating head pressures and shall provide adjustment to zero leakage.(Per AWWA C-563)

2.03 DESIGN CRITERIA

A. Composition of the sluice gate laminate shall be in accordance with the recommendations shown in the Quality Assurance Report for Reinforced Thermostat Plastic (RTP) Corrosion Resistant Equipment prepared under the sponsorship of the Society of the Plastics Industry, Inc. (SPI) and the Material Technology Institute of the Chemical Process Industries, Inc. (MTI) for “Hand Lay-up Laminates” and shall meet the specifications for Type 1, Grade 10 laminates shown in Appendix M-1 of said report.

1. Visual inspection for defects shall be made without the aid of magnification and defects shall be classified as to type and level as shown in Table 1 of ANSI/ASTM D2563-0, approved 1977, (or any subsequent revision). Allowable surface tolerances are as follows:

DEFECTS	ALLOWABLE TOLERANCE
Cracks Crazing Blisters Chips Pits Dry Spots Fish Eyes Burned Areas Entrapped Air	None
Wrinkles and solid blisters, not to exceed 1/8”	Maximum Deviation: 10% of thickness
Surface porosity (pinholes or pores in the laminate surface)	None
Exposed Glass Exposure of cut edges	None
Scratches	None more than .002” deep (.05mm)

Foreign Matter	None

B. Maximum Fiber Stress

1. Ultimate or yield, whichever applies, does not exceed 2.5 times the working stress.

C. Deflection

1. Deflection across the gate width shall be limited to: L/360 or ¼" (6mm), whichever is less, at the maximum operating head.

D. Head Pressure

1. Gate shall be designed for a maximum head pressure of: 17feet

E. Gate Size (see Plans and Gate Schedule)

F. Surface Conditions

1. All slide gates shall be flat and level.

2. Warpage throughout the entire gate shall not produce a crown of more than 1/16" (1.6mm) in any direction.

3. Gates having reinforcing members bolted or bonded to flat sheet stock will not be acceptable.

G. Sealed Area

1. Sluice gate shall seal on bottom and sides.

H. Electric Motorized Actuators

1. Provide motorized actuators where shown on plans.

2. Actuator type and submittals shall be as specified in Section on Gate Electric Actuators (15103?).

3. Actuators and specified accessories shall be furnished, sized, and installed by the gate manufacturer/supplier. Suppliers shall assume sole source responsibility for power-operated assemblies.

4. Operators, actuators, and accessories shall be factory mounted and shipped as a complete assembly for the replacement gates.

5. When installing actuators on existing gates, provide floor stands, gear boxes, drive bushings, and all required work to interface with the existing gate. Install actuators in the field.

2.04 CONSTRUCTION

A. Gate Body

1. Slide gate body shall be manufactured of fiberglass reinforced polyester totally encapsulating an internal reinforcing structure.

2. Each gate shall be molded individually to the exact dimensions specified. Seams and joints in and on the body are not acceptable.

3. Slide gates shall be manufactured of reinforced thermoset plastic.

4. Gate body shall have UV Stabilizing pigment in the Resin to provide long-term protection from UV.

5. The surface shall be resin rich to a depth of .010 inches to .020 inches (.25 - .51mm) and reinforced with C-glass and/or polymeric fiber surfacing material.

6. The surface shall be free of exposed reinforcing fibers.

7. The composition of these layers shall be approximately 95% (by weight) resin. The remaining laminate shall be made up of copolymer composite and reinforcing fibers in a form, orientation and position to meet the mechanical requirements.

8. Structural reinforcing shall be utilized to attain the necessary stiffness to meet deflection requirements, and shall be well encapsulated with a laminate not less than 1/4” (6mm) thick on each side to ensure against any permeation by water to the core areas.

9. A T-316L stainless steel stem mounting bracket shall fasten to the gate with through bolts. The through holes shall not pass through or be in contact with the internal mild steel reinforcing.

10. Core material must be 100% resistant to decay and attack by fungus and bacteria and be resistant to hydrocarbons.

B. Seals

1. The gate shall be equipped with elastomeric seals to reduce leakage conforming to Section 2.02B.

2. Elastomeric J-seals shall be made of molded or extruded neoprene / EPDM having a hardness range of 55 to 65 shore A durometer and conforming to ASTM spec. D-2000 having a maximum compression set of 25%, and low temperature brittleness to meet suffix F-17 (-400).

3. Seals, including bottom seals, shall be mounted on guide (or gate) with T-316L stainless steel cap screws and T-316L stainless steel or FRP clamping bars.

C. Frames and Guides

1. Guides shall be styled for embedment / wall mounting / in-channel mounting as shown on the plans and/or gate schedule.

2. Guides shall be fabricated from vinyl ester resin T-316L stainless steel and shall have a slot suitable for mating with the gate body.

3. Where self-contained guides are extended above the operating floor level to form the bench stand upon which the lift mechanism is fastened, they must be suitably strong and rigid without the use of additional stiffening members.

4. The head rail shall be affixed so as to allow the gate to be removed from the guide without disassembly.

5. The head rail shall have a maximum deflection of 1/4" (6mm) when subjected to a horizontal force of four times the 40 lb. (2.8 ksc) maximum hand wheel pull.

6. Where a wall mounted guide frame extends above a concrete wall, the top anchor bolt shall be not more than 6" (152mm) below the top of the wall.

7. If the Gate width is greater than 2x the gate height, a tandem stem shall be used.

8. Guides to be bolted to the head wall shall be equipped with heavy duty mounting angle for ease of mounting to the channel wall by means of T-316L stainless steel anchor bolts.

9. The guide frame will have a 3/8" (9.5mm) x 2" (51mm) deep slot and shall have a minimum thickness of 1/4" (6mm).

10. All guides shall be factory assembled with bonded corners using contoured butt straps.

11. The corner shall be capable of withstanding a torque of 300 foot pounds (41.5kgf m) pull applied parallel to the gate slot in either direction.

12. No wall thimbles shall be required for installation.

D. Lifts & Operators

1. Operators shall be sized to start the gate moving under a maximum head pressure with a pull of not more than 40 lbs (2.8 ksc).

2. A manual hand wheel / crank shall be supplied that is compatible with the lift.

E. Electric, Operators

1. Gate Manufacturer shall provide actuators per Motor Operator Manufacturer's recommended sizes based on Operating Forces and design requirements and shall be for open/close service.

F. Operating Stems

1. Each slide gate shall be equipped with a rising / non-rising operating stem. The stem shall be T-316L stainless steel stainless steel.

2. The stem will have Acme threads and shall be provided with adjustable stop collars to limit upward and downward travel.

3. Stems shall have a maximum L/R of 200.

4. Stem guides with bronze or FRP bushings shall be used to maintain an L/R of 200.

G. Stem Covers

1. Transparent plastic stem covers shall be provided with vent holes to minimize condensation.

2. The stem covers shall be marked with `Open' and `Closed' position indicators.

H. Pedestals

1. For non self-contained guide frames a floor / wall mounted pedestal as shown on plans shall be furnished for mounting the operator.

2. Pedestal material shall be T-316L stainless steel.

3. Pedestal material shall be type T-316L stainless steel.

2.05 PHYSICAL PROPERTIES

A. Structural characteristics for a 1/8" (3mm) glass mat laminate shall meet the following minimum physical properties:

Tensile strength	15,000 psi (1034 ksc)
Flexural Modulus	1,000,000 psi (70307 ksc)
Flexural Strength	20,000 psi (1406 ksc)
Compressive Strength	22,000 psi (1547 ksc)
Impact Strength	9.0 ft-lbs/in. (1.24 kgf.m/25mm)
Water absorption	0.13% (in 24 hours)

B. Seals: Extruded Virgin Neoprene/ EPDM Seals shall have the following physical characteristics:

Specific Gravity	1.25
Hardness	55 – 65 Shore A Durometer
Tensile Strength	1500 psi min. (0.07ksc)
Elongation	300%
Low temperature brittleness	- 40^{o} F

PART 3 E X E C U T I O N

3.01 INSTALLATION

A. Thoroughly clean and remove all shipping materials prior to setting.

B. Install Gates per Manufacturer's recommendations.

C. Operate all gates from fully opened to totally closed.

3.02 FIELD TESTING

A. After installation, all slide gates will be field tested in the presence of the ENGINEER and OWNER to ensure that all items of equipment are in full compliance with this section. Each slide gate assembly shall be water tested by the CONTRACTOR at the discretion of the ENGINEER and OWNER, to confirm that leakage does not exceed the specified allowed leakage.

B. Qualified Factory representative shall provide (8) hours of training for facility employees.

C. Representative shall complete a Certification of Proper Installation and provide copies to the Owner, Engineer, Contractor and Manufacturing Facility.

END OF SECTION

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SECTION 11317

SUBMERSIBLE NON-CLOG CHOPPER PUMP EQUIPMENT

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. This section includes all labor, material, and equipment necessary to furnish the submersible Non-Clog Chopper Pumps and motors to pump solids from the existing scum accumulation box.

1.02 REFERENCES

A. ASTM A 48 - Specification for Gray Cast Iron Castings.

B. ANSI B 16.1 - Cast Iron Pipe Flanges and Flanged Fittings Class 125.

C. HIS - Hydraulic Institute Standards Test Code.

D. NEMA MG1 - Motors and Generators.

E. NFPA 70 - National Electrical Code (NEC).

F. SSPC SP6 - Commercial Grade Finish.

G. SSPC SP10 - Near White Finish

1.03 SUBMITTALS

A. Conform to the requirements of Section 01330 – Submittal Procedures.

B. Shop drawings showing arrangement, dimensions, and materials. Shop drawings need to be submitted within 14 days of award of the construction contract.

C. Characteristic performance curves for pumps, showing total dynamic head, pump runout, shutoff head, efficiency, brake horsepower, and net positive suction head required plotted against capacity in gpm. Include full curve from shutoff head to maximum capacity for all impeller sizes. Indicate operating point and impeller diameter being furnished.

D. Pump power consumption information, connection diagrams, and information on any necessary electrical control and protection devices as specified.

E. Motor Data.

F. Manufacturer's Certificate: Certify that products meet or exceed specified requirements. Certify that manufacturer of bowl assembly is supplier of column pipe, lineshafting and discharge head.

G. Operation and maintenance data according to Section 01782.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Receive and unload shipments to plant site from suppliers of equipment under this contract.

B. Unload equipment as soon as possible after arrival.

C. Pay freight car and truck demurrage, detention, and any other costs which may be billed to Owner due to failure to unload cars or trucks within time required by freight companies.

D. Provide physical protection for equipment placed in storage.

1. Support stored equipment above ground and cover with canvas or other heavy-duty sheeting. Cover shall be securely fastened and shall be replaced if torn or otherwise damaged during storage period.

2. Store motors in dry, warm place and in accordance with manufacturer's recommendations.

3. Maintain desiccant between cover and motor frames on motors. Provide desiccant of type permitting visual determination of condition of desiccant. Replace desiccant when it becomes ineffective.

4. Store the following items in weatherproof, heated (minimum 50 degrees F.) building complete with bins for storage of small pieces of equipment. Storage inside of existing treatment plant not available.

a. Electrical equipment with general purpose enclosures.

b. Insulation materials.

c. Rotating equipment.

d. Miscellaneous electronic equipment, gaskets, and small machined parts.

E. Inspect stored equipment weekly. Renew protective coatings as necessary to preserve fitness of equipment.

F. Provide for safekeeping of materials or equipment received. Store and maintain materials and equipment after receipt until completed installation is accepted by Owner. Such storage and maintenance shall be in accordance with manufacturer's recommendations and requirements of these Specifications. Provide materials, equipment, and labor required for such storage and maintenance.

G. Contractor shall be accountable for any deterioration of materials or equipment occasioned by improper storage or maintenance, and shall recondition, repair, or replace any such materials or equipment without additional cost to Owner.

1.05 SERVICE REPRESENTATIVE

A. Provide qualified service representative to perform functions described in Section 01450-Contractor’s Quality Control.

B. At the Engineer’s request, the manufacturer’s representative shall furnish a written report confirming the proper installation of the equipment. The report shall indicate that the equipment has been operated under full flow requirement conditions and that it operated satisfactory.

C. Include necessary trips by the manufacturer's representative to provide two separate 8-hour work days on-site (travel time not included) for startup and training of operations personnel. Training may be video taped by Owner.

D. Additional trips required by the Contractor before or after final startup and training shall not be charged to the Owner.

1.06 FACTORY TESTS

A. Hydraulic Performance Shop Test:

1. Factory test all pumps at manufacturer's plant. Perform tests in accordance with Test Code of Hydraulic Institute Standards (HIS). Pump test will not be witnessed by Owner or Engineer.

2. Test curves shall cover full range of operation from shutoff to maximum capacity; plot capacity as abscissa; plot operating head, brake horsepower, efficiency and NPSHR as ordinates. Conduct tests for variable speed

pumps at maximum and minimum operating speeds.

3. Test Points:

   a. Shutoff.

   b. Maximum pump runout.

   c. Design operating point.

   d. Two additional points, one on each side of the rated operating point.

4. Test Tolerances:

   a. Operate pumps during tests within one of the following tolerances:

      1) At rated head: +10% of the rated capacity.

      2) At rated capacity: +5% of the rated head.

   b. No minus tolerance or margin with respect to capacity or total head at rated or specified condition.

5. Provide shop space, tools, equipment, instruments, personnel, and facilities required for satisfactory completion of tests.

6. Payment for tests shall be included in Contract amount.

7. Submit test curves and allow Engineer's review prior to pump shipments.

B. Pump Tests:

1. Pump manufacturer shall perform following inspections and tests on pumps prior to shipment.

   a. Inspect for conformance to Contract Documents with respect to correct model number, motor rating, and electrical connections.

   b. Test motor and seal housing chambers for moisture content or insulation defects.

   c. Prior to submergence, allow pump to run dry to establish correct rotation and mechanical integrity.

d. Discharge piping attached to pump shall operate submerged under a minimum of 6 feet of water for a minimum of 30 minutes.

e. After operational test, motor and cable shall be tested again for moisture content or insulation defects.

2. Pumps failing inspection or tests shall be repaired or replaced at no cost to Owner.

1.07 QUALITY ASSURANCE

A. All pumps shall be products of single manufacturer.

B. Pump manufacturer shall be engaged primarily in design and fabrication of submersible pumps, including solids handling type pumps for wastewater service for at least the last 10 years.

1. Minimum of 100 similar units installed and operating successfully in U.S.

C. Control Systems manufacturer shall be engaged primarily in design and fabrication of control systems for wastewater pumping stations for at least the last 10 years.

1. Minimum of 100 similar units installed and operating successfully in U.S.

1.08 WARRANTY

A. Warranty shall conform to requirements of 00700-General Conditions.

PART 2 P R O D U C T S

2.01 SUBMERSIBLE PUMPS

A. Manufacturers:

1. Vaughn.

2. Hayward Gordon.

3. Flygt.

4. Engineer approved equivalent.

B. General

1. Furnish and install two (2) submersible chopper pumps,motors, and all appurtenances as indicated on Drawings. Units shall consist of submersible chopper pumps and motors, guide rails, lifting chains, discharge connection and mounting plate, anchor bolts, access frame and cover, electrical cables, and accessories for a complete operable system.

2. Service: See Pump Schedule at end of Section.

3. Rotation: Counter-clockwise, when viewed from the top of pump.

4. Pumps shall be suitable for continuous operation at flow conditions stated herein without excessive noise, vibration, heating, cavitation, or damage to pump.

5. Head characteristics for pumps: Continuously rising as flow is decreased. Shutoff head shall be minimum of 1.35 times rated head.

6. Pump, appurtenances, and cable shall be capable of continuous submergence underwater to depth shown on plans without loss of watertight integrity.

C. Pump Design

1. Type: Submersible arrangement with bottom suction, integral discharge mating with discharge connection and guide rails. Elbow type discharge connection.

2. Pumps shall be of a centrifugal chopper design, of heavy duty construction, intended for services requiring a combined chopping and pumping action on fluids with entrained solids.

3. Pumps shall be suitable for the following inlet conditions:

   a. Fluid: Domestic wastewater.

   b. Solids Type/Size: varies with unscreened wastewater.

   c. S.G.: 1.00.

   d. Temperature: Ambient deg-F

D. Casing

1. ASTM A-48 Cast Iron, Class 35B.

2. Provide flanged discharge connections conforming to the requirements of ANSI B 16.1, Class 125.

3. Provide a spiral cutting groove on the surface of the backplate that is in close clearance to the rear flange of the impeller.

4. Volute: Single-piece design with smooth fluid passages.

5. Pump casing shall be of sufficient thickness to withstand a minimum hydrostatic test pressure of 125 psig.

6. Provide with replaceable wearing ring.

7. Mating surfaces requiring watertight sealing shall be machined and fitted with nitrile rubber O-rings. Sealing shall be accomplished by metal-to-metal contact and controlled compression of O-ring without specific torque requirement.

8. Cable entry design:

   a. Ensure a watertight and submersible seal without specific torque requirement.

   b. Provide close tolerance fit against cable outside diameter and cable entry inside diameter and shall produce compression seal when installed.

   c. Entry body shall provide strain relief separate from sealing function to prevent strain in cable from damaging seal and allowing entry of water.

   d. Cable entry junction chamber and motor shall be separated by stator lead sealing gland or terminal board which shall prevent foreign material from coming in contact with motor interior.

   e. Junction chamber, containing terminal board with permanently affixed connectors between cable conductors and stator leads, shall provide completely leakproof seal from motor.

f. Cable sealing design which does not utilize compression fitted power cord and requires epoxy or other secondary sealing system to be reapplied after each cable disconnection or removal shall not be considered acceptable.

E. Impeller and Cutter Bar:

1. Semi-open type with pump-out vanes to reduce seal area pressure.

2. Chopper-type with leading edges of the impeller moving across a cutting bar at the intake opening to chop or macerate incoming material.

a. Clearance Between Cutter Bar and Impeller: 0.010" to 0.015".

b. Extend cutter bar diametrically across the entire pump suction opening, with the cutter bar plate being recessed into the pump bowl.

c. Impeller and Cutter Bar:

1) Heat treat to a Brinell Hardness of 550.

2) A248 GR 90-60 cast alloy steel.

3. Statically and dynamically balanced.

4. Provide replaceable, externally-adjustable suction plate.

5. One-piece, enclosed, nonclog-type capable of handling solids normally present in sewage.

6. Statically and dynamically balanced, securely positioned and locked to shaft using key and cap screw. Provide means for impeller clearance adjustment.

7. Impellers shall have smooth contours.

F. Pump Shaft

1. Constructed of stainless steel.

2. Machine and polish over entire length.

3. Dynamically balanced with impeller at all operating speeds.

4. Isolated from pumped liquid.

5. Shaft shall provide rigid support of impeller and prevent critical vibration and all operating speeds.

G. Bearings

1. Anti-friction ball and/or roller bearings, minimum AFBMA L10 life rating of 40,000 hours, designed to carry thrust and radial loads.

2. Lubrication: Permanently lubricated with grease or oil specifically suited for high temperature applications.

H. Thermal Protection

1. Provide a thermal sensor in each phase winding of the stator to monitor stator temperatures and respond to thermal overloading of the motor.

2. Provide any manufacturer-required thermal overload remote indicating module and deliver to the Systems Integrator for installation into the pump control panel.

I. Moisture Protection

1. Provide a sensing device in the motor housing or seal chamber to detect water or moisture leakage passing by the seal and into the motor housing or seal chamber.

2. Provide any manufacturer-required seal failure remote indicating module and deliver to the Systems Integrator for installation into the pump control panel.

J. Seals

1. Provide pump with shaft sealing system utilizing oil chamber.

a. Oil chamber shall provide means to compensate for changes in oil pressure.

b. Provide oil chamber with easily accessible drain and inspection plug equipped with positive, antileak seal. Access to plug shall not require any disassembly of pump.

2. Dual independent mechanical rotating shaft seal system running in oil reservoir.

    a. Lower seal unit, between pump and oil chamber: One stationary and one positively driven rotating tungsten-carbide.

    b. Upper seal unit, between oil chamber and motor housing: One stationary tungsten-carbide and one positively driven rotating carbon ring.

    c. Seal faces: Hold in contact by integral springs and hydrodynamically lubricate at constant rate.

3. Seals shall require neither maintenance nor adjustment and shall be easily inspected and replaceable.

K. Spare Parts

1. One set of gaskets and O-rings required for disassembly and reassembly.

2. One set of upper and lower seal units.

3. One shaft sleeve if used.

4. One volute and impeller wear rings.

5. One cable entry grommet.

6. One complete pump assembly with motor and electrical wiring for emergency stand-by. All pumps to be identical.

L. Discharge Connection

1. Discharge connections shall be permanently installed in wet well with discharge piping. Pump shall automatically connect to discharge connection when lowered into place and shall disengage easily and automatically without removal of fasteners or piping when pump is raised.

M. Lifting Accessories

1. Fit each pump with centered lifting loop and stainless steel lifting chain of adequate strength to raise and lower pumping unit. Chain shall be of length required for installation depth shown on Drawings.

2. Working load of lifting system shall be 50 percent greater than the pump unit weight.

3. Attach sliding guide bracket to pump units which will slide between a minimum of 2 guide rails to properly position pump discharge on discharge connection elbow.

N. Guide Rails and Brackets

1. Guide rails: Minimum Schedule 40 Type 304 stainless steel pipe of sufficient size to remain rigid and unbending under intended loading conditions. Coordinate size of guide rail with pump manufacturer.

2. Guide rails shall not support any portion of weight of pump.

3. Secure lower end of guide bars to discharge connection. Secure upper ends to frame of access cover with upper guide bar bracket.

4. Provide intermediate guide bar spacer supports when clear span distances between supports will exceed 12'.

5. Sliding guide brackets: Cast iron or fabricated steel, galvanized after fabrication.

O. Access Frame and Cover

1. Access hatch (floor hatch as specified). Supplied by pump manufacturer for wet well and valve vault as shown on Contract Drawings.

P. Motors

1. The submersible motor shall be explosion proof class 1, division 2, and group D.

2. Motor horsepower shall be adequate so that pump is non-overloading throughout the entire pump performance curve from shut-off through run-out.

3. Submergence: Design pump motors to operate continuously at design conditions with 50% of motor unsubmerged and with continuous submerged conditions without overheating.

4. Standards: Applicable parts of NEMA MG1.

5. Type: Squirrel cage induction, shell-type design, housed in air-filled, watertight chamber. Oil-filled ball bearing motor acceptable alternate.

6. Enclosure: Completely submersible, watertight.

7. Ratings: Continuous duty, 1.15 service factor, capable of sustaining a minimum of 10 starts per hour.

8. Insulation and temperature rating: Class F insulation rated 155°C (40°C ambient plus 155°C rise).

9. Operation: Constant speed.

10. Nameplate horsepower shall be not less than maximum required pump input for all conditions of head and capacity for full range of impeller furnished.

11. Motors shall be furnished with preassembled power and control cables of adequate length to reach electrical terminal box location shown on Drawings.

    a. Cable shall be capable of continuous submergence underwater without loss of watertight integrity to a depth of 65'.

2.02 IDENTIFICATION

A. Permanently attach stainless steel nameplate to pump with the following information:

1. Equipment number.

2. Serial number of pump.

3. Rated Capacity in gpm.

4. Rated pumping head in feet.

5. Speed in rpm.

6. Manufacturer's name.

7. Size and type of pump.

8. Design pressure and temperature.

B. Cast-in or permanently attached direction of rotation arrow.

C. Stainless steel motor nameplate with horsepower, speed, power characteristics, efficiency, enclosure type, power factor, and other data.

2.03 PAINTING

A. All external surfaces of the pumps and motors, except where stainless steel, aluminum or other corrosion-resistant materials are used, given one (1) shop coat of rust-inhibitive primer. The compatibility of the primer with specified finish coats to be verified by the Contractor.

B. Field finish painting according to Section 09901-Protective Coatings.

C. Interior surfaces of pumps and motors, and internal elements except for items of stainless steel or other special materials, shop sandblasted per SSPC-SP10 and coated with potable epoxy paint system as per Section 09901-Protective Coatings.

D. All touch-up and field coatings furnished and applied by the Contractor.

PART 3 E X E C U T I O N

3.01 EXAMINATION

A. Before assembly or erection, thoroughly clean equipment of temporary protective coatings and foreign materials; completely remove shop-applied flushing compound.

B. Blow out with compressed air as required to remove foreign material.

C. After erection of equipment, clean external surfaces of oil, grease, dirt, or other foreign materials; touch up shop paint, primer, and filler; leave surfaces smooth and ready for finish painting.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions and as indicated on Drawings, by qualified craftsmen.

B. Provide access space around equipment for service. Provide no less than minimum as recommended by manufacturer.

C. Include all required related items necessary for a complete installation.

D. Coordinate for compatibility of manufacturer's shop coating and final finish.

E. Support and anchor as indicated on Drawings.

F. Start up in presence of manufacturer's service representative.

G. Test power draw and motor vibration during initial operation with manufacturer's service representative.

3.03 SPECIAL ERECTION PROCEDURES

A. Field welding to existing structural members shall conform to following requirements:

1. Conform to AWS D1.1.

2. Welding to high strength steels or preheating of highly-stressed members will not normally be permitted.

3. Remove any temporary welded attachments, grind area smooth, and apply 1 coat of primer to match existing primer.

B. Welding of piping shall conform to ANSI B31.1 Code for Power Piping and ASME Boiler and Pressure Vessel Code, Section IX when either or both are applicable.

3.04 SPECIAL EQUIPMENT TO BE PROVIDED

A. Provide dowel pins and shims necessary for leveling and doweling equipment to baseplates if necessary. Shims shall be stainless steel.

B. Provide bolting required to anchor equipment securely to building structural steel; holes required in structural steel shall be drilled; burning with cutting torch not allowed.

C. Provide expansion anchors where required, subject to review by Engineer. Use appropriate type of anchor devices on vibratory equipment.

D. Provide welding rod for field erection of equipment installed under this contract.

3.05 FLOOR SHORING

A. Shore any parts of structure for which design loading would be exceeded during construction or installation of equipment.

B. Protect flooring and other finished surfaces by means of heavy planking.

C. Remove shoring and repair any damage to floors or other parts of structures after equipment has been installed.

3.06 EQUIPMENT ALIGNING

A. Align equipment in accordance with manufacturer's recommendations.

B. Use shims of sheet and plate steel; use shims with laminations having individual layers not heavier than 0.015" for 1/32" to 1/8" directly under equipment.

C. Check alignment of equipment after piping and other external connections have been made and before equipment is placed in operation. Realign equipment as necessary.

D. After alignment, hot run and recheck alignment; drill and ream items of equipment and fasten to baseplates with tapered dowel pins.

E. Include costs for labor required to obtain alignment within allowable limits on equipment installed and for any hanger adjustments required.

3.07 EQUIPMENT SUPPORTS

A. Provide devices to support equipment.

B. Fabricate supports of structural steel sections, plates, or rods arranged to provide rigid and sturdy mounting for equipment.

C. Provide connections or fasteners required between equipment supports and 1building structure.

D. Equipment foundation pads: As shown on Drawings.

E. Provide devices to support equipment piping and appurtenances where specific support is not detailed on Drawings. Support piping adjacent to equipment such that no weight is carried on equipment.

3.08 GROUTING

A. Place a minimum of 1" nonshrink grout under equipment being mounted on concrete foundations unless specified otherwise.

B. Determine quantity of grout required.

C. Space between top of foundation and bottom of equipment base shall be filled with grout, free of any voids.

D. Place no grout that has been allowed to set, after mixing, beyond time limitations set forth by grout manufacturer.

3.09 PUMP SCHEDULE

A. NW WWTP Improvements

1. Installed Quantity: 2, two shall be provided.

   a. Total Number Pumps: 2

2. Design Point: 600 GPM @ 26' TDH.

3. Nominal speed (rpm): 1750.

4. Motor Horsepower (hp): 10.

5. Rating: 3 phase, 460 volts, 60 Hz.

6. NPSH: Flooded.

END OF SECTION

SECTION 11319

VERTICAL TURBINE PUMPS

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Water lubricated vertical turbine pumps for the Non-potable Water Pumping System. The product water is chlorinated plant effluent. The pumping arrangement shall be complete with a drive unit support, surface discharge assembly and a motor.

1.02 MEASUREMENT AND PAYMENT

A. Unless noted in the Bidsheet, no separate payment will be made for work under this Section. Include payment for applicable work as noted on the Bidsheet.

B. Refer to Section 01270 – Measurement and Payment.

1.03 REFERENCES

C.	ASTM A48	Grey Iron Castings
D.	ASTM A53	Pipe, Steel, Black and Hot-Dipped Zinc Coated, Welded and Seamless
E.	ASTM A108	Steel Bars, Carbon, Cold Finished, Standard Quality
F.	ASTM A276	Stainless and Heat-Resisting Steel Bars and Shapes
G.	ASTM A320/A320M	Alloy Steel Bolting Materials for Low Temperature Service
H.	ASTM B584	Copper Alloy Sand Castings for General Applications

I. Hydraulic Institute Standards of the Hydraulic Institute

1.04 QUALITY ASSURANCE

A. Manufacturer's Qualifications

1. Pumps and appurtenances provided under this Section shall be the standard product in regular production by manufacturers whose products have proven reliable in similar service for at least 5 years.

2. Insofar as possible all valves of the same specific type shall be the product of one manufacturer.

1.05 SUBMITTALS

A. Submit shop drawings and product data under provisions of Sections 01330 - Submittal Procedures and 15010 - Basic Mechanical Requirements.

B. Shop Drawings

1. Submit for review detailed drawings, data and descriptive literature on valves and appurtenances, including:

a. Dimensions.

b. Size.

c. Materials of construction.

d. Weight.

e. Protective coating.

f. Motor data.

g. Wiring diagram, where applicable.

h. Guaranteed pump performance curves developed for specified operating conditions showing relationship between flow, head, efficiency, and horsepower.

C. Manufacturer's Certifications

1. Submit manufacturer's certificates of compliance with ANSI, AWWA and other listed standards.

1.06 WARRANTY

A. Warranties shall conform to requirements of 00700 – General Conditions

1.07 OPERATION AND MAINTENANCE DATA

A. Submit operation and maintenance data under provisions of Section 01730 - Operations and Maintenance Data.

B. Submit a detailed operation and maintenance manual for the pump, motors and appurtenances provided under this Section.

1.08 DELIVERY, STORAGE AND HANDLING

A. Have products delivered, stored and protected under provisions of Section 01610 - Basic Product Requirements.

B. Store pumps and appurtenances off the ground in enclosed shelter and accordance with Manufacturer's recommendations.

1.09 EQUIPMENT LIST

Item	Number of Units of Equipment
NPWS Pumps	3

1.010 OPERATING CONDITIONS

A. Pumping Condition

1.	Capacity, gpm	300
2.	TDH, ft	175
3.	Bowl efficiency, min., %	75
4.	Minimum intake water depth, ft	3

B. Speed, maximum, RPM 1,775

C. Discharge head size, Column x disch, in 6 x 6

D. Thrust

1. All components of the specified equipment shall be designed and sized for equipment weight plus the maximum hydraulic downthrust at all points on the pumping curve. Additionally, pumps shall be provided with drivers having a momentary upthrust capacity equal to or exceeding 30 percent of the downthrust rating.

PART 2 P R O D U C T S

2.01 MATERIALS

Suction case, bowl assembly discharge case and impeller	Cast iron, ASTM A48, Class 30

Bowl bearings	Bronze, ASTM B584
Pump shaft	Stainless steel, ASTM A276, Type 316 or 416
Lineshaft	Stainless steel, ASTM A276, Type 316 or 416
Pump bearings	Bronze, ASTM B584
Lineshaft bearings	Fluted rubber, bronze backed or bronze
Pump discharge column	Steel, ASTM A53
Discharge head	Cast iron, ASTM A48, or fabricated steel
Tension nut assembly	Cast iron, ASTM A48
Tube stabilizing spider bushings	Neoprene
Strainer	Bronze, ASTM B584
Bolts, studs, and nuts	Stainless steel, ASTM A320, Type 304

2.02 EQUIPMENT FEATURES

A. Strainer

1. The suction inlet shall be provided with a basket or cone type strainer having a net inlet opening area of not less than four times the area of the suction pipe. The strainer or mesh openings shall be sized to prevent passage of particles larger than the solids handling capability of the impeller.

B. Suction Case

1. The suction case shall be designed to provide conservative entrance velocities and evenly distribute the flow to the impeller. The inner surface of the case shall be smooth and free from projections or cavities. The pump shaft lower bearing shall be provided in a streamlined casing, centered and held in place by means of rigid, cast vanes. The casing shall be drilled and tapped to permit connection of an external lubrication supply source.

C. Pump Bowl

1. The pump bowl shall be flanged for registered fit. Flow passages through the bowl shall be polished or porcelain lined. If required on multistage installations, the first stage bowl may be designed to facilitate a low NPSH impeller arrangement.

D. Impeller

1. The impeller shall be constructed free from projections, cavities, or abrupt transitions. The impeller surfaces shall be either polished or porcelain lined.

2. Impellers shall be of the open type, with the shroud designed to rotate against wearing rings installed in the bowl assembly. Impellers shall be secured to the pump shaft using tapered collets or keyways.

E. Shafts

1. Shafts shall be sized to prevent excessive elongation and transmit the required torque without distortion in both the forward and reverse direction. Shafts shall have a first critical speed not less than 20 percent above maximum operating speed. The pumping units shall utilize a two piece headshaft, solid intermediate lineshafts supplied in maximum 10 foot lengths, and a single pump shaft shall be provided extending from the suction case through a discharge case or upper bowl containing an upper pump shaft bearing.

F. Bearings

1. Suction case, bowl, and lower tube case bearings shall be close tolerance, sleeve type. The suction case bearing shall be grease lubricated sealed bearings.

2. Lineshaft bearings shall be spaced at not more than 5 feet apart. The lineshaft bearings shall be product lubricated.

G. Discharge Column

1. Discharge columns shall be fabricated with interchangeable pipe sections connected with threaded sleeve type couplings. Column interiors shall be free of offsets, burrs, discontinuities, or irregularities. The column shall be supplied in sections not exceeding 10 feet in length. Intermediate spider bushings shall be provided which align and support the lineshaft enclosure.

H. Discharge Head and Drive Unit Support

1. The discharge head shall be of the aboveground discharge type. The discharge elbow shall be mitered or cast to form a smooth 90 degree transition. The discharge head shall be fitted with a tension box cast

integrally into the head or otherwise fitted to prevent leakage between the connection. As a unit, the discharge head shall provide a mounting base for the driver. Adequate space shall be provided to access and dismantle the shaft coupling without removing the motor.

2. Each pump head shall be provided with a subbase or baseplate manufactured expressly for the discharge head provided.

I. Tension Nut Assembly

1. The lineshaft enclosing tube shall terminate in a tension nut assembly. The assembly shall contain a sleeve bearing, packing, and a packing follower. The tube nut cap shall have a drilled and tapped l/4 20 connection. The assembly shall be constructed to allow injected flow of fluid into the lineshaft enclosing tube, while eliminating the flow of process fluid from around the enclosing tube.

J. Couplings

1. A threaded coupling shall be provided to connect the two piece headshaft between the motor and the tension nut assembly.

2. Lineshaft couplings shall be a perfect butt fit. They shall be designed with a safety factor of l 1/2 times the shaft safety factor and shall have a left hand thread to tighten during pump operation.

K. Motor

1. All pumps shall be driven by continuous duty, energy efficient, Type 2, TEFC, vertical, hollow shaft, high thrust, 460V, 3ph electric motors as specified in Section 16171, Low Voltage Electric Motor.

2. The motor top shaft shall be provided with a non-reverse ratchet device, which prevents backspin of the pump.

L. Corrosion Protection

1. The interior and exterior of the discharge column and all exterior below grade surfaces of the pump shall be protected with a coating system specified in Section 09900 Painting.

2.03 SPARE PARTS

A. Spare parts shall be furnished for each pump as follows:

One (1) suction bell/manifold bearing assembly.
One (1) bowl bearing set.
One (1) lineshaft bearing assembly.
One (1) packing gland follower.
One (1) set wear rings.

PART 3 E X E C U T I O N

3.01 INSTALLATION

A. The pumps shall be aligned, connected, and installed at the locations specified and in accordance with the Manufacturer's recommendation.

3.02 FIELD TESTING

A. After the completion of installation, each pumping unit shall be field tested to demonstrate compliance with the performance requirements as specified.

B. Testing procedures shall duplicate as nearly as possible the conditions of operation and shall be selected to demonstrate that the equipment is operational and free from damage. Each control device, item of mechanical, electrical, and instrumentation equipment, and control circuits shall be considered in the testing procedures to demonstrate that the equipment has been properly serviced, aligned, connected, calibrated, and adjusted prior to operation.

END OF SECTION

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SECTION 11332

STATIC SCREEN

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. This section includes all labor, material, and equipment necessary to furnish the static screen for the separation of municipal waste solids and debris pumped from the existing scum accumulation box.

1.02 SUBMITTALS

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

B. Drawings showing screen dimensions, screen length, assembly length, interface dimensions to outlet flange, materials of construction, and assembly weight. At time of equipment shipment, the following shall be submitted for the static screen furnished under this specification:

1. Complete installation and assembly drawings, showing the manufacturer's dimensions, weights, and loadings.

2. Manufacturer's installation instruction and certification.

3. Operation and maintenance manual.

4. Manufacturer's warranty agreement.

C. Evidence of physical testing to verify mathematical model of velocity.

D. Evidence of experience in having supplied at least five (5) assemblies of similar type and size, and have been in successful operation for at least five (5) years.

1.03 FACTORY ASSEMBLY AND INSPECTION

A. Equipment shall be thoroughly inspected by the manufacturer prior to shipment to ensure proper interface and adjustment of all parts.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Items to be shipped as complete assemblies except where partial disassembly is required by transportation regulations or for protection of equipment.

1.05 SERVICE REPRESENTATIVE

A. Provide qualified service representative to perform functions described in Section 01450-Contractor's Quality Control.

B. At the Engineer's request, the manufacturer's representative shall furnish a written report confirming the proper installation of the equipment. The report shall indicate that the equipment is in accurate alignment, is free from any undue stress imposed by connecting piping or anchorage, and has been operated under full load conditions and that it operated satisfactory.

C. Include necessary trips by the manufacturer's representative to provide two separate 8-hour work days on-site (travel time not included) for startup and training of operations personnel. Training may be video taped by Owner.

D. Additional trips required by the Contractor before or after final startup and training shall not be charged to the Owner.

1.06 WARRANTY

A. Warranty shall conform to requirements of 00700-General Conditions.

PART 2 P R O D U C T

2.01 MANUFACTURERS:

A. Parkson Corporation.

B. Andritz Separation, Inc.

C. JDV Equipment Corporation.

D. Engineer approved equivalent.

2.02 GENERAL

A. Screen shall consist of a screen cabinet with inlet, outlet, and drain connections, influent distribution chamber, curved screen panel, doors and covers, solids discharge chute, and water spray system.

B. The screen shall have a maximum capacity of 600 gpm at a suspended solids

concentration typical of scum from an activated sludge secondary clarifier.

C. The static screen shall be coordinated with a shaftless screw conveyor. See section 11333 for screw conveyor specifications.

D. The static screen and the screw conveyor specified in section 11333 shall be provided by a single manufacturer to ensure coordination and compatibility of equipment.

2.03 SCREEN CABINET

A. Screen cabinet shall be 10-gauge type 304 stainless steel.

B. The cabinet shall have a 12.00 inch diameter ANSI 150-lb flanged-end influent connection secured to the back panel by a full penetration weld.

C. The cabinet shall have a 12.00 inch diameter ANSI 150-lb flanged-end effluent connection secured to the lower discharge hopper with a full penetration weld.

D. Both the influent and effluent connection shall be constructed of 10-gauge type 304 stainless steel.

E. The cabinet wall shall be extended and flanged with mounting holes for purposes of support.

F. The cabinet shall be fitted with two (2) observation ports, each having a non-metallic grommet secured around the circumference.

G. Cabinet shall be fully enclosed with observation ports as indicated, removable access panel to front of screen to accommodate all maintenance procedures fully, and two (2) 6” plain-end connection locations for future odor control connections. Plain end shall be securely capped.

2.04 INFLUENT DISTRIBUTION CHAMBER

A. The screen cabinet shall have an integral influent distribution chamber.

B. The chamber shall receive the incoming flow and evenly distribute the flow to the weir.

C. The discharge weir shall be the full width of the cabinet, having a well radiused crown with a minimum 11-inch long screen apron.

D. The influent chamber shall have a 3-inch diameter drain with pipe plug and

valve.

2.05 FLOW DISTRIBUTION BAFFLE

A. A fully hinged flow distribution baffle extending the full width of the weir shall be furnished.

B. The baffle shall be constructed of 16-gauge type 304 stainless steel.

C. The baffle shall be accurately positioned and located so that the contoured extension lip is parallel with the weir approach apron.

2.06 SCREEN PANEL

A. Construction: Single curved panel following the contour of 25-35-45 degrees to the vertical and positioned in the chassis in the direction of the slurry flow.

B. Dimensions: 72 inches wide by 54 inches long as measured on an 80-inch radius.

C. Material: Type 304 stainless steel transverse bars having a triangular cross section and a 360 degree looped attachment of each bar to longitudinal 0.313 inch diameter support rods. The support rods shall be on 4-inch centers, and constructed of type 3-4 stainless steel. The transverse bars shall be curved in a double arc between the longitudinal support rods by a radius of approximately 1-1/4 inches, and the bends shall be made in the direction of the slurry flow. Each 61-degree arc shall be separated by a 5/8-inch chord.

D. Screen Opening: 0.060 inches.

E. The coined transverse bars shall have a face width of 0.078 inches and a maximum depth of 0.125 inches.

F. No rivets, bolts, or other mechanical fastening of transverse bars to the supports shall be used.

G. Screen Panel Pivot: The wedgewire screen panel shall be pivot-mounted to allow the panel to be pivoted on a horizontal axis to allow for inspection of the tapered side of the wedgewire.

H. Drip Lip: Along the bottom edge of the screen panel a 12-gauge stainless steel contoured lip shall be furnished to control excess water from running off the screen panel. The drip lip contour shall be designed so as to direct the free wastewater into the screen cabinet for discharge.

2.07 DOORS AND COVERS

A. The static screen unit shall be equipped with doors and covers constructed of 304 stainless steel.

B. The doors shall cover the screen panel, allowing clearance for solids to slide off the screen.

C. The covers shall be located atop static screen unit, thereby enclosing weir/headbox area.

D. The front and sides of each door frame shall be covered.

E. The doors shall be attached to static screen unit using type 316 stainless steel threaded fasteners and type 316 stainless steel continuous hinges.

F. Closed doors shall be held shut by gravity resting against a reinforcing framework; opened doors may be held open by sliding prop rods located on the cabinet sides.

G. The covers shall be held in place by use of 316 stainless steel threaded fasteners.

H. Neoprene gasketing shall be applied to the static screen unit to act as a seal.

2.08 SOLIDS DISCHARGE CHUTE

A. A 24 inches long solids discharge chute constructed of 12 gauge stainless steel shall be attached to the static screen unit.

B. The discharge chute shall be mounted at xx degrees from horizontal.

C. The discharge chute shall have 3-inch high sides.

PART 3 E X E C U T I ON

3.01 INSTALLATION

A. Install in accordance with Manufacturer's Instructions and as shown on plans.

B. Support wall pipe by formwork to prevent contact with reinforcing steel.

END OF SECTION

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SECTION 11333

SCREW CONVEYOR

PART 1 G E N E R A L

1.1 SECTION INCLUDES

A. This section includes all labor, material and equipment necessary to furnish and install the screw conveyor integrated to the static screen located adjacent to the existing scum accumulation box. The conveyor will be used to compact and transport dewatered scum solids from the static screen to the dumpster located in the screenings load out area.

B. The conveyor shall be furnished and installed complete with:

1. Pivot supports pedastal and swivel casters.

2. Mechanical equipment required for proper operation, including complete drive unit.

3. Flighting, troughs and liners, covers, hopper, flex chute, safety devices, and other metal components indicated on the drawings or specified herein; any additional materials or construction required by the manufacturer’s design and for proper operation.

1.2 QUALITY ASSURANCE

A. Reference Standards

1. American Institute of Steel Construction (AISC).

2. American Society of Testing and Materials (ASTM).

3. Conveyor Equipment Manufacturer's Association (CEMA).

4. American Welding Society (AWS).

5. Steel Structures Painting Council (SSPC).

B. Miscellaneous

1. Evidence of experience in having supplied at least five (5) assemblies of similar type and size, and have been in successful operation for at least five (5) years.

C. Coordination

1. Contractor shall field inspect condition and dimensions of structures and equipment to coordinate screw conveyor installation with static screen. If detrimental conditions or discrepancies exist it shall be brought to the attention of the Engineer, in writing, immediately. Failure to do so will not relieve the Contractor of responsibility.

D. The screw conveyor and the static screen specified in section 11332 shall be provided by a single manufacturer to ensure coordination and compatibility of equipment.

1.3 SUBMITTALS

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

B. Shop Drawing

1. Complete installation and assembly drawings, showing the manufacturer's dimensions, weights, and loadings. Product Technical Data Including layout drawings, conveyor dimensions; interface dimensions to equipment, all materials of construction, thicknesses and finishes; and assembly weight.

2. Certification of bearing life and details of lubrication system. Complete fabrication drawings.

3. Details and dimensions of equipment layout, support design and anchor bolt location.

4. Manufacturer's warranty agreement.

5. Electrical control schematics showing all components.

6. Catalog data on all ancilliary electrical components, including limit switches, torque and speed sensors, etc.

7. Motor data.

8. Gear reduction unit catalog data indicating the unit's AGMA service classification and service factor.

9. Structural calculations for the design of the conveyor support and anchoring system signed by a registered professional engineer confirming anchor embedment as well as conveyor design.

C. Operation and Maintenance Manuals

1. See Section 01782.

1.4 FACTORY ASSEMBLY AND INSPECTION

A. Equipment shall be shipped as complete assemblies except where partial disassembly is required by transportation regulations or for protection of equipment.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Items to be shipped as complete assemblies except where partial disassembly is required by transportation regulations or for protection of equipment.

1.6 SERVICE REPRESENTATIVE

A. Provide qualified service representative to perform functions described in Section 01450-Contractor's Quality Control.

B. At the Engineer's request, the manufacturer's representative shall furnish a written report confirming the proper installation of the equipment. The report shall indicate that the equipment is in accurate alignment, is free from any undue stress imposed by connecting piping or anchorage, and has been operated under full load conditions and that it operated satisfactory.

C. Include necessary trips by the manufacturer's representative to provide two separate 8-hour work days on-site (travel time not included) for startup and training of operations personnel. Training may be video taped by Owner.

D. Additional trips required by the Contractor before or after final startup and training shall not be charged to the Owner.

1.7 WARRANTY

A. Warranty shall conform to requirements of 00700-General Conditions.

1.8 PROJECT/SITE CONDITIONS

A. Screen Characteristics:

1. Dewatered scum screenings typical of an activated sludge plant secondary clarifier.

2. Solids Content: 10-20%

B. Corrosive atmosphere.

1.9 MAINTENANCE MATERIALS

A. As a minimum, the screw conveyor shall be provided with the following manufacturer's recommended spare parts:

1. One set of shaft seals.

2. 15 linear feet of UHMW polyethylene liner.

3. 1 speed sensor (Motion detector)

PART 2 P R O D U C T S

2.1 MANUFACTURERS

A. Parksons Corporation

B. Andritz Separation Inc.

C. JDV Equipment Corporation.

D. Engineer approved equivalent.

2.2 MATERIALS AND FABRICATION

A. Materials of construction:

1. Sidewall splash plates: AISI, Type 304 Stainless Steel.

2. Trough, end plates, lids, and drive: AISI, Type 304 Stainless Steel.

3. Hoppers: AISI, Type 304 Stainless Steel.

4. Supports, Brackets: AISI, Type 304 Stainless Steel.

5. Guards: AISI, Type 304 Stainless Steel.

6. Flight screw and spiral insert: High Strength Alloy Carbon Steel with minimum hardness of 250 Brinnel, 80,000 psi tensile strength minimum.

7. Wear liner: UHMW or Ceramic Chip Embedded Polyurethane, Minimum ½ inch thick.

8. Gaskets: Neoprene.

9. All nuts, bolts, washers, fasteners: AISI Type 316 Stainless Steel.

B. Troughs and Sidewalls:

1. Trough shall be U-shaped fabricated from a minimum ¼ inch stainless steel plate.
   Stiffeners shall be placed across the top of the trough and fastened to both sides of the trough to maintain trough shape and act as a face seal for the sidewalls.

2. A continuous gasket one inch wide shall be provided to the entire top face of the trough top flange and stiffeners.

3. Sidewall splashguards shall be minimum 1/8-inch stainless steel flanged, gasketed and bolted to the trough.

4. Discharge openings shall be flanged for bolting and gasketing. Discharge shall be fabricated from a minimum ¼-inch 304 stainless steel.

5. Sidewalls shall be full length of conveyor except at screen discharge points and shall effectively contain splashing material off the screen face.

6. Conveyor supports shall be provided suitable for mounting onto a steel support structure.

7. A 3-inch flanged drain outlet shall be provided with the conveyor at the low point to facilitate cleaning. A 1-inch NPT connection for overflow when drain is plugged shall be provided at the top edge above the drain.

8. The conveyor shall discharge to a screenings dumpster located in the screening loading area using a flexible chute provided by the conveyor manufacturer.

9. The screw conveyor manufacturer shall provide the pivot support pedestal and swivel casters as indicated on the drawings for the conveyor system, including supports for discharge chute.

C. Spiral:

1. The spiral shall be constructed of high strength carbon steel, prime coated for protection during shipment.

2. The spiral shall be shaftless through the conveying section of the trough.
3. The spacing, size, and pitch of the flights shall be as required to provide the specified performance.

4. The material to be handled may be abrasive, hardened steel material shall be provided for both conveyor flights and insert.

5. The minimum diameter of all coupling bolts shall be 7/8 inch.

6. Spiral flighting shall be formed in sections from one continuous flat bar and shall be concentric to within plus or minus 2 mm.

7. The shaftless screw shall be designed to handle a torque of at least 3,200-foot-pounds. Supplier shall demonstrate that, at 250 percent of the motor nameplate horsepower, the drive unit cannot produce more torque than the torsional rating of the flighting, and that the “spring effect” of the spiral shall not exceed 0.08 inch per feet of length at maximum load conditions.

8. The spiral will be fitted with a special water-resistant nylon brush with stainless steel holder to clean the drain area. The brush will be welded to the spiral in the trough drainage area only.

9. Spiral flighting shall have full penetration welds at all splice connections. The flights shall be aligned to assure true alignment when assembled in the field and shall be made in accordance with the supplier’s requirements. The spiral flights shall be coupled to the end shaft by a flanged bolted connection.

10. A gland-packing ring consisting of two Teflon coated packing rings shall seal the driveshaft at its penetration through the end plate.

11. The connection of the spiral to the drive system shall be through a flanged connection plate that is welded to the spiral forming a smooth and continuous transformation from the flange plate to the spiral. The drive shaft shall have a mating flange and shall be bolted to the spiral connection plate. Additionally a grease lubricated labyrinth seal shall

be shaft mounted internally in the conveyor between the back plate and spiral coupling connection.

D. Hopper:

1. Screw conveyor supplier shall coordinate all hopper/sidewall configurations and connection points shown on the Drawings with the static screen equipment and coordinate with those manufacturers. Refer to Section 11332. Hopper shall be 3/16 inch 304 stainless steel reinforced for the required service.

E. Speed Sensor:

1. The conveyor shall be provided with a 120 VAC non-contact speed sensor. The speed sensor shall be mounted such that any repair on the conveyor shaft shall not require removal of the speed sensor. The speed shall be provided in accordance with Division 16. The speed sensor alarm contact shall open in case of speed failure.

F. Pivoting Supports:

1. The manufacturer shall design and furnish the pivoting support members, anchor bolts, bearings, swivel casters, and accessories as indicated on the drawings and as required for installation. The conveyor support system shall be manufactured to carry all horizontal and vertical design loads with an impact factor of 1.25.

2. The pivoting support system for the conveyor shall be 304 stainless steel.

3. All structural members and connections shall be designed so that the unit stresses will not exceed AISC allowable stresses by more than one-third when subjected to loadings equal to twice the running torque of the drive motor.

4. The pivot support pedastal shall be provided with “Rotek” Bearings.

5. Swivel casters to be provided with brakes to prevent pivoting of the conveyor during operation.

G. Drive Unit:

1. The conveyor drive unit shall consist of a 2-hp constant speed electric drive squirrel-cage induction type, motor.

2. The motor shall have a totally enclosed fan-cooled enclosure.
3. The electric motor shall be energy-efficient explosion-proof class I,

division 2, group D, NEMA B designed for 480 volt, 3-phase, 60 HZ electric service.

4. Guards shall meet OSHA requirements.

5. Motors shall be protected against corrosion due to high humidity, hydrogen sulfide atmosphere, and high pressure with a special corrosion resistant finish, and encapsulated windings meeting the requirements of NEMA MG1-1.27.1.substitutes.

H. Equipment Protection:

1. The conveyor drive unit shall be equipped with an emergency trip cord and safety switch and torque switch.

2. The emergency cord shall run the full length of each conveyor.

3. The trip switch shall immediately stop the conveyor when the switch is actuated.

4. The torque switch setting shall be adjustable from torque at empty to torque required to protect the screw.

5. Motors shall be controlled by reversing starters located in motor control centers specified in Division 16.

I. Gear Reducer:

1. Gear reducers shall conform to AGMA Class II. Gear reducers shall be single-, double-, or triple- reduction helical gear units with roller bearings and shall be directly coupled to the screw.

2. Bearings shall have an AFMBA L-10 life of 100,000 hours. The gear reducers shall be air-cooled with no auxiliary cooling allowed.

3. The shaft seals shall be suitable for the service conditions. Guards shall meet OSHA requirements.

J. Surface Preparation

1. All iron and mild steel surfaces to be painted in accordance with Section 09901.

2. Grit blasted surfaces shall be painted within 24 hours to prevent rusting and surface discoloration.

3. Stainless steel components shall be provided with an ASTM A480, No. 1 finish.

K. Wear Liner:

1. The wear liner for the conveyor shall be fabricated of 3/8 inch thick ultra-high molecular weight polyethylene sintered with an anti-wear filler to reduce wear and synthetic lubricant to reduce friction.

2. The wear liner shall be furnished in maximum 4-foot sections to provide ease of replacement.

3. The liner shall be held in place with clips.

L. Torque Switches:

1. Torque switches shall be provided on the connection between the drive shaft and the drive motor.

2. The switches shall open on excessive torque to stop the drive motor.

3. The switch contacts shall be rated 120 VAC, 2 amperes. The torque switch enclosures shall be rated NEMA 4X/ and, corrosive/explosion-proof.

M. Control Panel:

1. The control panel shall contain all the necessary controls to operate the conveyance equipment.

2. The reversing motor starter will be provided in a NEMA 12 panel along with the over torque protection.

3. The panel will be mounted remotely in the preliminary treatment building electrical room.

4. Refer to Division 16 for a description of the functional control of the screw conveyor.

5. The control panel shall be provided with a 480-volt, 3 phase, 60 hertz, 20-amp power circuit. The panel shall be provided with all NEMA rated motor starters, operator control devices and ancillary control components (control relays, timing relays, etc. for a complete control system. All protective and interlocking functions as shown on the process and instrumentation diagrams and electrical control diagrams shall be incorporated into the design.

6. The Hand-Off-Auto switches and Forward-OFF-Reverse switches from the drive motor will be located next to the equipment at a control station that is a NEMA 7 enclosure. When the switch is in the “hand” position, the motor can be operated in either the forward or reverse direction. In the “auto’” position, the interlocking function actuates the conveyor cycle with a momentary (1 second) contact closure. The H-O-A switch shall have an extra contact, which closes, in the auto position.

7. An emergency stop switch (maintained) will be provided next to the equipment to shutdown the conveyor with one switch. The switch shall open when the button is pushed. This shall cause the motor to immediately stop.

8. The unit shall be provided with local indicating lights for alarm and status. Status lights shall be provided to indicate run and ready conditions. Alarm lights shall be provided to indicate the following conditions:

   a. Torque Overload

9. Provide status contacts to indicate that the conveyor is running and a common trouble alarm contact shall be provided for remote indication and alarm. Each set of contacts shall be electrically isolated and shall be NEMA B600 (10 amperes) and wired to terminals within each control panel. The trouble alarm contacts shall open when any alarm condition occurs and shall close after all alarm conditions have been corrected and a manual alarm reset button has been depressed. Manual alarm reset button shall be surface mounted on the local control panel. Status signal contacts shall close during the run cycle, maintain closure during the entire run cycle, and open after the cycle is complete and the drive mechanism is in its normal parked position.

PART 3 E X E C U T I O N

3.1 INSTALLATION

A. Install in accordance with the contract drawings and in accordance with manufacturer's instructions.

B. Installation shall be carried out by mechanics/millwrights skilled in work of this kind, under the general provisions of a factory-trained representative of the manufacturer.

C. Raceway and cable shall be in accordance with Division 16.

D. The equipment shall be checked, aligned, tested, and placed into operation in accordance with Section 01755-Starting Systems.

3.2 ADJUSTMENT

A. After completion of installation of the screw conveyor and all related equipment, the equipment and installation shall be inspected and approved by a representative of the manufacturer as being in compliance with the manufacturer's recommendations and requirements. After such inspection, the equipment shall be given any required adjustment and when complete, the various items of equipment shall be placed into operation under the supervision of the manufacturer's representative.

3.3 STARTING OF SYSTEMS

A. Shall conform to requirements of Section 01755-Starting Systems.

END OF SECTION

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SECTION 11337

AUTOMATIC SELF-CLEANING FILTERS

PART 1 GENERAL

1.01 DESCRIPTION

A. This Section includes all labor, materials, equipment and accessories to install the self-cleaning filters, motors, exhaust valves, system controls and accessories.

1.02 MEASUREMENT AND PAYMENT

A. Unless noted in the Bidsheet, no separate payment will be made for Work under this Section. Include payment for applicable work as noted on the Bidsheet.

B. Refer to Section 01270 – Measurement and Payment

1.03 RELATED SECTIONS

A. Section 01330 - Submittal Procedures

B. Section 01610 - Basic Product Requirements

C. Section 01782 - Operation and Maintenance Data

D. Section 09900 - Painting and Coating

E. Section 13446 – Primary Instrumentation Devices

F. Section 15100 – Miscellaneous Valves

G. Section 16171 – Low Voltage Electric Motor

H. Section 11206 – Hydropneumatic Tank

1.04 REFERENCES

A. A. Governing Standards. Except as modified or supplemented herein, all materials and construction methods shall comply with the applicable provisions of the following standards:

1. American Society of Mechanical Engineers (ASME): B16.5, Pipe Fittings and Flange Fittings

2. National Electrical Manufacturer's Association (NEMA): 250 Enclosures for Electrical Equipment (1,000 V Maximum)

B. Requirements of Regulatory Agencies: Manufactured units shall comply with construction requirement of codes, standards and approving bodies referenced herein. Comply with Certifications and the National Electrical Manufacturers' Associations (NEMA) as applicable to electrical equipment or apparatus forming parts of the Equipment.

1.05 QUALITY ASSURANCE

A. The manufacturer of the strainer shall have a quality management system in place and shall be ISO 9001 certified.

B. Provide materials that are new, of high grade, and with properties best suited to the work required.

C. All equipment, accessories and materials shall be supplied by the same manufacturer for equipment compatibility and complete functioning system responsibility.

D. Material and equipment shall be standard products of a manufacturer regularly engaged in the manufacturing of the specified product. Manufacturer shall show evidence of at least 5 years experience in the production of substantially similar type of equipment and such equipment have proven reliable in similar service.

E. If requested by the City Engineer, manufacturer shall provide evidence of satisfactory equipment operation in at least 5 similar installations that currently are and have been in operation at least 5 years, including reference list showing Owner's name, contact name and phone number.

F. The City Engineer reserves the right to reject any unnamed manufacturer based on an unsatisfactory experience record or the inability to meet the specifications.

G. Contractor shall retain overall responsibility for equipment coordination, installation, testing and operation.

1.06 1.06 WARRANTY

A. A. Provide warranty under provisions of Specification Section 00700 – General Conditions and 01770 – Closeout Procedures.

B. The manufacturer shall warrant that the equipment is free of defects in material and workmanship under normal use and service, and when properly installed. The manufacturer shall repair or replace such equipment or any part thereof furnished by the manufacturer and found defective after inspection by the manufacturer excepting only those items that are normally consumed in service.

C. The manufacturer shall provide written document to the City of Houston that warrants 100 percent of parts and labor for at least 24 months from the date of substantial completion as defined in the Contract Documents. Warranty shall be in printed form and previously published as the manufacturer's standard warranty for the manufactured products.

1.07 SUBMITTALS

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

B. Submit complete detailed shop drawings, including physical layout of the filter, drive unit and control equipment, piping diagrams and field wiring diagrams, control diagrams and a complete description of the control system, manufacturer's installation instructions, and equipment operating characteristics.

C. Shop Drawings and Product Data: Submittals shall include the following:

1. Certified shop drawings in AutoCAD format showing all important details of construction, dimensions and anchor bolt locations.

2. Descriptive literature, bulletins and/or catalogs of the equipment. Data on the characteristics of the strainer.

3. The total weight of the equipment including weight of the single largest item.

4. A complete total bill of materials.

5. Complete data on motors.

6. A list of the manufacturer's recommended spare parts.

7. Complete description of surface preparation and shop priming painting.

D. Operations and Maintenance Data

1. Furnish Operation & Maintenance (O&M) Manuals per Section 01782 prepared specifically for the supplied equipment. The O&M Manual shall include all required section drawings, approved Shop Drawings, parts lists, protective coatings, recommended spare parts, operation instructions, maintenance instructions, etc., that are required to instruct operating and maintenance personnel unfamiliar with this equipment.

2. Provide two (2) preliminary copies of the O&M Manual in 3-ring binders including all required data.

3. Four (4) copies of the Final O&M Manuals bounded in D-ring binders shall be submitted for final acceptance of the installed system. One copy shall be submitted for review and returned with comments and three (3) copies shall be submitted as final. The Final O&M Manuals shall include all required data, as-built drawings with field modifications and/or corrections, and manufacturer's certifications including inspection, testing and start-up completion reports. Each Final O&M Manual shall include attached an electronic copy of all the O&M Manual data in portable document files (PDF) on a computer disc (CD) with the content bookmarked for easy search.

PART 2 P R O D U C T S

2.01 GENERAL

A. DETAILS OF CONSTRUCTION

1. Furnish and install two (2) automatic, self-cleaning type strainers and all appurtenances as specified herein.

a. Number of units: 2 (one duty/one standby)

b. Design Capacity: 300 gpm

c. Motor HP: 1/4, U/L listed, Class 1, Division 2

B. One set of all special tools required for normal operation and maintenance shall be provided as specified in Section 01782.

C. All tools and spare parts shall be furnished per manufacturer's recommendation.

2.02 MATERIALS AND EQUIPMENT

A. Filter

1. The filter unit shall be an automatic, self-cleaning type. The body of the filter shall be carbon steel (ST 37-2). The inside and outside of the body shall be coated with red multi-layer polyester. The body shall contain two raised face flange connections drilled with dimensions conforming to 150 pound ANSI. The cover shall be removable to facilitate maintenance. The maximum operating pressure of the filter body shall be 150 psi and the maximum operating temperature shall be 140˚F. Minimum operating pressure during the cleaning cycle shall be 40 psi.

2. Inlet and outlet flange connections shall be 4 inches in diameter.

3. The filter system shall have a clean-screen pressure drop of no greater than 1.4 psi at a flow rate of 300 gpm.

4. Cleaning shall be accomplished by an electric motor driven rotating cleaning element made of Type 316L stainless steel that simultaneously moves linearly as a result of a threaded-shaft/fixed-threaded-bearing mechanism. This linear movement shall be limited by two normally closed limit switches and monitored by the PLC in the control panel. The cleaning element, called a "suction scanner," shall have four radially oriented nozzles of circular cross section, each of which shall have a thread mounted polyacetal nozzle cap with a circular orifice for sacrificial wear. The sum of the cross sectional areas of the four nozzle orifices shall not exceed 0.7 square inches. The velocity created at the nozzle head shall be 30 feet per second. The motor drive for the rotating cleaning element shall turn the cleaning element at no more than 24 RPM, shall be suitable for operation with 115/230-volt, 1-phase, 60 Hz current and shall be minimum ¼ hp. The cleaning cycle shall last for no more than 20 seconds.

5. The filter shall be supplied with spring loaded nozzles with polymer tips that press against the fine screen inner surface at a constant pressure. This ensures highly focused flush flow for superior cleaning of the

four-layer fine screen. (Note this was recommended by the manufacturer.)

6. The filter shall have a removable cylindrical four-layer filtration element made entirely of Type 316L stainless steel weave-wire screen with a 50-80 micron filtration degree. First, against the dirty liquid, shall be a 3,000-micron square-weave woven-wire layer. Next shall be the fine weave-wire layer providing the solids removal. A second 3,000-micron square-weave woven-wire layer shall make up the third layer. The fourth layer surrounding the entire cylinder is a welded wedge-wire grid providing structural strength. The total effective filtration area of the cylindrical filtration element shall be 700 square inches. Filtration elements with filtration degrees ranging from 500 microns to 10 microns shall be interchangeable in the same filter body.

7. The cleaning system for the filter shall include a 2-inch hydraulic diaphragm valve operated by the pressurized liquid on the upstream side of the cleaning element. The body of this valve shall be polyester coated cast iron. The discharge from the cleaning operation shall drain to location as shown on the Drawings.

B. Controls

1. The filter control panel shall be complete factory wired. It shall contain all required control and power elements to provide automatic self-cleaning system operations as described herein. The filter control panel shall include main power disconnect switch, starters, transformer, Programmable Logic Control (PLC), relays, timers, alarm logic modules, Time & DP - DP Only - Continuous three position toggle selector switch (where DP = differential pressure), indicating lights, mounting brackets and accessories, wiring harnesses, terminal strips, wiring and an enclosure with keyed handle and hinged front door.

2. The automatic self-cleaning system shall provide continuous or intermittent operation of the cleaning cycle based on the position of the TIME & DP - DP Only - Continuous selector switch. The cleaning cycle shall open the hydraulic diaphragm exhaust valve and start the motor to rotate the cleaning element for the required cleaning interval. After the cleaning interval is completed, the cleaning cycle shall stop the motor of

the rotating cleaning element, close the exhaust valve and reset the cleaning cycle for the next operation.

3. With the selector switch in the CONTINUOUS mode, the cleaning cycle shall operate continuously to clean the filter. In the CONTINUOUS selector position the timers and differential pressure switch shall be overridden.

4. With the selector switch in the TIME & DP position, timers shall intermittently initiate the cleaning cycle at preset adjustable intervals ranging from 0 to 24 hours for the length of time necessary to complete one cleaning cycle.

5. A differential pressure switch shall be arranged on the filter or across the inlet and outlet piping of the filter to override the timer in the TIME & DP mode or acting alone in the DPONLY mode to initiate the cleaning cycle whenever a differential pressure across the filter exceeds a preset value. The differential pressure switch shall continue to operate the cleaning cycle until the differential pressure across the filter returns to normal or an adjustable timer inside the control panel elapses. If the cleaning cycle continues until this preset timer elapses, then the control panel shall shut down the cleaning operation completely causing the red alarm FAULT light to glow on the cover of the control panel and send a 24 volt AC alarm signal to terminals 12 and 13 inside the control panel.

6. A “TEST” button shall be located on the control panel door that will initiate a cleaning cycle upon demand.

7. A “RESET” button shall be located on the control panel door.

8. Indicating lights for the control panel shall include a control circuit “energized” indicating light (green lens) and a “malfunction” indicating light (red lens) both located on the control panel door.

9. The control panel enclosure shall be a NEMA 4 enclosure with interior backplate. The control panel shall be designed for wall mounting and shall only require conduit connections and lug wiring connections to the terminal strips in the field.

10. Components of each control panel shall be Underwriter’s Laboratory listed.

11. External Interfaces: Provide the following interfaces as a part of the control system for monitoring and control.

    a. Flush in progress – relay contact closure output

    b. System fault alarm – relay contact closure output

C. Motors

1. Motors shall meet the requirements of Section 16171 Low Voltage Electric Motor.

D. Pressure Differential Switch

1. The nonadjustable differential pressure switch shall be preset at 7-psi, enclosed in a NEMA 4 enclosure and shall be suitable for up to 240V AC/DC.. The differential pressure switch shall have an easy to read “pointer & dial” gauge and shall be the fully automatic diaphragm type differential pressure switch.

E. Valves

1. Valves shall meet the requirements of Section 15101 – Valves and Gates for Pump Station.

F. Piping

1. Piping shall meet the requirements of 15071 Wastewater Piping.

2.03 ACCESSORIES

A. Equipment Anchor Bolts: The Contractor shall provide anchor bolts as specified in Section 15050 Basic Mechanical Materials and Methods.

B. Equipment Identification Plates: The Contractor shall provide 316 SS identification plates securely mounted on each separate equipment component and control panel(s) in a readily visible location.

2.04 FINISHES

A. Prepare, prime and finish coat in accordance with the manufacturer’s standard coating.

2.05 ACCEPTABLE MANUFACTURERS

A. Filters:

1. Amiad Filtration Systems
2. Or Approved Equal

B. Differential Pressure Switches:

1. Midwest
2. United Electric
3. Or Approved Equal

C. Limit Switches:

1. Pizzato
2. Allen Bradley
3. Honeywell
4. Or Approved Equal

D. Solenoids:

1. ASCO
2. Gemsol
3. Or Approved Equal

E. Electric Motors:

1. Baldor
2. STM
3. Or Approved Equal

F. Gear Drive:

1. STM
2. Or Approved Equal

G. Transformers:

1. Hulda
2. Or Approved Equal

H. Reset Timers and Repeat Cycle Timers:

1. Omron
2. Crouzet
3. Or Approved Equal

I. Control Panel Enclosures:

1. Himel
2. Or Approved Equal

J. Valves:

1. Raphael
2. Bermad
3. Matco-Norca
4. Or Approved Equal

PART 3 EXECUTION

3.01 INSTALLATION

A. Installation shall be in strict accordance with the manufacturer's instructions and recommendations in the locations shown on the Drawings. Installation shall include furnishing all required materials for initial operation in accordance with the manufacturer's recommendations. Anchor bolts shall be set in accordance with the manufacturer's recommendations.

3.02 FIELD QUALITY CONTROL

A. Manufacturer's Field Services: Provide 1 day of service at the site by a qualified representative of the system manufacturer to inspect the installation of their respective unit, make any necessary adjustments, test the equipment, place the equipment in initial hands-free operation and instruct the operating

personnel in its operation and maintenance in accordance with Section 01782 Operations and Maintenance Data.

3.03 ELECTRICAL AND CONTROL INSTALLATION

A. Instrumentation, wiring and conduits for electrical power and controls shall be provided per specification under Division 13 – Special Construction and Division 16 – Electrical.

END OF SECTION

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SECTION 11338

SCUM MIXER

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. All labor, materials, equipment and accessories to provide, install and test a right angle drive, combination helical and spiral bevel gear drive mixer for the Scum Accumulation Box including electrical work as shown on the Drawings and specified herein.

1.02 RELATED WORK

A. Section 01330: Submittal Procedures.

B. Section 01450: Contractor's Quality Control.

C. Section 01782: Operations and Maintenance Data.

D. Section 09901: Protective Coatings.

E. Electrical Specification Sections as required

1.03 MEASUREMENT AND PAYMENT

A. Unless noted in the Bidsheet, no separate payment will be made for work under this Section. Include payment for applicable work as noted on the Bidsheet.

B. Refer to Section 01270 – Measurement and Payment.

1.04 REFERENCES

a. American Society for Testing and Materials (ASTM) Publications

b. Anti-Friction Bearing Manufacturers Association (AFBMA)

c. American Gear Manufacturers Association (AGMA)

d. American National Standards Institute (ANSI) Standards

e. Occupational Safety and Health Administration (OSHA) Standards

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications

a. Manufacturer regularly engaged in manufacturing of mixing and aeration equipment in the United States for not less than 10 years.

b. The manufacturer of the pump shall have a quality management system in place and shall be ISO 9001 certified.

c. Provide materials that are new, of high grade and with properties best suited to the Work required.

d. All equipment, accessories and materials shall be supplied by the same manufacturer for equipment compatibility and complete functioning system responsibility.

e. The manufacturer must possess a test basin where full scale performance of the system shall be verified from a mixing standpoint. . The basin must have the ability to simulate on-site conditions such as platforms, columns, and any wall configurations.

1.06 WARRANTY

A. Provide warranty under provisions of Specification Section 01770 – Closeout Procedures.

B. The manufacturer shall warrant that the equipment is free of defects in material and workmanship under normal use and service, and when properly installed. The manufacturer shall repair or replace such equipment or any part thereof furnished by the manufacturer and found defective after inspection by the manufacturer excepting only those items that are normally consumed in service.

C. The manufacturer shall provide written document to the City of Houston that warrants 100 percent of parts and labor for at least 24 months from the date of substantial completion as defined in the Contract Documents. Warranty shall be in printed form and previously published as the manufacturer's standard warranty for the manufactured products.

1.07 SUBMITTALS:

A. Conform to the requirements of Section 01330 – Submittal Procedures.

B. Submit shop drawings, product data and information required to establish compliance with the Section. Where deviations from this specification are proposed, the manufacturer shall submit a list of deviations and provide a detailed description and explanation for each deviation.

C. Shop Drawings and Product Data: Submittals shall include the following:

a. Certified shop and working drawings

b. Descriptive literature, bulletins and/or catalog cuts of the equipment. Data on the characteristics and performance of the mixer

c. Operating and maintenance instructions and parts lists

d. Certified test reports verifying quality of gears in Gear Reduction Units

e. Shop drawing data for accessory items

f. Templates or certified setting plans, with tolerances for anchor bolts

g. Motor data

h. Motor shop test results

i. Field inspection/testing reports

j. A list of the manufacturer's recommended spare parts

k. Mixer shop test results

l. Recommendations for short and long term storage

m. Shop and field testing procedures and equipment to be used

n. Tag numbers for all equipment

o. Special tools

p. Results of vibration tests including a vibration signature for each mixer drive assembly. Provide vibration testing procedure for review.

D. Operations and Maintenance Data

a. Furnish Operation & Maintenance (O&M) Manuals per Section 01782 prepared specifically for the supplied equipment. The O&M Manual shall include all required section drawings, approved Shop Drawings, parts lists,

protective coatings, recommended spare parts, operation instructions, maintenance instructions, etc., that are required to instruct operating and maintenance personnel unfamiliar with this equipment

b. Provide two (2) preliminary copies of the O&M Manual in 3-ring binders including all required data.

c. Four (4) copies of the Final O&M Manuals bounded in D-ring binders shall be submitted for final acceptance of the installed system. One copy shall be submitted for review and returned with comments and three (3) copies shall be submitted as final. The Final O&M Manuals shall include all required data, as-built drawings with field modifications and/or corrections, and manufacturer's certifications including inspection, testing and start-up completion reports. Each Final O&M Manual shall include attached an electronic copy of all the O&M Manual data in portable document files (PDF) on a computer disc (CD) with the content bookmarked for easy search.

PART 2 P R O D U C T S

2.01 SERVICE CONDITIONS:

A. Operation shall be within maximum and minimum liquid levels of tank, as specified. Mixers shall be normally operated automatically. Manufacturer shall provide manual control devices for mixer unit.

B. A quantity of one (1) right angle drive mixer is required for the Scum Accumulation Box. The mixer shall be designed to meet the following requirements:

Number of Mixers	1	
Tank Dimensions (LxWxD)	(12x17x18.7)	feet
Liquid Level Variation (min-max)		inches
Volume	15,664.40	gallons
Tank Baffles (quantity @ width x height)	See Drawings	
Minimum Motor Nameplate Power	7.5	hp
Maximum Nominal Motor Speed	1,800	RPM
Material of Wetted Parts	316 Stainless Steel	
Impeller Type	3 Bladed Anti-Ragging Hyperfoil	
Maximum Output Speed	45	RPM
Minimum Impeller Diameter	48	inches
Impeller Off Bottom Spacing	16	inches
Minimum Shaft Diameter	3.50	inches

2.02 MATERIALS:

A. Design for long, continuous, and uninterrupted service; easy adjustment or replacement of parts; minimum 1/4-in. thickness, steel members; minimum 1/2-in. diameter, structural bolts.

B. Structural steel shall be provided in accordance with ASTM A36.

C. Iron castings shall be provided in accordance with ASTM A48.

D. Wetted parts shall be defined as the bottom half of the upper most coupling, the agitator shaft, any additional shafts (excluding the gearbox output shaft), impeller hubs, impeller blades and hardware below the mounting surface with exception of the gearbox output shaft coupling hardware. Wetted parts shall be of the specified material.

E. Non-wetted parts shall be any component other than the wetted parts. Any non-wetted parts shall be of a material appropriate to the location and design conditions.

2.03 MECHANICAL REQUIREMENTS:

A. Gear Reduction Units:

a. The mixer gear drive must be built and rated in accordance with the current AGMA Standard 6010-E88. The AGMA calculated drive HP rating shall be stamped on drive nameplate. Drive housings shall be of high quality close-grained cast iron, stress relieved and reinforced, and shall be provided with lifting lugs or holes. Housings not composed entiredly of metal will not be allowed. Plastic or fiberglass housing components will not be allowed. Fabricated housings will not be allowed.

b. All gear reducers shall incorporate a combination of helical and spiral bevel gearing to insure highest efficiency coupled with convenience of mounting, maintenance, and installation. It shall not be necessary to remove the motor to perform routine maintenance on the speed reducer. Worm gears are not acceptable.

c. Gearing shall be of AGMA Quality 10 (ten) or better per AGMA Standard 390.03a and ANSI/AGMA 2000-A88.

d. All gearing and bearings shall be located in a single housing and lubricated by a common oil bath. The use of an auxiliary reducer to achieve the required output speed will not be acceptable.

e. The full load operating noise levels of the mixer drives shall meet current OSHA Occupational noise standards, and/or AGMA standard 299.1, and shall not exceed 85 dBA at 3 feet from any part of the drive assembly.

f. The drive's minimum AGMA service factor, based upon motor nameplate horsepower, shall be 1.5. Gear rating calculations with approval drawings shall be submitted for review.

g. The mixer gear drive shall be designed with a shaft and bearing system suitable for the loadings imposed by the application. All designs shall be based upon the hydraulic loadings experienced in this specific mixing application. Standard commercial gear drives will not be acceptable.

h. All components of each gear drive shall be designed, manufactured and assembled in full compliance with all applicable AGMA requirements.

i. All drive bearings shall be of antifriction type, tapered roller bearings. All bearings within the drive, except for the output shaft bearings, shall have minimum AFBMA L-10 lives of 100,000 hours when operating at full motor nameplate horsepower at design speed. Output shaft bearings shall have a minimum L-10 life of 100,000 hours. Mixer supplier must submit bearing life calculations, with approval drawings. Bearing calculations must be based upon hydraulic loadings as seen in this specific mixing application.

j. The thermal rating of the gear reducer must exceed the design mechanical rating. No external cooling devices are allowed.

k. Lubrication of each speed reducer shall be accomplished by bearings and gears beingsplash lubricated or immersed in oil. The drive shall be provided with a dipstick to observe oil level. Grease lubricated bearing are acceptable on the output shaft, provided adequate sealing is provided to separate them from the oil bath.

l. Each drive must have an effective drywell feature to eliminate oil leakage down the output shaft. The base of this drywell feature must be integral to the reducer housing casting. Drywell configurations in which the base is threaded into the gearbox housing will not be acceptable.

m. All oil fill and drain lines shall be located so as to be easily accessible, with the oil drain located at least 12 inches above the mounting elevation (pedestal mounted.) All gearing must be contained within a single housing and lubricated by a common oil bath.

n. The pedestal mount shall be of the “milk stool” type. I-beam type pedestals will not be accepted.

o. Gearmotor attachments to reduce speed will not be allowed.

p. Drives which utilize an oil pump feature will not be allowed.

q. In order to ensure system responsibility, the drive must be designed, tested, and manufactured by the wetted parts supplier. Commercially available gear drives will not be acceptable.

r. The gearbox output shaft shall be composed of carbon steel. Any portion of the output shaft external to the gearbox housing shall be painted with epoxy paint of the same color as is used for the remainder of the gear reducer.

B. Impellers:

a. Minimum impeller diameter and maximum operating speed shall be as previously specified.

b. Impeller type and number of blades shall be as previously specified.

c. Impeller blades shall be bolted to the impeller hub.

d. The impeller hub shall attach to the shaft by means of a hook key designed to prevent the impeller from slipping down the shaft even if the set screws are not tightened. .

e. The maximum stress in any impeller component shall not exceed 12,000 psi under maximum operating loads

f. The shaft-impeller system design shall be such that its operating speed shall not exceed 75% of its first lateral critical speed. The use of stabilizing rings or fins shall not influence this limitation.

g. Impeller blades shall be designed with a swept profile to prevent the accumulation of rags anywhere on the impeller leading edges. They shall produce an axial flow directed downwards towards the tank bottom.

C. Impeller Shafts:

a. The agitator shaft shall be of the above specified grade of material. The shaft shall be designed such that the maximum nominal shear stress shall not exceed 9,000 psi under maximum operating loads. The shaft shall be of overhung design; the use of underwater steady bearings is not permitted.

b. Shafts shall be manufactured to a minimum straightness such that they

are straight to within 1/8 inches per every 10 feet of length. Certification of straightness at time of shipment shall be provided by the manfacturer for each shaft.

c. The lower mixer shaft shall be connected to the upper, or drive output shaft, by means of a rigid flanged coupling, of either the welded or interference fit hub type. Coupling face shall have a rabbeted male and female piloted connection for accurate concentricity and shall not require match marks for alignment. A shaft arrangment which does not include a separate gearbox output shaft and a flange style coupling located below the gear reducer shall not be acceptable. If located above tank top surface, the rigid coupling may be of carbon steel construction; if located below level of tank top, its material of construction must match that of the agitator shaft.

d. Liquid immersed impeller shaft supported bearings are not acceptable.

e. Shaft support bearings located below top cover of mixing tank are not acceptable.

D. Drive Motors:

a. The electric motor driver shall be commercially available standard NEMA C-Face, TEFC.

b. Insulation shall be Class F, limited to Class B temperature rise at 400C ambient at 1.0 service factor.

c. Service factor shall be 1.15 on sine wave power and 1.0 on inverter power.

d. Rating: 230/460 Volt, 3-phase, 60 Hz.

e. L-10 Bearing Life: 100,000 hrs at full load and speed.

f. Maximum Speed as indicated above.

E. Flexible Couplings

a. A flexible coupling shall connect motor and gear reducer.

b. Design to withstand continuous full load motor horsepower including torques to 150 percent of full load running torque, minimum 1.5 service factor.

F. Guards

a. Supply rotating shafts above platform level with guards conforming to OSHA Requirments.

G. Anchor Bolts

a. Anchor bolts are to be provided by the Contractor and set per the requirements of the mixer manufacturer. The mixer manufacturer shall supply any required templates for setting the anchor bolt dimensions.

H. Baffles

a. When indicated above, tank baffles are to be supplied by the Contractor. Mixer manufacturer shall coordinate design with the Contractor.

2.04 PAINTING

A. Specified in section 09901-Protective Coatings.

2.05 SPARE PARTS

A. Spare parts shall be provided as recommended by the mixer manufacturer to last for a minimum of 2 years of operation.

2.06 MANUFACTURERS

A. Acceptable manufacturers:

a. Philadelphia Mixing Solutions Limited (PMSL)

b. Or Approved Equal

PART 3 E X E C U T I O N

3.01 INSTALLATION

A. Installation shall be in strict accordance with the manufacturer's instructions and recommendations in the locations shown on the Drawings. Installation shall include furnishing the required oil and grease for initial operation. The grades of oil and grease shall be in accordance with the manufacturer's recommendations. Anchor bolts shall be set in accordance with the manufacturer's recommendations.

3.02 FIELD SERVICE

A. Provide qualified service representative to perform functions described in Section 01450-Contractor's Quality Control.

B. At the Engineer's request, the manufacturer's representative shall furnish a written report confirming the proper installation of the equipment. The report shall indicate that the equipment is in accurate alignment, is free from any undue stress imposed by anchorage, and has been operated under full load conditions and that it operated satisfactory.

C. Include necessary trips by the manufacturer's representative to provide two separate 8-hour days on-site(travel time not included) for startup and training of operations personnel. Training may be video taped by Owner.

D. Additional trips required by the contractor before or after final startup and training shall not be charged to the owner.

3.03 ACCEPTANCE TESTS

A. Contractor shall perform a full scale factory test of all equipment before shipment. The mixer shall be operated for a period of 24 hours after installation to ensure that all parts are installed correctly and fully functional.

B. Contractor shall make all adjustments necessary to provide for proper operation and full functionality.

3.04 ELECTRICAL AND CONTROL INSTALLATION

A. Instrumentation, wiring and conduits for electrical power and controls shall be provided per specification under Division 13 – Special Construction and Division 16 – Electrical.

END OF SECTION

SECTION 11350

FIXED HEADER COARSE BUBBLE DIFFUSED AERATION SYSTEM
(STAINLESS STEEL)

PART 1 G E N E R A L

1.01 SCOPE

A. Furnish all materials and equipment for the fixed header aeration systems in Aeration Basins 1-5 and Influent Channel to Aeration Basins 1-6 as shown on drawings.

B. Furnish all equipment as shown on the drawings and as specified herein.

C. Provide services and testing associated with the equipment.

D. All items furnished by the equipment supplier under this section are for installation by the Contractor.

1.02 MEASUREMENT AND PAYMENT

A. Unless noted in the Bid Form, no separate payment will be made for Work under this Section. Include payment for applicable work as noted on the Bid Form.

B. Refer to Section 01270 – Measurement and Payment

1.03 REFERENCES

A. ASTM A240 Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications

B. ASTM A276 Standard Specification for Stainless Steel Bars and Shapes

C. ASTM A380 Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems

D. ASTM A554 Standard Specification for Welded Stainless Steel Mechanical Tubing

E. ASTM A774 Standard Specification for As-Welded Wrought Austenitic Stainless Steel Fittings for General Corrosive Service at Low and Moderate Temperatures

F. ASTM A778 Standard Specification for Welded, Unannealed Austenitic Stainless Steel Tubular Products

1.04 EQUIPMENT COMPONENTS INCLUDED

A. Stainless steel dropleg, distribution header(s) and diffusers.

B. Stainless steel supports and anchor bolts.

C. Stainless steel flanged and expansion joints.

D. Bolts, nuts and gaskets for aeration system flange connections.

1.05 RELATED WORK AND COMPONENTS NOT INCLUDED

A. Section 15061 Miscellaneous Piping.

B. Section 15115 Resilient Seated Butterfly Valves for Air Service.

1.06 SUBMITTALS

A. Submit information to establish compliance with the specifications in accordance with the provisions of Section 01330 Submittal Procedures.

1. Submittal drawings showing plan, elevation and cross sections of the equipment.

B. Component details of the aeration equipment showing diffusers, diffuser connectors, supports, expansion joints and flanges.

C. Materials and manufacturing specifications.

D. Equipment booklet to include:

2. Equipment data sheets

3. Performance data including oxygen transfer calculations.

4. Head loss calculation and pressure requirements.

5. Descriptive literature and bulletins.

6. Customer contact list with telephone numbers (minimum of 10 contacts from similar size facilities).

E. Operation and maintenance manual with installation instructions. Submit after approval of equipment and prior to shipment.

F. At the time of submitting shop drawings, submit the equipment manufacturer's warranty and certification form attesting that the manufacturer has examined the Contract Drawings and specifications and that the equipment provided will meet the performance criteria and conforms to specification requirements.

G. Detailed list of any or exceptions taken to these specifications. Include specification reference and proposed alternative with reason stated for exception.

H. Certified Oxygen Transfer Performance Curve(s)

1. Submit certified oxygen transfer performance curves to demonstrate capability of the aeration equipment to meet the specified oxygen transfer requirements.

2. Base oxygen transfer curves on the following criteria:

a. A minimum of 3 tests for each specified condition in complete accordance with ASCE Clean Water Test Procedure (1992 or latest edition)

b. Conduct tests by an independent aeration testing firm in a full scale aeration test tank (minimum of 200 sq. ft.) at the specified submergence and water depth with a diffuser density equivalent to the specified tank configuration.

c. Conduct shop test with air rate and mass rate of oxygen transfer directly proportional to the ratio of the shop test tank volume and the design tank volume.

d. Plot of pounds of oxygen per day per 1000 cubic feet of tank volume versus air per 1000 cubic feet of tank volume in tap water at 14.7 psia, 20°C and zero dissolved oxygen at the specified submergence. (lbs-O2/day/1000 cubic feet-tank) vs. (SCFM/1000 cubic feet-tank)

3. Certify and stamp all curves by a Professional Engineer.

4. Submit curves for all specified conditions for approval by the Engineer prior to manufacturing aeration equipment.

1.07 WARRANTY

A. Warranties shall conform to requirements of 00700 – General Conditions

1.08 SYSTEM DESIGN AND PERFORMANCE

A. Basin Design

a. Basins	Aeration Basins 1-5	Influent Channel South of Basins 1-6
b. Number of Basins	**5**	**1**
c. Dimensions/Pass		
Length, ft	140	186
Width, ft	30	28
Sidewater Depth, ft	14	14

B. Design aeration system to transfer not less than the following pounds of oxygen per day in clean water at 14.7 PSI, 20°C and zero dissolved oxygen at the specified submergence, air rate and pressure.

Parameters	Aeration Basins 1-5	Influent Channel South of Basins 1-6
1. Std. O2 Transfer Rate (SOTR) (Total-lbs-O2/day/Basin)	19,409	N/A
2. Volumetric Air Rate (SCFM/Basin)	6,800	1,500
3. Oper. Press. At top of Dropleg	6.0	5.9

(psig)		
4. Diffuser Submergence (ft.)	13	13
5. Diffuser Placement i.e. side roll, midwidth, etc. (Per Drawings)	Side Roll 2-Sides	Side Roll 2-Sides

PART 2 P R O D U C T S

2.01 ACCEPTABLE MANUFACTURERS

A. Diffusers shall be as manufactured by Xylem/Sanitaire Products, Brown Deer, Wisconsin or approved equal.

B. The naming of a manufacturer in this specification is not an indication that the manufacturer's standard equipment is acceptable in lieu of the specified component features. Naming is only an indication that the manufacturer may have the experience and capability of engineering and supplying a system as specified.

C. The manufacturer shall have experience in design, manufacturing, supplying and commissioning of coarse bubble fixed header aeration equipment of the type specified for this project. The equipment quoted shall be a proven design and shall be referenced by at least five installations of similar size, having been in successful operation for a period of not less than five years.

D. In the event the manufacturer elects to bid an air diffuser system that does not comply with the above experience requirements, then the manufacturer shall submit with the shop drawings, a maintenance bond executed by an Officer of the Corporation in the amount of 150% of the bid price guaranteeing repair or replacement of the air diffusion system in the event of a failure for a period of three years after the specified warranty. During such three year period the manufacturer shall repair, modify or replace the air diffusers in a manner acceptable to the Owner, if the operation of the air diffusers is unsatisfactory. Normal wear or malfunctions due to neglect or abuse will not be considered justifiable reasons for unsatisfactory operation. In the event the Owner determines the operation of the air diffusers to be unsatisfactory during this three year period and the manufacturer fails to correct the deficiencies within six months from the time the manufacturer is first notified

in writing that such deficiencies exist, the Owner will, as its sole option, make the necessary repairs or replacement and deduct costs from the aforementioned bond of the manufacturer.

2.02 MATERIALS, FABRICATION and FINISHING

A. Stainless Steel

1. Fabricate all welded parts and assemblies from sheets and plates of 304L stainless steel with a 2D finish conforming to ASTM A240.

2. Fabricate non-welded parts and flanges from sheets, plates or bars of 304 stainless steel conforming to ASTM A240 or ASTM A276.

3. Provide droplegs, manifolds and headers of the diameter shown on the drawings with dimensional tolerances conforming to ASTM A554 and fabrication procedures in accordance to ASTM A774 & A778.

4. Furnish air distribution headers with the following minimum nominal wall thicknesses.

   a. For gusset-reinforced diffuser connectors and header systems as specified in Section 2.03E.

Header Diameter (Inches)	**Wall Thickness (Inches)**
3 Thru 18	0.109

   b. For diffuser connectors and headers that are not gusset reinforced as specified in Section 2.03E, the minimum allowable header wall thickness is 0.25 inches to minimize potential for connector failure.

5. Furnish diffuser connector from cast 316L Stainless Steel.

6. Furnish all flanges from stainless steel per paragraph 2.02 A 2.

7. Furnish all nuts, bolts and washers including anchor bolts in 18-8 series stainless steel.

8. Furnish 304L stainless steel diffusers conforming to the material as listed in paragraph 2.02 A 1,2, and 3 with a cast 316L Schedule 80 threaded inlet nozzle.

9. Welds & Welding Procedure

   a. Weld in the factory with ER 316L filler wire using MIG, TIG or plasma-arc welding inert gas processes. Provide a cross section equal to or greater than the parent metal.

   b. Provide full penetration butt welds to the interior surface with gas shielding to interior and exterior of joint.

   c. Provide smooth, even distribution interior weld beads with an interior projection not exceeding 1/16 inch beyond the I.D. of the air header or fittings.

   d. Continuously weld both sides of face rings and flanges to eliminate potential for crevice corrosion.

   e. Field welding is NOT permitted.

10. Corrosion Protection and Finishing

   a. Clean all welded stainless steel surfaces and welds after fabrication by using the following procedure:

   b. Pre-clean all outside weld areas to remove weld splatter with the use of stainless steel brushes and/or deburring and finish grinding wheels.

   c. Finish clean all interior and exterior welds and piping by full immersion pickling and rinse with water to remove all carbon deposits, oxide film and contaminants to regenerate a uniform corrosion resistant chromium oxide film.

      1). Completely immerse all stainless steel assemblies and components in an acid solution as described in Section 6.2.11 of ASTM A380-88. The acid shall be a nitric-hydrofluoric solution as defined in Table A.2.1 of Annex A2 of ASTM A380.

      2). Provide a final thorough rinse using ordinary industrial or potable water and dry in conformance per Section 8.3 of ASTM A380.

   d. Corrosion protection techniques not utilizing full immersion methods are unacceptable and will be cause for rejection of the equipment.

e. Engineer/Owner at their option may choose to observe the equipment cleaning procedure by notifying the manufacturer of their intent to visit thirty (30) days prior to the date. Cost of the travel and expenses are by the Owner.

B. Neoprene – furnish all gaskets of fiber reinforced neoprene – 45 to 50 durometer (Shore A).

2.03 FIXED AERATION HEADERS, MANIFOLD AND DROPLEGS

A. Provide a dropleg from the air main connection or air isolation valve to the aeration system as shown on the drawings.

1. Provide a stainless steel Van Stone style flange design with a 150 pound drill pattern flange ring for the top connection.

2. Provide a stainless steel band clamp coupling with gasket for the lower dropleg to header connection for ease of installation and alignment.

B. Fabricate air distribution headers in sections up to 41 feet in length.

1. Provide eccentric reducers for changes in diameter for constant invert elevation.

2. Provide 8 inch diameter and smaller headers with removable end caps and 10 inch diameter and larger headers with welded end caps.

C. Join sections of air distribution headers with flanged joints or expansion joints. Design individual header sections for rotation independent of adjacent sections for alignment purposes during installation.

1. Provide flanged joints consisting of face rings, rotating ring flanges, bolts and gaskets.

2. Provide expansion joints consisting of a welded flanged expansion barrel, “O” ring gasket, “O” ring locking flange and hardware to accommodate + 2 inch of movement.

D. Furnish expansion/contraction system for all headers designed for temperature range of 125° F consisting of simple and fixed supports and expansion joints.

1. Lengths of header can extend up to 80 feet from restraining point without an expansion joint.

2. Limit maximum distance between restraining points on a continuous length of header to 120 feet maximum.

3. Provide an expansion joint on continuous lengths of header between two restraining points.

4. Provide simple supports to restrain header from buoyant uplift forces in compliance with Section 2.04.

5. Provide fixed supports in compliance with Section 2.04.

    a. Limit movement to prevent expansion joint blow apart and transmit expansion forces from the header to the fixed support stand.

        1). Provide a mechanical link to connect the header and fixed support stand.

        2). Reinforce the header at the attachment point of the mechanical link.

E. Duplex Diffuser Connectors

1. Factory weld to the invert centerline of the air header.

2. Design diffuser connectors for two diffusers.

3. Furnish PVC plugs for all unused diffuser connectors.

4. Provide connectors of length appropriate to the header diameter and positioned so that air exiting the diffusers clears the header.

5. Design header and diffuser connectors as follows:

    a. Reinforce the connector header weld joint by providing and continuously welding gussets between the vertical side wall of the header and the connector ends to limit long term flexure failure. Minimum gusset thickness is 0.125 inch.

    b. Weld connector to the header with a full penetration butt weld to minimize potential for crevice corrosion between header and connector. Use of fillet welds at the connection between the diffuser connector and header is NOT permitted.

c. Resist a vertical dead load applied to the threaded end of the connector that results in a bending moment of 1000 inch-lbs without exceeding 24,000 psi design stress in any part of the header wall or connector.

d. Header wall thickness for unreinforced connectors must comply with Section 2.02, A.4.b.

2.04 SUPPORTS AND ANCHOR BOLTS

A. Provide each section of air header with a minimum of two supports with the maximum spacing between supports not to exceed 17 ft 6 inches.

B. Limit header or manifold cantilever to no more than 4 ft.

C. Provide header supports with a vertically adjustable header hold down locking mechanism. (See typical support detail in drawings.)

D. Provide supports with a mechanism to provide for ±2 inch of vertical adjustment and ±1/2 inch of lateral adjustment for alignment of the header in the field.

E. Anchor Bolts

1. Design anchor bolts for embedment in 4000 psi concrete with a pullout safety factor of 4.

2. Attach supports to the tank with two stainless steel anchor bolts.

3. Provide a mechanical stainless steel expansion type anchor bolt system.

2.05 AIR DIFFUSERS

A. Provide diffusers fabricated of stainless steel material – refer to Section 2.02 Materials, Fabrication and Finishing.

B. Design diffuser for operating range of 10 to 40 SCFM.

C. Design diffusers with cast schedule 80 – 3/4 inch NPT threaded nozzle and acetyl orifice insert if required, an inverted air reservoir, air exit ports and a full length deflector.

1. Design diffusers to provide full wide band aeration with a minimum air release perimeter of 48 inches per diffuser. Release air uniformly along a minimum two foot band beyond each side of the header.

2. Locate exit ports discharging air into liquid on horizontal planes at two levels.

D. Diffuser Deflector

1. Provide factory welded deflector below each diffuser for its full length and width.

2. Design deflector to direct the liquid being aerated along the diffuser reservoir walls so that the air exits through the ports and is sheared into small bubbles and distributed into the liquid.

PART 3 E X E C U T I O N

3.01 INSTALLATION PROCEDURE

A. Follow equipment manufacturer's recommendations for sequencing of equipment installation.

B. Layout and install support anchors in accordance with equipment manufacturer's recommendations and anchor setting plan.

C. Level aeration system such that all diffusers connected to a header are within plus or minus 3/8 inch of a common horizontal plane.

3.02 INSTALLATION/START UP SERVICES

A. Provide services of a factory representative for (6) days to verify the proper installation of the equipment.

B. Provide services of a factory representative for (1) days to instruct owner’s personnel on operation and maintenance.

3.03 WARRANTY

A. Warrant all parts to be free from defects in materials and workmanship for a period of one year after installation or 18 months after delivery, whichever occurs first.

B. Furnish replacement parts to the Owner for any items found to be defective within the one year warranty period.

END OF SECTION

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SECTION 11402

BIOLOGICAL ODOR CONTROL SYSTEM

PART 1 G E N E R A L

1.01 DESCRIPTION

A. Furnish all labor, materials, equipment and incidentals required to refurbish three (3) existing biotrickling filters (BTFs), install one (1) additional new 5,000 cubic feet per minute (cfm) capacity biotrickling filter and two (2) new granular activated carbon (GAC) filters. The Work shall include testing the complete odor control system including all appurtenances as specified herein. Manufacturer shall furnish biotrickling filter equipment including fan, biotrickling filter vessel, replacement media and labor (to install replacement media), carbon filters, carbon, interconnecting ductwork, nutrient addition system, water addition system and control panel along with instrumentation and controls for a fully functioning system.

1.02 MEASUREMENT AND PAYMENT

A. Unless noted in the Bid Forms, no separate payment will be made for Work under this Section. Include payment for applicable work as noted on the Bid Forms.

B. Refer to Section 01270 – Measurement and Payment

1.03 RELATED SECTIONS

A. Section 01330 - Submittal Procedures

B. Section 01610 – Basic Product Requirements.

C. Section 01782 - Operations and Maintenance Data

D. Section 09900 - Painting

E. Section 13446 - Primary Instrumentation Devices

F. Section 13471 - Control Cabinet Enclosures

G. Section 15100 – Miscellaneous Valves

H. Section 15990 - Testing, Adjusting and Balancing of HVAC

I. Section 16171 – Low Voltage Electric Motor

1.04 SYSTEM DESCRIPTION

A. The system shall comprise of the following major components:

1. Single or multi-stage biotrickling filter vessel. The FRP vessel shall be comprised of one main module and one removable top piece to allow for ease of media replacement. Each media module shall house the structured synthetic media in series and contain a single water/nutrient injection spray system.

2. Two (2) single or dual bed FRP granular activated carbon filter vessels. The carbon filter vessels shall house sufficient granular activated carbon to provide a minimum 3 foot bed.

3. Structured, engineered, plastic, synthetic media to optimize mass transfer and facilitate the growth of bacteria necessary for biological oxidation of odorous compounds. The media bed shall be uniform and structured throughout and made entirely of a plastic, synthetic, non-reactive material.

4. A UL, factory-labeled electrical control panel housing a single Programmable Logic Controller (PLC) system and other components required for the control and monitoring of the system.

5. A water panel that houses all components necessary for the control and monitoring of the media irrigation system for all four BTFs, including an automatic flow control system with capability to automatically compensate for supply pressure changes.

6. One odor control fan with a VFD to move the odorous air from the source and be able to compensate for all pressure losses in the system at the design airflow.

1.05 CONTRACTOR RESPONSIBILITY

A. Installation of all Manufacturer supplied equipment components, which includes among others, placement and bolting of all equipment to the concrete

pad, connection of ductwork, water piping, drainage piping, and power and control wiring, all in accordance with the Manufacturer's installation instructions.

B. Supply of all odorous air ductwork and modifications to existing ductwork including flex connectors and damper valves between the fan and the odor control system.

C. Site preparation and clearing.

D. Construction of concrete equipment pad for placement of the biotrickling and carbon filter(s) and supply of system anchor bolts.

E. External water piping and drain piping to and from the biotrickling filter(s).

F. Power supply to the electrical control panel, water supply to the water panel, and water drain line from the biotrickling filter(s) drain sump.

G. Installation of any additional items as noted on the contract drawings.

H. Heat tracing and insulation of any air ductwork and/or water pipes as required by this Specification or elsewhere in the Contract Documents.

I. Temporary piping for startup of the system.

1.06 PROCESS DESCRIPTION

A. The odor control system shall remove hydrogen sulfide, organic reduced sulfur compounds (RSCs) and other odorous compounds from the foul air stream from City lift stations LS-2 and LS-3 on site using a biotrickling filter system comprised of three existing BTFs (7,000 cfm capacity total/2,333 cfm each) and a 5,000 cfm new BTF, all operating in a counter-current fashion. Co-current systems shall not be allowed.

B. The foul air shall enter the system at the bottom of each reactor and flow upward through each of the media layers. The media bed shall be intermittently irrigated from above using suitable de-chlorinated reclaimed plant effluent or potable water in a once through fashion. The water then trickles through the media and is collected in a sump at the bottom of the reactor. The drain water from the system will pass from the sump in the bottom of the reactor vessel and be piped to a discharge point as detailed on the Drawings. Systems using recirculation of irrigation water through the reactor vessel shall not be allowed.

C. The hydrogen sulfide is oxidized by the autotrophic bacteria resident on the lower media layer(s). As the foul air passes through the upper media layer (s), the resident heterotrophic bacteria will oxidize other organic odorous compounds. The airstream is further polished by the granular activated carbon system before being released to the atmosphere via the exhaust stack at the top of the carbon filters.

1.07 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. ASTM E679: "Standard Practice of Odor and Taste Thresholds By a Forced-Choice Ascending Concentration Series Method of Limits".

2. ASTM D-2563: "Recommended Practice for Classifying Visual Defects in Glass Reinforced Plastic Laminate Parts".

3. ASTM D-2583: "Standard Test Method for Indentation Hardness of Rigid Plastics by Means of Barcol Impressor".

4. ASTM C582: "Revision of C582-02 Standard Specification for Contact-Molded Reinforced Thermosetting Plastic (RTP) Laminates for Corrosion-Resistant Equipment".

5. ASTM D-883: "Definition of Terms Relating to Plastics".

6. ASTM D-3299: "Standard Specification for Filament-Wound Glass-Fiber-Reinforced Thermoset Resin Corrosion-Resistant Tanks".

7. ASTM D-4097: " Standard Specification for Contact Molded Glass Fiber Reinforced Thermoset Resin Corrosion-Resistant Tanks".

8. ASTM D-3982: "Standard Specification for Contact Molded Fiberglass Ducts".

9. PS 15-69: National Bureau of Standards Voluntary Product Standard "Custom Contact Molded Reinforced Polyester Chemical Resistant Process Equipment".

10. American National Standards Institute (ANSI).

11. American Society of Mechanical Engineers (ASME).

12. Institute of Electrical and Electronic Engineers (IEEE).

13. National Electrical Manufacturers Association (NEMA).

14. National Electrical Code (NEC).

15. National Fire Protection Agency (NFPA).

16. National Bureau of Standards (NBS).

17. Underwriters Laboratories (UL).

18. American Society for Testing and Materials (ASTM).

1.08 SUBMITTALS

A. The Manufacturer shall submit information as required to show complete compliance with these specifications. At a minimum this information should include the following:

1. Manufacturer's catalog/data sheets and descriptive literature for each piece of equipment supplied.

2. Technical data on each major piece of equipment including weights of all items greater than 200 pounds.

3. Structural calculations and drawings for the main reactor vessel, to include wind and seismic load calculations and anchor bolt sizing.

4. For the new biotrickling filter, modeling results, in graphical format, with velocity contour plots at 24 inch media height over the entire media cross section shall be provided to confirm that the airflow through the media is homogeneous at the average airflow rate. For the purpose of this specification, homogeneous is defined as being when the upflow velocity over the entire media cross sectional area is equal to the average upflow velocity ± 10 percent.

5. Detailed bill of material complete with material of construction.

6. Dimensional shop drawings showing elevation and plan views of the system and all applicable connections.

7. Process and Instrumentation Diagram (P&ID) showing all main equipment components, flow rates and instrumentation.

8. Process control narrative.

9. Description of Automatic Flow Control equipment to demonstrate compliance with Section2.05.F.3.

10. Equipment offloading and installation instructions with sufficient detail to allow the Contractor to complete the mechanical and electrical installation of all system components.

11. Annual utility and nutrient usage calculations (if applicable).

12. Statement of Manufacturer's Warranty.

13. Information on hazards associated with the system and appropriate safety precautions, including applicable Material Safety Data Sheets (MSDS).

B. The Manufacturer shall submit the following information, as a minimum, for the Operation and Maintenance Manuals.

1. As-built dimensional drawings showing plan and elevation views of the system and all applicable connections.

2. As-built Process and Instrumentation Diagrams (P&IDs).

3. Detailed bill of material along with specification of system components and materials of construction. The list to include the make, model number and descriptive literature of all items furnished by the Manufacturer.

4. Performance data for the odor control fan, to include curves showing capacity, pressure, horsepower demand and efficiency over the entire operating range, including fan manufacturer's descriptive literature and fan model number(s).

5. Special precautions for any components or materials associated with the system and its operation that should be subject to particular safety precautions, including MSDS.

6. Manufacturer's Service Department contact information and service order form.

7. Statement of Manufacturer's Warranty.

8. System startup and restart instructions.

9. Detailed information on proper settings and operation of the Automatic Flow Control System.

10. Special maintenance procedures, including recommended weekly, monthly and annual preventative maintenance requirements.

11. Troubleshooting guide.

12. Individual Operation and Maintenance instructions for all major system components.

1.09 SHIPPING, DELIVERY, STORAGE & HANDLING

A. All equipment and materials shall be properly protected such that no damage will occur from the time of shipment until the time of installation.

B. All exposed openings shall be protected to prevent entrance of debris, moisture or water during transportation and storage.

C. Contractor shall be responsible for offloading all shipped equipment and shall inspect all equipment upon arrival. Contractor shall notify the Manufacturer within 24 hours of any damage to equipment or surface finish due to shipping.

D. Contractor shall store all equipment such that, for the duration of the storage period, there will be no deterioration in equipment appearance or performance. Manufacturer shall supply detailed storage instructions, as necessary, at the time of shipment.

1.010 WARRANTY

A. The biotrickling filter Manufacturer shall warrant that all new equipment supplied meets these specifications and the performances detailed in Section 2.04 and that it is new and unused, free from defects in materials and/or workmanship. This warranty shall be for 18 months from equipment delivery to the job site or 12 months from equipment handover, whichever comes first. In the event that it is determined that a defect exists, at the Manufacturer's discretion, the Manufacturer shall repair or replace the defective components, provided that any such defect was not the result of misuse of the component by the Owner or his agents.

B. The biotrickling filter Manufacturer shall warrant both the new and replacement plastic, synthetic media against defects in material and workmanship for five (5) years from equipment delivery. In addition, the manufacturer shall warrant the

media against shrinking, swelling, plugging and against anything greater than a 5 percent increase in total pressure drop across the entire media bed for a period of five (5) years. In the event that it is determined that a defect exists, at the Manufacturer's discretion, the Manufacturer shall repair or replace the defective components, provided that any such defect was not the result of misuse of the component by the Owner or his agents.

PART 2 P R O D U C T S

2.01 GENERAL

A. The odor control equipment supplied under this section must be provided by a single Manufacturer who will be solely responsible for the design, delivery and performance of the system. The equipment must be new and unused and meet the detailed specifications and warranty requirements stated herein.

2.02 QUALITY ASSURANCE

A. The biotrickling filter Manufacturer is responsible for the coordination of all equipment specified herein. Systems shall be manufactured by BioAir Solutions, or approved equal.

B. Experience Requirements

1. The biological odor control system Manufacturer shall be experienced in the design, manufacture, installation and operation of biotrickling filters designed to remove hydrogen sulfide and organic RSCs from municipal water and wastewater odor sources. The system Manufacturer shall have a minimum of five (5) years of experience producing substantially similar equipment with structured synthetic media, and shall show evidence of at least five (5) systems in satisfactory operation for at least three (3) years in the State of Texas. Any manufacturer whose main business is FRP manufacturing will not be accepted as a supplier for the odor control system specified herein.

C. Substitution

1. Any substitutions or deviations in equipment or arrangement from that shown on the drawings or specified herein shall be the responsibility of the Contractor. Any deviation must be accompanied by detailed

structural, mechanical and electrical drawings and additional supporting data for review by the Owner and the Owner's Engineer and must be stamped and certified by a Professional Engineer (PE) registered in the State of Texas.

All costs associated with the review of substitutions or deviations, and costs to the Engineer or Owner associated with project drawing changes as a result of approval of the substitution, shall be borne by the Contractor. There shall be no additional costs to the Owner due to substitutions or deviations.

D. Acceptable Manufacturers

1. BioAir

2. Or Engineer approved equal.

2.03 OPERATING CONDITIONS

A. The system shall be suitable to treat air coming from a continuous supply from the odor source and all equipment must be suited to the operating conditions to which it will be subjected and the various compounds/substances with which they will reasonably be expected to come into contact. The operating conditions, at a minimum, include the following:

Duty	Continuous air supply and odor source
Location	Outdoors
Inlet air temperature	55 – 100°F
Inlet relative humidity	60 - 100%
Contaminants	Including, but not limited to, hydrogen sulfide, organic reduced sulfur compounds (RSCs), ammonia, methyl mercaptans and sulfuric acid

2.04 DESIGN REQUIREMENTS

A. At a minimum, the system shall treat the following and meet the following minimum performance criteria:

Number of new BTFs	One (1)

Foul air flowrate	5,000 cfm for new unit/12,000 cfm system total
Maximum System pressure drop	8" w.c.
Contaminant concentration:	
Average hydrogen sulfide concentration	50 ppmv
Peak hydrogen sulfide concentration	100 ppmv
Max. instantaneous irrigation water flow	46 gpm
Irrigation water pressure (dynamic)	65 psi

Performance requirements:

New Biotrickling Filter Treatment Unit Stage:

Average Hydrogen sulfide removal:	≥ 99% or ≤ 0.50 ppmv in outlet, whichever is higher.

Biotrickling Filter and Carbon (System):

Average H_2S removal:	≥ 95% or ≤ 0.1 ppmv in outlet, whichever is higher.
Average odor removal	≥ 95% or ≤ 200 D/T* in outlet, whichever is higher.

**Odor criteria shall be based on specification ASTM 679 with a presentation rate of 20 LPM.*

2.05 SYSTEM COMPONENTS

A. Biotrickling Filter Vessel

1. The biotrickling filter vessel shall be free standing and of vertical "tower" configuration operating in a counter-current manner. The vessel shall consist of one (1) module containing inorganic, structured media and one (1) top piece. The module shall be constructed from fiberglass reinforced plastic (FRP) and be designed with adequate strength to support the number of required modules. The FRP module shall

contain, as a minimum, a 100 mil vinyl ester resin corrosion barrier. The structural layer shall consist of isophthalic resin with chop strand and continuous glass. The exterior top coat shall be isophthalic resin with UV resistant pigment (minimum service life of 10 years). The exterior color shall be CCP base white enamel.

2. The biotrickling filter vessel shall not provide access to any area beneath the media or any location within the vessel where there is a chance for dripping acidic filtrate or hydrogen sulfide gas.

3. The reactor vessel shall be provided with 316 stainless steel hold down lugs to account for all anticipated loads to comply with state and local wind code requirements.

B. Media

1. All biotrickling filter media for the refurbishment of the existing biotrickling filters and the additional biotrickling filter, shall, without exception, be engineered, structured, high porosity, chemically resistant, synthetic porous material made from polyvinyl chloride, polyethylene or polyurethane. Organic media and non-synthetic inorganic media materials shall not be allowed.

2. The media characteristics (available surface area, density, and pressure drop) shall be structured and uniform throughout the media bed with pre-manufactured, engineered flow channels. Without exception, random media types (chips, clay balls, foam cubes, etc.) shall not be allowed.

3. The media shall have a minimum available specific surface area of 230 ft^2/ft^3 and a void opening of more than 96 percent. P ressure drop shall not exceed 0.25 inch w.c. per ft or media depth.

4. The media shall be guaranteed not to clog or require cleaning, scrubbing, backwashing, acid-washing or replacement for a period of five (5) years.

5. Media shall resist compaction or swelling due to varying moisture levels and shall not degrade when subjected to low pH (i.e. pH < 2) conditions.

6. The uniform structure of the media shall minimize the potential for short circuiting and encourage a uniform water and air flow pattern over the entire media cross sectional area.

7. The manufacturer shall provide evidence that the airflow through the media at 24 inch height from the bottom of the media is homogeneous at the average airflow rate. For purposes of this specification, homogeneous is defined as being when the upflow velocity over the entire media cross sectional area is equal to the average upflow velocity ± 10 percent. The airflow modeling results with velocity contour plots at 24 inch media height over the entire cross section shall be provided in graphical format as part of the Submittal requirements.

8. Sufficient media shall be provided to ensure the performance requirements listed in section 2.04 are met.

9. Media shall be pre-installed in the FRP module (s) prior to shipment to the job site.

C. Granular Activated Carbon Filter Vessel

1. The granular activated carbon (GAC) filter vessels shall be a single/dual bed and free standing and of vertical “tower” configuration. Each vessel shall consist of one (1) or two (2) beds containing premium coconut shell carbon. Each module shall be constructed from fiberglass reinforced plastic (FRP) and be designed with adequate strength to support the required media beds. The FRP vessel shall contain, as a minimum, a 100 mil vinyl ester resin corrosion barrier. The structural layer shall consist of isophthalic resin with chop strand and continuous glass. The exterior top coat shall be isophthalic resin with UV resistant pigment (minimum service life of 10 years). The exterior color shall be CCP base white enamel.

2. Outlet stack shall be integral to FRP vessel top, with no flange connection or attachments. No rain cap shall be allowed, as it reduces atmospheric dispersion and increases pressure drop.

3. Vessel and media bed to be grounded with 316 SS rod.

4. Vessel to contain sample ports at 1 ft intervals up reactor wall for air measurement.

5. Beds of activated carbon material shall be supported on a polypropylene screen liner and FRP grating with minimum open area of 80 percent.

Polypropylene Liner, for carbon retention shall, contain 0.125 inch thick wall and 0.125 in diameter perforated screen openings.

6. Carbon filter vessels shall not provide access to any area beneath the media or any location within the vessel where there is a chance for exposure to hydrogen sulfide gas.

7. The reactor vessels shall be provided with 316 stainless steel hold down lugs to account for all anticipated loads to comply with local wind code requirements, and 316SS lifting lugs to allow ease of installation and movement.

D. Granular Activated Carbon Media

1. The carbon media shall be premium, selected grade coconut shell carbon that meets the following criteria:

• H_2S Capacity (ASTM D6646), g/mL	0.2 minimum
• Moisture, % as packed	8 maximum
• Mesh size (US Sieve Series)	
o Greater than 4 mesh (4.75 mm), %	10 maximum
o Less than 8 mesh (2.36 mm), %	5 maximum
• Apparent Density, poured, g/mL	0.40 minimum
lb/ft³	25 minimum
• Mean Particle Diameter, mm	0.34

2. Sufficient media shall be provided to ensure the performance requirements listed in section 2.04 are met.

3. Media shall be shipped separately for installation in the FRP vessels prior to startup at the job site.

E. Irrigation System

1. Each reactor shall be configured with no more than one (1) irrigation point which shall distribute the irrigation water evenly over the entire upper surface of the media layer.

2. Each spray nozzle shall be tested by the Manufacturer and a certificate of conformity supplied with the shop drawings to show that the nozzle has been tested and meets the Specified standards for uniform distribution.

3. The spray systems in the three (3) existing biotrickling filters will be replaced by the manufacturer and the new spray pattern certified to provide a uniform distribution over the surface of the replacement structured synthetic media.

4. Spray nozzle array systems with multiple nozzles, shall not be acceptable.

5. The irrigation system shall be supplied with a nutrient addition system to provide the macro and micronutrients required by the bacteria for optimal metabolism of the odorous compounds being treated.

F. Control System

1. Electrical Control Panel (ECP)

   a. The ECP enclosure shall be NEMA 4X and constructed of 316 SS, and the panel shall come with a 316 SS panel stand.

   b. The ECP shall house the necessary electronic components and a Siemens S7 PLC with Siemens HMI for the control and monitoring of the irrigation system. Dry contacts shall be provided for external notification of alarm status. Alarms, at a minimum, shall be provided for low irrigation water flow, high irrigation water flow, no nutrient flow (if applicable) and fan fail. There should be an allowance to manually open the irrigation spray valve (located in the water control panel) for the purpose of routine maintenance checks but the valve should be normally closed.

   c. The ECP and PLC will provide control and monitoring for the odor control system, including three (3) refurbished biotrickling filters, one (1) new biotrickling filter and two (2) new carbon filters.

   d. The ECP shall require a single electrical connection of 480V/3Phase/60Hz. Transformers shall be provided as necessary for power and control voltages.

2. Water Control Panel (WCP)

a. The Water Control Panel shall be constructed of 316 SS and be mounted on the common 316 SS panel stand, back-to-back with the ECP.

b. The WCP shall contain a panel heater, valves, motorized ball valves, strainers, instruments and piping for the control of the irrigation system and shall operate from control signals from the ECP.

c. The WCP shall allow for a single connection to either a potable water source or suitable final effluent plant water source. The WCP shall control the irrigation cycles to all four (4) biotrickling filters.

d. The WCP shall house the nutrient addition system.

e. The WCP shall also contain a flexible spray hose with a hand trigger to allow for convenient rinsing of the strainer, filling of the nutrient barrel, and general convenience. A dedicated ball valve shall be provided in front of the spray hose to allow for the operation of the water panel while simultaneously allowing for isolation in case of a leak in the hose.

3. Automatic Flow Control System

a. Without exception, the ECP and WCP shall contain the necessary programming, circuitry, and hardware for an Automatic Flow Control System, which shall have the following features and shall be capable of meeting the Automatic Flow Control System performance test outlined in Section 3.05.E.

b. The system will periodically monitor the irrigation water flow rate during the irrigation sequence.

c. If the irrigation water flow rate is outside of the target flow range the irrigation valve will automatically adjust to correct the irrigation water flow rate.

d. The following parameters shall be operator-adjustable:

1. Target irrigation flow rate
2. Allowable flow error
3. Amount of valve adjustment when error is detected
4. Flow evaluation period

e. The following non-adjustable readings shall be shown on the ECP HMI:

1. Instantaneous irrigation water flow rate
2. Actual irrigation valve open percentage

f. The following will NOT be considered to be meeting the Automatic Flow Control Systems requirements:

1. Systems using irrigation valves that are only capable of fully-open or fully-closed operation. Solenoid Valves do not meet this requirement and are not allowed.
2. Systems using mechanical-only means of adjusting the irrigation water flow such as manual diaphragm valves, globe valves, pressure reducing or adjusting valves.
3. Systems that require operator interaction in order to correct the irrigation water flow.

G. Odor Control Fan

1. The fan(s) shall be single-width wheel, single-inlet as designed and manufactured by Hartzell, New York Blower Company, or Engineer approved equal.

2. The fan shall be constructed such that all surfaces in contact with the odorous airstream are to be made of corrosion resistant FRP.

3. All nuts, bolts and fasteners in contact with the gas stream shall type 316 SS.

4. Fans shall be AMCA Arrangement 8. AMCA Arrangement 4, which places the motor shaft in the odorous airstream, is not allowed.

5. Fan ratings shall be based on tests made in accordance with AMCA Standard 210 and licensed to bear the AMCA Certified Ratings Seal for Air Performance. Fans not licensed to bear the AMCA Seal for performance shall be tested, at Contractor's expense, in an AMCA Registered Laboratory.

6. Fan brake horsepower shall be equal to or less than 50 bhp at 12,000 cfm and 16.4 inches static pressure.

7. Fan shall be constructed in accordance with ASTM D-4167 standard specification for FRP fans and fans to ensure structural integrity.

8. Fan housing shall be constructed of polyester resin.

9. Wheel shall be radial, or backwardly-inclined, non-overloading design. Wheel shall be fabricated of vinyl ester resin.

10. Wheel hub shall be securely fastened to the shaft and completely encapsulated in FRP to ensure corrosion-resistant integrity. Wheels shall be ground and polished carbon steel, encapsulated in FRP.

11. The fan motor shall be a standard efficiency, explosion proof, 480V/3/60 electric motor as manufactured by US Electric Motors, Baldor, Reliance or approved equal.

12. Fan shall be equipped with a Teflon shaft seal and a drain at the bottom of the fan wheel to allow drainage of condensation in the ducts.

H. Recirculation System

1. Systems requiring a permanent recirculation system shall not be allowed.

2.06 SPARE PARTS

1. At a minimum, the following spare parts shall be supplied with the equipment.

   a. One (1) set of fuses, one (1) for each fuse rating

   b. One (1) set of lamp lenses

   c. One (1) strainer

2. Spare parts shall be stored, by the Contractor, on site and shall be handed over to the Owner at equipment handover.

PART 3 E X E C U T I O N

3.01 FACTORY ACCEPTANCE TEST

A. Reactor Vessel

1. FRP reactor vessels shall be inspected prior to shipping for conformance to the following:

a. Dimensions match those shown on submittal drawings and are within Manufacturer's specified tolerances.

b. Flanges and connections between reactor parts fit securely without improper bending or stressing of parts.

c. Damage or imperfections to paint or fiberglass work, including cracking/crazing are minimal and in accordance with FRP specifications in Section 2.05A.

d. Manufacturer shall keep a record of the quality control document for each reactor vessel(s) that is available to the Engineer upon request.

B. Electrical Control Panel

1. Electrical control panel shall be inspected prior to shipping for conformance to the following:

a. NEMA rating according to Section 2.05F and bear the UL 508 label.

b. PLC program and HMI shall be tested for proper communication and functionality.

c. PLC digital and analog inputs shall be electrically tested to ensure input recognition in the proper area of the PLC program.

d. All wiring between panel components and terminal strips shall be checked for proper labeling and connection.

C. Water Panel

1. All water panel piping and/or other pre-installed piping shall be tested prior to shipping for conformance to the following:

2. System shall have no leaks when subjected to a pressure test at 80 psi for a minimum of 1 hour.

3. All installed instruments, sensors, pumps, actuated valves, and other electrical components shall be tested for proper operation.

4. All wiring from terminal strips to all electrical components shall be tested to ensure proper wiring.

D. Spray nozzle

1. Spray nozzle shall be factory tested to ensure compliance with Manufacturer standards for uniform distribution.

3.02 INSTALLATION & EQUIPMENT STARTUP

A. As far as is reasonably possible, all equipment should be pre-assembled prior to shipment, to minimize the need for on-site assembly. Media should be pre-installed by the Manufacturer and certified to meet the specified performance requirements.

B. Installation of all equipment and carbon media will be conducted by the Contractor and must be in accordance with Manufacturer's written installation and startup instructions and by workers experienced in the handling of fiberglass vessels, electrical work, plumbing and instrumentation. The final installation must be certified by the Manufacturer as complete and correct.

C. The Manufacturer shall provide the Contractor with required clearances, tolerances and limitations, such as smoothness/flatness of concrete pad and shall be available to answer questions prior to and during the installation of the equipment.

D. Once the installation has been certified by the Manufacturer, the Contractor, with assistance from the Manufacturer, shall start the system to begin the biological acclimation period. This startup period shall take no longer than six (6) weeks but at any point during this startup period, at the discretion and direction of the Manufacturer, the contractor shall switch the system over to normal operation. Any minor re-piping or plumbing required will be clearly detailed in the Manufacturer's installation and startup manual and will be performed by the Contractor.

E. Any special tools or materials required for this startup/acclimation period shall be provided by the Manufacturer.

F. After satisfactory startup and the corresponding switch over to normal operation, the Contractor shall, in the presence of the Engineer, conduct the performance test as detailed in section 3.05 below.

3.03 FIELD PAINTING & CORROSION PROTECTION

A. If painted surfaces are damaged during shipment, off-loading or installation, as long as the damage is surface only and in no way affects the integrity of the equipment or its ability to perform, these blemishes, scratches or other imperfections shall be touched up by the Contractor in accordance with instructions from the Manufacturer. Materials used shall me compatible with the original coating material in quality and color.

3.04 PERFORMANCE TESTING

A. Performance testing shall not commence until the Manufacturer and Engineer agree that they system has been satisfactorily started-up and sufficient time has been allowed for the acclimation of the bacteria.

B. After the odor control system has been satisfactorily started-up and switched to normal operation, the Contractor shall, in the presence of the Engineer, demonstrate that the system will perform as specified in section 2.04 of this specification.

C. The Contractor shall provide the Engineer with a written test protocol and the performance test may not be conducted until the test protocol has been reviewed and approved by the Engineer.

D. The Manufacturer may be present during the performance test and, at its own discretion, may conduct a parallel performance test as long as they do not interfere with the performance test being conducted by the Contractor.

E. The Contractor shall supply, install and operate all equipment, sensors and instrumentation required to complete the performance test.

F. H_2S Testing procedure

1. Measure airflow into each unit and, if necessary, adjust to the design airflow +/- 10 percent. Airflow balancing can be conducted by the Manufacturer and witnessed by the Engineer and/or Contractor if desired. Airflow shall be measured at the beginning of the test period. The set position on the damper(s) and/or VFD(s) will be marked or noted. Airflow will not change as long as damper(s) and/or VFD(s) remain in position.

2. Measure pressure drop across each biotrickling filter at beginning of test period.

3. Measure temperature and relative humidity of the inlet, outlet and ambient air.

4. Performance test period to begin at a noted time and last for four (4) hours. H_2S data from the common inlet location and from the outlet of each odor control system will be measured and logged once every 10 minutes to demonstrate performance during test period.

   a. The inlet H_2S data will be logged with a pre-calibrated OdaLog gas data logger with appropriate range and accuracy for the inlet air stream (0-1000 ppmv or 0 - 200 ppmv range, 1 ppm display resolution or 0.0 - 50.0 ppmv range, 0.1 ppmv display resolution).

   b. The outlet H_2S data will be logged with a pre-calibrated OdaLog gas data logger with appropriate range and accuracy for the outlet air stream. (0.00 - 2.00 ppmv range, 0.01 ppmv display resolution or 0.0 - 50.0 ppmv range, 0.1 ppmv display resolution).

G. Biotrickling Filter H_2S Acceptance criteria:

1. The system's H_2S removal efficiency shall be determined by calculating the average inlet H_2S concentration and the average outlet H_2S concentration and using the following formula: H_2S removal efficiency (%) = (1 – average outlet H_2S concentration/average inlet H_2S concentration) x 100. The system shall have passed the H_2S performance test if the H_2S removal efficiency is 99% or more for inlet air H_2S concentrations ≥ 50 ppmv but ≤ 100 ppmv, or the average outlet air H_2S concentration is ≤ 0.5 ppmv, whichever is greater.

2. In the event that the maximum H_2S concentration during the four (4) hour test period exceeds the maximum allowable H_2S concentration as listed in this Specification, the H_2S acceptance criteria shall not apply and the system shall be considered to have passed the performance test.

H. System H_2S Acceptance criteria:

1. The system's H_2S removal efficiency shall be determined by calculating the average inlet H_2S concentration and the average outlet H_2S concentration and using the following formula: H_2S removal efficiency (%) = (1 – average outlet H_2S concentration/average inlet H_2S concentration) x 100. The system shall have passed the H_2S performance test if the H_2S removal efficiency is 95% or more for inlet

air H_2S concentrations ≥ 20 ppmv but ≤ 100 ppmv, or the average outlet air H_2S concentration is ≤ 0.1 ppmv, whichever is greater.

2. In the event that the maximum H_2S concentration during the four (4) hour test period exceeds the maximum allowable H_2S concentration as listed in this Specification, the H_2S acceptance criteria shall not apply and the system shall be considered to have passed the performance test.

I. System Odor Testing procedure

1. Measure airflow into each unit and, if necessary, adjust to the design airflow +/- 10 percent. Airflow balancing can be conducted by BioAir and witnessed by the Engineer and/or Contractor if desired. Airflow shall be measured at the beginning of the test period. The set position on the damper(s) and/or VFD(s) will be marked or noted. Airflow will not change as long as damper(s) and/or VFD(s) remain in position.

2. Measure pressure drop across each biofilter at beginning of test period.

3. Measure temperature and relative humidity of the inlet, outlet and ambient air.

4. One (1) set of air samples, each consisting of one (1) inlet air sample and one (1) outlet air sample from each odor control system (existing units and new unit), will be collected in 10 L Tedlar bags with an air sampling chamber as near simultaneously as possible. A separate inlet air sample will be taken for each outlet air sample as near simultaneously as possible. Each set of samples shall be collected in duplicate to minimize the risk of sample loss during shipping. Only one (1) set of bag samples per biotrickling filter shall be analyzed for odors. Bag samples shall be shipped to St. Croix Sensory (Lake Elmo, MN) or equal laboratory via UPS Next Day Air for analysis within 30 hours in accordance with ASTM 679-91. The airflow presentation rate shall be 20 L/min.

J. Odor Acceptance criteria

1. The system shall have passed the odor performance test if the average (if more than one sample per system) inlet and outlet odor Detection Thresholds indicate 95 percent removal of odors for inlet air odor

Detection Thresholds ≥ 2,000 but ≤ 60,000 OU. If the inlet air has an average odor Detection Threshold of < 2,000 OU then the outlet air will have an average Detection Threshold of ≤ 200 OU.

2. Odor measurements that exceed the dilution limit of the laboratory shall be presented as >60,000 OUs, and for purposes of estimating the odor removal efficiency, 1 OU = 0.5 ppb H_2S. For measurable values the laboratory shall present the results as the actual odor value, plus the upper and lower 95 percent confidence interval range of the measured value ("Range"). The odor removal acceptance shall be acceptable if the guaranteed odor value falls within the Range."

K. Automatic Flow Control System Testing Procedure

1. In the presence of the Engineer, the Manufacturer shall demonstrate the operation of the Automatic Flow Control System as given below.

2. Review the requirements list given in Section 2.05.F.3 and prove or demonstrate compliance with each point.

3. The following procedure shall be followed for each irrigation valve in the system. The cycle time shall be minimized to allow the procedure to be completed within 30 minutes.

   a. Open all manually controlled valves allow for maximum flow through the WCP. Set the target irrigation flow rate to 3 times the normal irrigation flow rate (to allow the irrigation valve to fully open). Demonstrate that the valve will reach 100 percent open status within 20 seconds during irrigation.

   b. In between irrigation cycles, while the irrigation valve is CLOSED, set the target irrigation flow rate to the proper design irrigation flow rate. Demonstrate that the irrigation valve will automatically close in order to reach the design flow rate within 30 seconds during its next irrigation cycle.

   c. Repeat steps a. and b. above for a minimum of 3 additional set points both above and below the normal target irrigation flow rate.

   d. Set the target irrigation flow rate to the normal target irrigation flow rate. Partially close at least one valve upstream of the modulating ball valve and demonstrate that the irrigation valve will automatically adjust to a more open position in order to reach

the design flow rate within 30 seconds during its next irrigation cycle.

e. Return all Automatic Flow Control settings to their normal positions and fully open all upstream and downstream valves. Demonstrate that the system will return to normal flow control operation.

3.05 MANUFACTURERS SERVICES

1. In addition to being available by phone to assist the Contractor during the off-loading, installation, and startup of the equipment, the following Manufacturer's services shall be provided with the number of trips and days on site as a minimum.

   a. Startup assistance — One (1) Trip, Two (2) days on site

   b. Performance testing assistance/training — One (1) Trip, One (1) day on site

2. Notwithstanding the above, the Manufacturer shall continue to assist the contractor with questions, issues and remote assistance until the system is properly installed, running satisfactorily and handed over to the Owner.

3.06 EQUIPMENT NAME PLATES

1. Each separate piece of equipment shall be furnished with a unique name plate identifying the Manufacturer, model & serial number, date of manufacture and, if applicable, capacity and any performance limitations. The nameplates shall be Gravograph Gravoply 2 ply plastic, or equal, and firmly affixed to the exterior surface of the equipment and in a location that is accessible and easily read.

END OF SECTION

SECTION 13120

PRE-CAST CONCRETE BUILDING

PART 1 GENERAL

1.01 SUMMARY

A. Furnish a precast concrete building to house the odor control fan to be delivered pre-assembled and placed on prepared poured-in-place concrete foundation as shown on the Contract drawings and in accordance with manufacturer's recommendations. The Fan Shed Building shall be provided by the Manufacturer with all necessary openings as specified and as shown on the Drawings in conformance with Manufacturer's structural requirements.

1.02 MEASUREMENT AND PAYMENT

A. Unless noted in the Bidsheet, no separate payment will be made for Work under this Section. Include payment for applicable work as noted on the Bidsheet.

B. Refer to Section 01270 – Measurement and Payment

1.03 CODES, STANDARDS AND REFERENCES

A. ACI-318-05, "Building Code Requirements for Structural Concrete".

B. ASCE-7-05, " Minimum Design Loads for Buildings and Other Structures".

C. 2006 IBC, "2006 International Building Code".

D. PCI Design Handbook, Precast/Prestressed Concrete Institute. 5th Edition.

E. "Manual of Standard Practice", Concrete Reinforcing Institute.

F. ASTM, American Society for Testing and Materials:

1. C150 - Standard Spec. for Type I and Type II – Low Alkali Portland Cement.

2. C33 - Standard Spec. for Concrete Aggregates.

3. A36 - Standard Spec. for Carbon Structural Steel.

4. A615 - Standard Spec. for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.

5. A706 - Standard Spec. for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement.

6. A416 - Standard Spec. for Steel Strand, Uncoated Seven-Wire for Prestressed Concrete.

7. A185 - Standard Spec. for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement.

8. A307 - Standard Spec. for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.

9. A123 - Standard Spec. for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

10. A153 - Standard Spec. for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

1.04 QUALITY ASSURANCE

A. Fabricator must be a producer member of the National Precast Concrete Association (NPCA).

B. Building fabricator must have a minimum of 10 years experience manufacturing pre-cast concrete buildings.

1.05 DESIGN REQUIREMENTS

A. Dimensions:

Exterior: 18 foot x 14 foot x 12 foot

Interior: 17 foot-4 inch x 13 foot-4 inch x 12 foot inch

B. Standard Design Loads:

1. Standard Wind Loading - 140 mph (ASCE 7-05, Category II, Exposure C, Enclosed Building)

2. Standard Roof Live Load - 60 psf

3. Standard Floor Live Load - 250 psf

4. Seismic Design Category 'D', Seismic Importance Factor, I=1.0

C. Roof: Roof panel shall be sloped 1 inch from front to back. The roof shall extend a minimum of 3 inches beyond the wall panel on each side and have a turndown design which extends 1/2 inch below the top edge of the wall panels to prevent water migration into the building along top of wall panels. Roof shall also have an integral architectural ribbed edge.

D. Foundation (poured-in-place floor slab by contractor): There shall be a 1-1/2 inch deep by 7-1/2 inch recess cast into the perimeter of floor slab except at doorways. The 1-1/2 inch recess makes the interior floor surface 1-1/2 inch higher than the joint between the wall panel and floor slab preventing intrusion of water. Building manufacturer will provide wall anchors at time of erection of panels. Cast-in-place foundation by contractor

E. Roof, floor and wall panels must each be produced as single component monolithic panels. No roof, floor, or vertical wall joints will be allowed, except at corners. Wall panels shall set on top of floor slab.

1.06 SUBMITTALS

A. Building engineering calculations that are designed and sealed by a professional engineer, licensed in the state of manufacture, shall be submitted for approval.

1.07 SHIPPING, DELIVERY, STORAGE & HANDLING

A. All materials shall be properly protected such that no damage will occur from the time of shipment until the time of installation.

B. All exposed openings shall be protected to prevent entrance of debris, moisture or water during transportation and storage.

C. Contractor shall be responsible for offloading all shipped equipment and shall inspect all equipment upon arrival. Contractor shall notify the Manufacturer within 24 hours of any damage to equipment or surface finish due to shipping.

D. Contractor shall store all equipment such that, for the duration of the storage period, there will be no deterioration in equipment appearance or performance. Manufacturer shall supply detailed storage instructions, as necessary, at the time of shipment.

1.08 WARRANTY

A. The Manufacturer shall guarantee the building is new and unused, free from defects in materials and/or workmanship. This warranty shall be for 18 months from delivery to the job site or 12 months from handover, whichever comes first. In the event that it is determined that a defect exists, at the Manufacturer's discretion, the Manufacturer shall repair or replace the defective components, provided that any such defect was not the result of misuse of the component by the Owner or his agents.

PART 2 PRODUCTS

2.01 MATERIALS

A. Concrete: Steel-reinforced, 6,000 psi minimum 28-day compressive strength.

B. Reinforcing Steel: ASTM A615, Grade 60 or ASTM A185, Grade 80 unless otherwise indicated.

C. Post-tensioning Strand: 41K Polystrand CP5O, .50, 270 KSI, 7-wire strand, greased plastic sheath, (ASTM A416), roof and floor to be each post-tensioned by a single, continuous tendon. Said tendon shall form a substantially rectangular configuration having gently curving corners and a corner where the tendon members are anchored. Tendons shall be greased and enclosed within a sheath.

D. Sealant: All joints between panels shall be sealed on the exterior and interior surface of the joints. Sealant shall be SIKAFLEX-IA elastic sealant or equal. Exterior sealant joint to be 3/8 inch x 3/8 inch square so that sides of joint are parallel for correct sealant adhesion. Back of joint to be taped with bond breaking tape to ensure adhesion of sealant to parallel sides of joint and not the back.

E. Wall Block-outs: There shall be a 36 inch diameter block-out and a 24-inch block-out for FRP duct (FRP duct furnished and installed by the Contractor). These penetrations shall be made waterproof as per Manufacturer's recommended method and engineering details of these penetrations submitted with shop drawings.

F. Panel Connections: All panels shall be securely fastened together with 3/8 inch thick stainless steel brackets. Steel is to be of structural quality. All

fasteners to be 1/2 inch diameter bolts complying with ASTM A307 for low-carbon steel bolts. Cast-in anchors used for panel connections to be Dayton-Superior #F-63, or equal. All inserts for corner connections must be secured directly to form before casting panels. Floating of connection inserts will not be allowed.

G. Manufacturers:

1. Lonestar Prestress Manufacturing, Inc.

2. Approved Equal

2.02 ACCESSORIES

A. Door and Frame: Shall comply with Steel Door Institute "Recommended Specifications for Standard Steel Doors and Frames" (SDI-l00), and as herein specified. The building shall be equipped with double 3 foot-0 inch x 7 foot-0 inch x 1-3/4 inch, 18-gauge 304 stainless steel door, with insulated core. Door shall open as noted on drawings. Frame shall be 16-gauge stainless steel.

B. Door Hardware:

1. Handle: Lindstrum pull-handle stainless steel, 8-1/2 inch x 2 inch, or passage knob or equal.

2. Lockset: Cal-Royal lever lock or Easi-Set or equal.

3. Deadbolt: Yale or Easi-Set stainless steel keyed outside only or equal.

4. Hinges: Hagar stainless steel five knuckle ball bearing with non-removable pins or equal.

5. Threshold: Hagar or National Guard Products extruded aluminum with neoprene seal or equal.

6. Overhead Door Holder: Yale surface mounted overhead slide type with safety release or equal.

7. Drip Cap: Hager or National Guard Products aluminum with stainless steel screws or equal.

8. Door Closer: Norton 7500 or Yale 4410 with hold open or equal.

C. Overhead Coiling Service Door

1. Curtain: Interlocking roll-formed galvanized steel slats, flat crown profile type CAW, 26 gauge for widths up to 12 feet 4 inches (3.75 m), 24 gauge for widths up to 16 feet (4.88 m). End of each slat shall be locked from lateral movement by a staking lock system. (Galvanized alternate malleable end locks.)

2. Finish:

a. Curtain slats and hood shall be galvanized in accordance with ASTM A 653 and receive rust-inhibitive, roll coating process, including 0.2 mils thick baked-on prime paint, and 0.6 mils thick baked-on polyester top coat. Applied industrial textured powder coat to entire door system including slats, guides, bottom bar and head plate. Non-galvanized exposed ferrous surfaces shall receive one coat of rust-inhibitive primer.

3. Weatherseals: Vinyl bottom seal.

4. Bottom Bar: Extruded aluminum.

5. Guides: Roll-formed galvanized steel shapes attached to continuous galvanized steel wall angle.

6. Brackets: Galvanized steel to support counterbalance and curtain.

7. Counterbalance: Helical torsion spring type housed in a steel tube or pipe barrel and supporting the curtain with deflection limited to 0.03 inch per foot of span. Spring tension shall be adjustable.

8. Hood: 24 gauge galvanized steel with intermediate supports as required.

9. Manual Operation: Chain hoist

10. Lock: Chain keeper locks for chain hoist operation.

11. Wall Mounting Condition: Face-of-wall.

2.03 FINISHES

A. Interior of Building: Interior walls and ceiling surfaces shall be painted with white epoxy.

B. Exterior of Building: Hand seeded exposed San Jacinto aggregate finish on all exterior wall panels.

PART 3 EXECUTION

3.01 SITE PREPARATION REQUIREMENTS (Cast-in-place floor)

A. Contractor to pour a concrete floor slab with turndown footing the same length and width of building. The floor slab shall be designed to support the anticipated load of the building walls and its contents.

B. The finished floor slab elevation shall be above the exterior grade. The grade shall have a positive slope and drainage away from the building at all points.

C. Concrete slab to be steel reinforced and level within 1/8 inch in both directions.

D. Footer depth and reinforcement to be in accordance with design drawings.

E. Floor slab to have a 1-1/2 inch deep by 7-1/2 inch wide recess around perimeter except at the doorway.

F. Corner of slab must be square, not chamfered, to allow for proper sealant joint.

3.02 ACCESS

A. Contractor must provide level unobstructed area large enough for crane and tractor/trailer to park adjacent to pad. Crane must be able to place outriggers within 5 foot-0 inch of edge of pad and truck and crane must be able to get side-by-side under their own power. No overhead lines may be within 75 foot radius of center of pad. Firm roadbed with turns that allow 65 foot lowbed tractor-trailer must be provided directly to site. No building shall be placed closer than 2 foot-0 inch to an existing structure.

END OF SECTION

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SECTION 13440

PROCESS CONTROL SYSTEM

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Programmable logic controllers (PLCs), Human Machine Interface (HMI), remote input/output (I/O) units, communication equipment, pump controller, programmer, control switches, relays, and indicators.

1.02 REFERENCES

A. National Electrical Manufacturers Association (NEMA).

1. NEMA ICS 1 - General Standards for Industrial Control and Systems.

2. NEMA ICS 2 - Standards for Industrial Control Devices, Controllers and Assemblies.

3. NEMA ICS 3 - Industrial Systems.

4. NEMA ICS 6 - Enclosures for Industrial Controls and Systems.

5. NEMA ST 1 - Standard for Specialty Transformers (Except General Purpose Type).

B. Instrument Society of America (ISA).

C. Underwriters Laboratories, Inc. (UL).

D. Factory Mutual (FM).

E. Institute of Electrical and Electronic Engineers (IEEE).

F. National Fire Protection Association (NFPA). ANSI/NFPA 70 - National Electrical Code (NEC).

G. Joint Industrial Council (JIC).

H. American National Standards Institute (ANSI).

1.03 SUBMITTALS

A. Submit product data, shop drawings and samples (if samples are requested by the City Engineer) under provisions of Section 01330 - Submittal Procedures.

1. Submit in complete packages grouped to permit review of related items as outlined in these specifications.

2. Bind submittals in three-ring binders with complete indexing and tab dividers. Completely tag and label equipment information to correspond with Drawings.

3. Review of Submittals will be for conformance to Contract Documents and for application to specified functions.

B. Product Data: Submit descriptive product literature including manufacturer's specifications for each component specified.

C. Shop Drawings: Indicate layout and mounting of completed assemblies and systems, interconnecting piping and cabling, dimensions, weights, external power and communication connections and programming information.

1. Panel, Console and Cabinet Information.

a. Layout drawings, including the following:

1) Front, rear, end and plan views to scale.

2) Dimensional information.

3) Tag numbers and functional names of components mounted in and on panels, consoles or cabinets.

4) Product information on panel components.

5) Nameplate locations and legends, including text, letter sizes and colors to be used.

6) Location of anchoring connections and holes.

7) Location of external wiring and piping connections.

8) Mounting and installation details.

9) Proposed layouts and sizes of graphic display panels.

b. Wiring and piping diagrams, including the following:

1) Name of panel, console or cabinet.

2) Wiring sizes and types.

3) Piping and tubing sizes and types.

4) Terminal strip numbers.

5) Color coding for each wire and color coding legend.

6) Functional name and manufacturer's designation of components to which wiring and piping are connected.

c. Electrical control schematics in accordance with JIC standards.

d. Plan showing equipment layout in each area.

2. Field Wiring and Piping/Tubing Diagrams

a. Wiring and piping/tubing sizes and types.

b. Terminal strip, device terminal and wire numbers.

c. Color coding.

d. Designation of conduits in which wiring is to be located.

e. Location, functional name and manufacturer's designation of items to which wiring or piping are connected.

f. Point-to-point wiring diagrams identifying every termination point and connection.

3. Instrumentation Diagrams

a. Prepare instrument loop diagrams for analog and digital displays, and control and I/O loop diagrams, using ISA standard symbols in accordance with ISA Standard S5.4. Drawings shall follow the format in Attachment C and include the following:

1) Instrument tag numbers.
2) Functional name, manufacturer's name, product name and model or catalog number of each item.
3) Location of each item.

b. Submit loop diagrams, wiring diagrams, PLC and control schematics on 4.7 GB DVD, formatted as AutoCAD files using the latest release of AutoCAD current and available on bid date, or any subsequent version. Identify diagrams, schematics and other files with computer-printed labels affixed to each diskette. Leave at least 200,000 bytes free space available on each DVD.

c. In addition, submit such diagrams and schematics laser-printed on 8.5-inch x 11-inch paper. Use lettering and numerals of at least 1/16-inch nominal height.

4. Programmable Controller System I/O Loop Wiring Diagrams

a. Prepare drawings on a module-by-module basis. Include the following information:

1) Rack numbers, module types and slot numbers, module terminal point numbers, and location and identification of intermediate panel and field terminal block and strip numbers to which I/O wiring and power supply wiring is connected. Identify power supply circuit numbers and ratings.

2) Wiring sizes, types, wire numbers and color coding.

3) Designation of conduits in which field I/O wiring is to be run.

4) Locations, functional names, tag numbers and manufacturer's names and model numbers of panel and field devices and instruments to which I/O wiring is connected. Label wiring and cables at both ends and within junction and terminal boxes. Use sleeve-type plastic wire markers covered with clear heat-shrink labels, or machine-printed permanent ink heat-shrink labels by Brady or approved equal.

b. For each drawing, submit one reproducible hardcopy and one copy on 4.7 GB DVD, formatted as AutoCAD files using the latest release of AutoCAD current and available on bid

date, or any subsequent version. Identify diagrams, schematics and other files with computer-printed labels affixed to each diskette. Leave at least 200,000 bytes free space available on each DVD.

c. In addition, submit such diagrams and schematics laser-printed on 11 x 17 inch paper. Use lettering and numerals of at least 1/16 inch nominal height.

5. System Programming Information

a. At least six weeks prior to substantial completion, submit detailed programming information consisting of ladder logic and proposed program code, complete input, output, relay, register and controller identification labels, memory allocation table, and written description of program operation.

b. Ladder logic diagrams shall contain a written descriptive note for each line of program code describing the function and logic of that line.

c. Submit documents in hard copy and as computer-readable files 4.7 GB DVD. Leave at least 200,000 bytes free space available on each DVD. PLC, HMI, MOR, VFD, controllers and all other operational, installation and application related programs required necessary by the City of Houston with the installation shall be submitted in native programming language files.

D. Quality Control Submittals

1. Factory Test Reports: If specified, submit six copies.

2. Testing Procedures: Submit testing procedures proposed to verify input, output, loop, and register operations, system logic verification, and spare memory capacity. Testing procedures shall detail, as a minimum, verification of required functions as follows:

a. Verification of pump start, pump stop, and well level alarm outputs by simulation of analog signals representing pump level.

b. Verification of each discrete input via external manually-operated switch.

c. Verification of each analog input by connection of external analog indicator in input loop.

d. Verification of each analog output by connection of external analog indicators.

e. Verification of communications system by hardwire connection via modem and wiring to a similar unit. Demonstrate operation and status monitoring of each register specified for external monitoring.

f. Verification of spare memory capacity by hard copy printout of full memory bit map after successfully demonstrating that system logic, inputs, outputs and communications features are fully installed and operational.

g. Test and verify system with external devices required to simulate field connections connected simultaneously for a full system test. Reconnecting external devices to verify portions of the systems at a time is not acceptable.

3. Certificates: Under provisions of Section 01450 - Contractor's Quality Control, submit manufacturers' certificates that equipment and systems meet or exceed specified requirements.

4. Instructions: Submit manufacturer's installation instructions for each component specified.

5. Field Reports: Submit 6 copies of Manufacturer's Installation Inspection, Field Calibration and Field Testing Reports.

6. Site Acceptance:

E. Operations and Maintenance (O&M) Data.

1. Submit operation and maintenance data notebook in accordance with Section 01782 - Operations and Maintenance Data.

2. Information and drawings submitted must reflect the final installed condition. Revise documents requiring updates following testing and start-up.

3. In addition to the content specified in Section 01782 - Operation and Maintenance Data, provide the following information:

a. Name, address and telephone number of the control system

supplier's local service representative.

b. Complete list of supplied system hardware parts with full model numbers referred to system part designations, including spare parts and test equipment provided.

c. Copy of approved submittal information and system shop drawings as specified in Paragraph 1.3, Submittals, with corrections made to reflect actual system as tested, delivered and installed at the site. Provide half-size blackline reproductions of all shop drawings larger than 11 inches x 17 inches.

d. Complete up-to-date system software documentation.

e. Original copies of manufacturer's hardware, software, installation, assembly and operations manuals for the programmable controller and data communication system, single loop and multi-loop controllers and other control system components. In addition to hard copy versions, provide all manuals in PDF format on 4.7 GB DVD.

f. Instructions for PLC replacement adjustment, and preventive maintenance procedures and materials.

g. Control system description and system operation sequence instructions.

h. For each major system/subsystem, in separate binders, submit PLC ladder logic programming documentation, PLC I/O schematics, control and loop diagrams, electrical drawings, system description, operation instructions and files on 650 MB 4.7 GB DVD.

F. Project Record Documents

1. Submit record documents under provisions of Section 01785 - Project Record Documents.

2. Revise system shop drawings, software documentation and other submittals to reflect system as installed. Accurately record locations of controller cabinets and input and output devices connected to system. Include interconnection wiring and cabling information and terminal block layouts on rite in the rain all weather writing paper model 8511 in a suitable drawing pocket installed

inside the controller cabinet door.

3. Insert half-size blackline prints of wiring diagrams applicable to each control panel in a clear plastic envelope and store in a suitable print pocket or holder inside each control panel.

1.04 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Manufacturer shall be a company specializing in manufacturing products specified in this Section, having proven compatibility with the City's existing facilities and at least three years of documented experience. The company shall maintain service facilities within 100 miles of the City of Houston.

1.05 DELIVERY, STORAGE AND HANDLING

A. Deliver products to site in factory-sealed containers. Store and protect products under provisions of Section 01610 - Basic Product Requirements.

B. Check for damage upon receiving products on site.

C. Store products in a clean, dry area; maintain temperature in accordance with NEMA ICS 1.

1.06 ENVIRONMENTAL REQUIREMENTS

A. Maintain temperature above 32 degrees F and below 104 degrees F during and after installation of products.

B. Maintain area free of dirt and dust during and after installation of products.

C. Provide temporary heating and air conditioning units and equipment required to maintain environmental conditions specified for control and MCC panels.

1.07 MAINTENANCE SERVICE

A. Provide manufacturer's maintenance services for programmable logic controllers for one year from Date of Substantial Completion without additional cost to the City.

PART 2 P R O D U C T S

2.01 PROGRAMMABLE LOGIC CONTROLLER (PLC)

A. Manufacturer and Product: Siemens Model S7-315-2PN/DP; (with integral Ethernet, the latest version at the time of delivery), or approved equal, must be latest series model.

B. Description: Modular Programmable Controller and Removable 2 MB Micro Memory Card.

C. Service Conditions

1. Temperature: 32 to 140 degrees F, horizontally installed.

2. Humidity: 5 to 95 percent, non-condensing.

3. Electromagnetic Compatibility: Noise suppression to EN 50082-2, Noise emission to EN50081-2.

4. Vibration: IEC 68, Part 2-6/10 to 58 Hz.

5. Shock: IEC 68, Part 2-27/half-sine: 15 g peak, 11 milliseconds.

D. Configuration

1. Processor Rack: Include processor, power supply, micro memory card, communication modules, and input/output modules with front connectors.

2. Expansion Unit: Include interface module, power supply, communication module, input/output modules, front connectors and necessary connection cables.

3. Mounting Rail: Provide passive mounting rail for processor, power supply, communication, and input/output modules.

E. Processor Unit

1. Integrated Memory: Internal 256 KB minimum

2. Execution Time, Bit Operations: 0.1 microseconds.

3. Execution Time, Word Operations: 0.2 microseconds.

4. Execution Time, Fixed Point Arithmetic: 2 microseconds.

5. Execution Time, Floating Point Arithmetic: 3 microseconds.

6. Ports: See 2.01.H

7. Storage Memory: Micro Memory Card, minimum 2 MB.

F. Power Supply

1. Input: 85-132/170-264 VAC, switch-selectable.

2. Output: 24 VDC, 5-amp.

3. Mounting: On PLC Mounting Rail.

4. Front Panel: Green status LED, On/Off Switch, Input Voltage Selector.

5. Output Terminations: Screw terminations with connector to PLC CPU, plus additional terminations for wiring to other control system 24 VDC needs.

G. Input/Output Units

1. Spare Input/Output Capacity: At least 25 percent spare capacity of each I/O type installed.

2. Discrete Input Characteristics: 16 points 24 volts DC. for disinfection system. Refer to drawings to verify the voltage rating as required for each system.

3. Analog Input Characteristics: 8 channels for configurable in groups of 2, 4 to 20 milliamperes DC.

4. Discrete Output Characteristics: 16 points 24 VDC; Relay Discrete Output for disinfection system. Refer to drawings to verify the voltage rating as required for each system

5. Analog Output Characteristics: 8 channels, 4 to 20 milliamperes DC.

H. Communication Interfaces

1. Profibus-DP: Integral to CPU, master/slave, capable up to 12 Mbit/sec, configured in standard PLC programming environment. Supports Profibus-DP Master, Profibus-DP Slave, MPI with programmer, HMI and S7 communications.

2. Ethernet Interface: Integral to CPU, 10/100 Mbps with automatic speed detection, supports open TCP/IP, PLC programming, HMI communications, ST Communications, Profinet CBA and Profinet IO-Controller.

3. Ethernet Remote Base Controller: IM153 controller shall be

provided where the remote base is provided for Ethernet communication with Siemens S7-300 and Siemens 545 PLC.

4. Ethernet Switch: Managed Industrial Ethernet Switch to be mounted in control panel and connected to PLCs with Ethernet interface.

   a. Scalance X204-2

      1) Manufacturer and Model: Siemens X204-2

      2) Electrical Ports: Four RJ45, 10/100 Mbps, connectors latch to housing for strain relief.

      3) Optical Ports: Two female ST pairs, 100 Mbps

      4) Fiber Topology: Bus, Star, and ring

      5) Power: Redundant 24 VDC

      6) Mounting: Standard DIN rail, PLC Rail

      7) Diagnostic LEDs: Power, Link Status, Communications

      8) Housing: Metal

I. Ethernet Networking

1. Industrial Ethernet Switch: Managed Industrial Ethernet Switch to be mounted in control panel and connected to PLCs with Ethernet interface. This device to be provided if additional copper port needed to connect Ethernet devices to the network at the New SCUM PLC System and New BTF PLC System panel where multiple Ethernet remotes are connected.

   a. Copper-Only Networks: SCALANCE X208

      1) Manufacturer and Model: Siemens X208

      2) Electrical Ports: Eight RJ45, 10/100 Mbps, Connectors latch to housing for strain relief.

      3) Power: Redundant 24 VDC

      4) Mounting: Standard DIN rail, PLC Rail

5) Diagnostic LEDs: Power, Link Status, Communications

6) Housing: Metal

7) Include C-Plug Configuration Plug

2. Industrial Ethernet Cable, Copper, for Runs Outside Control Panels

a. Manufacturer and Model: Siemens Energy & Automation, 6XV1-840-2AH10

b. Style: Industrial Ethernet Fast Connect (FC) Standard Cable

c. Type: Four-wire, shielded

d. Jacketing: Green PVC Sheath, 6.5 +/- 0.4 mm OD

e. Temperature: -40 to 70 deg. C operating, transport and storage

f. Include Stripping Tool: Siemens Energy & Automation, 6GK1-901-1GA00

3. Industrial Ethernet Connectors, Copper

a. Manufacturer and Model: Siemens Energy & Automation 6GK1-901-1BB10-2AA0 (straight) or 6GK1-902-1BB20-2AA0 (90-degree)

b. Permissible Cable: Industrial Ethernet FastConnect Cable

c. Installation: Insulation Displacement via simple cable insertion and housing closure

d. Strain Relief: Via quarter-turn locking mechanism

e. Housing: Metal with metal spring clip

4. Industrial Ethernet and Profibus Cable, Fiber Optic

a. Manufacturer and Model: Optical Cable Corp or approved equal by wastewater operation.

b. Fibers: 6 multimode fibers minimum, 25% spare pairs minimum, 62.5/125 graded index

c. Type: Tight-Buffered, Riser-Rated, Multi-fiber Breakout-Grade Cable

d. Jacketing: Indoor/outdoor PVC outer jacket, Color-coded subcables protected to permit direct field termination without patch boxes, jumpers, splices, etc

e. Primary Fiber Buffer: 500 micron acrylate buffer over each optical fiber

f. Secondary Fiber Buffer: 900 micron elastomeric tight buffer over each optical fiber

g. Connectors: ST, Factory-terminated or field-installed and tested

h. Diameter: 9.5 mm (0.37 in)

i. Tensile Load Rating: 270 lbs. long-term, 670 lbs. short-term (installation)

j. Minimum Bend Radius: 3.7” under long-term tensile load, 7.4” under installation load

k. Temperature: -40 to 85 deg. C operating

5. Industrial Ethernet and Profibus Fiber Optic Patch Panel

a. Manufacturer and Model: AWC PB-12ST-WM (up to 12 fibers) or PB-24ST-WM (up to 24 fibers)

b. Design: Metal box with latching door covering two chambers

c. Connectors: Populated 6-packs with ST connectors

d. Mounting: Wall mount

J. Profibus Networking

1. Profibus Cable, Copper

a. Manufacturer and Model: Siemens Energy & Automation, 6XV1-830-0EH1

b. Style: Profibus Fast Connect (FC) Standard Cable

c. Type: Two-wire, shielded

d. Jacketing: Purple PVC Sheath, 8.0 +/- 0.4 mm OD

e. Include Stripping Tool: Siemens Energy & Automation, 6GK1-905-6AA00

2. Profibus Connector, Copper

a. Manufacturer and Model: Siemens Energy & Automation, 6ES7-972-0BA50-0XA0

b. Cable Outlet: 90-degree, dual cable path

c. Terminating Resistor: Integrator resistor combination, slide switch enabled

d. Interfaces: DB9F connector and four insulation displacement terminals

K. Programming, Software and Programming Equipment

1. Configure system and program for operation as specified in this Section.

2. System Software: Siemens Step 7 software will be loaned by City for utilization by contractor on this project. Contractor to supply any other software or interfaces and cables needed to support equipment supplied on this project.

3. Control Program Data Sheet: Contractor shall complete and submit each system Data Sheet to Control Program Librarian designated by City of Houston. System I/O list shall be submitted with Data Sheet to the City of Houston two weeks prior to the 7-day test where communication can be verified by the Control Center.

4. Programmer: HP EliteBook 8540w Mobile Workstation or equivalent current model, new, submitted in the original package including manuals having at least the following features as minimum:

a. Operating system: Genuine Windows 7 Professional 64

b. Processor: Intel Core i7-620M Processor (2.66 GHz, 4MB L3 cache)

c. Memory: 8GB 1333 MHz DDR3 SDRAM.

d. Hard drive: 500 GB 7200 rpm SATA II

e. Optical drive: DVD-ROM; DVD+-RW SuperMulti DL LightScribe; Blue-ray R/RE DVD+/-RW SuperMulti DL

f. Display: 15.6 diagonal LED-backlight HD anti-glare

g. Graphics: NVDIA Quadro FX 1800M graphics with 1 GB dedicated GDDR5 video memory.

h. I/O Ports: External – 3USB 2.0, 2USB 3.0, 1eSATA, 1 external VGA monitor, 1 Display Port, 1 1394a, 1 stereo microphone in, 1 stereo headphone/line-out, 1 AC power, 1 RJ-11, 1 RJ-45, 1 docking connector, 1 secondary battery connector.

i. Slots: 1 Express Card/54, 1 Smart Card Reader, 1 Secure Digital.

j. Network interface: Integrated Intel Gigabit Network Connection (10/100/1000 NIC).

k. Wireless: HP Mobile Broad (powered by Gobi) with GPS; Intel Centrino Ultimate-N 6300 (3x3) 802.11 a/b/g/n; HP Integrated Module with Bluetooth 2.1 Wireless Technology.

l. Energy Efficiency: ENERGY STAR

m. Battery: HP Long Life 8-cell (68 WHr) Li-Ion

n. Power supply: External 150-watt Smart AC adapter; External 120-watt Smart AC adapter; External 90-watt Smart AC adapter; HP Fast Charge

o. Security management: Standard – Integrated Smart Card Reader, HP ProtectTools, TPM Embedded Security Chip 1.2, Enhanced Pre-Book Security, HP Spare Key (require initial user setup), HP Disk Sanitizer, Enhanced Drive Lock, drive Encrption for HP ProtectTools, Credential Manager for HP ProtectTools, File Sanitizer for HP Protect Tools

p. Warranty: HP services offers limited 3-year standard parts and labor onsite, next business day warranty, and toll-free 7

x 24 hardware technical phone support; 1-year limited warranty on primary battery. On-site service and warranty upgrades are also available.

q. Preinstalled Microsoft Windows in latest versions currently available that are compatible with HMI software.

r. Programming cable and adapter for PLC programming.

s. Compaq Workstation carrying case (overall size 18"x13"x5").

L. Spare Capacity: Provide at least 25 percent spare rack space, and 25 percent spare I/Os configured, wired, terminated, and identified as such, but not used in program.

M. Provide at least 25% of each PLC module furnished as spare parts. Minimum spare parts will include the following for each type furnished:

1. One discrete input, of each type.

2. One discrete output, of each type.

3. One analog input, of each type.

4. One analog output, of each type.

5. One PLC power supply, of each type.

6. One CPU with Profibus-DP and Ethernet ports.

7. One Ethernet remote base (IM153).

8. One Ethernet Switch.

9. One Operator TP900.

N. Connect PLC inputs/outputs including analog inputs through snap-on isolated fused terminal blocks.

O. Separate the AC and control signals from DC and loop signals by at least 6 inches. Provide a barrier between AC and DC within the raceways.

2.02 LOCAL WORK STATION

A. General

1. Manufacturer and Model: Siemens Energy & Automation, TP900

touch panel.

2. Display: 9.0” 800 x 480 TFT LCD Touch Panel.

3. Keyboard: Numeric / Alphabetic Entry.

4. Memory: 12 MB.

5. Memory Card: Two MMC/SD combination slot

6. Operating System: Windows CE

7. Ports: One RS 422/485, USB, Ethernet RG-45

8. Power: 24 VDC.

9. Certifications: IP65 / NEMA 4 / FM Class I, Division 2 when mounted.

10. Configuration: HMI shall be programmed to display the process diagrams shown on the drawing and display status and alarms indicated on the P&ID diagram as required for scum system, NPW, NTF, and odor control system. Where displays required modification by Software Engineer (SE). Refer to section 13441 for SE qualifications, Wastewater Operations shall provide the application program or hardcopy of displays to be used by the contractor to display required information needed by the operations. The CONTRACTOR (SE) shall provide necessary modifications and configurations and enter the required variable parameters to provide a complete functional integrated system for each process unit. The CONTRACTOR (SE) shall customize the application software to meet site-specific conditions for each HMI installed or used when existing. The system shall be fully tested to be operational prior to substantial completion.

11. Configuration Software: Configuration software and cable will be loaned by City for utilization by CONTRACTOR (SE) on this project. The CONTRACTOR (SE) to supply any other software needed to support equipment supplied on this project.

12. Provide necessary cables, connectors, and interfaces to communicate between Operator Panel and PLC processor. New HMI shall be installed for SCUM System PLC and New Bio Trickling Filter PLC.

13. Supply configuration software, latest version, and download cable.

14. Note: Pump Information and necessary status points shall be Configured as needed. All configurations shall be performed by the contractor for panels show to be installed on the drawings:

    a. Scum PLC: Display all screens (see below a sample of display as minimum)

        1) PLC Screen List
        2) Scum system equipment diagram (show scum pit, scum pumps, mixer and conveyor system interconnection)
        3) Scum pit with level bars and pumps set points indication (equipment on “RED” off “GREEN)
        4) Scum Status/Alarms, and meter readings
        5) PLC I/O Health Status
        6) 7-day level/flow trends/alarm summary

    b. Bio Trickling Filter (BTF) PLC: Display all existing screens (below see a sample of display as minimum)

        1) PLC Screen List
        2) BTF system equipment diagram (show H2S and flow reading, sensors and valves monitored for each tank and equipment status
        3) BTF Status/Alarms, and meter readings
        4) PLC I/O Health Status
        5) 7-day flow, tank level, and analyzers trends/alarm summary

    c. HMI display shall be provides at the SCADA console for all above displays as well as all points for NPW similar to screens above showing pressure, flow, high pressure, equipment status and alarms.

2.03 CONTROL SWITCHES AND INDICATOR LIGHTS

A. Manufacturers

1. Automatic Timing and Controls Company.
2. Cutler Hammer.

3. Eagle Signal Company.

4. General Electric Company.

5. Square D Company.

6. Allen Bradley.

7. Siemens

B. Substitutions: Comply with Section 01630 - Product Substitution Procedures.

C. Control Switches

1. Contacts: NEMA ICS 2; at least two Form C contact sets.

2. Contact Ratings: NEMA ICS 2; 120V, 10 ampere inductive.

3. Selector Switch Operators: NEMA ICS 2; heavy-duty, oil-tight, NEMA 4 multi-position rotary selector switch.

4. Push-button Operator: NEMA ICS 2; heavy-duty oil-tight NEMA 4 unguarded and lockable type; black for start, red for stop.

D. Indicator Lights: Red for run, amber or yellow for alarm, green for control mode; LED, oil-tight, 100,000-hour rated life expectancy; rated voltage approximately 125 percent of nominal 120 VAC operating voltage. To be push-to-test type.

2.04 CONTROL RELAYS

A. Contacts: Three Form C contact sets (3PDT).

B. Rating: 120 volt, 10 ampere inductive.

C. Coil Voltage: 120 volt, 60 Hz AC.

D. Socket: DIN Rail, Include hold-down clip.

E. Features: 11-pin tube socket relay base, external color-coded test button, mechanical and electrical status indications, impact-resistant thermoplastic case.

F. Manufacturer: Turck, Siemens, or equal approved by end user.

G. Spare Units: In addition to units installed, furnish 2 spare units.

2.05 TIME DELAY RELAYS

A. Contacts: Three Form C contact sets (3PDT).

B. Contact Ratings: DPDT Class; 120 volt 10 ampere inductive.

C. Coil Voltage: 120 volt 60 Hz AC.

D. Socket: Turck S3B with coding system, label and label holder (11-pin).

E. Description: Control relay as specified above in Paragraph 2.04, with added Time Cube Module as manufactured by Turck, Inc.; series CT3, with on or off delay, as indicated.

F. Features: DIP switch-selectable timing ranges of 0.2 to 3 seconds, 0.8 to 12 seconds, 0.1 to 1.5 minutes and 0.8 to 12 minutes; externally-adjustable graduated time dial; solid-state digital timing system.

G. Spare Units: In addition to units installed, furnish 2 spare units.

PART 3 E X E C U T I O N

3.01 SYSTEM DESCRIPTION

A. Bio Trickling Filter

1. General: The Bio Trickling Filter is a vendor provided package with its own controller (Siemen S7-315). It consists of one reactor, one blower, water control solenoid valves, controller and instrumentation indicated on the drawings.

2. There shall be remote control capabilities as shown on the P&ID where the operator can adjust the feed rate and other control associated with this package. The system is monitored and controlled from the SCADA and local HMI. The PLC shall be connected to the Ethernet switch at the disinfection building via Cat5e/Cat 6.

B. Odor Control

1. General: There is one blower supplying air to the Lift Station Wet Well. This blower has an individual VFD controller.

2. Local Manual Control: There shall a three-position HOA switch at the Local Control Station (LCS) for the blower. When this switch is in Hand, operator can start the blower and adjust the speed potentiometer to control the blower. Operator can also monitor the operational status and alarm conditions of the blower from the SCADA.

3. Remote Manual Control: When the HOA switch is in Auto, the operators can monitor the blower, send a Start/Stop command to the blower, and adjust blower speed from the plant HMI. There will be no automatic sensor to control the VFD automatically.

4. Refer to the P&ID diagram as well as control schematics for all PLC I/O points to be monitored and controlled by SCADA system.

C. Scum System

1. General:

a. There are two scum pumps one mixer, and a conveyor. The mixer shall normally run (1 minute set by the timer on the pump) before the scum pump starts. Conveyor starts as the scum pump runs and run a minute after scum pump stops (1 minute off time delay)

b. There are redundant level transmitters in the scum well. Operator can select the level instrument to be used to control the scum well. If that instrument fails, the backup instrument will be used to operate system (pump controller).

2. Local Manual Control: There shall be a three-position HOA switch at the Local Control Station (LCS) for each, mixer, and conveyor. When this switch is in Hand, the operator can run pumps and mixer manually. The operator can also monitor the operational status and alarm conditions of the equipment from the HMI. When scum pump runs in any mode, the mixer and conveyor will be starting and stopping in a sequence similar to auto mode. This function is hardwire interlocked to provide safety and flexibility to avoid any spill from the conveyor.

3. When HOA switch is in Auto, the system start/stop pumps on preset levels set within the PLC or backup controller.

4. Local Auto Control:

a. The pumps and mixer are controlled by the scum well level. Upon start level, the mixer begins running for 30 seconds to 1 minute (time duration is adjustable on the timer relay) which time the scum pump starts. If the mixer fails to start, the scum pump does not start. Both the pump and mixer stop when the scum well level reaches the stop level

setpoint.

b. Only one pump operates at a time. Upon failure of the operating pump, the mixer will stop. The standby pump will be called to run the next time the scum well level reaches the start level setpoint.

c. The role of operating pump and standby pump rotates every time the scum well level reaches the stop level setpoint.

d. Conveyor will start upon scum pump run command and runs for additional minute when scum pumps stops (off delay timer).

5. Refer to the P&ID diagram as well as control schematics for all PLC I/O points to be monitored and controlled by SCADA system

D. Aeration

1. General: There are manual gates to the inlet and outlet of the aeration basins were is indicated with new actuator.

2. Local Manual Control: There is a three-position HOA switch at the gate actuator. When this switch is in HAND, the operator uses the Open/Close push buttons to control the valve. The gate are not controlled or monitored by SCADA system.

3. Local Automatic Control: This does not exist for these gates and set for future need.

4. Refer to the P&ID diagram as well as control schematics for all PLC I/O points to be monitored and controlled by SCADA system.

E. NPW System

1. General: The Non-Potable Water system provided with pump controller similar to scum pump back up system as define on the drawing to control three (3) NPW pumps and hydro tank. Discharge pressure will control the pumps as needed to maintain distribution pressure for the plant use. The pressure setpoints for pumps lead and lags is set within the pump controller.

2. There shall be Mag meter on the discharge header to measure water usage.

3. Compressor shall maintain the tank pressure within a preset pressure set within the pressure switch.

4. High pressure safety shall be installed to shut all pumps and the

compressor off when activated.

5. Local Manual Control: There shall be a three-position HOA switch at the Local Control Station (LCS) for each NPW and compressor. When this switch is in Hand, operator can run pumps and compressor manually. The operator can also monitor the operational status and alarm conditions of the equipment from the plant HMI.

6. When HOA switch is in Auto, the pump controller start/stop pumps on preset levels set within the controller.

7. Local Auto Control:

   a. The pumps controller will start the lead pump when the pressure fall below the start set point. If one pump cannot meet the pressure demand, the lag pump will come on to provide adequate water need and pressure. Pump 3 will be a standby when one of the pumps is not in service or fails during operation. Only one pump operates at a time. Upon failure of the operating pump, the mixer will stop. The standby pump will be called to run the next time the scum well level reaches the start level setpoint.

   b. The role of operating pump and standby pump rotates every time the NPW pressure reaches the stop setpoint.

8. There is no remote control associated with this package. The system is monitored only from the HMI to show pump run/fail, high pressure alarm, system discharge pressure, and system discharge flow.
9. Refer to the P&ID diagram as well as control schematics for all PLC I/O points to be monitored and controlled by SCADA system.

F. Communications: PLC shall be capable of full two-way communications with the City of Houston Central Control facility. Communications shall have the capability to transmit all control panel PLC status and alarm additional information indicated in the Drawings, and shall receive equipment start/stop Set points, alarm Set points and miscellaneous data via City of Houston SCADA software package and protocol. Provide necessary hardware and software required to implement the communications system as part of system integration and testing.

Programming and modifications required at the City of Houston Central

Control facility will be performed by Software Engineer (SE). Refer to section 13441 for SE qualifications. SE shall provide iFIX application graphic and programming required and develop displays to monitor and control all existing equipment and systems associated with scum system, NPW system, bio tricking filter, and odor control blower. SE shall demonstrate communication and data exchange at the local SCADA and Groveway Control Center. Contractor shall submit the list of all I/O points with new S7 PLC address showing the COH tags and existing Siemens 505 PLC addresses for the SCADA groups to re-address all the existing displays with the new PLC address. All new and existing I/O points to be verified by SE for any bit change and message displays for status, analog, and rate databases. The programming of the package units such as Bio Trickling Filter may be excluded from SE requirement as the system may need to be test in the factory.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions and Drawings. Provide sufficient clearance for calibration and maintenance access.

B. Do not install products until major construction is complete and building interior is enclosed and environmentally conditioned.

C. Connect input and output devices as shown on Drawings.

D. Provide complete programming, testing and verification of the programmable controller and associated inputs and outputs, including work required to interface with the existing City of Houston system.

3.03 MANUFACTURER'S FIELD SERVICES

A. Prepare and start systems under provisions of Section 01755 - Starting Systems.

3.04 DEMONSTRATION

A. Provide systems demonstration under provisions of Section 01770 - Closeout Procedures.

B. Demonstrate operation and programming of controller. Provide two sessions of four hours of instruction each for four persons, to be conducted at project site with manufacturer's representative.

C. System demonstration shall include the following:

1. Complete verification of field wiring.

2. Complete verification of system software.

3. Demonstration of functionality of each discrete input and output by Simulation of actual field device action.

4. Demonstration of functionality of each analog input and output by actual variations in the process variable (e.g. well level, etc.).

5. Complete demonstration of each alarm by simulation of actual field device action.

6. Complete demonstration and verification (status/alarm points) of 2-way communication with City of Houston Central Monitoring Facility.

3.05 TRAINING

A. Provide engineering and programming schools preferably at the Houston offices of the PLC manufacturer or distributor or at the manufacturer's factory, as specified below. This training shall be performed by fully-qualified and manufacturer-certified training personnel who can clearly illustrate experience in teaching previous courses. Obtain approval from the Owner's representative for training facility and course outline before scheduling training.

B. If such training is provided somewhere other than Houston, then the system supplier shall provide coach airfare (weekday travel), motel expenses ($95.00/day/person), rental cars ($50.00/day/2 people), and meal allowances $35.00/day/person) for selected City personnel for the duration of the schools.

C. Schedule classes at the City of Houston's convenience. The supplier should not assume that the City's personnel will attend these courses in a continuous and sequential manner. When training is submitted in voucher form, it shall be valid for a minimum of two years at no extra cost to the City.

D. Training shall consist of the following as a minimum:

1. PLC basic/advanced programming/maintenance (five days): Six people.

2. HMI (Siemens TP900) basic/advanced programming (three days): Four people.

END OF SECTION

Section 13441

SOFTWARE ENGINEERING REQUIREMENTS

PART 1 P U R P O S E

1.01 The Wastewater Operations Automation and Electrical Support Service Group maintain this document for the communication of the requirements of the SCADA software used for the control and monitoring of the wastewater facilities. These requirements are intended to address three related areas: A) SCADA Homeland Security Requirements, B) Texas Engineering Practice Act, C) COH Wastewater SCADA system quality requirements:

A. According to the National Strategy for Homeland Security Wastewater treatment facilities are part of the nation's critical infrastructure and the government agencies that are responsible shall take specific steps to improve SCADA security.

1. Government agencies are required to "Establish policies to minimize the likelihood that organizational personnel will inadvertently disclose sensitive information regarding SCADA system design, operations, or security controls" and "Release data related to the SCADA network only on a strict, need-to-know basis, and only to persons/entities explicitly authorized to receive such information".

2. In compliance with these Homeland Security requirements all SCADA related information is restricted to authorized personnel.

3. Only SCADA information directly related to the scope of this project will be transferred to SE.

B. In compliance with Texas Engineering Practice Act (Article 3271a) and the recognition that SCADA software is an integral part of the electrical control of the Wastewater facilities and is therefore within the jurisdiction of the act:

1. All SCADA software related work shall be performed by a licensed engineering firm meeting the qualifications as specified in these requirements and referred to within as the Software Engineer (SE). The software produced for the project shall be stamped by SE in accordance with (Article 3271a §137.33 Sealing Procedures for engineering software).

C. Additionally, these requirements are to refine and perpetuate software engineering and software quality standards that will benefit the Wastewater Operation Branch in the areas of facility operations, maintenance, and facility

construction projects:

1. The requirements are intended to benefit facility operations through encouraging SCADA standards of consistency in facility functionality and operation, improved process visibility, improved efficiency and control, lower operating costs and reduced potential permit violations. The SCADA standardization also addresses improved technical support and ease of maintenance.

2. These requirements specify SCADA related issues in construction, deliverables and qualifications that will help ensure the availability and quality of SCADA system integration.

3. SCADA related software integration activities have been identified as a key point of quality control for construction projects. The SE shall subcontract directly to the general contractor and shall perform an independent assessment of the SCADA related work of the other subcontractors and equipment suppliers to ensure complete system and software integration within the facility per the construction specification and Wastewater SCADA design guidelines.

PART 2 S C O P E

2.01 The requirements defined in this document apply to Wastewater facility SCADA software including system control, monitoring and integration. The scope includes new and existing facility construction projects where new SCADA software is required or where the existing SCADA software is modified.

2.02 SCADA software activities shall be performed only by the pre-approved SE and include: PLC programming, HMI configuration and graphics development, historical logging software application and report generation, network configuration and programming.

2.03 Manufactured packaged subsystems with pre-engineered software may be specifically excluded if specified in that subsystem equipment specification, that the system shall be shipped with the software as a fully functional unit. The system PLC and HMI hardware and software application shall meet the requirements for SCADA integration and software documentation. The packaged system provider shall deliver all software to SE as soon as possible for the purpose of review and integration.

2.04 These requirements apply to all SCADA security related activities including configuration of servers, workstations and network equipment.

PART 3 S O F T W A R E E N G I N E E R I N G R E Q U I R E M E N T S

3.01 The SE shall perform the software engineering functions as required within the scope section meeting the requirements within.

A. The SE shall use the Wastewater standards for SCADA software (iFIX and Wonderware applications) engineering and Homeland Security in all work performed.

1. The SE shall identify and communicate omissions and required modifications to these standards.

2. Details on these standards are restricted to authorized personnel only according to the Homeland Security requirements and are not included in these requirements. The pre-approved SE is authorized for access to these standards.

3.02 The SE shall provide the SCADA related submittals as defined in the submittals section.

A. The SE shall perform the work required to complete the required SCADA software submittals.

B. The SE shall review and report on the SCADA related submittals of the project subcontractors and equipment providers.

3.03 The SE shall assist the project team including; the engineer, the Wastewater operations SCADA Group and equipment suppliers with the SCADA integration issues.

A. The SE shall attend project meetings as required by the project team.

B. The SE shall assist the project team with functional test of the system.

C. The SE shall provide project related process data from the SCADA system.

PART 4 S U B M I T T A L S

4.01 Within 45 days of the notice to proceed the SE shall submit a letter of SE qualifications specifically addressing each item of qualification as defined in these requirements.

A. Include the SE professional engineering firm licensed number and date of issuance.

B. Include a statement addressing the awareness of the Homeland Security

concerns and intention to restrict the dissemination of security sensitive SCADA network information to those who are authorized by the COH and require the information in the support of this project.

4.02 Within 90 days of the notice to proceed the SE will submit the Software Engineering Manual (Preliminary Report).

A. Include the software conventions for the use in the HMI development.

B. Include diagrams and schedules for all network devices associated with the process control and monitoring for the facility/facilities.

C. Include the interfaces for the City SCADA network.

D. Identify every network component (new and existing).

E. The Software Engineering Manual will be updated for the final O&M.

4.03 The SE will submit letters of software and network integration compatibility to be included in all the control related submittals.

A. Included but not limited to: PLCs, network devices, computers, HMI devices.

B. Include deviations from City standards and the construction specifications for electrical control drawings and tag naming conventions.

C. Include deviations from the submitted Software Engineering Preliminary Report.

D. Include the manufacturer supplied package systems with control panels.

E. The SE shall distribute monthly a Software Engineering Integration Schedule highlighting software and system integration progress and issues.

4.04 Factory demonstration test confirmation report

A. After the required factory demonstration test the SE shall submit a report confirming the related software and network compatibility.

4.05 Field Acceptance Functional Test

A. Shall be completed prior to performance and reliability testing.

B. Field Acceptance Functional Test Submittals shall include:

1. Field Acceptance Functional Test Plan Submittal.

2. Description of plan for testing field devices.

3. Description of plan for function test and system integration of each subsystem.

4. Field Acceptance Functional Test Schedule shall be submitted after the acceptance of the test plan submittal.

5. Field Acceptance Functional Test plan completion report shall be submitted.

4.06 Software Engineering Manual (Updated Final Version)

A. Update and submit a singled CD with all related SCADA software.

B. Control and network components.

C. Inventory of software components.

D. Network device configuration documentation.

E. Software Engineering documentation.

F. PLC and HMI software shall be documented using the product development tool.

G. Software shall be stamped as required in Texas Engineering Practice Act (Article 3271a §137.33 Sealing Procedures) with the date, the engineers name, the PE designation with license number.

H. The SE will collect and submit all software and network device configuration programs and data developed for the project.

PART 5 S O F T W A R E E N G I N E E R (S E) Q U A L I F I C A T I O N S

5.01 The Wastewater Operations Automation and Electrical Support Services group has set forth these qualifications for performing all SCADA related software activities for the wastewater facilities as defined in these requirements.

5.02 The SE shall be pre-approved by Wastewater Operations SCADA staff.

5.03 Specific qualifications for pre-approved SE:

A. The SE shall be a Texas Registered Professional Engineering firm with a minimum of five (5) years of licensed history with the software engineering of the control systems for advanced wastewater treatment processes.

B. The SE shall be experienced with the software application development packages which are used as standards for Wastewater Operations including a minimum five (5) years of software engineering experience with G.E. IFIX HMI application development packages and Siemens PLCs.

C. The SE shall demonstrate a minimum of five (5) years of network System expertise. This ensures the SE has the required expertise to configure, secure and maintain the SCADA system network for applicable projects

D. The SE shall have errors and omissions insurance with coverage required by COH.

E. The SE shall have an existing office, within the City of Houston area of less than 75 miles, and shall maintain that office for the duration of the warranty and extended software service requirement.

F. To ensure effectiveness and objectivity in the review and reporting of SCADA related integration issues, the SE shall be an independent entity and provide only software engineering services for the construction projects.

END OF SECTION

SECTION 13446

PRIMARY INSTRUMENTATION DEVICES

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Control power transformers, phase/voltage monitor relay, terminal blocks, surge protections, flow meter transmitter, ultrasonic level transmitter, pressure transmitter and accessories for use with control panels and instrumentations.

1.02 REFERENCES AND STANDARDS

A. NEMA ICS 1 - General Standards for Industrial Controls and Systems.

B. NEMA ICS 2 - Standards for Industrial Control Devices, Controllers and Assemblies.

C. NEMA ICS 3 - Industrial Systems.

D. NEMA ICS 6 - Enclosures for Industrial Controls and Systems.

E. NFPA 70 - National Electrical Code (NEC).

F. Underwriters Laboratories, Inc. (UL).

G. ANSI B40.1 - Gauges, Pressure Indicating Dial Type Elastic Element.

1.03 SUBMITTALS

A. Comply with Section 01330 - Submittal Procedures.

B. Submit shop drawings indicating layout of completed assemblies, interconnecting cabling, dimensions, weights and external power requirements.

C. Submit product data for each component specified.

D. Submit manufacturer's certificate that all equipment meets or exceeds specified requirements. Submit manufacturer's installation instructions.

1.04 PROJECT RECORD DOCUMENTS

A. Submit record documents under provisions of Section 01770 - Closeout Procedures.

B. Accurately record actual locations of controller cabinets and input and output devices connected to system. Include interconnection piping, wiring and cabling information, and terminal block layouts in controller cabinets.

C. During drawing submittal phase, submit detailed programming information consisting of ladder logic and line code of proposed program, and complete input, output, relay, register and controller identification labels.

D. Submit factory testing procedures proposed to verify input, output, PID loop and register operations, system logic verification, and spare memory capacity.

1.05 OPERATION AND MAINTENANCE DATA

A. Submit operation in accordance with Section 01782 - Operations and Maintenance Data.

1.06 QUALIFICATIONS

A. Manufacturer: A company specializing in manufacturing the products specified in this Section having at least 3 years documented experience maintaining service facilities within 100 miles of project and having proven compatibility with existing City wastewater facilities. Like devices shall be of the same Manufacturer.

1.07 REGULATORY REQUIREMENTS

A. Conform to requirements of ANSI/NFPA 70 (NEC).

B. Furnish products listed and classified by Underwriters Laboratories, Inc., as suitable for the purpose specified and shown; install in accordance with UL requirements.

1.08 DELIVERY, STORAGE AND HANDLING

A. Deliver products in factory-sealed containers. Store, handle and protect products under provisions of Section 01610 - Basic Product Requirements.

B. Upon delivery, inspect products for damage.

C. Store products in clean, dry area; maintain temperature in compliance with NEMA ICS 1.

1.09 ENVIRONMENTAL REQUIREMENTS

A. Maintain temperature above 32 degrees F and below 104 degrees F during and after installation of products.

B. Maintain area free of dirt and dust during and after installation of products.

PART 2 P R O D U C T S

2.01 PUMP CONTROLLERS

A. Manufacturer:

1. DCC, Universal Pump Controller (UPC) Model 11436-H for up to four pump control or approved equal.

B. Display: 0-30' LED bar graphs for level reading and level set point and four character display.

C. Alternation: Built-in first-on first-off sequence for up to four pumps.

D. Level simulation: Front-face mounted level simulation switch with spring return to normal.

E. Input signal: Two 4-20 mA signal, can be loop powered non-isolated or isolated.

F. Power: 24 VDC

G. Interface: 2 RS-232 serial ports that uses "Modbus" protocol for SCADA support.

H. Standard Control: 4 variable or single speed pumps.

I. 5 to 6 Pumps operation: Includes standard variations listed A-H above.

a. Dual isolated inputs: Primary fail, Secondary resumes.

b. 5^{th} pump turns on by channel 5 upper set point, off by channel no. 4 lower set point.

c. 6^{th} pump turns on by channel 5 lower set point, off by channel no. 4 lower set point.

J. 7 Pumps operation: Includes standard variations listed A-H above.

a. (2) 11346-H controllers required.

b. Single 4-20ma input

c. First unit has isolated 4-20ma module in 4th location

d. For level in 2nd unit, staggered channel set points.

K. 8 Pumps operation: Includes standard variations listed A-H above.

a. (2) 11346-H controllers required.

b. Each has an external 4-20ma input signal

c. Staggered set points for pump on/off

L. For 5-8 pumps operation: Contact DCC Manufacture at 800-335-5219.

2.02 SUBMERSIBLE PRESSURE TRANSMITTERS

A. Manufacturer:

1. Endress and Hauser: Model FMX167-A2B FE1C7

2. Blue Ribbon: Model Birdcage 01 (15, 30 psi)

3. AMETEK: Model 575P

4. Dwyer Instruments, Inc.: Model PBLT2 series

B. Description: Solid-state two-wire submersible electronic differential pressure transmitter with 4-20 mA output proportional to input pressure.

C. Range: 0-30 feet range, or as required by wet well depth, with +/- 0.3 % accuracy and 0.5% max temperature across calibrated span.

D. Power: Loop-powered, 24 VDC

E. Spare Unit: Provide a spare unit in addition to the unit installed.

F. Transmitters to be calibrated to match the chart recorder range.

G. Warranty: 18 months minimum from the time acceptance by City.

2.03 MAGNETIC FLOW METER

A. Manufacturer:

1. Rosemount
2. ABB
3. SIEMENS

B. Hardware:

1. Provide sufficient lengths of Manufacturer's specialty cables for installation of power and signal conductors as provided with each instrument.
2. Output: 4-20 mA DC with HART.
3. Metering Tube:
   a. Carbon steel with 304 Stainless interior unless otherwise indicated.
   b. Tube Flanges: Match piping AWWA rating of the pipe. Minimum AWWA 150# Flange.
   c. Tube Liner: Polyurethane or EDPM unless noted otherwise.
   d. Tube Electrodes: ANSI 316 stainless steel, bullet nosed or elliptical self-cleaning type unless otherwise noted.
4. Transmitter:
   a. Transmitter Enclosure: NEMA 4X.
   b. Microprocessor based intelligent type.
5. Bio Trickling Filter Flow Meter:
   a. The unit manufacturer shall provide the metering tube and flow transmitter with material to meet the chemical being used in the Nutrient tank.

C. Accuracy: Plus or minus 0.5 percent of rate (including converter/transmitter.

D. Accessories:

1. The Transmitter shall be installed inside a NEMA 4X 316 Stainless Steel enclosure as shown in the drawings.
2. Factory calibration: Each meter shall be factory calibrated, with a copy

of the Report delivered with the device and in the O&M manual.

3. Grounding: Meter shall be grounded with rings. Provide 316 Stainless Steel ground rings, ground wires, and gaskets, etc. All materials shall be suitable for the liquid being measured.
4. Provide a hand held programmer for each transmitter, where full setup is not available for the instrument directly.

E. Power Connection: As shown on the Drawings.

F. Operating Temperature: -20 to + 160 deg. F

G. Warranty: 1 year parts and labor warranty.

2.04 PRESSURE TRANSMITTERS

A. Manufacturer:

1. Rosemount
2. ABB
3. SIEMENS

B. Description:

1. Solid-state two-wire transmitter with 4-20 mA with HART output proportional to input pressure.
2. Provide sufficient lengths of Manufacturer's specialty cables for installation of power and signal conductors as provided with each instrument.
3. Microprocessor based intelligent type.
4. Accuracy: 0.1 percent of span (linear output).
5. Sensor Technology: Digital.

C. Range: As shown on the Drawings

D. Power: Loop-powered, 24 VDC

E. Spare Unit: Provide a spare unit in addition to the unit installed.

F. Physical:

1. Electrical Classification: Intrinsically safe for Class I and Class II, Division 1 locations.
2. Enclosure: NEMA 4X.

3. Sensor Diaphragm Material: Cobalt-Nickel-Chrome alloy or Hastelloy C.
4. Gaskets: Teflon.
5. Sensor Fill Fluid: Shall be suitable for process fluid being measured. When used for chemical metering service, sensor fill fluid shall be rated specifically for the chemical being measured.
6. Diaphragm Seals: 316 SS, fill liquid with Ethylene Glycol (Anti-Freeze)

G. Warranty: 18 months minimum from the time acceptance by City.

2.05 CONTROL POWER TRANSFORMERS

A. Transformer: NEMA ST 1 machine tool transformer with isolated secondary winding.

B. Power Rating: 250 VA or 200 percent power requirement, whichever is greater.

C. Voltage Rating: 480/240 volt primary, 120 volt secondary, single phase.

2.06 PHASE/VOLTAGE MONITOR RELAY

A. Manufacturer, Product: Diversified Electronics Inc.; Model PBD Series or approved equal.

B. Description: All three phases monitored individually for preselected under and over voltage limit phase loss, phase unbalance, phase reversal, frequency shift and phase shift. Automatic reset after adjustable release delay when line conditions return to normal.

C. Indicators: LED indicators for under and over voltage limit.

D. Output Rating: DPDT, 3 amps resistive at 600 VAC.

E. Phase Sequence: ABC.

F. Sampling Time: 2 seconds.

G. Spare Unit: In addition to the unit installed, furnish one spare phase/voltage monitor relay.

2.07 TERMINAL BLOCKS

A. Manufacturers

1. Bussmann.
2. Phoenix Contact.
3. General Electric Company.
4. Weidmuller.
5. Allen Bradley.

B. Substitutions: Comply with Section 01630 - Product Substitution Procedures.

C. Terminal Blocks: Provide isolated fused snap-on type terminal blocks.

D. Power Terminals: Unit construction type with closed back and tubular pressure screw connectors, rated 600 volts.

E. Signal and Control Terminals: Modular construction type suitable for channel mounting with tubular pressure screw connectors; 300 volt rating.

F. Provide color-coded (green/yellow) ground bus terminal block, with each connector bonded to enclosure.

2.08 SURGE PROTECTION AND SUPPRESSION DEVICES

A. Definitions

1. TVSS: Transient Voltage Surge Suppressor
2. SPD: Surge Protection Devices

B. Codes and Reference Standards

1. The TVSS / SPD shall comply with the following standards:
    a. UL Listed or recognized to UL 1449, 3nd Edition
    b. Application Guide A and IEEE C62.41.1-2002 Category C area
    c. IEC 61024/ Application Guide A
    d. National Electrical Code

e. IEC 61643-1

C. General

1. The TVSS / SPD shall be available in a non enclosed Din rail mounted version or mounted in a suitable enclosure.

2. The TVSS / SPD components can be either a self contained wired in unit or a modular unit with field replacement capability without the removal of any wires.

3. TVSS/ SPD for 4-20ma shall be available in either series or parallel connection depending on the application.

4. The TVSS/ SPD shall be capable of supporting local and or remote alarming for failure notification.

D. Main Power Panel Requirements

1. Facility incoming voltage of 3 phase 480/277 AC or 3 phase 120/240 AC will require TVSS/ SPD protection with the following requirements:

a. 50 KA per IEC 61024 or 100 KA each phase per ANSI/IEEE C62.41

b. MOV, Arc Chute or Hybrid technology is acceptable

c. Response time: 1< nanosecond or di/dt rise for lighting strikes

d. Din Rail mounted or suitable enclosure

e. Multi-modes of protection (minimum L, N, and G)

f. Must comply with UL 1449 3rd Edition Type 1 SPD 200 KA SCCR

2. Manufacturer

a. ERICO CRITEC, TDX 100 M Series

b. Dehn, Dehnguard 908 Series

c. Phoenix Contact model SYS N4 277/480Y

d. Or City of Houston approved equivalent

E. Secondary Power Panel Requirements

1. Secondary power panels supplying power to single phase 120/ 240 VAC or 120 VAC systems will require TVSS/ SPD protection with the following requirements:

a. 40 KA each leg per ANSI/ IEEE

b. MOV or Hybrid technology is acceptable

c. Response time: <1 nanosecond

d. Din Rail mounted or suitable enclosure

e. Must comply with UL 1449 3rd Edition Type 2 SPD

2. Manufacturer

a. ERICO CRITEC, TDS Series

b. Dehn, Dehnguard 908 Series

c. Phoenix Contact, Plugtrab PT2-PE/S 120AC-ST with PT-BE/FM base

d. Or City of Houston approved equivalent

F. 4-20 ma Instrumentation Loops

1. Surge current rating of 10 KA per ANSI/ IEEE

2. The TVSS/SPD must be base with interchangeable circuit protection

3. Din Rail mounted.

4. Shall have means for field testing.

5. Manufacturer

a. ERICO CRITEC UTB30SP (Single loop) or UTB30DP (Two

loops)

b. Dehn, Blitzductor BSP M2 BD 24 (Single loop) or BSP M4 BD 24(Two loops) Plug with BSP BAS 4 base

c. Phoenix Contact, Plug Trab PT 1x2-24DC-ST Plug with PT 1x2- BE base (Single loop) or PT 2x2-24DC-ST Plug with PT 2x2-BE (Two loops)

G. Testing Requirement

1. Vendor shall provide verifiable third party test results of the stated specification of TVSS/ SPD

H. Warranty

1. 10 Years unlimited, free replacement unit or replacement parts for all Malfunctioning TVSS/ SPD devices

I. Listed manufacturers or approved equal

1. Dehn

2. Phoenix Contact

3. ERICO CRITEC

2.09 ACCESSORIES

A. Plastic Raceway: Plastic slotted wireway with snap-on locking covers.

B. Manufacturer

1. Anixter Bros., Inc.

2. Delaware Industries, Inc.

3. Panduit Corp.

4. Iboco

PART 3 E X E C U T I O N

3.01 INSTALLATION

A. Furnish complete enclosure, factory tested and ready for installation and field termination.

B. Terminate wiring with spade lugs at terminal strips corresponding to designations on Drawings.

C. When not installed in plastic wireways, such as along back of door, neatly bundle and support air tubing and internal panel wiring with self-adhesive nylon clips. Provide adequate slack for proper door operation without damage to wiring or tubing.

D. Identification: Identify system components in accordance with Section 16195 - Wiring and Conduit Identification.

E. Furnish and install as shown on the drawing for Scum, Bio Trickling Filter, and NPW system PLC panels.

1. Identify conductors and termination points (device and relay terminals).

2. Identify transmitters, switches and devices with stainless steel tags.

3. Provide nameplates for panel-mounted devices and instruments as shown on Drawings.

3.02 SYSTEM TESTING

A. Perform system testing as required by individual component Sections. Calibrate and adjust components for proper operation. Submit 6 copies of Manufacturer's Installation Inspection, Field Calibration and Field Testing Reports. Replace components found to be defective.

END OF SECTION

SECTION 13471

CONTROL CABINET ENCLOSURES

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Indoor and outdoor control cabinets for scum system, NPW system, and BTF system instrumentation and control panels. Contractor shall provide submittal and specify equipment per drawing and equipment and device layout required for a fully functional system.

1.02 REFERENCES

A. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

B. ANSI/NFPA 70 - National Electrical Code (NEC).

C. Underwriters Laboratories, Inc. (UL).

D. Factory Mutual (FM).

E. Occupational Safety and Health Administration (OSHA).

F. American National Standards Institute (ANSI).

1.03 SUBMITTALS

A. Conform to Section 01330 - Submittal Procedures.

B. Product Data: Provide manufacturer's product literature and specifications.

C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency specified under Paragraph 1.04, Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product.

1.04 REGULATORY REQUIREMENTS

A. Conform to requirements of ANSI/NFPA 70 (NEC).

B. Furnish products listed and classified by Underwriters Laboratories, Inc., as suitable for purpose specified and shown; install in accordance with UL

requirements.

1.05 EXTRA MATERIALS

A. Insert half-size blackline prints on rite in the rain all weather writing paper model 8511 of the complete wiring diagrams, schematics, and loop diagrams applicable to each control panel in a clear plastic envelope and store in a suitable print pocket or holder inside each control panel.

PART 2 P R O D U C T S

2.01 MANUFACTURERS

A. Acceptable Manufacturers

1. Rittal
2. Hennessey Products, Inc.
3. Hoffman Engineering.
4. Hammond Manufacturing
5. The EMF Company.
6. Rose Enclosure.
7. Weigman Company.
8. N.E.M.A. Enclosure Mfg. Co.

B. Substitutions: Comply with Section 01630 - Product Substitutions and Procedures.

2.02 INDOOR CONTROL CABINETS

A. Enclosure: NEMA 250, Type 12; if requested by City Engineer, obtain Underwriters Laboratory, Inc. approval after completion.

B. Enclosure Size: As indicated on Drawings; or, if not indicated, at least 72 inches high by 20 inches deep by 36 inches wide, or larger, as required to mount equipment indicated to U.L. Standards.

C. Backboard for mounting terminal blocks and components: 12 gauge steel,

finished in white enamel.

D. Fronts: Steel pan-type doors with concealed stainless steel hinges, held closed by stainless steel 3-point latch operable by pistol-grip handle.

E. Provide solid metal barriers to separate compartments containing control wiring operating at less than 50 volts from power wiring.

F. Clean surfaces to remove dirt and corrosion residue. Phosphatize for corrosion protection. Prime with two coats, and finish with one coat, of factory-applied textured polyurethane, minimum 5 mils thickness, color as selected by City Engineer from manufacturer's standard colors.

G. Panel Construction: Provide panel stiffeners and bracing. Fully gasket doors. Weld seams and grind smooth.

H. Conduit Entrances: Bottom entry unless otherwise indicated on Drawings.

I. Material: Minimum 12 gauge steel.

J. Finish: Enamel; gray outside, white inside.

K. Provide convenience outlets and internal fluorescent lighting, as shown on Drawings.

L. Nameplates: On the outside of each cabinet's inner door, provide motor data nameplate information for each pump motor; copy all information exactly as shown on each motor nameplate. Provide engraved laminated plastic nameplates; black letters with white background; fasten to outside of cabinet door of each motor starter section with stainless steel screws. Provide nameplates for all devices within panel.

M. Install wiring in open-slot plastic wiring duct.

N. On indoor panels install a 4-inch passive vent in the side near the top and near the bottom of an adjacent side panel. These vents shall have removable filters to resist dust and insect entry.

2.03 OUTDOOR CONTROL CABINETS

A. Enclosures: NEMA 3 type 5052-H32 aluminum with 0.125 inch thickness 5052-H32 aluminum back panel for mounting components. If requested by City Engineer, obtain inspection and approval by Underwriters Laboratory, Inc., after installation of control system in cabinet.

B. Enclosure Size: As indicated on Drawings, as required to accommodate equipment and as indicated in UL standards.

C. Material: Exterior and interior enclosure doors, shelves and component enclosures: Fabricate of 14 gauge type 316 stainless steel or 0.125 inch thick type 5052-H32 aluminum.

D. Doors: Stainless steel pan-type construction, with full-length stainless steel piano hinge (for stainless steel or aluminum). Equip exterior door with padlock, heavy-duty locking pistol-grip handles and 3-point latching mechanism of the draw roller type (0.750 inch minimum diameter rollers). Handles shall be 3/4 inch minimum diameter stainless steel. Equip interior doors with flush quarter-turn closure devices. Equip interior and exterior doors with neoprene gaskets.

E. Provide rain shield with 1 inch drip lip for outdoor cabinets to protect against direct sun radiation and rainfall. Design shield to provide 2-1/2 feet of cover front and back and 6 inches of cover on the sides. Design shield shall have a 1-inch open panel door clearance. Shielding material: Type 316 stainless steel or type 5052-H32 aluminum.

F. Nameplates: On the outside of each cabinet's inner door, provide motor data nameplate information for each pump motor; copy all information exactly as shown on each motor nameplate. Provide engraved laminated plastic nameplates; black letters with white background; fasten to outside of cabinet door of each motor starter section with stainless steel screws. Provide nameplates for all devices within panel.

G. In each cabinet section, provide a 120V convenience outlet and a switched 40 watt minimum fluorescent light fixture, with 0 degrees F ballast in each section.

H. Inside and outside of cabinet shall be smooth and free from burrs.

I. If aluminum cabinet, hinges shall be .090 inch thick minimum, aluminum, and shall have .250 inch diameter stainless steel hinge pin. Hinge leaves shall not be exposed externally when door is closed.

J. NEMA 4X enclosures shall have all bolt holes gasketed.

K. A divider of same material and thickness as the cabinet shall be added to divide electrical components and wiring from instrumentation and pneumatic components and wiring.

PART 3 E X E C U T I O N

3.01 EXAMINATION

A. Verify that surface and job conditions are ready for construction; report unsatisfactory conditions to the City Engineer. Do not proceed with work until unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Transport, handle and install products in accordance with manufacturer's instructions.

B. Install on prepared pads. Anchor securely at each corner. Shim and grout as required to form a watertight seal.

C. Install cabinet fronts plumb.

D. Field-cut bottom conduit entrance openings for outdoor cabinets. Seal removable plates with silicone sealant.

E. Install ground rod and equipment ground conductor.

F. Install separate instrument ground lug and ground conductor; connect to common station ground grid.

G. Mount devices to allow removal and reinstallation without backboard removal. Use stainless steel mounting hardware.

H. Except for nameplate fasteners, mounting or other hardware shall not penetrate panel exterior.

I. Exterior panels: Mount with stainless steel anchor bolts and ground to the station ground field. Install and test ground field to provide maximum 5 ohm resistance to ground in accordance with Section 16170 - Grounding and Bonding.

J. Provide door restraints for outer and inner doors to positive lock and hold doors open at 115 degrees minimum.

K. Label all wires with heat shrink markers per Section 16195.

END OF SECTION

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SECTION 15010

BASIC MECHANICAL REQUIREMENTS

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. This Section includes general administrative and procedural requirements for mechanical installations as shown on the drawings and referenced in the applicable specifications. The following administrative and procedural requirements are included in this Section:

1. Submittals.

2. Coordination drawings.

3. Record documents.

4. Maintenance manuals.

5. Rough-ins.

6. Mechanical installations.

7. Cutting and patching.

B. Base bid includes Mechanical (HVAC), and Plumbing work as shown and described in the contract documents.

C. This Division requires the furnishing and installing of all items Specified herein, indicated on the Drawings or reasonably inferred as necessary for safe and proper operation; including every article, device or accessory (whether or not specifically called for by item) reasonably necessary to facilitate each system's functioning as indicated by the design and the equipment specified. Elements of the work include, but are not limited to, materials, labor, supervision, transportation, storage, equipment, utilities, all required permits, licenses and inspections. All work performed under this Section shall be in accordance with the Project Manual, Drawings and Specifications and is subject to the terms and conditions of the Contract.

D. The approximate locations of Mechanical (HVAC) and Plumbing items are indicated on the Drawings. These Drawings are not intended to give complete and accurate details in regard to location of outlets, apparatus, etc. Exact

locations and routing are to be determined by actual measurements at the building, and will in all cases be subject to the Review of the City, who reserves the right to make any reasonable changes in the locations indicated without additional cost to the City.

E. Items specifically mentioned in the Specifications but not shown on the Drawings and/or items shown on Drawings but not specifically mentioned in the Specifications shall be installed by the Contractor under the appropriate section of work as if they were both specified and shown.

F. All discrepancies between the Contract Documents and actual job-site conditions shall be reported to the Project Manager that they will be resolved prior to the bidding, where this cannot be done at least 7 working days prior to bid; the greater or more costly of the discrepancy shall be bid. All labor and materials required to perform the work described shall be included as part of this Contract.

G. It is the intention of this Section of the Specifications to outline minimum requirements to furnish the City with a turn-key and fully operating system in cooperation with other trades.

1.02 MEASUREMENT AND PAYMENT

A. No separate payment will be made for work under this section. Include payment in the Lump Sum Base Bid Price

1.03 WORK SPECIFIED IN OTHER SECTIONS

A. Protective coatings are specified in section 09901.

B. City furnished equipment and equipment furnished by other trades shall be properly connected to Mechanical (HVAC) and Plumbing systems.

C. Furnishing and installing all required Mechanical (HVAC) and Plumbing equipment control relays and electrical interlock devices, conduit, wire and J-boxes are included in the Work of this Division.

D. Concrete housekeeping pads and equipment pads are specified under Division 3, however, anchor bolts, dimensions and locations, framing and pouring of equipment concrete pads are included in the Work of this Division.

1.04 REFERENCES

A. Obtain all required permits and inspections for all work required by the Contract Documents and pay all required fees in connection thereof.

B. Arrange with the serving utility companies for the connection of all required utilities and pay all charges, meter charges, connection fees and inspection fees, if required.

C. Comply with all applicable codes, specifications, local ordinances, industry standards, utility company regulations and the applicable requirements of the following nationally accepted codes and standards:

1. Underwriters' Laboratories, Inc., UL.
2. Air Moving & Conditioning Association, AMCA.
3. American Standards Association, ASA.
4. American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc., ASHRAE.
5. American Society of Mechanical Engineers, ASME.
6. American Society of Plumbing Engineers, ASPE.
7. American Society of Testing Materials, ASTM.
8. American Water Works Association, AWWA.
9. National Bureau of Standards, NBS.
10. National Fire Protection Association, NFPA.
11. Sheet Metal & Air Conditioning Contractors' National Association, SMACNA.
12. Underwriters' Laboratories, Inc., UL.

D. Where differences existing between the Contract Documents and applicable state or city building codes, state and local ordinances, industry standards, utility company regulations and the applicable requirements of the above listed nationally accepted codes and standards, the more stringent or costly application shall govern. Promptly notify the City in writing of all differences.

E. When directed in writing by the City, remove all work installed that does not comply with the Contract Documents and applicable state or city building codes, state and local ordinances, industry standards, utility company regulations and the applicable requirements of the above listed nationally accepted codes and standards, correct the deficiencies, and complete the work at no additional cost to the City.

1.05 SITE VISIT AND FAMILIARIZATION

A. Before submitting a bid, each Contractor or Subcontractor shall visit the site and ascertain for himself the conditions to be met therein in installing his work and make due provision for same in his bid. It will be assumed that this Contractor or Subcontractor in submitting his bid has visited the premises and that his bid covers all work necessary to properly install the equipment shown. Failure on the part of the Contractor or Subcontractor to comply with this requirement shall not be considered justification for the omission or faulty installation of any work covered by these Specifications and Drawings.

1.06 DEFINITIONS AND SYMBOLS

A. General Explanation: A substantial amount of construction and Specification language constitutes definitions for terms found in other Contract Documents, including Drawings which must be recognized as diagrammatic and schematic in nature and not completely descriptive of requirements indicated thereon. Certain terms used in Contract Documents are defined generally in this article, unless defined otherwise in Division 1.

B. Definitions and explanations of this Section are not necessarily either complete or exclusive, but are general for work to the extent not stated more explicitly in another provision of the Contract Documents.

C. Indicated: The term "Indicated" is a cross-reference to details, notes or schedules on the Drawings, to other paragraphs or schedules in the Specifications and to similar means of recording requirements in Contract Documents. Where such terms as "Shown", "Noted", "Scheduled", "Specified" and "Detailed" are used in lieu of "Indicated", it is for the purpose of helping the reader locate cross-reference material, and no limitation of location is intended except as specifically shown.

D. Directed: Where not otherwise explained, terms such as "Directed", "Requested", "Accepted", and "Permitted" mean by the City. However, no such implied meaning will be interpreted to extend the City's responsibility into the Contractor's area of construction supervision.

E. Reviewed: Where used in conjunction with the City's response to submittals, requests for information, applications, inquiries, reports and claims by the Contractor the meaning of the term "Reviewed" will be held to limitations of City's responsibilities and duties as specified in the General and Supplemental Conditions. In no case will "Reviewed" by City be interpreted as a release of the Contractor from responsibility to fulfill the terms and requirements of the Contract Documents.

F. Furnish: Except as otherwise defined in greater detail, the term "Furnish" is used to mean supply and deliver to the project site, ready for unloading, unpacking, assembly, installation, etceteras, as applicable in each instance.

G. Install: Except as otherwise defined in greater detail, the term "Install" is used to describe operations at the project site including unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protection, cleaning and similar operations, as applicable in each instance.

H. Provide: Except as otherwise defined in greater detail, the term "Provide" is used to mean "Furnish and Install", complete and ready for intended use, as applicable in each instance.

I. Installer: Entity (person or firm) engaged by the Contractor or its Subcontractor for performance of a particular unit of work at the project site, including unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protection, cleaning and similar operations, as applicable in each instance. It is a general requirement that such entities (Installers) be expert in the operations they are engaged to perform.

J. Minimum Quality/Quantity: In every instance, the quality level or quantity shown or specified is intended as minimum quality level or quantity of work to be performed or provided. Except as otherwise specifically indicated, the actual work may either comply exactly with that minimum (within specified tolerances), or may exceed that minimum within reasonable tolerances limits. In complying with requirements, indicated or scheduled numeric values are either minimums or maximums as noted or as appropriate for the context of the

requirements. Refer instances of uncertainty to City via a request for information (RFI) for decision before proceeding.

K. Abbreviations and Symbols: The language of Specifications and other Contract Documents including Drawings is of an abbreviated type in certain instances, and implies words and meanings which will be appropriately interpreted. Actual word abbreviations of a self-explanatory nature have been included in text of Specifications and Drawings. Specific abbreviations and symbols have been established, principally for lengthy technical terminology and primarily in conjunction with coordination of Specification requirements with notations on Drawings and in Schedules. These are frequently defined in Section at first instance of use or on a Legend and Symbol Drawing. Trade and industry association names and titles of generally recognized industry standards are frequently abbreviated. Singular words will be interpreted as plural and plural words will be interpreted as singular where applicable and where full context of Contract Documents so indicate. Except as otherwise indicated, graphic symbols and abbreviations used on Drawings and in Specifications are those recognized in construction industry for indicated purposes. Where not otherwise noted symbols and abbreviations are defined by 1997 ASHRAE Fundamentals Handbook, chapter 34 "Abbreviations and Symbols", ASME and ASPE published standards.

1.07 DRAWINGS AND SPECIFICATIONS

A. These Specifications are intended to supplement the Drawings and it will not be the province of the Specifications to mention any part of the work which the Drawings are competent to fully explain in every particular and such omission is not to relieve the Contractor from carrying out portion indicated on the Drawings only.

B. Should items be required by these Specifications and not indicated on the Drawings, they are to be supplied even if of such nature that they could have been indicated thereon. In case of disagreement between Drawings and Specifications, or within either Drawings or Specifications, the better quality or greater quantity of work shall be estimated and the matter referred to the City for review with a request for information and clarification at least 7 working days prior to bid opening date for issuance of an addendum.

C. Requirements related to listing of product manufacturers, materials and methods shall be governed by the General Conditions. The fact that a specific manufacturer is listed as an acceptable manufacturer should not be interpreted to mean that the manufacturers' standard product will meet the requirements of the project design, Drawings, Specifications and space constraints.

D. The City shall be the sole judge of quality and equivalence of equipment, materials and methods.

E. Products by other reliable manufacturers, other materials, and other methods, will be accepted as outlined in the General Conditions, provided they have equal capacity, construction, and performance. However, under no circumstances shall any substitution by made without the written permission of the City.

F. Where permission to use substituted or alternative equipment on the project is granted by the City in writing, it shall be the responsibility of the Contractor or Subcontractor involved to verify that the equipment will fit in the space available which includes allowances for all required Code and maintenance clearances, and to coordinate all equipment structural support, plumbing and electrical requirements and provisions with the Mechanical (HVAC) and Plumbing Design Documents and all other trades, including Division 16.

G. Coordinate with Division 1 requirements for substitution, unless noted otherwise the Contractors wishing to substitute products, materials or methods from those indicated or specified, shall submit such requests in accordance with the General Conditions. Requests for permission to utilize alternates or substitutions will not be considered after that time, unless the Specified item is unavailable or will adversely effect to completion of the Project. Claims submitted for consideration will require notarized letters from all parties involved and will be considered only if the Contractor has been timely in his delivery for review of all required equipment and material submittals. City will investigate such requests for substitution and if acceptable will issue a letter allowing the substitution.

H. If any request for a substitution of product, material or method is rejected, the Contractor will automatically be required to furnish the product, material or method named in the Specifications. Repetitive requests for substitutions will not be considered.

I. Requests shall be bound and shall consist of three (3) sets of descriptive literature and performance data covering each item of equipment or material. The submittal shall include the following:

1. Name of the individuals or company originating the submittal.

2. Name of the project for which the submittal is made.

3. An index page of the items submitted.

4. A written list of variations between the specified product and the submitted product.

5. Sufficient information, including scaled drawing of area and equipment involved at a scale of 1/4" = 1'-0" minimum, as required to demonstrate that the alternate or substituted product will fit in the space available.

6. Identification of each item of material or equipment matching that indicated on the Drawings. All applicable industry or national Listings, Labels, Approvals and Standards shall be clearly indicated.

7. Sufficient pictorial, descriptive and diagrammatic data on each item to show its conformance with the Drawings and Specifications. Any options or special requirements shall be so indicated. All non- applicable information shall be crossed out.

8. Provide upon request of the City, samples of materials and/or equipment as may be required.

J. The City will investigate all requests for substitutions when submitted in accordance with above. The City shall be the sole authority to approve or disapprove any and all substitutions.

K. Where equipment other than that used in the design as specified or shown on the Drawings is substituted (either from an approved manufacturers list or by submittal review), it shall be the responsibility of the substituting Contractor or Subcontractor to coordinate space requirements, building provisions and connection requirements with his trades and all other trades.

1.08 SUBMITTALS

A. Provide Submittals in accordance with Section 01330 and the requirements specified herein. All literature pertaining to an item subject to Shop Drawing submittal shall be submitted at one time. A submittal shall not contain information from more than one Specification section, but may have a section subdivided into items or equipment as listed in each section. Each submittal shall include the following items enclosed in a suitable binder:

1. A cover sheet with the names and addresses of the Project, Design Consultant, Contractor and the Subcontractor making the submittal. The cover sheet shall also contain the section number covering the item or items submitted and the item nomenclature or description.

2. An index page with a listing of all data included in the Submittal.

3. A list of deviations page with a listing all deviations, including unfurnished or additional required accessories, items or other features, between the submitted equipment and the specified equipment. If there are no deviations, then this page shall state "NO DEVIATIONS". Where deviations affect the work of other Subcontractors, then the Contractor shall certify on this page that these variations have been fully coordinated with the affected Subcontractors. Deviations shall be identified in the Submittals as required in Section 01330.

4. Equipment information including manufacturer's name and designation, size, performance and capacity data as applicable. All applicable Listings, Labels, Approvals and Standards shall be clearly indicated.

5. Dimensional data and scaled drawings as applicable to show that the submitted equipment will fit the space available with all required Code and maintenance clearances clearly indicated and labeled at a minimum scale of 1/4" = 1'-0", as required to demonstrate that the alternate or substituted product will fit in the space available.

6. Identification of each item of material or equipment matching that indicated on the Drawings.

7. Sufficient pictorial, descriptive and diagrammatic data on each item to show its conformance with the Drawings and S pecifications. Any options or special requirements or accessories shall be so indicated. All applicable information shall be clearly indicated with arrows or another approved method.

8. Additional information as required in other Sections of this Division.

9. Certification by the Contractor and Subcontractor that the material submitted is in accordance with the Drawings and Specifications, signed and dated in long hand. Submittals that do not comply with the above requirements shall be returned to the Contractor and shall be marked "REJECTED - RESUBMIT".

B. Refer to Division 1 for additional information on shop drawings and submittals.

C. Equipment and materials submittals and shop drawings will be reviewed for compliance with design concept only. It will be assumed that the submitting Contractor or Subcontractor has verified that all items submitted can be installed in the space allotted. Review of shop drawings and submittals shall not be considered as a verification or guarantee of measurements or building conditions.

D. Materials and equipment which are purchased or installed without shop drawing review shall be at the risk of the Contractor and the cost for removal and replacement of such materials and equipment and related work which is judged unsatisfactory by the City for any reason shall be at the expense of the Contractor. The responsible Contractor shall remove the material and equipment noted above and replace with specified equipment or material at his own expense when directed in writing by the City.

E. Shop Drawing Submittals shall be complete and checked prior to submission to the City for review.

F. Submittals are required for, but not limited to, the following items:

1. Pipe Material and Specialties.

2. Pipe Fabrication Drawings.

3. Basic Materials, Heat Trace Cable & Accessories.

4. Noise and Vibration Controls.

5. Plumbing Fixtures and Specialties.

6. Plumbing Equipment.

7. Waste and Sanitary DWV Fittings, Pipe and Accessories.
8. Domestic Hot and Cold Water Pipe, Fittings and Accessories.
9. HVAC Pipe and Duct Insulation & Accessories.
10. Hydronic and Plumbing Valves.
11. Hydronic Piping and Accessories.
12. Fire Sprinkler System Layout Drawings and Hydraulic Calculations.
13. Air Handling Units and Accessories.
14. Prefabricated Duct roof Penetration Curbs.
15. Duct Specialties.
16. Duct Fabrication Drawings.
17. Air Distribution Devices.
18. Filters.
19. Fans.
20. Temperature Controls and Control Sequences.
21. Test, Adjust and Balance Reports.

G. Refer to other Division 15 sections for additional shop drawing requirements. Provide samples of actual materials and/or equipment to be used on the Project upon request of the City.

1.09 COORDINATION DRAWINGS

A. Prepare coordination drawings to a scale of 1/4"=1'-0" or larger; detailing major elements, components, and systems of mechanical equipment and materials in relationship with other systems, installations, and building components. Indicate locations where space is limited for installation and access and where sequencing and coordination of installations are of importance to the efficient flow of the Work, including (but not necessarily limited to) the following:

1. Indicate the proposed locations of pipe, duct, equipment, and other materials. Include the following:

a. Wall and type locations.

b. Clearances for installing and maintaining insulation.

c. Locations of light fixtures and sprinkler heads.

d. Clearances for servicing and maintaining equipment, including tube removal, filter removal, and space for equipment disassembly required for periodic maintenance.

e. Equipment connections and support details.

f. Exterior wall and foundation penetrations.

g. Routing of sanitary sewer piping.

h. Fire-rated wall and floor penetrations.

i. Sizes and location of required concrete pads and bases.

j. Valve stem movement.

k. Structural floor, wall and roof opening sizes and details.

2. Indicate scheduling, sequencing, movement, and positioning of large equipment into the building during construction.

3. Prepare floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations.

4. Prepare reflected ceiling plans to coordinate and integrate installations, air distribution devices, light fixtures, communication systems components, and other ceiling-mounted items.

B. The Contractor shall be responsible for coordination of all items that will affect the installation of the work of this Division. This coordination shall include, but not be limited to: voltage, ampacity, capacity, electrical and piping connections, space requirements, sequence of construction, building requirements and special conditions.

C. By submitting shop drawings on the project, the Contractor is indicating that all necessary coordination has been completed and that the systems, products

and equipment submitted can be installed in the building and will operate as specified and intended, in full coordination with all other Subcontractors.

1.10 RECORD DOCUMENTS

A. Prepare record documents in accordance with Section 01785 - Project Record Documents, in addition to the requirements specified therein, indicate the following installed conditions:

1. Duct mains and branches, size and location, for both exterior and interior; locations of dampers, fire dampers, duct access panels, and other control devices; filters, fuel fired heaters, fan coils, condensing units, and roof-top A/C units requiring periodic maintenance or repair.

2. Mains and branches of piping systems, with valves and control devices located and n umbered, concealed unions located, and with items requiring maintenance located (i.e., traps, strainers, expansion compensators, tanks, etc.). Valve location diagrams, complete with valve tag chart. Indicate actual inverts and horizontal locations of underground piping.

3. Equipment locations (exposed and concealed), dimensioned from prominent building lines.

4. Approved substitutions, Contract Modifications, and actual equipment and materials installed.

5. Contract Modifications, actual equipment and materials installed.

B. The Contractor shall maintain a set of clearly marked black line record "PROJECT RECORD" prints on the job site on which he shall mark all work details, alterations to meet site conditions and changes made by "Change Order" notices. These shall be kept available for inspection by the City at all times.

C. Refer to Division 1 for additional requirements concerning record drawings. If the Contractor does not keep an accurate set of as-built drawings, the pay request may be altered or delayed at the request of the Architect. Mark the drawings with a colored pencil.

D. The record prints shall be updated on a daily basis and shall indicate accurate dimensions for all buried or concealed work, precise locations of all concealed pipe or duct, locations of all concealed valves, controls and devices and any

deviations from the work shown on the Construction Documents which are required for coordination. All dimensions shall include at least two dimensions to permanent structure points.

1.11 OPERATING MANUALS

A. Prepare maintenance manuals in accordance with Section 01782 and in addition to the requirements specified in Section 01782, include the following information for equipment items:

1. Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of replacement parts.

2. Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions; and summer and winter operating instructions.

3. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.

4. Servicing instructions and lubrication charts and schedules.

1.12 CERTIFICATIONS AND TEST REPORTS

A. Submit a detailed schedule for completion and testing of each system indicating scheduled dates for completion of system installation and outlining tests to be performed and schedule date for each test. This detailed completion and test schedule shall be submittal at least 90 days before the projected Project completion date.

B. Test result reporting forms shall be submitted for review no later than the date of the detailed schedule submitted.

C. Submit 4 copies of all certifications and test reports to the City for review adequately in advance of completion of the Work to allow for remedial action as required to correct deficiencies discovered in equipment and systems.

D. Certifications and test reports to be submitted shall include, but not be limited to those items outlined in Section of Division 15.

1.13 MAINTENANCE MANUALS

A. Provide maintenance manuals in accordance with Section 01782 and as specified herein. Unless noted otherwise bind together, in rigid cover 3 ring binders, all approved shop drawing submittals, fabrication drawings, bulletins, maintenance instructions, operating instructions and parts exploded views and lists for each and every piece of equipment furnished under this Specification. All sections shall be typed and indexed into sections and labeled for easy reference and shall utilize the individual specification section numbers shown in the Mechanical Specifications as an organization guideline. Bulletins containing information about equipment, which is not installed, on the project shall be properly marked up or stripped and reassembled. All pertinent information required by the City for proper operation and maintenance of equipment supplied by Division 15 shall be clearly and legibly set forth in memoranda which shall, likewise, be bound with bulletins.

B. Prepare maintenance manuals in accordance with Section 01782 and as specified herein, in addition to the requirements specified in Division 15, include the following information for equipment items:

1. Identifying names, name tags designations and locations for all equipment.

2. Valve tag lists with valve number, type, color coding, location and function.

3. Reviewed shop drawing submittals with exceptions noted compliance letter.

4. Fabrication drawings.

5. Equipment and device bulletins and data sheets clearly highlighted to show equipment installed on the project and including performance curves and data as applicable, i.e., description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and model numbers of replacement parts.

6. Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation,

control, stopping, shutdown, and emergency instructions; and summer and winter operating instructions.

7. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions, servicing instructions and lubrication charts and schedules.

8. Equipment and motor name plate data.

9. Wiring diagrams.

10. Exploded parts views and parts list for all equipment and devices.

11. Color coding charts for all painted equipment and conduit.

12. Location and listing of all spare parts and special keys and tools furnished to the City.

13. Furnish recommended lubrication schedule for all required lubrication points with listing of type and approximate amount of lubricant required.

C. Refer to Division 1 for additional information on Operating and Maintenance Manuals.

1.14 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to the project properly identified with names, model numbers, types, grades, compliance labels, and other information needed for identification in accordance with Section 01610.

B. Deliver products to the project at such time as the project is ready to receive the equipment, pipe or duct properly protected from incidental damage and weather damage.

C. Damaged equipment, duct or pipe shall be promptly removed from the site and new, undamaged equipment, pipe and duct shall be installed in its place promptly with additional charge to the City.

1.15 FACTORY SUPERVISED STARTUP

A. The Contractor shall furnish the services of factory-trained specialists to supervise the start up of the following major pieces of equipment:

1. Chiller (Not applicable).

2. Cooling Tower (Not applicable).

1.16 OPERATOR TRAINING

A. The Contractor shall furnish the services of factory-trained specialists to instruct the City's operating personnel. The City's operator training shall include 12 hours of on site training in three 4-hour shifts.

B. Before proceeding with the instruction of City Personnel, prepare a typed outline in triplicate, listing the subjects that will be covered in this instruction, and submit the outline for review by the City. At the conclusion of the instruction period obtain the signature of each person being instructed on each copy of the reviewed outline to signify that he has a proper understanding of the operation and maintenance of the systems and resubmit the signed outlines.

C. Refer to other Division 15 Sections for additional Operator Training requirements.

1.17 FINAL COMPLETION

A. At the completion of the work, all equipment and systems shall be tested and faulty equipment and material shall be repaired or replaced. Refer to General Conditions for additional requirements.

B. Clean and adjust all air distribution devices and replace all air filters immediately prior to final acceptance.

C. Touch up and/or refinish all scratched equipment and devices immediately prior to final acceptance.

1.18 CONTRACTOR'S GUARANTEE

A. Use of the HVAC and Plumbing systems to provide temporary service during construction period will not be allowed without permission from the City in writing and if granted shall not be cause warranty period to start, except as defined below.

B. Contractor shall guarantee to keep the entire installation in repair and perfect working order for a period of one year, and shall furnish free of additional cost to the City all materials and labor necessary to comply with the above guarantee throughout the year beginning from the .warranty date as defined in the Contract.

C. This guarantee shall not include cleaning or changing filters except as required by testing, adjusting and balancing.

D. Refer to Sections in Division 15 for additional guarantee or warranty requirements.

PART 2- P R O D U C T S (Not Applicable)

PART 3 – E X E C U T I O N

3.01 ROUGH-IN

A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected via reviewed submittals.

B. Refer to equipment specifications in Divisions 2 through 16 for additional rough-in requirements.

3.02 MECHANICAL INSTALLATIONS

A. General: Sequence, coordinate, and integrate the various elements of mechanical systems, materials, and equipment. Comply with the following requirements:

1. Coordinate mechanical systems, equipment, and materials installation with other building components.

2. Verify all dimensions by field measurements.

3. Arrange for chases, slots, and openings in other building components during progress of construction, to allow for mechanical installations.

4. Coordinate the installation of required supporting devices and sleeves to be set in poured-in-place concrete and other structural components, as they are constructed.

5. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the Work. Give particular attention to large equipment requiring positioning prior to closing in the building.

6. Where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide the maximum headroom possible.

7. Coordinate connection of mechanical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide required connection for each service.

8. Install systems, materials, and equipment to conform with architectural action markings on submittal, including coordination drawings, to greatest extent possible. Conform to arrangements indicated by the Contract Documents, recognizing that portions of the Work are shown only in diagrammatic form. Where coordination requirements conflict with individual system requirements, resolve conflicts and route proposed solution to the City for review.

9. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components, where installed exposed in finished spaces.

10. Install mechanical equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations. Extend grease fittings to an accessible location and label.

11. Install access panel or doors where units are concealed behind finished surfaces. Access panels and doors are specified.

12. Install systems, materials, and equipment giving right-of-way priority to systems required to be installed at a specified slope.

1.10 CUTTING AND PATCHING

A. Protection of Installed Work: protect adjacent installations. During cutting and patching operations,

B. Perform cutting, fitting, and patching of mechanical equipment and materials required to:

1. Uncover Work to provide for installation of ill-timed Work.

2. Remove and replace defective Work.

3. Remove and replace Work not conforming to requirements of the Contract Documents.

4. Remove samples of installed Work as specified for testing.

5. Install equipment and materials in existing structures.

6. Patch existing finished surfaces and building components using new materials matching existing materials and experienced Installers. Patch finished surfaces and building components using new materials specified for the original installation and experienced

7. Installers; refer to the materials and methods required for the surface and building components being patched; Refer to Section "DEFINITIONS" for definition of "Installer."

C. Cut, remove and legally dispose of selected mechanical equipment, components, and materials as indicated, including but not limited to removal of mechanical piping, mechanical ducts and HVAC units, plumbing fixtures and trim, and other mechanical items made obsolete by the new Work.

D. Protect the structure, furnishings, finishes, and adjacent materials not indicated or scheduled to be removed.

E. Provide and maintain temporary partitions or dust barriers adequate to prevent the spread of dust and dirt to adjacent areas.

END OF SECTION

Section 15050

BASIC MECHANICAL MATERIALS AND METHODS

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Basic mechanical requirements specifically applicable to Division 15 Sections, in addition to Division 1 - General Requirements.

1.02 REFERENCES

A. ANSI: American National Standards Institute.

B. ARI: American Refrigeration Institute.

C. ASHRAE: American Society of Heating Refrigeration and Air Conditioning Engineers.

D. ASME: American Society for Mechanical Engineers.

E. ASTM: American Society for Testing and Materials.

F. AWWA: American Water Works Association.

G. MSS: Manufacturer's Standardization Society of the Valve and Fitting Industry.

H. NEMA: National Electrical Manufacturers' Association.

I. NFPA: National Fire Protection Association.

J. SMACNA: Sheet Metal and Air Conditioning Contractors' National Association.

K. UL: Underwriters' Laboratories, Inc.

1.03 SUBMITTALS

A. Submit under provisions of Section 01330 - Submittal Procedures.

B. Submittals as specified in individual sections.
C. Submit shop drawings and product data grouped to include complete submittals of related systems, products, and accessories in a single submittal.

D. Mark dimensions and values in units to match those specified.

1.04 REGULATORY REQUIREMENTS

A. Conform to applicable City of Houston Building Code for the Pump Station Control Building.

B. Fire Protection: Conform to National Fire Prevention Association Code.

C. Plumbing: Conform to National Plumbing Code.

D. Obtain permits, and request inspections from authority having jurisdiction on of this Project.

1.05 PROJECT/SITE CONDITIONS

A. Install Work in locations shown on Drawings, unless prevented by Project conditions.

B. Prepare drawings showing proposed rearrangement of Work to meet Project conditions, including changes to Work specified in other Sections. Obtain permission of City Engineer before proceeding.

1.06 SEQUENCING AND SCHEDULING

A. Construct Work in sequence under provisions of Section 01310 - Construction Schedule.

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 15053

PUMP STATION PIPING

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Piping as shown on the Drawings.

1.02 REFERENCES

A. ANSI A21.10, AWWA C110 - Ductile Iron Fittings 3 in. through 48 in., for water and other liquid.

B. ANSI B36 - Stainless Steel Pipe.

C. AWWA C151 - Ductile Iron Pipe, centrifugally cast in metal molds or sand-lined molds for water or other liquids.

D. ANSI A21.15, AWWA C115 - Flanged Ductile Iron Pipe with Threaded Flanges.

E. ANSI B16.1 Ductile Iron Pipe Flanges and Flanged Fittings.

F. AWWA C111, ANSI A21.11 - Rubber Gasket Joints.

G. AWWA C600 - Hydrostatic Testing.

H. AWWA C606 - Grooved and Shouldered Joints.

I. ANSI B1.1 Screw Threads.

J. ASTM A193 - Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service.

K. ASTM A194 - Carbon and Alloy-Steel Nuts for Bolts for High-Pressure and High-Temperature Service.

1.03 SUBMITTALS

A. Submit shop drawings and product data under provisions of Sections 01330 – Submittal Procedures and Section 15050 - Basic Mechanical Materials and Methods.

B. Submit detailed drawings on pipe, joints, gaskets, fittings, flange coupling adapters, and appurtenances.

C. Submit shop drawings indicating dimensions, layout of piping, elevations, intersections, connections, support system, etc.

D. Submit manufacturer's Certification of Compliance with ANSI, AWWA and other Standards listed herein.

E. Submit description of proposed testing methods, procedures and apparatus and test reports for each system.

1.04 QUALITY ASSURANCE

A. Manufacturer's Qualifications

1. Piping and appurtenances provided under this Section shall be the standard product in regular production by manufacturers whose products have proven reliable in similar service for at least 5 years.

2. Insofar as possible all piping and appurtenances of the same specific type shall be the product of one 1 manufacturer.

1.05 DELIVERY, STORAGE AND HANDLING

A. Have products delivered, stored and protected under provisions of Section 01610 - Basic Product Requirements.

PARTS 2 P R O D U C T S

2.01 MATERIALS

A. Ductile Iron Pipe: AWWA C151, Class 53 minimum.

1. Fittings: AWWA C110

2. Joints: AWWA C115, with threaded flanges and rubber gaskets.

3. Bolts, studs and nuts: ASTM A-316 stainless steel.

4. Flanges: Same material as pipe and screwed onto the pipe in accordance with ANSI B16.1. Use screwed-on flanges attached to the pipe by the pipe manufacturer or pipe manufacturer's authorized fabricator.

5. After flange attachment, have flange and pipe re-faced so that the end of the pipe is even with the face of the flange and both are perpendicular to the axis of the pipe.

6. All flanged joints shall be hydrostatically tested after fabrication to a pressure rating of 300 psi minimum. All flanged joints shall be marked (Tested at 300 psi) and notarized certification papers supplied to the purchaser.

7. Align bolt holes on both flanges at the end of each piece of pipe.

8. Where cap screws or stud bolts are required, incorporate tapped holes for such cap screws or stud bolts in the flanges.

9. Interior Lining: Use one of the following interior lining systems.

   a. Nominal 40 mils (35 mils minimum) virgin polyethylene complying with ASTM D1248, heat fused to interior of pipe.

   b. Nominal 40 mils (35 mils minimum) polyurethane, such as Corro-pipe II by Madison Chemicals, or Polythane by U.S. Pipe.

   c. Approved equal.

10. Exterior Coating: Coat pipe in accordance with Section 09901 - Protective Coatings.

11. Performance: Use pipes and fittings designed for an internal working pressure range of -10 to +150 psi.

B. Wall Pipes: Ductile iron flanged with water stop collar.

1. Ductile iron water stop collar to be welded on the wall pipe prior to installation of the interior lining.

2. Interior Lining: As specified for pipe in paragraph 2.01A.9.

3. Bolts, studs and nuts: Type 316 stainless steel.

C. Flanged Coupling Adapter:

1. Type: Ductile iron; Romac Industries, Style FCA501, Dresser Style 128, or approved equal.

2. Interior Lining: As specified for pipe in paragraph 2.01A.9, or heat-fused epoxy coating complying with AWWA C213.

3. Bolts, studs and nuts: Type 316 stainless steel

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D. Grooved Couplings: Grooved couplings conforming to AWWA C606 may be used for exposed piping outside of the wet well.

1. Manufacturers: Gustin-Bacon, Victualic Style 31 (flexible or rigid).

2. Bolts and Nuts: Type 316 Stainless Steel.

3. Gaskets: Flush seal type, compatible with the fluid, according to the manufacturer's recommendations.

4. Pipe Wall Thickness: Wall thickness of grooved piping shall conform to the coupling manufacturer's recommendations to suit the highest expected pressure.

5. Equipment Connections: Equipment connections shall be rigid-type grooved couplings unless thrust restraint is provided by other means.

6. Require the manufacturer to verify correct choice and installation of couplings, gaskets, and workmanship to assure correct installation.

E. Air Release Piping: Schedule 40, ANSI B36 stainless steel with ANSI B1.20.1 threaded joints.

PART 3 E X E C U T I O N

3.01 INSTALLATION

A. Check dimensions shown on the Drawings prior to installation of Work. Notify the City Engineer promptly of any conflicts or errors.

B. Run pipe lines straight and true in alignment, grade and location as shown on the Drawings.

C. Install piping through walls and floors as shown on the Drawings.

3.02 PIPE IDENTIFICATION LABELS

A. Label piping as follows:

1. Identify all piping with plastic sleeve snap-on markers equivalent to Seton Name Plate "Setmark" or approved equal with 3/4-inch letters on pipe sizes to 4-inch and 2-inch letters on pipe sizes 5-inches and larger, or approved equal.

2. Locate at each valve, each branch take-off, and at each side of floor or wall through which pipe passes.

3. Not more than one label is required every 12 feet if adjacent label is visible.

4. Place labels on all lines.

3.03 TESTING

A. Flush pipes clean. Tighten connections to stop any visible leaks.

B. Test piping in accordance with Section 4-Hydrostatic Testing, AWWA C600.

C. Test piping to a pressure of 150 percent of the maximum possible discharge pressure of the pumps.

3.04 PAINTING

A. Paint pipe in accordance with Section 09901 - Protective Coatings.

END OF SECTION

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SECTION 15060

EQUIPMENT BASES AND SUPPORTS

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Provide concrete equipment pads for all direct and isolated floor mounted equipment, and structural equipment supports for horizontal tanks, heat exchangers and similar equipment, where required.

1.02 MEASURMENT AN D PAYMENT

A. No separate payment will be made for work under this section. Include payment in the Lump Sum Base Bid Price.

1.03 SUBMITTALS

A. Submittals shall be in accordance with Section 01330.
B. Submit shop drawings on all structural supports.

PART 2 P R 0 D U C T S

2.01 CONCRETE

A. Provide 3000 psi concrete.

2.02 STRUCTURAL METAL

A. Construct floor stands of structural members or steel pipe for equipment supports.

PART 3 E X E C U T I 0 N

3.01 CONCRETE PADS

A. Pour minimum 3 1/2 inch thick pads on roughened floor slabs unless otherwise noted. Reinforce pad with No. 4 rebar set 12 inches on center unless indicated otherwise on structural drawings. Provide 2 inch clearance between

top of pad and rebar. Extend outer edges of pads a minimum of 2 inches beyond equipment. Secure equipment with anchor bolts in accordance with equipment installation instructions.

3.02 STRUCTURAL SUPPORTS

A. Bolt floor stands to concrete pads.
B. Hang ceiling-mounted equipment from suitable brackets, platform framing or similar supports fabricated of structural members.
C. Paint in accordance with Section 09901.

END OF SECTION

SECTION 15061

MISCELLANEOUS PIPING

PART 1 G E N E R A L

1.01 SCOPE

A. This section covers furnishing and installation of miscellaneous piping and piping accessories for the services specified herein.

1.02 MEASUREMENT AND PAYMENT

A. No separate payment will be made for work under this section. Include payment in the Lump Sum Base Bid Price.

1.03 SUBMITTALS

A. Complete specifications, data, and catalog cuts or drawings covering the following items furnished under this section shall be submitted in accordance with Section 01330 - Submittal Procedures.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Coated black steel pipe and fittings shall be handled and stored in a manner which will ensure installation in sound, undamaged condition. Handling methods and equipment used shall prevent damage to the protective coating and shall include the use of end hooks, padded calipers, and nylon or similar fabric slings with spreader bars. Bare cables, chains, or metal bars shall not be used. C oated pipe shall be stored off the ground on wide, padded skids. Whenever the storage period on the jobsite exceeds 30 days, plastic-coated pipe shall be covered or otherwise protected from exposure to sunlight.

PART 2 P R O D U C T S

2.01 SERVICE AND TYPE REQUIREMENTS

A. Except as otherwise specified, pipe and tubing shall conform to the general requirements in the Piping Schedule in paragraph 3.01 Hand the schedule in paragraph 2.01 D for the services listed. Pipe materials for service conditions

not listed shall be as specified in other sections, as indicated on the drawings, or, in the absence of any definite requirement, as determined by the City.

B. Where optional pipe materials or fittings are listed for a particular service, the Contractor may select the materials and fittings from the options offered.

C. For all services where ASTM A53 steel pipe is required, ASTM A106 steel pipe of equivalent wall thickness will be acceptable.

D. The following table designates the type of pipe material to be provided for the following services.

Miscellaneous Piping Schedule			
Service	Size	Material	Special Conditions
Booster Air	½ inch	Steel, ASTM A53 Type E std. weight Grade A or B or ASTM A106 of equivalent thickness	Malleable Iron fittings
Compressed Air	2-inch and smaller	Steel, ASTM A53 Type E std. weight Grade A or B or ASTM A106 of equivalent thickness	Malleable Iron fittings
Compressed Air	2 ½ inch and larger	Steel, ASTM A53 Type E std. weight Grade A or B or ASTM A106 of equivalent thickness	Butt Welded Fittings
Mineral Oil	All	Steel, ASTM A53 Type E std. weight Grade B or ASTM A106 of equivalent thickness	Forged Steel socket welded fittings
Dewatered Cake Conveyance	All	Steel, ASTM A53 Schedule 80	Grooved coupling fittings(Victualic Style HP-70ES or City approved equal) , large radius

			elbows
Nitrogen Supply Upstream of Vaporizers	All	Copper Water Tubing, ASTM B819, Type K	Hard drawn with solder joint fittings
Nitrogen Supply Downstream of Vaporizers	2-inch and smaller	Steel, ASTM A53/A106, Extra Strong, Type S	Forged steel threaded fittings
Nitrogen Supply Downstream of Vaporizers	2 ½ inch and larger	Steel, ASTM A53 Type S, Std. Weight Grade B or ASTM A106 of equivalent thickness	Butt welded fittings
Non Potable Water	2-inch and smaller	As specified in 15071	
Non Potable Water	2 ½ inch and larger	As specified in 15071	
Protected Water	2-inch and smaller	As specified in 15071	
Protected Water	2 ½ inch and larger	As specified in 15071	

2.02 MATERIALS

A. Steel Pipe

The following types of steel pipe shall be provided. The specific type of pipe material and wall thickness for each service listed shall conform to the requirements of the applicable Piping Schedule paragraph.

Nipples	ASTM A53, seamless (Type S), or electric resistance welded, (Type E), Grade A or B.
Fittings	ASTM A106, Grade A or B.
Cast Iron	ASTM A733, seamless, extra strong (Schedule 80); "close" nipples will be permitted only by special authorization in each case.
Threaded	ANSI/ASME B16.4, Class 125.
Flanged	ANSI/ASME B16.1, Class 125.

Malleable Iron		ANSI/ASME B16.3, Class 150, or Fed Spec WW-P-521, Type II (galvanized) for galvanized pipe or Type I (black) for non-galvanized pipe.
Forged Steel		ANSI B16.11; Bonney, Crane, Ladish, or Vogt.
Socket-Welding		Class 3000.
Threaded		Class 2000 or Class 3000.
Buttwelding		ANSI/ASME B16.9; standard weight for use with standard weight pipe and extra strong for use with extra strong pipe.
Unions Malleable Iron		Fed Spec WW-U-531, Class 2; Type B (galvanized) for galvanized pipe or Type A (black) for ungalvanized pipe.
Flanges For Standard Weight		ANSI/ASME B16.5, Class 150, flat Pipe faced when connected to flat faced flanges; otherwise, raised face.
Flange Bolts and Nuts		ASTM A307, Grade B, length such that, after installation, the bolts will project 1/8 to 3/8 inch beyond outer face of the nut.
Flange Gaskets For Aeration Air Service	Raised Face Flanges	Non-asbestos inorganic fiber with EPDM binder; dimensions to suit flange contact face, 1/16 inch minimum thickness for plain finished surfaces, 3/32 inch minimum thickness for serrated surfaces, rated for 275°F service; Garlock "IFG 5507".
	Flat Faced Flanges	Premium Grade, EPDM, ring type, 1/8 inch thick, rated for 275°F service; Garlock "8314".
Flange Gaskets For Water Service		ASTM 01330, Grade I, red rubber, ring type, 1/8 inch thick.
Flange Gaskets For Other Services		

Flat Faced Flanges		Non-asbestos filler with neoprene or nitrile binder; dimensions to suit flange contact face; 1/16 inch minimum thickness for plain finished surfaces, 3/32 inch minimum thickness for serrated surfaces.
Raised Face Flanges		Continuous stainless steel ribbon wound into a spiral with non- asbestos filler between adjacent coils with a carbon steel gauge ring. Compressed gasket thickness shall be 0.095 inch ±0.005 inch.
Grooved Couplings		AWWA C606; Gustin-Bacon "No. 120 Rigid" or Victaulic "07 Zero-Flex".
Mechanical Couplings		Dresser "Style 38" or Smith-Blair "Type 411 Flexible Coupling"; without pipe stop.
Expansion Joints		Senior Flexonics, Inc. "Model H Expansion Compensators" for 3 inch or smaller; Senior Flexonics, Inc. "Low Pressure High Corr Expansion Joints" 150 psig with flanged ends and stainless steel bellows for 4 inch or larger.
Copper Tubing		
Water Tubing	Hard Drawn	ASTM B88, Type L.
	Soft Annealed	ASTM B88, Type K.
Instrument Tubing	Material	ASTM B280, soft annealed.
	Dimensions	ASTM B280.
Fittings	Flared	ANSI/ASME B16.26.
	Solder-Joint Compression	ANSI B16.18 or ANSI/ASME B16.22. Brass; Crawford "Swagelok" or Parker Hannifin "CPI".
Insulating		
Threaded		Dielectric steel pipe nipple, ASTM A53, Schedule 40, poly- propylene lined, zinc plated; Perfection Corp. "Ciearflow Fittings".
Flanged		Epco "Dielectric Flange Unions" or Central Plastics "Insulating Flange Unions".

Solder	Solid wire, ASTM B32, Alloy Grade Sb5, (95-5).
Soldering Flux	Paste type, Fed Spec 0-F-506, Type I, Form A.
Brazing Filler Metal	AWS A5.8, BCuP-5; Engelhard "Silvaloy 15", Goldsmith "GB-15", or Handy & Harman "Sii-Fos".
Brazing Flux	Paste type, Fed Spec 0-F-499, Type B.
Flanges	ANSI B16.24, Class 150, cast bronze, brazed joint.
Flange Bolts and Nuts	ASTM A307, Grade B, length such that, after installation, the bolts will project 1/8 to 3/8 inch beyond outer face of the nut.
Flange Gaskets	ASTM 01330, Grade I, red rubber, ring type, 1/8 inch thick.
Expansion Joints	Tempflex "Model HB Expansion Compensators", with copper tube ends.

Nitrogen pipe insulation	Pre-insulated pipe, molded, rigid urethane foam, 95 percent closed cell suitable for a temperature range of -320 f to 250 F; maximum thermal conductivity of 0.14 at 75F; minimum density of 2 lb per cubic ft; moisture absorption less than 0.04 percent; PVC jacket for UV resistance with a minimum thickness of 0.06 inch. Insulation shall be suitable for exposure to weather and direct sunlight. All materials shall be suitable for use with liquid nitrogen. Contraction joints shall be provided for the insulation and jacketing, as required. Insulation thickness shall be 3.5 inches minimum. Pre-insulated piping shall be as manufactured by Energy Task Force, Inc. of Trenton, NJ. Nitrogen pipe support/anchor insulation shall be as specified for the piping, or comparable material suitable for nitrogen service. Sufficient insulation shall be provided to cover the full length of each support.
Watertight/Dust tight Pipe Sleeves	0-Z Electrical Manufacturing "Thruwall" and "Floor Seals", or Thunderline "Link-Seals"; with modular rubber sealing elements, nonmetallic pressure plates, and galvanized bolts.
Anti-Seize Thread Lubricant	Jet-Lube "Nikal", John Crane "Thred Gard Nickel", Never-Seez "Pure Nickel Special", or Permatex "Nickel Anti-Seize".
Teflon Thread Sealer	Paste type; Hercules "Real-tuff', John Crane "JC-30", or Permatex "Thread Sealant with Teflon".
Teflon Thread Tape	Hercules "Tape Dope" or John Crane "Thred-Tape".
Pipe Sleeve Sealant	Polysulfide or urethane, as specified in the caulking section.

2.03 HEAT TRACING

A. Heat tracing shall be suitable for 120 volt, 60 Hz, single phase power. Heat tracing shall be supplied with splice and end seal kit.

PART 3 E X E C U T I O N

3.01 PIPE JOINTS

A. Pipe joints shall be carefully and neatly made in accordance with the requirements which follow.

1. Threaded

a. Pipe threads shall conform to ANSI/ASME 81.20.1, NPT, and shall be fully and cleanly cut with sharp dies. Not more than three threads at each pipe connection shall remain exposed after installation. Ends of pipe shall be reamed after threading and before assembly to remove all burrs.

2. Threaded

a. Joints in plastic piping shall be made up with Teflon thread tape applied to all male threads. Threaded joints in stainless steel piping shall be made up with Teflon thread tape applied to all male threads. At the option of the Contractor, threaded joints in other piping may be made up with Teflon thread tape, thread sealer, or a suitable joint compound. Thread tape and joint compound or sealers shall not be used in threaded joints which are to be seal welded.

3. Compression

a. Ends of tubing shall be cut square and all burrs shall be removed. The tubing end shall be fully inserted into the compression fitting and the nut shall be tightened not less than 1-1/4 turns and not more than 1-1/2 turns past finger tight, or as recommended by the fitting manufacturer, to produce a leak tight, torque-free connection.

4. Flared

a. Ends of annealed copper tubing shall be cut square, and all burrs shall be removed prior to flaring. Ends shall be uniformly flared without scratches or grooves. Fittings shall be tightened as required to produce leak tight connections.

5. Soldered and Brazed

a. Where solder fittings are specified for lines smaller than 2 inches, joints may be soldered or brazed at the option of the Contractor. Joints in 2 inch and larger copper tubing shall be brazed.

b. Surfaces to be joined shall be thoroughly cleaned with flint paper and coated with a thin film of flux. At each joint, tubing shall enter to the full depth of the fitting socket.

c. Care shall be taken to avoid overheating the metal or flux. Each joint shall be uniformly heated to the extent that filler metal will melt on contact. While the joint is still hot, surplus filler metal and flux shall be removed with a rag or brush.

6. Flanged

a. Flange bolts shall be tightened sufficiently to slightly compress the gasket and effect a seal, but not so tight as to fracture or distort the flanges. A plain washer shall be installed under the head and nut of bolts connecting plastic pipe flanges. Anti-seize thread lubricant shall be applied to the threaded portion of all stainless steel bolts during assembly. Pipe sealant, thread compounds, or other coatings shall not be applied to flange gaskets unless recommended by the gasket manufacturer for the specified service and approved by the City.

7. Welded

a. Welding shall conform to the specifications and recommendations contained in the "Code for Pressure Piping", ANSI 831.1.

8. Grooved Couplings

a. Grooves for grooved couplings shall be cut with a specially designed grooving tool. Grooves cut in steel pipe shall conform

to flexible grooving dimensions, as set forth in AWWA C606, and shall be clean and sharp without burrs or check marks.

9. Other Pipe Joints

   a. Coupled joints in tempered glass pipe, plastic joints in vitrified clay pipe, and other proprietary type joints shall be made in accordance with the manufacturer's recommendations and to the satisfaction of the City.

B. PIPE SLEEVES

1. Piping passing through concrete or masonry shall be installed through sleeves installed before the concrete is placed or when masonry is laid. Pipe sleeves installed through floors with a special finish, such as ceramic or vinyl composition tile, shall be flush with the finished floor surface and shall be provided with nickel or chromium plated floor plates. Unless otherwise indicated on the drawings, in all other locations where pipes pass through floors, pipe sleeves shall project not less than 1 inch nor more than 2 inches above the floor surface, with the projections uniform within each area. In the case of insulated pipes, the insulation shall extend through pipe sleeves. Where the drawings indicate future installation of pipe, sleeves fitted with suitable plastic caps or plugs shall be provided.

   a. Holes drilled with a suitable rotary drill will be considered instead of sleeves for piping which passes through interior walls and through floors with a special finish.

   b. Unless otherwise indicated on the drawings, all pipes passing through walls or slabs which have one side in contact with earth or exposed to the weather shall be sealed watertight with special rubber-gasketed sleeve and joint assemblies, or with sleeves and modular rubber sealing elements.

   c. Piping passing through room walls and floor shall be made dust-tight and gastight with special rubber-gasketed sleeve and joint assemblies with sleeves sealed with modular rubber sealing elements.

C. PIPE INSTALLATION

1. Pipe shall be installed as specified, as indicated on the drawings, or, in the absence of detail piping arrangement, in a manner acceptable to the City.

   a. The potable and non-potable (flushing) water supply piping shall be provided with a shutoff valve and union at each fixture or unit of equipment, whether or not indicated on the drawings, to permit isolation and disconnection of each item without disturbing the remainder of the system.

   b. A union shall be provided within 2 feet of each threaded-end valve unless there are other connections which will permit easy removal of the valve. Unions shall also be provided in piping adjacent to devices or equipment which may require removal in the future and where required by the drawings or the specifications.

   c. Pipe shall be cut to measurements taken at the site, not from the drawings. All necessary provisions shall be made in laying out piping to allow for expansion and contraction. Piping shall not obstruct openings or passageways. Pipes shall be held free of contact with building construction to avoid transmission of noise resulting from expansion.

   d. Water supply piping within structures shall be arranged, and facilities provided, for complete drainage. All piping serving metering equipment shall be uniformly graded so that air traps are eliminated and complete venting is provided.

   e. Drilling and tapping of pipe walls for installation of pressure gauges or switches will not be permitted.

   f. In all piping except air and gas piping, insulating fittings shall be provided to prevent contact of dissimilar metals, including but not limited to, contact of copper, brass, or bronze pipe, tubing, fittings, valves, or appurtenances, or stainless steel pipe, tubing, fittings, valves, or appurtenances with iron or steel pipe, fittings, valves, or appurtenances. Insulating fittings shall also be provided to prevent contact of copper, brass, or bronze pipe,

tubing, fittings, valves or appurtenances with stainless steel pipe, tubing, fittings, valves, or appurtenances.

D. HEAT TRACING

1. The mineral oil piping shall be provided with heat tracing. A heat trace system shall be designed by the heating equipment supplier and shall be sized to maintain equipment temperature of 180°F with an ambient temperature of 20°F. Minimum design start-up temperature shall be 20°F.

   a. Heat trace shall be provided as required, and shall include all pressure gauges, pressure relief valve pressure reducing stations, automatic valve stations, valves, solenoid valves, and air release valves. Heat trace shall be the self-regulating type and shall be suitable for 120 volt, 60 Hz, single phase power.

   b. Ambient sensing thermostat controllers, junction boxes, splicing and terminating components, and all other equipment required for a complete operating system shall be provided to automatically control the heating equipment. The equipment shall be suitable for use in normal and hazardous Class 1, Division 2 areas. Heat trace cable shall be covered with a metal braid and other jacket.

   c. Aluminum tape shall be applied to the pipe prior to installing the heat tracing. Heat tracing shall be secured to the underside of all piping by glass cloth tape at approximately 12-inch intervals and wrapped around all valves. A second application of aluminum tape shall be applied over the heat tracing before insulation is installed.

   d. Submittals shall include calculations used to size the equipment and feeder circuit breaker. A 30 ampere, 120 volt, 60 Hz, single phase, circuit breaker with 30 rnA ground fault protection will be provided by others.

E. PRESSURE AND LEAKAGE TESTING

1. All specified tests shall be made by and at the expense of the Contractor in the presence, and to the satisfaction, of the City. Each piping system shall be tested for at least 1 hour with no loss of pressure. Piping shall be tested at the following pressures:

Service	Test Pressure	Test Medium
Other piping	1-1/2 times working pressure but not less than 50 psi	suitable fluid or gas

   a. Compressed air or pressurized gas shall not be used for testing plastic piping unless specifically recommended by the pipe manufacturer.

   b. Leakage may be determined by loss-of-pressure, soap solution, chemical indicator, or positive and accurate method acceptable to the City. All fixtures, devices, or accessories which are to be connected to the lines and which would be damaged if subjected to the specified test pressure shall be disconnected and the ends of the branch lines plugged or capped as required during the testing.

   c. All necessary testing equipment and materials, including tools, appliances and devices, shall be furnished and all tests shall be made by and at the expense of the Contractor and at the time directed by the City.

   d. All joints in piping shall be tight and free of leaks. All joints which are found to leak, by observation or during any specified test, shall be repaired, and the tests repeated.

F. CLEANING

1. The interior of all pipe, valves, and fittings shall be smooth, clean, and free of blisters, loose mill scale; sand, dirt, and other foreign matter when installed. Before being placed in service, the interior of all lines shall be thoroughly cleaned, to the satisfaction of the City.

G. INSULATION

1. Coordination.

   a. CONTRACTOR shall be responsible for coordinating the installation of insulation with the installation of the items or systems to be insulated. Each item or system shall be tested and accepted by CITY before installation of the insulation materials.

      CONTRACTOR shall verify that each component of the insulation systems is compatible with all other parts of the system; that all insulation materials are appropriate for the intended applications; and that all necessary devices and accessories have been provided.

      All insulation of the same class shall be the product of a single manufacturer; however, all the insulation types need not be the products of one manufacturer.

   b. At the option of the Contractor, extra strong black steel pipe in buried locations shall have exterior surfaces protected either by shop-applied plastic coating or by shop or field applied tape wrap.

2. Governing Standards

   a. Except as modified or supplemented herein, all work covered by this section shall be performed in accordance with all applicable municipal codes and ordinances, laws, and regulations. In case of a conflict between this section and any state law or local ordinance, the latter shall govern.

      All work shall comply with UL, NFPA, and ASTM safety requirements.

3. Metal Thickness

   a. Metal thickness and gages specified herein are minimum requirements. Gages refer to US Standard gage.

4. Surface Burning Characteristics

a. Insulation, jackets, tapes, and adhesives to be used indoors shall have a composite flame spread rating not to exceed 25 and a composite smoke developed rating of 50 when tested by UL 723, NFPA 255, or ASTM E84. All testing shall be done on materials of the same densities and installed thicknesses as the materials being installed. Insulation materials which have been treated with a flame retardant additive to meet the required flame spread and smoke developed ratings are not acceptable.

5. Painting and Identifications

a. Field painting and identification shall be as specified in the protective coatings section.

6. Submittals

a. A complete list of materials and catalog cuts, together with detailed specifications, materials performance data, installation instructions, parts, devices, and accessories furnished, shall be submitted in accordance with Section 01330- Submittal Procedures. Information shall include certified test results to show compliance with UL, NFPA, and ASTM safety requirements. Information shall include certified test results to show compliance with UL, NFPA, and ASTM safety requirements.

7. Manufacturer E xperience

a. A manufacturer shall have furnished material of the type specified which has been in successful operation for not less than the past 5 years.

8. Acceptable Manufacturers

a. Type PMF1 Insulation

1) Type PMF1 mineral fiber pipe insulation shall be Johns Manville "Micro-Lok", Knauf "Pipe Insulation" or Owens-Corning.

Type PMF1 pipe insulation shall be a one-piece molded glass fiber material with all-purpose jacket. The all-purpose jacket shall be factory-applied, fiberglass reinforced vapor barrier type, with white kraft bonded to aluminum foil and self sealing adhesive lap. The insulation shall be suitable for a temperature range of ooF to 850°F [-18°C to 454°C], shall have a maximum thermal conductivity (k) of 0.24 Btu in/hr ft2 oF at 75°F [0.035 W/m oc at 24°C], and shall conform to ASTM C547.

b. Type PFC1 Insulation

1) Type PFC1 flexible cellular elastomeric pipe insulation shall be Armacell "AP/Armaflex" or Nomaco K-Fiex "Insui-Tube 180" for unslit insulation and Armacell "AP/Armaflex SS" or Nomaco K-Fiex "Insui-Lock II" for factory pre-slit insulation. Flexible cellular polyolefin foam insulation shall be IMCOA "lmcolock" or" lmcoshield".

Type PFC1 pipe insulation shall be one-piece, molded elastomeric or polyolefin foam insulation suitable for a temperature range of -40°F to 21ooF [-40°C to ggoc], and shall have a maximum thermal conductivity (k) of 0.28 Btu in/hr oF at 75°F [0.040 W/m oc at 24°C]. The insulation shall be suitable for exposure to weather and direct sunlight or, where not indicated to be jacketed, shall be given two coats of an ultraviolet-resistant finish recommended by the manufacturer. The insulation shall conform to ASTM C534.

9. Accessories

a. PVC Insulation Jackets

1) PVC insulation jackets for piping systems shall be furnished and installed as specified herein and indicated on the drawings.

All fittings in piping systems insulated with mineral fiber shall be jacketed with a polyvinyl chloride (PVC) jacketing

material. Piping systems where indicated to have PVC jackets shall be jacketed with the same PVC jacketing material. Jackets for fittings shall be one piece, factory molded to the contour of the fitting. The PVC jacket and fitting covers shall have a minimum thickness of 0.020 inches [0.51 mm] when installed indoors and 0.030 inches [0.76 mm] when installed outdoors. PVC jacketing shall be Johns Manville "Zeston 2000 Series".

b. Aluminum Insulation Jackets.

1) Aluminum insulation jackets for insulated piping systems shall be furnished and installed as required and indicated on the drawings.

Fittings in insulated piping systems and equipment where indicated in the insulation schedule shall be provided with aluminum jackets of the same aluminum jacketing material as the piping systems. The aluminum jacket shall be Alclad 3004 complying with ASTM 8209. The jacket shall have a nominal thickness as required, with an embossed finish. A factory-applied asphalt and kraft paper vapor barrier or polyethylene film and kraft paper vapor barrier shall extend the full width of the jacket.

10. Installation

a. General

1) CONTRACTOR shall install all insulation materials as specified herein for the piping systems, as required, that are not factory insulated. Insulation materials shall be installed in accordance with the manufacturer's written instructions and recommendations. Surfaces to be insulated shall be cleaned and dried. All work shall be performed within the temperature ranges recommended by the insulation product manufacturer. Insulation shall be kept clean and dry and shall remain in the factory container until it is installed. Packages or factory containers shall bear the manufacturer's stamp or label

with the name of the manufacturer and description of materials.

Seams of exposed insulation and jackets shall be in the least visible location.

b. Type PMF1 Insulation

2) Pipe insulation shall be installed to cover all piping, fittings, and appurtenances. Insulation shall be full length of the factory unit using a single cut piece to complete the run. Abutting cut pieces or scraps shall not be used. End joints and longitudinal seams shall be tightly butted. Insulation for fittings shall be of the same thickness and conductivity as the adjoining pipe insulation.

Insulated piping conveying fluids at lower than ambient temperatures shall be jacketed with a continuous vapor barrier. The insulation shall be continuous through hangers and penetrations, except at firewall penetrations, and shall be sealed with vapor barrier coating. The vapor barrier coating shall be applied at intervals not exceeding 15 feet [4.6 m] for straight runs and not more that 6 inches [150 mm] from fittings. Fibrous insulation laps and butt strips that are not self-sealing shall be secured with adhesive and stapled. Staples and seams shall be coated with vapor barrier material.

On piping 2 inches [50 mm] and larger where the insulation is continuous through the hanger, an insert shall be installed between the support shield and piping. The insert shall be of the same thickness and contour as the adjacent insulation and installed to maintain a continuous vapor barrier through the support. The insert shall be constructed of wood or heavy density insulating material suitable for the system operating temperatures.

c. Type PFC1 Insulation

1) Pipe insulation shall be installed to cover all pipe, fittings, and appurtenances with all seams and joints sealed by a factory or field applied adhesive. Insulation at fittings and appurtenances shall be carefully formed and fitted. Insulation at elbows shall be mitered using segments of pipe insulation.

d. PVC Jacketing

1) PVC jacketing for piping systems shall be installed as specified herein and indicated on the drawings. End joints and longitudinal seams on piping systems conveying fluids at lower than ambient temperatures shall be vapor-sealed, and covered with vapor-barrier tape to ensure a continuous vapor seal. Fittings shall be insulated with glass fiber material.

e. Aluminum Jacketing

1) Aluminum jacketing for piping systems shall be installed as specified herein and indicated on the drawings. Jacketing shall be held in place with stainless steel securing bands uniformly spaced at not more than 18 inches [457 mm] to produce tight joints without "bulging". The jacket shall overlap at least 2 inches [51 mm] at longitudinal and circumferential joints. Joints shall be overlapped and sealed with caulk to prevent moisture penetration, and longitudinal joints shall be placed to shed water. Exposed ends of pipe insulation shall be provided with covers constructed of the same material as the jacketing.

Elbows shall be jacketed with spirally wrapped aluminum strips or individual mitered segments or gores cut to fit the insulation.

H. INSULATION SCHEDULE

INSULATION SCHEDULE				
Service	Size Inches [mm]	Mechanical Insulation		Notes
		Type	Thickness Inches [mm]	
PIPING -INDOOR (CONCEALED OR EXPOSED)				
Compressed & Booster Air	All	PMF1	1 [25]	(1)
PIPING - OUTDOOR (EXPOSED)				
Compressed Air	All	PMF1	1 [25]	(1), (4)
Mineral Oil	All	PMF1	1-1/2 [40]	
Nitrogen	Upstream of Vaporizer	See 2.02		

Mechanical Insulation Types: FC - Flexible Cellular MF- Mineral Fiber

Notes:

(1) Aluminum jacket.

(2) PVC jackets shall be provided on exposed portions of insulated piping located less than 8 feet [2.4 m] above finished floor. On all other portions of the insulated piping system PVC jackets shall be provided only for fittings.

(3) Insulation shall be provided for portions of the piping system which pass through space above finished ceilings or is exposed above equipment, electrical panels, or cabinets.

(4) Insulation shall be provided for exposed portions of the piping system located less than 8 feet [2.4 m] above the finished floor or grade.

(5) Insulation shall be provided for outside air plenums and ducts that are located upstream of the heating coil or pass through unheated spaces after the heating coil, unless indicated to be internally lined.

(6) Insulation shall be provided for outside air plenums and ducts, air conditioning supply and return ducts, and dehumidifier reactivation air discharge ducts, unless indicated to be internally lined.

(7) Insulation thickness shall be sufficient to provide a cold face temperature not to exceed 150°F [66°C].

Unless otherwise indicated in the insulation schedule, all mechanical piping, ductwork, equipment, and accessories with an operating temperature in excess of 140°F [60°C] and below 60°F [15°C] shall be insulated.

END OF SECTION

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SECTION 15071

WASTEWATER PIPING

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Installation of wastewater piping.

B. Specifications identify requirements for wastewater lines.

C. This section shall have precedence over the individual pipe material sections.

1.02 MEASUREMENT AND PAYMENT

A. No separate payment will be made for work under this section. Include payment in the Lump Sum Base Bid Price

1.03 REFERENCES

A. American Water Works Association (AWWA).

B. American National Standards Institute (ANSI).

C. American Society of Testing Materials (ASTM).

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 videotapes conforming to requirements of Section 01323 - Construction Videotapes, if applicable.

E. Submit Lone Star notification transmittal number prior to beginning excavation.

F. Submit, a minimum of 15 days before beginning pipe laying operations, layout drawing identifying proposed sections for hydrostatic testing and site

restoration for entire project for review and approval. Layout drawing to identify sequence of sections for:

1. Hydrostatic testing and transfer of services.
2. Site restoration; not to exceed limits specified; sequence in order of disturbance.

PART 2 P R 0 D U C T S

2.01 PIPE SCHEDULE

A. Pipe Designation. Following is a description of the various wastewater piping system designations.

B. Service Description (Service abbreviations as shown on drawings)

C. Nonpotable Water

1. Above Ground

a.	2-1/2 inch and smaller	Galvanized steel
b.	3 inch and larger	Ductile iron, galvanized steel

2. Buried

a.	2-1/2 inch and smaller	Galvanized steel, PVC
b.	3 inch and larger	Ductile iron, PVC, HDPE

D. D. Process Air

1. 1. Above Ground

a.	a. 2-1/2 inch and smaller	Galvanized steel
b.	b. 3 inch and larger	Galvanized steel

2. Buried-not applicable

E. Pressurized, Sewage and Sludge (5 psi and greater).

1. Above Ground

a. 2-1/2 inch and smaller Galvanized steel

F. Nonpressurized Sewage and Sludge (less than 5 psi).

1. Above Ground

a. 2-1/2 inch and smaller Galvanized steel

b. 3 inch and larger Ductile iron

2. Buried

a. 4 inch to 30 inch Ductile iron, PVC, FRP, HDPE

b. 36 inch and larger Ductile iron, PVC, FRP

2.02 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

a. If galvanized, it shall be in accordance with ASTM A53.

3. Section 02505- High Density Polyethylene (HDPE) Solid and Profile Wall Pipe

4. Section 02506 - Polyvinyl Chloride Pipe

B. Conform to American National Standards Institute/National Sanitation Foundation (ANSI/NSF) Standard 61 and have certified by an organization accredited by ANSI.

C. Type of pipe materials used is Contractor's option unless specifically identified on Drawings. Systems may only be changed for a given service when transitioning from aboveground to below ground service.

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 AWWA C605.

C. Restrained Joints where required on DIP and PVC pipe:

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.

2.04 FITTINGS

A. Steel Pipe, 2-1/2 inch and Smaller

1. Fittings for use with steel pipe with threaded joints shall be 150- pound malleable iron screwed fittings in accordance with ANSI B16.3. Provide pipe with American Standard taper pipe threads. Unions shall be 150-pound malleable iron, ground-joint unions with bronze seat.

B. Steel Pipe 3 inch to 4 inch

1. Joints

a. Unless otherwise noted, may be screwed, welded, flanged or grooved. In general, pipe three inches and over in diameter shall be flanged or grooved and pipe under three inches shall be screwed. Flanges for steel pipe with screwed joints shall be cast iron companion flanges in accordance with ANSI B16.1, Class 125. Welding flanges for steel pipe shall be steel flanges in accordance with AWWA C207, Class D, or welding slip-on flanges conforming to ANSI B16.5, Class 150, with flat face. Use welding neck type flanges on all fittings. Grooved end couplings shall be Victaulic Style 77, standard rigid, or approved substitution.

b. For Steel pipe over 4 inch Section 02502 - Steel Pipe and Fittings, shall apply.

c. Use fittings of same size as pipe they serve. Reducers are not permitted to facilitate on off-size fitting. Reducing bushings are also prohibited. Reduction in piping size will be made by reducing fittings. Fittings shall be lined and coated as specified for pipe they serve. Fittings for use with galvanized pipe shall be galvanized in accordance with ASTM A153.

2.05 Steel Pipe Coating.

A. Exterior Coating.

1. The general requirements for coatings listed in Section 02502 - Steel Pipe and Fittings, may be used, however the epoxy polyurethane coatings used shall be appropriate for wastewater service. Dry film thickness for wastewater service shall be as recommended by the coating manufacturer.

B. Internal Coating.

1. The general requirements for coatings listed in Section 02502 - Steel Pipe and Fittings, may be used, however the epoxy polyurethane coatings used shall be appropriate for wastewater service. Dry film thickness for wastewater service shall be as recommended by the coating manufacturer.

2.06 Ductile Iron Pipe Coating

A. Exterior Coating

1. Refer to Section 02501.

B. Internal Coating

1. Refer to Section 02501.

2.07 Excavation and Backfill

A. See Specification 02317- Excavation and Backfill for Utilities.

PART 3 E X E C U T I 0 N

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 9 feet minimum separation from potable water lines and sanitary sewer manholes or separation of 4 feet minimum from force mains as specified in

Section 02511 -Water Lines, 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. 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.

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 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 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. 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 Backfill for Utilities.

B. Bedding: Use bedding materials in conformance with Section 02320 - Utility Backfill Materials.

C. Backfill: Use bank run sand or earth or native soil as specified in Section 02320 - Utility Backfill Materials. Backfill excavated areas in 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 pipe 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 section 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. Perform following additional procedures when working on plant sites.

1. Seventy-two hours prior to each plant shutdown or connection, schedule coordination meeting with Project Manager and City 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 City's Wastewater Operations Division operators prior to making connections to existing piping.

5. Make connections to existing piping only when two valves are closed off between connection and source of water pressure for pressurized lines. Do not make connection relying solely on one valve, unless otherwise approved by Project Manager.

6. Excavation equipment used on plant sites to have smooth bucket; no teeth or side cutters.

7. Submit to Project Manager Lone Star Notification transmittal number prior to beginning excavation.

8. 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.

9. 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.

10. 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.

11. No night work or plant shutdown will be scheduled to begin two working days before or after designated City Holidays.

F. For tie-ins to existing lines, provide necessary material on hand to facilitate connection prior to shutting down existing line. Provide City a minimum of two weeks notice prior to shutting down existing line.

3.06 JOINTS AND JOINTING

A. Rubber Gasketed Bell-and-Spigot Joints for 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.

B. Flanged Joints where required on 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 (180E 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 (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 1-1/2-inch minimum lap is maintained. Spigot end may be miter cut to take deflections up to 5 degrees as long as joint tolerances are maintained. Miter end cuts of both ends of butt-welded joints may be used for joint deflections of up to 5 degrees.

5. Align piping and equipment so that no part is offset more than 1/8 inch. Set fittings and joints square and true, and preserve alignment during welding operation. For butt-welded joints, align abutting ends to minimize offset between surfaces. For pipe of same nominal wall thickness, do not exceed 1/16 inch offset. Use line-up clamps for this purpose; however, 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. 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.

14. 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.

15. Provide cylindrical corrosion barriers for lined steel pipe 24-inch diameter and smaller, unless minimum wall thickness is 0.5 inch 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. Restrained Joints:

1. For existing pressurized 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 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.

E. 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.

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 begin upstream and proceed downstream, with respect to normal flow of water in pipe. If installation and testing differs from this assumption, submit for approval revised method of restraining pipe joints upstream and downstream of device used to test against (block valve, blind flange or dished head plug).

C. Use adequate temporary blocking of fittings when making connections to distribution system and during hydrostatic tests. Use sufficient anchorage and blocking to resist stresses and forces encountered while tapping existing water line.

3.09 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. Immediately after transfer of services, begin abandonment of old lines and site restoration.

2. 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.

3. 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.

3.10 FIELD HYDROSTATIC TESTS

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

END OF SECTION

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SECTION 15100

MISCELLANEOUS VALVES

PART 1 G E N E R A L

1.01 SCOPE

A. This section covers all valves that are to be furnished for the services specified herein, except where specific requirements are stipulated in other sections.

1.02 MEASUREMENT AN D PAYMENT

A. No separate payment will be made for work under this section. Include payment in the Lump Sum Base Bid Price.

1.03 GENERAL

A. Basic Product Requirements

1. The Basic Product Requirements shall apply to all equipment furnished under this section.

1.04 SUBMITIALS

A. Complete specifications, data, and catalog cuts or drawings covering the items furnished under this section shall be submitted in accordance with the Section 01330- Submittals.

1. Drawings and data submitted shall include complete connection and schematic wiring diagrams for electric actuators and controls.

PART 2 P R O D U C T S

2.01 VALVE CONSTRUCTION

A. Length Tolerance

1. Unless otherwise specified, the actual length of valves shall be within plus or minus 1/16 inch of the specified or theoretical length.

B. Ends

1. Unless otherwise indicated on the drawings or specified, all 3 inch or larger buried valves shall have push-on or mechanical joint ends; all other 2-1/2 inch or larger valves shall have flanged ends; and all 2 inch or smaller valves shall have threaded, solder, or welding ends, as required for the piping system in which the valve is to be installed. Unless otherwise indicated on the drawings, flange diameter and drilling shall conform to ANSI/ASME 816.1, Class 125, or ANSI/ASME 816.5, Class 150. P ush-on and mechanical joints shall conform to ANSIIAWWA C111/A21.11. Wafer style valves shall be designed for installation between ANSI Class 125 flanges.

C. Unions

1. A union or a flanged connection shall be provided within 2 feet of each threaded end valve unless the valve can be easily removed from the piping.

D. Shop Painting

1. All ferrous metal surfaces of valves and accessories, both interior and exterior, shall be shop painted for corrosion protection. The valve manufacturer's standard paint will be acceptable, provided it is functionally equivalent to the specified paint and is compatible with the field painting specified in the protective coatings section.

a. Materials

Asphalt Varnish	Fed Spec TT-C-494
Medium Consistency	Carboline "Kop-Coat Bitumastic
Epoxy Enamel	
For Liquid Service	Ameron "Amerlock 400 High-Solids Epoxy Coating", Carboline "Kop-Coat Super Hi-Gard 891", or Tnemec "Series 140 Pota-Pox Plus"
Rust-Preventive Compound	Houghton "Rust Veto 344"

b. Surfaces To Be Painted

Unfinished Surfaces		
Interior Surfaces		
For Liquid Service	Asphalt varnish (two coats) or epoxy	
Exterior Surfaces of	Universal primer	
All Other Valves		
Polished or Machined Surfaces		Rust-preventive compound
Actuators and Accessories	Universal primer	

2.02 MANUAL ACTUATORS

A. All valves, except those which are equipped with power actuators or are designed for automatic operation, shall be provided with manual actuators. Unless otherwise specified or indicated on the drawings, each manual actuator shall be equipped with an operating handwheel.

B. Chainwheels

1. Unless specifically required to be equipped with other types of actuators, all valves with center lines more than 7'-6" above the floor shall be provided with chainwheels and operating chains. Each chainwheel operated valve shall be equipped with a chain guide which will permit rapid handling of the operating chain without "gagging" of the wheel and will also permit reasonable side pull on the chain. Suitable actuator extensions shall be provided, if necessary, to prevent interference of chain and adjacent piping or equipment. Operating chains shall be hot-dip galvanized carbon steel and shall be looped to extend to within 4 feet of the floor below the valve.

C. Wrench Nuts

1. Wrench nuts shall be provided on all buried valves, on all valves which are to be operated through floor boxes, and where indicated on the drawings. Unless otherwise directed by the City, all wrench nuts shall comply with Section 3.16 of AWWA C500. At least two operating keys shall be furnished for operation of the wrench nut operated valves.

D. Rotation

1. Unless otherwise required by the City, the direction of rotation of the wheel, wrench nut, or lever to open the valve shall be to the left (counterclockwise). Each valve body or actuator shall have cast thereon the word "Open" and an arrow indicating the direction to open.

2.03 NUMBER PLATES

A. Each valve covered by this section which has been assigned a number on the drawings shall be provided with a number plate mounted on or adjacent to the valve in a manner acceptable to the City. Number plates shall be aluminum with engraved letters at least 3/4 inch high. Letters shall be painted black after fabrication.

2.04 CHECK VALVES

A. Check valves sized 3 through 12 inches, which are installed in water pump discharge or other clear water service piping with a working pressure of 200 psi or less, shall be wafer style designed for installation between two pipe flanges and shall be Marlin "Wafer Check A125HZNSF", Stockham "WG-970", Mission "Duo-Chek II Figure 12HMP", or Valve and Primer "9000AR1F". Each check valve shall have a cast iron body; bronze plates; stainless steel springs, hinge pins, and stops; Teflon spring and hinge bearings; and standard trim for IBBM construction. All wetted aluminum bronze valve components shall be heat treated in accordance with Section 2.2 of AWWA C504 to inhibit dealuminization.

B. Unless otherwise specified, check valves 2 inches and smaller in water, or other liquid piping shall be Class 125 or higher, all bronze, Y-pattem, regrinding, horizontal swing type. Threaded end valves shall be Stockham "B-321" or Walworth "Fig 3406". Soldered end valves shall be Nibco "S-413-B" or Walworth "Fig 3046SJ".

C. All 2 inch and larger check valves in air shall be Techno Corporation "Technocheck Silent Seatless Check Valves", or equal.

2.05 BALL VALVES

A. Unless otherwise indicated or specified, all 2-1/2 inch and smaller shutoff valves shall be ball valves.

B. Two inch and smaller ball valves for water service shall be of bronze or brass construction with two-piece end entry body, bronze or brass ball, Teflon or Viton stem seal, reinforced Teflon seats and thrust washer, a removable operating lever, and threaded ends. Each ball valve in gauge isolation service shall be furnished with a round handle. Valves shall be rated not less than 500 psi nonshock cold WOG and shall be driptight in both directions. Valves shall be Conbraco Industries "Apollo70-100 Series", Poweii"Fig 4210T", or Stockham "S-216".

C. Ball valves for water service in 2-1/2 inch size shall be ANSI Class 150 regular port valves with split ductile iron body, hard chrome-plated carbon steel ball, reinforced Teflon seats, 0-ring or adjustable chevron stem packing, a removable operating lever, and flanged ends. Flange diameter and drilling shall conform to ANSIIASME B16.5, Class 150. Valves shall be driptight in both directions and shall be Conbraco Industries "Apollo 88- 209" or Balon "Series F" ball valves.

D. Ball valves 2 inches and smaller for welded steel piping systems shall be of three-piece design, with carbon steel body and end caps, nickel-plated or hard chrome-plated carbon steel ball and stem, Teflon seats and seals, socket-weld ends, and a removable operating lever. Socket-weld ball valves shall be rated at least 800 psi nonshock cold WOG and shall be Conbraco Industries "Apollo 83-200 Series", Contromatics "C-1122-BB-DL", or Neles-Jamesbury "4C2200TT".

E. Ball valves 2-1/2 through 4 inches for welded steel piping systems shall be of three-piece design, with carbon steel body and end caps, nickel-plated or hard chrome-plated carbon steel ball and stem, Teflon seats and seals, buttwelding ends, and a removable operating lever. Buttwelding end ball valves shall be Contromatics "C-1133-BB-DL".

F. Ball valves for dewatered cake services in 12 inch size shall be ANSI B16.34 full port valve with carbon steel body, stainless steel (316) valve stem, trunnion stem, and ball, nylor or reinforced Teflon seat rings inserts, cast iron gear operating housing, cast iron or aluminum bronze gear, tool steel worm, and flanged ends. The valve shall be also be a non-lubricated valve, designed for dirty service (high solids applications for biosolids. The valve shall be Neles-Jamebury Series 5305 or City approved equal. The valves shall be rated for a maximum working pressure of 450 psi.

2.06 BUTTERFLY VALVES

A. Unless otherwise specified, butterfly valves shall be of the rubber-seat, tight-closing type. Except where other types are specified, butterfly valves shall be wafer type. Valve discs shall seat at 90 degrees with the pipe axis.

B. Flanged end valves shall be of the short-body type. Where mechanical joint ends are specified, either mechanical joint or push-on ends conforming to ANSI/AWWA C111/A21.11 will be acceptable. For buried or submerged service, shaft seals shall be 0-ring type.

C. Each valve shall be provided with an actuator having a torque capability sufficient to seat, unseat, and maintain intermediate positions under the operating conditions specified herein. Lever actuators may be furnished for 6 inch and smaller valves, except where chainwheel actuators are required. All 8 inch and larger valves shall have enclosed geared, handwheel or chainwheel actuators with position indicator. Actuators shall be designed to produce the rated torque with a maximum pull of 80 pounds on the lever or wheel.

D. Each valve actuator shall have a valve disc position indicator mounted on the end of the valve shaft. A disc position indicator shall also be provided on each operating stand or the actuator mounted thereon.

E. Air Service Valves

1. Butterfly valves in air piping shall be industrial valves suitable for 15 psi air service, a maximum air velocity of 100 fps, and an operating temperature of 225°F.

2. Materials of construction shall be as follows:

Body	Cast iron
Shaft	AISI Type 316 stainless steel
Disc	Bronze, or cast iron with corrosion-resistant metal plating
Seat	EPDM, or other elastomer with suitable temperature rating

Shaft Bearings	Upper and lower bearings or two upper bearings, bronze or reinforced Teflon
Shaft Seal	Synthetic rubber rings with suitable pressure and temperature rating

2.07 THROTTLING VALVES

A. Angle Valves

1. Angle valves shall be furnished where indicated or specified and may also be used as throttling valves for air or water service.

2. Two inch and smaller angle valves for water service shall be Class 125 valves with bronze body, seat, and disc; screwed bonnet; rising stem; Teflon impregnated packing; and threaded ends. Valves shall be Milwaukee "504", Stockham "8-216", or Walworth "Fig 3059".

3. Angle valves for water service in 2-1/2 inch and larger sizes shall be of cast iron construction with bronze trim, bolted bonnet, outside screw stem and yoke, Teflon impregnated packing, and flanged ends. Flanges shall be flat faced with ANSI/ASME 816.1, Class 125 diameter and drilling. V alves shall be Powell "Fig 1254" or Walworth "Fig 8907F".

B. Globe Valves

1. Globe valves shall be furnished where indicated or specified and may also be used as throttling valves for air or water service.

2. Two inch and smaller globe valves for water service shall be Class 125 valves of bronze construction with bronze seat and disc, screwed bonnet, rising stem, and Teflon impregnated packing. Threaded end valves shall be Milwaukee "502", Stockham "8-16", or Walworth "Fig 3058". Soldered end valves shall be Milwaukee "1502" or Stockham "8-17".

3. Globe valves for water service in 2-1/2 inch and larger sizes shall be of cast iron construction with bronze trim, bolted bonnet, outside screw stem and yoke, Teflon impregnated packing, and flanged ends. Flanges shall be flat faced with ANSI/ASME 816.1, Class 125 diameter and drilling. Valves shall be Milwaukee "F2981", Powell "Fig 1253", or Walworth "8096F".

PART 3 E X E C U T I O N

3.01 INSTALLATION

A. Each unit shall be leveled, plumbed, and aligned. Installation procedures shall be as recommended by the equipment manufacturer and as specified herein.

END OF SECTION

SECTION 15101

VALVES AND GATES FOR PUMP STATION

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Valves, gates and accessories for exposed, submerged and other types of piping for pump station.

1.02 MEASUREMENT AND PAYMENT

A. Unless noted in the Bid Forms, no separate payment will be made for Work under this Section. Include payment for applicable work as noted on the Bid Forms.

B. Refer to Section 01270 – Measurement and Payment

1.03 REFERENCES

A. ANSI B16.1 - Cast Iron Pipe Flanges and Flanged Fittings.

B. AWWA C509 - Resilient Seated Gate Valves.

C. AWWA C508 - Check Valves.

D. AWWA C500 - Gate Valves.

E. ASTM A126 - Gray Iron Castings for Valves, Flanges, and Pipe Fittings.

F. ASTM A395 - Ductile Iron Castings.

G. ASTM A48 - Gray Iron Castings.

H. ASTM A193 - Alloy-Steel and Stainless Steel Bolting Materials for High Temperature Service.

I. ASTM A194 - Carbon and Alloy Steel Nuts for Bolts for High Pressure and High Temperature Service.

1.04 QUALITY ASSURANCE

A. Manufacturer's Qualifications

1. Valves and appurtenances provided under this Section shall be the standard product in regular production by manufacturers whose products have proven reliable in similar service for at least 5 years.

2. Insofar as possible all valves of the same specific type shall be the product of one manufacturer.

1.05 SUBMITTALS

A. Submit shop drawings and product data under provisions of Sections 01330 - Submittal Procedures and 15050 - Basic Mechanical Materials and Methods.

B. Shop Drawings

1. Submit for review detailed drawings, data and descriptive literature on valves and appurtenances, including:

a. Dimensions.

b. Size.

c. Materials of construction.

d. Weight.

e. Protective coating.

f. Actuator weight, where applicable.

g. Calculations for actuator torque, where applicable.

h. Wiring diagram, where applicable.

2. Submit manufacturer's valve sizing calculations for verification of sizing for air release valves, air and vacuum valves, and surge relief valves.

C. Manufacturer's Certifications

1. Submit manufacturer's certificates of compliance with ANSI, AWWA and other listed standards.

1.06 OPERATION AND MAINTENANCE DATA

A. Submit operation and maintenance data under provisions of Section 01730 - Operations and Maintenance Data.

B. Submit a detailed operation and maintenance manual for valves and appurtenances provided under this Section.

1.07 DELIVERY, STORAGE AND HANDLING

A. Have products delivered, stored and protected under provisions of Section 01610 - Basic Product Requirements.

B. Store valves and appurtenances off the ground in enclosed shelter.

PART 2 P R O D U C T S

2.01 BASIC REQUIREMENTS

A. Mark and identify valves in conformance with standards, these Specifications or to the manufacturer's standard.

B. Bolts, studs and nuts to be Type 316 stainless steel.

C. End connections of valves shall be flanged and drilled to ANSI Class 125 unless otherwise specified.

D. For handwheel operators on valves 4-inches or larger where located more than 5 feet above the operating floor, provide chain and chainwheel or extension operators. Use chainwheels fabricated of malleable cast iron with chain guides. Provide stainless steel chains of a length to extend to within 5 feet of the operating floor.

E. To exterior surfaces of valves, apply a shop coating in accordance with Section 09900 - Painting.

2.02 CHECK VALVES

A. Swing check valves 4-inches through 14-inches having a system pressure 30 psi or less, shall be air cushioned with side mount lever and weight. The valve shaft shall extend through both sides of the body with minimum shaft diameters equal to APCO Series 6000. The cushion shall be totally enclosed, swivel mounted at the bottom, and equipped with a micrometer air control valve and air breather filters. Valves shall be similar to APCO Series 6000, or approved equal.

B. Swing check valves 10-inches through 14-inches having a system pressure greater than 30 psi shall be cushioned with side mount lever and weight. Valves shall be similar to APCO Series 6100, or approved equal.

C. Swing check valves 16-inches and larger regardless of system operating pressure shall be cushioned with side mount lever and weight. Valves shall be similar to APCO Series 6100, or approved equal.

D. Check valves of special design utilizing controlled closing of the disc, such as APCO Series 6000B (Bottom-Buffer) and Golden Anderson Fig. #25-DXH or approved equal shall be used when specifically indicated on the Drawings. These valves are special valves used to control the surge pressure in the force main upon multiple pump shutdown during a power failure. Other surge control check valves utilizing ball or cone valve and power cylinder operator may also be used as approved by the City Engineer.

E. All check valves shall have 300 series stainless steel hinge shafts, stainless steel body seats and stainless steel resilient seat retainer rings.

2.03 GATE VALVES

A. Gate valves 4 inches through 14 inches: Solid wedge type, with resilient nitrile rubber (Buna- N) tapered seat. Provide valves complying with AWWA C-509. Acceptable manufacturers include Mueller, M&H, AVK, or approved equal.

B. Gate valves 16 inches and larger: Solid wedge type with bronze to bronze seating surface. Provide valves complying with the AWWA C-500. Acceptable manufacturers include Mueller, M&H, AVK, or approved equal.

C. Supply gate valves rated as 200 psi water working pressure with 400 psi hydrostatic test for structural soundness for 2 inches through 12 inches and 150 psi water working pressure with 300 psi hydrostatic test for structural soundness for sizes 14 inches through 30 inches.

D. Stems: OS&Y rising type manganese bronze having a minimum tensile strength of 60,000 psi, a minimum yield strength of 20,000 psi for valve sizes through 24 inches, and a minimum tensile strength of 80,000 psi, a minimum yield strength of 32,000 psi for valve sizes 30 inches and larger.

E. Valve Bodies: Cast iron conforming to ASTM A126 or ASTM A395. Fabricate internal trim parts of 300 series stainless steel.

2.04 ECCENTRIC PLUG VALVES

A. Eccentric plug valves shall be the non-lubricated eccentric type with cast iron bodies, resilient-faced plugs or replaceable resilient seats in the bodies.

B. Operators: All valves for 4-inch and larger service shall have worm gear operators, nickel or stainless steel seats, and ANSI 125 psi flanged ends. Operators shall clearly indicate valve position. Operators on valves in submerged or buried service shall be lubricated and sealed to prevent entry of dirt and water into the operator.

C. Relisient facing shall be suitable for the intended service.

D. All shaft bearings shall be of stainless steel, furnished with permanently-lubricated bearing surfaces.

E. Valves up to and including 20 inches in size shall have an unobstructed port area of no less than 80 percent of the full pipe area, and not less than 70 percent for larger valves.

F. Eccentric plug valves shall be manufactured by Clow, De Zurik, Keystone, Val-Matic, or Victualic.

2.05 SEWAGE AIR RELEASE AND SEWAGE AIR AND VACUUM VALVES

A. Air Release and Air and Vacuum Valves: Provide when shown on Drawings.

B. Sewage Air Release Valve Design: Single float, single orifice, float operated with a compound lever mechanism to automatically release accumulated air and gases while the system is pressurized and operating.

C. Sewage Air and Vacuum Valve Design: Two float where the top float shuts off against the seat due to the lifting force of the bottom float as liquid enters the valve body. Once closed and pressurized the air and vacuum valve will not open to release air.

D. Fabricate valve body, cover and baffles of cast iron. Fabricate internal metal parts of stainless steel. Make valve seat of Buna-N nitrile rubber.

E. Fit valve with blow off valves, quick disconnect couplings and minimum 6-feet of hose to permit back flushing after installation with dismantling valve.

F. Provide air release valves equal to Series 400/450 SARV by APCO or Figure 925 by G.A. Induries.

G. Provide air and vacuum valves equal to Series 400 SARV by APCO. Figure 935 as manufactured by GA Industries, or Val-Matic.

2.06 SURGE RELIEF VALVES

A. Surge Relief Valves: Provide when shown on Drawings.

B. Operation: Surge relief valves shall protect piping systems from surges by opening quickly at a set pressure and throttling the flow to maintain line pressure at no more than 5 to 10 percent above the pressure setting indicated. Provide relief pressure adjustment by changing the tension on a spring holding the valve disc on its seat.

C. Valve Closing Control: By oil dashpots. Oil shall be drawn into the dashpot from a reservoir when the valve opens and return through a flow control valve when the relief valve closes.

D. Valve Construction: Fabricate valve bodies of cast iron with 300 series stainless steel seat rings. Provide seats that are renewable and resilient. Fabricate hinge shafts of stainless steel and the oil system of bronze. Unless otherwise indicated make the pressure setting 5 percent above normal line pressure.

E. Provide surge relief valves that are 90-degree elbow body configuration. Acceptable manufacturers include APCO series 3000, GA Industries 625-D, or approved equal.

PART 3 E X E C U T I O N

3.01 INSTALLATION

A. Install valves and specialties in accordance with manufacturer's written instructions to permit intended performance.

B. Support and anchor valves and gates in accordance with Section 15140 - Pipe Hangars, Supports and Restraints.

C. Eccentric plug valves shall be installed according to the following:

1. Position the valves with the stem in the horizontal direction.

2. In horizontal pipelines, position the vales so that the plug swings upward when opening to permit flushing of solids.

3. Orient the vales to prevent the valve bodies from filling up with solids when closed; however, orient the valves such that the pressure

differential forces the plug against the seat in cases where the pressure differential across a closed valve will exceed 25 psi.

3.02 PAINTING

A. Paint valves and specialties in accordance with applicable AWWA standards and with Section 09901 - Protective Coatings.

3.03 TESTING

A. Test valves using a hydrostatic pressure test in accordance with AWWA C-600.

B. Test valves and specialties in place. Correct defects in valves, specialties or connections.

END OF SECTION

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SECTION 15105

PIPE AND PIPE FITTINGS- GENERAL

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Requirements for pipe and pipe fittings for all sections of Division 15 - Mechanical which employ pipe and pipe fittings.

1.02 MEASUREMENT AND PAYMENT

A. No separate payment will be made for work under this section. Include payment in the Lump Sum Base Bid Price.

1.03 QUALITY ASSURANCE

A. Employ welders certified in accordance with applicable portions of Section IX, ASME Boiler and Vessel Code, or ASA Code for Pressure Piping.

B. Employ welders qualified to perform welding operations required either by certifications or by submitting to required tests.

C. Welds shall be wire brushed after completion, coated with rust inhibitor paint and, on galvanized pipes, given two coats of cold-applied galvanizing compound and one coat of aluminum paint.

1.04 SUBMITTALS

A. Submittals shall be in accordance with Section 01330 and the requirements below.

B. Submit manufacturer's product data showing compliance with requirements of Part 2.

PART 2 P R O D U C T S

2.01 PIPE AND FITTINGS

A. The particular type of pipe and fittings for each system is specified in the section on that system.

2.02 JOINTS

A. The particular type of joint for each system is specified in the section on that system.

2.03 BRANCH CONNECTIONS

A. For Pipe 2 Inches and Smaller. For threaded piping, use straight reducing tee. When branch is smaller than header, a nipple and reducing coupling or swaged nipple may be used.

B. For 2-1/2 Inches Through 36 Inches. For welding piping, when branch size is the same as header size, use welding tee. Use Weldolet when branch is smaller than header. For threaded branch connections, use 3000-pound full coupling welded to header.

2.04 GASKETS

A. High Temperature Piping. Provide 1/16-inch-thick ring Graph-Lock gaskets of flexible graphite with 316 stainless steel Tanged core in the center, such as Garlock No. 3125TC or approved substitution.

B. Other Piping (Chilled, Hot and Domestic Water Only). Provide 1/16-inch- thick ring gaskets of synthetic fiber, Garlock Style 3400 or approved substitution.

2.05 FLOOR AND CEILING PLATES

A. Provide escutcheons on all exposed pipes passing through floors, walls, floors and ceiling. Material shall be chrome-plated steel. Flange size shall be as necessary to cover penetrating openings. Plate size shall be as necessary to fit pipe or insulation and securely lock in place. Manufacturer/model shall be by Engineered Brass Company, Type CF, or approved substitution.

2.06 PIPE SUPPORTS

A. Refer to Section 15140, Pipe Hangers, Supports, and Restraints.

2.07 PIPE SLEEVES

A. Sleeves below grades in outside walls are detailed on drawings. Provide Thunderline Link-Seal with cadmium-plated nuts and bolts, with cast iron pressure plate.

2.08 PIPE GUIDES

A. Provide ADSCO Model H pipe alignment guides for uninsulated pipe or for insulated hot lines. Provide RS or RC spider as indicated or required. Use ADSCO Model E1 for cold insulated lines. Provide ADSCO or approved substitution.

2.09 FIRESTOPPING

A. Voids between sleeves or core-drilled holes and pipe passing through fire rated assemblies shall be firestopped to meet the requirements of ASTM E 814, in accordance with Section 07840, Firestopping. Contractors shall provide proper sizing when providing sleeves or core-drilled holes to accommodate their through-penetrating items.

PART 3 E X E C U T I O N

3.01 PREPARATION

A. Ream pipe and tube ends to remove burrs.

B. Remove scale and dirt on inside and outside before assembly.

3.02 PIPE FABRICATION AND INSTALLATION

A. Make piping layout and installation in the most advantageous manner possible with respect to headroom, valve access, opening and equipment clearance, and clearance for other work. Give particular attention to piping in the vicinity of equipment. Preserve the maximum access to various equipment parts for maintenance.

B. Do not cut or weaken any structural member.

C. Cut all pipes accurately to measurement determined at the site. After cutting pipe, ream it to remove burrs.

D. Install piping neatly, free from unnecessary traps and pockets. Work into place without springing or forcing. Use fittings to make all changes in direction. Field bending and mitering are prohibited. Make all connections to equipment using flanged joints or unions. Make reducing connections with reducing fittings only.

3.03 WELDING

A. Weld and fabricate piping in accordance with ANSI Standard B31.1, latest edition, Code for Pressure Piping by using a metallic arc welding process. Machine beveling in shop is preferred. Field beveling may be done by flame cutting to recognized standards. Conform to the current recommendations of the American Welding Society for all welding operations.

B. Align piping, fittings and equipment so that no part is offset more than 1/16 inch. Set all fittings and joints square and true, and preserve alignment during welding operation. Use of alignment rods inside pipe is prohibited.

C. Do not permit any weld to project within the pipe in excess of 1/16 inch so as to restrict it. Tack welds, if used, must be of the same material and made by the same procedure as the completed weld. Otherwise, remove tack welds during welding operation.

D. Do not split, bend, flatten or otherwise damage piping before, during or after installation.

E. Remove dirt, scale and other foreign matter from inside piping before tying in sections, fittings, valves or equipment.

F. Nondestructive examination of welds will be conducted at Owner's direction using radiography. Acceptable welds will not display any imperfections as indicated in Table 136.41 of Power Piping Code B31.1 1986.

3.04 OFFSETS AND FITTINGS

A. Because of the small scale of drawings, the indication of all offsets and fittings is not possible. Carefully investigate the structural and finish conditions affecting the work and take such steps as may be required to meet such conditions.

B. Install all piping close to walls, ceilings and columns so piping will occupy the minimum space. Provide proper space for covering and removal of pipe, special clearances, and for offsets and fittings.

3.05 SECURING AND SUPPORTING

A. Support piping adequately to maintain line and grade, with due provision for expansion and contraction. Use hangers as scheduled in Section 15140, Pipe Hangers, Supports, and Restraints, properly connected to structural members

of the building. All hangers and supports shall be in accordance with the American Standard Code for Pressure Piping, ANSI B31.

B. Use copper hangers with copper pipe. As an alternate, tape copper pipe at all points contacting steel hangers, structural members or sleeves. Use a dual wrap of polyvinyl tape.

C. Place hangers not more than 6 feet apart for all sizes of polyvinyl chloride pipe, not more than 5 feet on bell-and-spigot (adjacent to each joint), and not more than 4 feet apart on no-hub piping (adjacent to each joint). Place a hanger within 12 inches of each horizontal elbow.

D. Support vertical risers with steel strap pipe clamps of approved design and size, properly supported at every floor. Support piping assemblies in chases adequately enough to be rigid and self-supporting before the chase is closed. Provide adequate structural support for piping penetrating chase walls to fixtures.

E. Support piping from walls with welded steel bracket and wrought steel clamp. For hot pipes, furnish adjustable steel yoke and cast-iron rollers.

F. Where insulation occurs, design hangers to protect insulation from damage. Pipe saddles and insulation shields, where required, are specified in the appropriate insulation section.

G. Perforated bar hangers, straps, wires or chains are not permitted. Plastic support brackets as manufactured by P & M Company may be used in accordance with the manufacturer's recommendations.

3.06 ANCHORS

A. Provide anchors as indicated or required. All anchors shall be in accordance with the American Standard Code for Pressure Piping, ANSI B31. Use pipe anchors consisting of heavy steel collars with lugs and bolts for clamping to pipe and attaching anchor braces. Install anchor braces in the most effective manner to secure desired results. Do not install supports, anchors or similar devices where they will damage construction during installation or because of the weight or the expansion of the pipe.

3.07 PIPE SLEEVES

A. Fit all pipes passing through masonry and concrete construction above grade with sleeves of 20 or 22 gauge galvanized steel pipe. Size sleeve for minimum

clearance between pipe or insulation and sleeve. Use galvanized or black steel pipe for passing through fire-rated enclosures.

B. Extend each sleeve through the floor or wall. Cut the sleeve flush with each surface, except that in exposed locations, extend floor sleeves 3 inches above finished floor line.

C. Caulk all sleeves water and airtight. Seal annular space between pipes and sleeves with firestopping compound.

3.08 PIPE GUIDES

A. Guide expansion joints with two guides on the side opposite the anchor.

B. Guide pipe installed and supported by Unistrut supports using a duplicate set of pipe rolls on the top of the pipe.

C. Guide piping in vertical chases at a maximum guide spacing of 15 feet.

D. All guides shall be in accordance with the American Standard Code for Pressure Piping, ANSI B 31.

3.09 ISOLATION VALVES

A. Provide piping systems with line size shutoff valves located at the risers, at main branch connections to mains for all equipment, and at other locations as indicated and required.

3.010 . DRAIN VALVES

A. Install drain valves at all low points of water piping systems so that these systems can be entirely drained. Install a 2 inch drain for 2 inch pipes and larger. Install a line size drain valve for pipes smaller than 2 inches.

3.011 CLEANING OF PIPING SYSTEMS

A. Clean piping systems thoroughly. Purge pipe of construction debris and contamination before placing the systems in service. Provide whatever temporary connections are required for cleaning, purging and circulating.

B. Install temporary strainers in front of pumps, tanks, water still, solenoid valves, control valves, and other equipment where permanent strainers are not

indicated. Keep these strainers in service until the equipment has been tested, then remove either entire strainer or straining element only. Fit strainers with a line size blowoff valve.

C. Special cleaning requirements, if any, are specified in the sections on each type of piping.

3.012 COATING AND WRAPPING

A. Refer to Section 02527- Polyurethane Coating on Steel or Ductile Iron Pipe, or Section 02528 - Polyethylene Wrap.

END OF SECTION

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SECTION 15110

VALVES, STRAINERS AND VENTS- GENERAL

PART 1 GENERAL

1.01 SECTION INCLUDES

A. General requirements which apply to all applicable Division 15 sections.

1.02 MEASURMENT AND PAYMENT

A. No separate payment will be made for work under this section. Include payment in the Lump Sum Base Bid Price.

1.03 SUBMITTALS

A. Submittals shall be in accordance with Section 01330. Submittals shall verify the requirements of applicable specifications.

PART 2 P R OD U C T S

2.01 VALVE DESIGN

A. Provide valves designed for repacking under pressure when fully opened, equipped with packing suitable for intended service, equipped with gland followers, and having pressure/temperature rating not less than design criteria applicable to components of system. Provide packing of molded non-asbestos. Perform shell and seat tests and stamp valve to show that tests have been successfully completed. Provide valves conforming to following specifications:

Material	**Specifications**
Bronze - 150 psi maximum	ASTM B 62
Bronze - 300 psi maximum	ASTM B 61
Cast Iron	ASTM A 126, Class B

Carbon Steel, Cast	ASTM A 216, Grade WCB
Carbon Steel, Forged	ASTM A 105, Grade II

2.02 VALVE OPERATORS

A. Provide valve operator type indicated on the drawings.

B. Chain Operator. Furnish chain wheel of cast iron or malleable iron and designed to provide positive grip on wheel, if applicable. Provide chain guide to prevent chain from slipping or jumping on wheel. Employ rust-proof chain complete with closing link of sufficient length to operate at 6 feet 6 inches above floor level.

2.03 VALVE BOXES

A. Employ cast iron boxes, extension type with screw or locking slide adjustment, and flared base. Minimum thickness of metal shall be 3/16 inch. Install boxes over each underground valve. Use covers with appropriate cast-in identification of service.

2.04 VALVE TAGS

A. Furnish valves with 1 1/2-inch diameter brass valve tag with stamped and red-filled numbers. Service designations shall be 1/4-inch letters, and valve numbers shall be 1/2-inch letters. Service designations shall be approved by Engineer. Secure tags to valves by use of brass "S" hooks and brass chain. Secure chain to valve by use of copper or monel meter seals. Mount charts and drawings listing functions of each valve and its location in a metal frame and behind glass placed as directed. In addition on the record drawings, mark the symbols and furnish a valve schedule properly identifying the valve number and service with the exact location, the material being piped, and the room number of area that the valve services. This schedule shall be furnished on reproducible drafting paper or film suitable for reproduction on an Ozalid machine. The size of drafting paper shall be approved by the Owner.

2.05 STRAINERS

A. Unless specified or shown otherwise, provide strainers ahead of tanks, traps, pumps, solenoid and control valves and other equipment indicated on drawings. Furnish "Y" or 'T" pattern strainers. Arrange cap for easy removal of screen and provide with opening for blowout. Provide strainer with blowout nipple and plug valve of same size as blowout connection, and pipe to nearest floor or hub drain.

2.06 WATER SYSTEM AIR VENTS

A. Use Clark No. 045V venting traps at high points and at any other air pockets of closed circulating pipe systems. E xtend 1/2-inch discharge drains to nearest floor or hub drain, or air handling unit condensate drain pan. Place a gate valve between air vent and piping system.

PART 3 E X E C U T I 0 N

3.01 INSTALLATION

A. Install valves and stops in accessible locations; provide where shown or as required to make systems complete and readily maintained.

B. Provide valves at each piece of equipment to provide for isolation of the equipment from its connected system.

END OF SECTION

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SECTION 15115

RESILIENT SEATED BUTTERFLY VALVES FOR AIR SERVICE

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Butterfly valves used for isolation purposes on air mains and pipes.

1.02 MEASUREMENT AND PAYMENT

A. Unless noted in the Bid Form, no separate payment will be made for work under this section. Include the cost for this work in the lump sum base bid.

B. Refer to Section 01270 – Measurement and Payment

1.03 REFERENCES

A. ANSI B16.1 - Cast Iron Pipe Flanges and Flanged Fittings.

B. ANSI B 16.5 – Steel Pipe Flanges and Flanged Fittings.

C. AWWA C504-10 – Rubber-Seated Butterfly Valves, 3in. (74mm) through 72in. (1800mm).

D. ASTM A126 - Gray Iron Castings for Valves, Flanges, and Pipe Fittings.

E. ASTM A536 Grade 65-45-12 - Ductile Iron Castings.

F. ASTM A193 - Alloy-Steel and Stainless Steel Bolting Materials for High Temperature or High Pressure Service and other Special Purpose Applications.

G. ASTM A194 - Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or both.

H. MSS SP-67 Butterfly Valves.

1.04 QUALITY ASSURANCE

A. Manufacturer's Qualifications

1. Valves and appurtenances provided under this Section shall be the standard product in regular production by manufacturers whose products have proven reliable in similar service for at least 5 years.

2. Insofar as possible all valves of the same specific type shall be the product of one manufacturer.

3. The manufacturer furnishing the valves under the specification shall be prepared to show proof that the valves provided meet the design requirements of AWWA Standard C504.

1.05 SUBMITTALS

A. Submit shop drawings and product data under provisions of Sections 01330 - Submittal Procedures and 15050 - Basic Mechanical Materials and Methods.

B. Shop Drawings

1. Submit for review detailed drawings, data and descriptive literature on valves and appurtenances, including:

a. Dimensions.

b. Size.

c. Materials of construction.

d. Weight.

e. Protective coating.

f. Actuator weight, where applicable.

g. Calculations for actuator torque, where applicable.

h. Wiring diagram, where applicable.

C. Manufacturer's Certifications

1. Submit manufacturer's certificates of compliance with ANSI, AWWA and other listed standards.

1.06 OPERATION AND MAINTENANCE DATA

A. Submit operation and maintenance data under provisions of Section 01730 - Operations and Maintenance Data.

B. Submit a detailed operation and maintenance manual for valves and appurtenances provided under this Section.

1.07 WARRANTY

A. Warranties shall conform to requirements of 00700 – General Conditions.

1.08 DELIVERY, STORAGE AND HANDLING

A. Have products delivered, stored and protected under provisions of Section 01610 - Basic Product Requirements.

B. Store valves and appurtenances off the ground in enclosed shelter.

PART 2 P R O D U C T S

2.01 BASIC REQUIREMENTS

A. Mark and identify valves in conformance with standards, these Specifications or to the manufacturer's standard.

B. Bolts, studs and nuts to be Type 316 stainless steel.

C. End connections of valves shall be flanged and drilled to ANSI Class 125 unless otherwise specified.

D. To exterior surfaces of valves, apply a shop coating in accordance with Section 09900 - Painting.

2.02 RESLIENT SEATED BUTTERFLY VALVES

A. Butterfly valves shall be of the wafer body style in sizes 12” and smaller and the flanged body style in 24” and larger. All valves shall be suitable for installation between ANSI class 125 or 150 flanges.

B. Wafer Style (12” and smaller):

1. Pressure ratings shall be bi-directional bubble-tight shutoff at pressures to 150 psi with testing per MSS-SP67 requirements. Valves shall be proof-of-design tested to 10,000 cycles per AWWA C504 standards.

2. Bodies shall be cast iron and shall have four flange bolt guides to center the body in the pipeline. Face-to-face dimensions shall be in accordance with MSS-SP-67.

3. Discs shall be ductile iron with nickel plating.

4. Shafts shall be one-piece 416 stainless steel. Shaft shall be firmly attached to the disc utilizing solid pins. Multiple shaft seals shall be provided to prevent leakage.

5. Elastomer seats shall fully line the valve body and be permanently bonded to a replaceable cartridge. Seats shall be EPDM and shall have integral flange seals so flange gaskets are not required.

6. Three shaft bearings made of heavy-duty fiberglass reinforced PTFE shall be provided to ensure smooth, reliable valve operation.

7. Lever operators shall provide automatic, positive latching in the open, closed and eight intermediate positions on 6” and smaller valves unless otherwise specified or shown on the drawings.

8. Gear actuators with hand wheels shall be provided on valves 8” and larger unless otherwise specified or shown on the drawings. Actuators shall have cast iron weatherproof construction, and shall have adjustable open and closed position stops.

9. 2” Nut adaptors for operation with tee wrenches shall be furnished in lieu of levers where shown on the plans.

10. Wafer resilient seated butterfly valves shall be model BOS-US as manufactured by DeZURIK or pre-approved equal.

C. Flanged Style (24” and larger):

1. Butterfly valves 24 inch and larger shall meet or exceed the requirements of the latest revision of AWWA Standard C504, including shop testing requirements. All valves shall comply with the requirements of the AWWA class specified or if the AWWA class is not specified, the valve shall meet the requirements of AWWA C504 class 150B.

2. Valve bodies shall be cast iron per ASTM A126 Class B. Flanged end valves shall be of the short body design with 125 lb. flanged ends

faced and drilled per ANSI B16.1 standard for cast iron flanges. Mechanical joint ends shall meet the requirements of AWWA C111/ANSI A21.11.

3. Discs shall be offset to provide an uninterrupted 360 degree seating edge and shall be ductile iron per ASTM A536 (65-45-12). The disc seating edge shall be solid 316 stainless steel. The disc shall be securely attached to the valve actuating shaft using 304 stainless steel taper pins.

4. Valve shaft shall be of type 304 stainless steel. Valve shaft seals shall be self-compensating V-type packing with a minimum of four sealing rings. One-piece molded shaft seals and o-ring shaft seals are not acceptable.

5. The seat shall be EPDM for air service and shall be retained within a dovetail groove in the valve body and locked in place by an epoxy compound wedge. Compression between the seat and disc edge shall be adjustable from both the upstream and downstream side of the valve disc and the seat shall be field replaceable without disassembly of the disc and shaft. Seats with unidirectional adjustment, seats retained in the valve body by the use of fasteners and/or retaining rings, and seats retained on the valve disc are not acceptable.

6. Valve shaft bearings shall be Teflon lined with a non-metallic fiberglass composite backing and shall be permanently lubricated.

7. Unless otherwise specified, exterior and interior metallic surfaces of each valve shall be shop painted per the latest reversion of AWWA C504. All surfaces of the valve shall be clean, dry and free from grease before applying paint or coating

8. Handwheel, chainwheel, and buried service (if applicable) nut actuators shall conform in all respects to AWWA C504. The valve actuator shall be sized to the actual operating conditions. Each valve and valve actuator shall be assembled, adjusted, and tested as a unit per the latest revision of AWWA C504, by the valve manufacturer.

9. AWWA C504 Butterfly valves shall be DeZURIK BAW or pre-approved equal.

PART 3 E X E C U T I O N

3.01 INSTALLATION

A. Install valves and specialties in accordance with manufacturer's written instructions to permit intended performance. Operate all valves from fully opened to totally closed.

B. Installation of butterfly valves shall conform to Section 02522, 3.02, as applicable.

3.02 PAINTING

A. Paint valves and specialties in accordance with applicable AWWA standards and with Section 09901 - Protective Coatings.

3.03 TESTING

A. Test valves using a hydrostatic pressure test in accordance with AWWA C-504.

B. Test valves and specialties in place. Correct defects in valves, specialties or connections.

END OF SECTION

SECTION 15121

TELESCOPING VALVES

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. This section includes all labor, material, and equipment necessary to furnish telescoping valves and accessories.

1.02 REFERENCES

A. AWWA C550 - Protective Epoxy Interior Coatings for Valves and Hydrants.

1.03 SUBMITTALS

A. Conform to the requirements of Section 01330 – Submittal Procedures.

B. Submit the following as appropriate for each valve provided:

1. Outline and installation drawings for equipment and fixtures furnished.

2. Equipment performance data and operating characteristics.

3. Manufacturer's catalog data, marked to indicate materials being furnished as standard equipment, fixtures, specialties, and accessories.

4. Shop Drawings on shop-fabricated systems.

5. Drawings showing arrangement of piping, controls, and accessory equipment furnished.

C. Manufacturer's Certificate: Certify that products of this section meet or exceed specified requirements.

D. Operation and Maintenance Data as described in Section 01782.

1.04 DELIVERY, STORAGE, AND PROTECTION

A. Arrange delivery of products in accordance with construction schedules and to allow inspection prior to installation.

B. Coordinate deliveries to avoid conflict with conditions at site.

C. Deliver products in undamaged condition in original containers or packaging, with identifying labels intact and legible.

D. Clearly mark to identify partial deliveries of component parts to facilitate assembly.

E. Store products immediately on delivery and protect until installed. Storage to be done according to manufacturer's instructions with seals and labels intact and legible.

F. Provide platforms, blocking or skids, or coverings required to protect products from deterioration or damage.

G. Arrange storage in a manner to provide easy access for inspection.

H. Maintain storage conditions to prevent deterioration or damage.

I. Protect products after installation to prevent damage from subsequent operations. Remove when no longer needed.

J. Provide equipment and personnel necessary to handle products by methods to prevent damage to products or packaging.

K. Handle products by methods to prevent bending or overstressing.

1.05 SERVICE REPRESENTATIVE

A. Provide qualified service representative to perform functions described in Section 01450-Contractor’s Quality Control.

B. At the Engineer’s request, the manufacturer’s representative shall furnish a written report confirming the proper installation of the equipment. The report shall indicate that the equipment is in accurate alignment, is free from any undue stress imposed by connecting piping or anchorage, and that it operated satisfactory at maximum capacity.

C. Include necessary trips by the Manufacturer's representative to provide one 8-hour work day on-site (travel time not included) for startup and training of operations personnel.

D. Any additional trips required by the Contractor before or after final startup and training shall not be charged to the Owner.

1.06 WARRANTY

A. Warranty shall conform to requirements of 00700 General Conditions.

PART 2 P R O D U C T S

2.01 TELESCOPING VALVE

A. Materials:

1. General: Each valve shall comprise a complete assembly including a valve stand, adjusting mechanism with rising stem, sliptube and companion flange. Valves shall be designed for a maximum vertical travel of 3 FT – 6 IN., see drawings.

2. Valve stand and operator: Stainless Steel valve stand with stainless steel support base, operating handwheel, cut steel rising rack, steel pinion in cast iron housing, and rack stop. The pinion gearing shall be such that each complete revolution of the handwheel raises or lowers the rack a minimum of 4-inches.

3. Slip tube: Stainless steel (14 GA wall) tubing having a nominal O.D. of 12 IN. Slip tube fastened stainless steel (14 GA wall) tubing having a nominal O.D. of 12 IN. Slip tube fastened stainless steel fasteners to a bail of ASTM B-16 stainless steel. The bail shall be bolted to a steel bar bolted to the lower end of the rack.

4. Companion flange: Stainless steel (304) companion flange designed to match a 14 IN standard ductile iron pipe flange (Contractor to field verify). To be furnished with a sealing gasket of 1/4 IN thick neoprene rubber having an inner diameter equal to the outer diameter of the slip tube.

2.02 ACCESSORIES

A. Furnish any accessories required to provide a completely operable valve.

B. Provide clear plastic stem cover with rule scale.

C. An offset wall bracket shall be provided to support valve stand and operator.

2.03 MANUFACTURERS

A. Vulcan Industries.

B. Walker Process Corporation.

C. Watt.

D. Envirex.

E. Or approved equal.

PART 3 E X E C U T I O N

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions as shown on the plans by qualified craftsmen.

B. Location, orientation, and quantities as shown on the plans.

C. Include all required related items necessary for a complete installation.

D. Install with stem between 9:00 and 3:00 position (stem shall not be inverted). Valves in pipelines with suspended solids, slurries, or grit service shall be installed with stem at 9:00 or 3:00 position (horizontal) and plug at 12:00 position (up) when fully open.

E. Surface preparation shall follow the piping surface preparation specification. Contractor shall be responsible for compatibility of manufacturers shop coating and final finish.

F. Support independently or from piping.

END OF SECTION

Section 15139

WASTEWATER VALVES

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. This section covers all miscellaneous valves and appurtenances not covered in other sections.

1.02 MEASUREMENT AND PAYMENT

A. No separate payment will be made for work under this section. Include payment in the Lump Sum Base Bid Price.

1.03 SUBMITTALS

A. Complete specifications, data and detailed drawings covering the items furnished under this specification shall be submitted for approval in accordance with the procedure set forth in Section 01330 - Submittals and Section 01340 - Shop Drawings, Product Data and Samples. Catalog cuts, showing sufficient detail as determined by the Engineer, will be acceptable in lieu of detailed drawings for valves smaller than 16 inches in size and for other miscellaneous small items for which detailed drawings are not readily available.

B. Operation and Maintenance Instructions. Submit operating and maintenance manuals applicable to each item of equipment furnished as specified in Section 01782, Operations and Maintenance Data.

1.04 MEASUREMENT AND PAYMENT

A. No separate payment will be made for valves and related items under this Section.

PART 2 P R 0 D U C T S

2.01 BASIC REQUIREMENTS

A. All valves and accessories shall conform to the requirements shown and scheduled on the plans and as hereinafter specified. Pipe and valve purchase

orders shall be coordinated to ensure proper installation of the valves and piping in conformance with the specified requirements.

B. Valve Design.

1. Provide valves designed for repacking or reseating under pressure when fully opened. Perform shell and seat tests and stamp valve to show that tests have been successfully completed.

2. Packing. Use packing suitable for intended service, equipped with gland followers and having pressure and temperature ratings not less than design criteria applicable to components of the system as noted on the Valve Schedule.

3. Seals. For trunion mounted valves use resilient seals suitable for the intended service.

4. Provide valves conforming to the following material specifications:

Material	**Specifications**
Bronze 150 psi maximum	ASTM B 62
Bronze 300 psi maximum	ASTM B 61
Cast Iron	ASTM A 126, Class B
Nodular Cast Iron	ASTM A 339, Grade 60 4510
Carbon Steel, Cast	ASTM A 216, Grade WCB
Carbon Steel, Forged	ASTM A 105, Grade II
Fabricated Steel	ASTM A 7 or better

C. Valve Operators.

1. Unless otherwise shown or specified, each valve must be equipped with a manual operator and shall be provided with a suitable operating wheel.

2. Manual operators on aboveground valves 6 inches and larger shall be geared operators. These geared manual operators shall be fully

enclosed and shall be the traveling nut type, rack and pinion type, or worm gear type for valves 20 inches and smaller. The valve shaft shall extend from the valve to the operator and shall be as specified for valve shafts. The space between the operator housing and the valve body shall be completely enclosed such that no moving parts are exposed to the soil or the elements. Operator housings for valves shall be oil-tight and watertight, shall be specifically designed for buried service, and shall be factory packed with a suitable grease. The valve supplier shall install a valve position indicator on each operator housing. Operators 6 feet or less aboveground shall be provided with a handwheel for manual operation.

3. Worm gear operators shall be designed such that a torque in excess of 160 foot-pounds will not have to be applied to operate the valve at the most adverse condition for which valve is designed. Traveling nut operators shall be designed such that a torque in excess of 100 foot-pounds will not have to be applied to operate the valve at the most adverse condition for which the valve is designed. Limit stops shall be installed on the input shaft of all manual operators in the OPEN and CLOSED positions. The vertical axis of the operating nut shall not move as the valve is opened or closed.

4. Chainwheels. Any valve which is installed with operator located 6' 1" or more above the floor and is not required to be equipped with other type of operator shall be provided with suitable chainwheel and operating chain. Each chainwheel-operated valve shall be equipped with chain guide which will permit rapid handling of the operating chain without "gagging" of the wheel and will also permit reasonable side pull on the chain. Operating chains shall be heavily plated with zinc and cadmium and shall be looped to extend to within 4 feet of the floor below the valve.

5. Wrench nuts shall be provided on all buried valves, on all valves which are to be operated through floor boxes, where shown on the plans. All wrench nuts shall comply with Section 20 of AWWA C500. Not less than two operating keys shall be furnished for operation of the wrench nut operated valves, one 6-foot length and one 10-foot length.

6. Unless otherwise shown or specified, plug, ball and butterfly valves 6 inches and less in size shall be lever operated.

7. Rotation. The direction of rotation of the wheel, wrench nut and lever to open each valve shall be to the left (counterclockwise). Each valve body

or operator shall have cast thereon the word OPEN and an arrow indicating the direction to open.

8. Ends. Unless otherwise specified or shown on the plans, all 3-inch or larger buried valves shall have mechanical joint ends or push-on type joint ends. All other 3-inch or larger valves shall have ends conforming to plan drawing and schedule requirements either flanged or grooved-end coupled. Unless otherwise required by the plans, flanges shall conform to ANSI 816.1, Class 125, flat-faced serrated finish to match flanges on piping.

9. Valves 2 1/2 inches or smaller in size may have threaded ends unless otherwise shown on the plans. Screwed end gate valves shall be used in copper tubing.

2.02 GATE VALVES (GTV)

A. Gate valves shall open counterclockwise.

B. Gate Valves, 2-1/2 Inches and Smaller. Gate valves 2 1/2 inches in size and smaller shall be Class 125 psig SWP, bronze construction, rising stem, single wedge disc gate valves with screwed ends, with union bonnet, as manufactured by Crane (No. 428) or approved substitution.

C. Gate Valves, 3 Inches and Larger.

1. Gate valves 3 inches and larger for use in non-sewage applications shall conform to AWWA C500 or C509, shall be 200 psig SWP, iron body, bronze-mounted, bronze stems, double disc, parallel seat or fully encapsulated elastomer wedge, resilient seat as manufactured by M&H, Style 67, Style 3067 for buried service and Style 68, Style 3068 for aboveground service, or approved substitution.

2. Gate valves 3 inches and larger for use in sewage applications shall conform to AWWA C500, shall be 125 psig SWP, iron body, bronze-mounted, solid wedge disc as manufactured by M&H, Style 2067, for buried service and Style 2068 for aboveground service; or Resilient Wedge gate valves as manufactured by Mueller Co., Series 2360; or approved substitution.

2.03 CHECK VALVES (CKV)

A. Swing Check Valves, 3 Inches and Smaller.

1. Horizontal swing, regrinding type, Y-pattern, threaded ends, all bronze construction complying with Federal Specification WW-Y51d, Class A, Type IV.

2. Discs shall be either renewable bronze or teflon.

3. Working pressure shall be 125 psi saturated steam, 200 psi non- shock cold water, oil or gas.

4. Valve shall be ITT Grinnell Figure No. 3300 or approved substitution.

B. Swing Check Valves, 4-inch and Larger. Swing check valves 4 inches and larger shall be iron-body, bronze-mounted, full-opening check valves with 125-pound ANSI flanged ends, Mueller No. A 2600 6 01, M&H Style 159, Fabri-Valve 10 or approved substitution. Valves shall be rated at 175 psig. Valves shall have stainless steel hinge pin keyed to hinge, and adjustable packing glands. Valve shall be equipped with outside lever and weight so constructed and so positioned that it can operate without interference by any piping, supports or equipment.

C. Non-Slam Check Valves. Wafer type for mounting between flanges; cast- iron body with bronze-faced plates. Valve openings divided in half using lightweight plates spring locked with stainless steel torsion springs; shaft- mounted internal parts with external shaft seals using NPT socket head pipe plugs. Use resilient seating material suitable for pressure and temperature service (20°F to 250°F), bonded in grooved plates. Provide 316 stainless steel body and plate for process air service check valves. Valves shall be as manufactured by TRW Mission (Duo-chek II), Top Flow or approved substitution.

D. PVC Ball Check Valves. Ball check valves in PVC piping shall have ASTM D1784, Type I, Grade 1, polyvinyl chloride body with single or dual union socket weld ends, rated 130 psi at 73 F. Valves shall be equipped with EPDM seats and seals. Valves shall be Chemtrol as manufactured by Nibco, Asahi/America, or approved substitution.

2.04 BALL VALVES (BAV)

A. PVC Ball Valves. Thermoplastic ball valves 2 inches and smaller shall be rated 150 psi at 105 degrees F, with ASTM D-1784, Type I, Grade 1, polyvinyl chloride body, ball, and stem. Valves shall be of end entry, true union design. Valves shall have replaceable EPDM seats and 0-ring stem seals. Valves shall

have handle for manual operation. Valves shall be Chemtrol as manufactured by NIBCO; Asahi/America; or approved substitution.

B. Ball Valve, 2 inches and Smaller. Provide 125-pound cast bronze ball valve, two-piece body, Teflon seats, threaded ends, lever-operated, complying with Federal Spc. WW-V-35b, Type II, Class A, Style 3 (water or air service).

2.05 ECCENTRIC PLUG VALVE (PLV)

A. Provide nonlubricated, eccentric plug valves of semi-steel (ASTM A 126, Class B) with resilient-faced plugs. Valve seat shall have a welded-in overlay of not less than 90 percent nickel on all surfaces contacting the plug face. The stem bearing and bottom bearing shall be of Type 316 stainless steel. Port area of valve shall be not less than 80 percent of full pipe size. Valves shall open counterclockwise.

B. Eccentric plug valve shall be DeZurik Figure 118, Victaulic 365, or approved substitution, and shall be designed for 150 psig working pressure. The plug shall be coated with a resilient material which is oil and grease resistant, such as neoprene or Buna-N. Valves shall be adjustable and repackable without removal of valve bonnet while valve is in service. Valves 3 inches and larger shall be furnished with 125-pound ANSI flanged ends or, if Victaulic joints are used, with grooved ends.

C. Unless otherwise shown on the drawings, valves 6 inches and smaller shall be lever operated and valves 8 inches and larger shall be provided with enclosed worm gear handwheel operators. Equip buried plug valves with valve box, DeZurik Figure 341 and operating nut extensions per DeZurik Figure 614 or 615, or approved substitution.

2.06 BUTTERFLY VALVES (BFV)

A. Valves and operators shall conform to AWWA Standard for Rubber seated Butterfly Valves, AWWA C504, except as modified or supplemented herein. Valves may be short or long body, as determined by their location in the pipe system. All manually operated valves for open close service 20 inches in size and smaller shall be Class 150 B. Provide valves with cast iron body, bronze disc, and 416 stainless steel shaft. All portions of the shaft bearings shall be stainless steel, bronze, nylon, fiberglass and/or Teflon in accordance with

AWWA C504. Provide resilient seats of terpolymer or ethylene propylene material or approved substitution for air temperature to 250°F.

B. Seats shall be bonded to a rigid reinforced phenolic backup ring. The ring shall be retained but not bonded to the body to allow for field removal and replacement.

C. Provide locking lever operators on all valves through 6 inches. Use standard enclosed weatherproof gear operators on all valves larger than 6 inches. Operator mounting arrangements and handwheel positions shall be easily accessible or as shown on the plans. Provide all valves with a valve disc position indicator mounted on the end of the valve shaft. Provide lug style body.

2.07 KNIFE GATE VALVES (KGV)

A. Provide valves with full round port opening and metal seat of 304 stainless steel for particular valve service as recommended by manufacturer. All flanges to be drilled and tapped in accordance with ANSI Class 125/150 standard. Valves 24 inches in size and smaller shall have pressure rating of 150 CWP; valves greater than 24 inches shall have pressure rating of 125 CWP.

B. All wetted parts of knife gate valves, including gate, seat rings and metal seat, through the body and in the chest shall be of Type 304 stainless steel. The stem shall also be stainless steel and shall have double pitch threads. Valves shall have an adjustable packing gland.

C. Valves shall be installed so that liquid pressure from the water will push the gate on the seat. Mark all valves and identify seating side of valve.

D. Hydrostatically test the body of the valve at 1.5 times the working pressure.

E. Knife gate valves through 8 inches in size shall have handwheel operators; valves 10 inches and larger shall have enclosed bevel gear with handwheel operators, floor stands, gate position indicator, extension and fittings as required.

F. Provide lug body style, bonnetless knife gate valves. Valves as manufactured by Fabri-Valve (37R), DeZurik (Series L) or approved substitution.

2.08 TELESCOPING VALVES

A. Tubes shall be manufactured from seamless or welded stainless steel tube. Connecting bails and hardware shall be 304 stainless steel. Minimum wall

thickness for tube shall be 1/8 inch. Tube will be of sufficient length to provide adjustment between the elevations as shown on the plans.

B. A cast iron or stainless steel companion flange will be provided by the telescoping valve manufacturer along with a neoprene or Buna-N gasket of such dimension as to provide a friction seal around the sliding tube.

C. Seal flange to match riser tube or Contractor to provide complete and operable valves.

D. Stems shall be manufactured from solid Type 304 stainless steel rod and shall have Acme type threads for adjusting the tube height. The stem shall be fastened to the tube bail by welding or threaded stainless steel hardware.

E. Lifts shall be ball bearing supported handwheellifts, with torque plate, mounted on cast iron pedestals or offset type cast iron pedestals as required. Handwheels shall have a minimum diameter of 18 inches and shall include a clear plastic butyrate stem cover with mylar indicator strip to show opening calibrated in 1/4-inch increments. Mylar strip, provided by the manufacturer, will be affixed by the Contractor after installation to provide a true and accurate indication of the tube elevation by comparing it with the rising stem. Stainless steel anchor bolts shall be provided for all pedestals. Cleaning and shop coat prime paint will be manufacturer's standard.

2.09 MUD VALVES

A. Valves shall be flanged end, cast iron body with bronze seats. Provide 304 stainless steel non-rising stem with bronze stem nut. All assembly and mounting bolts to be 316 stainless steel. Valve will be operated with a handwheellift. Provide stem guides and wall brackets to make a complete and operable unit as required by valve manufacturer.

2.10 MISCELLANEOUS VALVES

A. Flap Valves. Flap valves shall have iron body bronze seats and disc rings; hinge pins shall be bronze or Type 316 stainless steel.

B. Globe Valves (GLV).

1. Globe valves shall be used where indicated on the drawings or specified. In general, unless otherwise shown or noted, all valves 1/2

inch and smaller on water or air lines shall be globe valves. Angle valves may be used in place of globe valves where convenient.

2. Globe valves 3 inches in size and smaller for ordinary service shall be 125 psig SWP, bronze, rising stem, bronze disc globe valves with screwed ends, Crane Nos. 1 and 2, Kennedy Figures 150 and 151, or approved substitution.

C. Hose Bibbs. Hose bibbs shall be bronze, angle pattern globe-type valves with renewable composition disc and American Standard hose coupling threads on outlet. Hose valves shall be Nibco KT 67UL for 1-inch bibb and Nibco T 301 W for 1-1/2 inch, or approved substitution.

D. Globe Needle Valve, 1/8 inch to 3/4 inch Size. Screwed bonnet, rising stem, threaded ends, brass stem and integral seat. Provide ITT Grinnell Figure No. 1066 or approved substitution.

E. Relief Valves (RV). Furnish spring loaded relief valves with a steel bonnet and 316 stainless steel trim with enclosed spring similar to Crosby Series 900. Valve to be compatible with service. For compressed air service use seats specially ground for air service and provide a lifting lever.

F. Sewage Air and Vacuum Valve (Force Main High Points).

1. Operation. Allow for unrestricted venting or re-entry of air through it during filling or draining of the force main. Valve design is to prevent water column separation or pipeline collapse due to vacuum.

2. Materials. Elongated body, cover and baffle shall be cast iron, ASTM A48, Class 30. Provide one upper and one lower stainless steel floats, connected by stainless steel float guide.

3. Baffle Design. Internal baffle shall be fitted with a guide bushing. It shall retain the Buna N seat in place.

4. Appurtenances. All internals shall be removable through the top cover. Provide blow-off valves, quick disconnect couplings, minimum 6 feet of hose and flanged gate sheet of valve.

5. Valves shall be APCO Series 400 SAW sewage air and vacuum valve or approved substitution.

G. Sewage Combination Air Vacuum Valve (Pump Station Discharge).

1. Operation. Allow for unrestricted venting or reentry of air through valve when filling or draining a pipeline or when air or gases enter the pipe or a vacuum develops. Combination valve does not spill or spurt sewage even at low pressures.

2. Materials. Body and cover shall be cast iron, ASTM A 126 GR. B. Provide stainless steel concave float with stainless steel stem.

3. Combination valve shall have double orifice construction: a large orifice to allow large volumes of air to escape or enter during pipeline filling or emptying; and a small orifice which shall remain operative when the pipeline is filled and pressurized to allow small pockets of air to escape. Valve needle and seat shall be Buna N.

4. Appurtenances. All internals shall be removable through the top cover. Provide blow-off valves, quick disconnect couplings, minimum 6 feet of hose and flanged gate sheet of valve.

5. Valves shall be APCO Series 440 SCAV sewage combination air/vacuum valve or approved substitution.

H. Tank Pressure Relief Valves.

1. Wall Type Relief Valve. The valve shall be of the vertical seal type with offset single pivoted hinge. The assembly shall consist of flap gate, gate seat retainer plate, hinge pin and body seat ring. The flap gate, body and gate seal retainer shall be of cast iron conforming to ASTM A-126 Class B. The body seat ring and hinge shall be bronze. T he gate shall have a neoprene rubber seat cemented and mechanically retained in place by a cast iron retainer plate. The body seat ring shall be threaded and screwed into place and the face machined to a smooth finish. The wall type pressure relief valve shall be a Claw F-1494 or approved substitution.

2. Floor Type Relief Valve. The assembly shall consist of a cover, body and strainer. All three parts shall be cast iron conforming to ASTM A-126 Class B. They shall be designed so that neither the cover nor strainer can become separated from the body of the valve, due to groundwater pressure around the tank. However, when necessary, both may be easily removed by turning them to right or left to from them from

locking lugs cast integrally on the inside of the body. The seats shall be of lead poured and peened into grooves on underside of cover and top o body. The seats shall be machined to form a non-corroding lead to lead contact when cover is in closed position. The floor type pressure relief valve shall be a Claw F-1492 or approved substitution.

PART 3 E X E C U T I 0 N

3.01 INSTALLATION

A. Installation of miscellaneous valves shall be as recommended by manufacturer. Valves shall be positioned as shown on drawings.

3.02 SETTING VALVES AND VALVE BOXES

A. Prior to installing valves, remove foreign matter from within the valves. Inspect the valves in open and closed position to verify that all parts are in satisfactory working condition.

B. Install valves and valve boxes where shown or as located by the Owner. Set valves plumb and as detailed on drawings. Center valve boxes on valves. Locate valves away from roads or streets. Carefully tamp earth around each valve box for a minimum radius of 4 feet, or to undisturbed trench face if less than 4 feet. Set fire hydrants 3 feet from the edge of the shoulder, at the point of curvature of the intersection curb radius and at such elevations that connecting pipe will not have less cover than distributing mains.

C. Place a Class B concrete thrust block opposite pipe connections, set against the vertical face of the trench to prevent the hydrant from blowing off the line. If the character of the soil is such that the fire hydrant cannot be securely wedged in this manner, provide bridle rods and rod collars of not less than 3/4-inch stock protected by a coat of acid-resisting paint.

D. Place at least 5 cubic feet of broken stone around the base of the fire hydrant to ensure drainage. Compact backfill thoroughly around the hydrant to grade line.

3.03 UNDERGROUND VALVE INSTALLATION

A. Each valve which is installed in direct contact with earth backfill shall be provided with a valve box of such type and design that surface loads, impact and shock will not be transmitted through the box to the valve.

B. Valves and valve boxes shall be set plumb. Each valve box shall be placed directly over the valve it serves, with the top of the box brought flush with the finished grade. After being placed in proper position, earth shall be filled in around each valve box and thoroughly tamped for a distance on each side of the box of 4 feet at the top of the pipe and 2 feet measured at the top of the trench.

C. Each valve shall be inspected before installation to ensure that all foreign substances have been removed from within the valve body, and shall be opened and closed to see that all parts are in first-class working condition. Geared valves shall be inspected to see that the gears are properly lubricated.

D. Extension stems for buried valves shall extend to within 6 inches of the surface of the ground. Each extension stem shall be connected to the valve operator with a suitable universal joint type coupling. All connections shall be pinned. Each extension stem shall be provided with spacers which will center the stem in a valve box having an inside diameter of 5-1/2 inches, and shall be equipped with a standard AWWA wrench nut as described in Section 20 of AWWA C500.

3.04 SHOP PAINTING

A. Unfinished interior surfaces of all valves shall be painted or coated for wastewater service in conformity with the standard practice of the manufacturer. All unfinished exterior surfaces of the valves, operators and accessories which are not exposed in manholes, buried or submerged shall be thoroughly cleaned and prime coated with primer compatible with the proposed coating system. Finish coats of paint will be applied after installation of the valves.

B. All exterior surfaces of valves which are exposed in manholes, buried or submerged, and their extension stems and accessories shall be thoroughly cleaned and coated.

C. All polished or machined surfaces of each valve shall be coated with rust-preventative compound, Dearborn Chemical "No-Ox-Id 2W," Houghton "Rust Veto 344," or Rust-Oleum "R-9."

END OF SECTION

Section 15140

PIPE HANGERS, SUPPORTS, AND RESTRAINTS

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Pipe and equipment hangers, supports, and associated anchors.

B. Equipment bases and supports.

C. Sleeves and seals.

1.02 REFERENCES

A. ANSI/ASME B31.1 - Power Piping, Sections 120 and 121 of ASME B31.1.

1.03 SUBMITTALS

A. Submit shop drawings and product data under provisions of Section 01330 - Submittal Procedures and Section 15050 - Basic Mechanical Materials and Methods.

B. As a minimum, submit the following items:

1. A layout of the systems including location on fixed and movable joints.

2. Details of design and fabrication of joints.

3. Details of support brackets, cradles, pads, thrust resisting elements, and other supporting elements.

4. Other pertinent elements necessary for a complete installation.

5. Design calculations for submitted items.

PART 2 P R O D U C T S

2.01 HANGERS AND SUPPORTS

A. For uninsulated lines 2 inches and less and for drainage and downspout lines provide hangers which are adjustable swivel ring type fabricated of malleable iron.

B. For uninsulated lines larger than 2 inches and for insulated lines, except drainage and downspout piping, provide adjustable clevis type hangers. Size hangers to allow insulation to extend unbroken through the hanger.

C. Fabricate hangers installed in valve vaults, wet wells, and other below grade areas of cadmium plated or stainless steel.

2.02 INSERTS

A. Make inserts for individual hangers of galvanized malleable iron; include removable nuts held in place by V-type teeth on the insert body and nut. Make continuous-slotted channel inserts of galvanized steel with integral anchors at 6-inch centers. Provide factory finished steel snap-on cover plates on channel inserts between support attachments.

2.03 EXPANSION BOLTS

A. Use expansion bolts for support which are stainless steel wedge type. Do not use expansion bolt anchors with lead.

2.04 PIPE SADDLES

A. Fabricate pipe saddles of hot dip galvanized steel. Saddles for supporting pipe from the floor shall be at least 9 inches in length and as wide as the outside diameter of the pipe. Make a bearing support of 120 degrees. Mount saddles on concrete pads at least 2-inches high.

2.05 FRAMING HANGERS

A. Use factory fabricated metal framing systems with factory applied primer paint as framing for wall type hangers, trapeze hangers, and tunnel stanchions. Attach supports to structures with inserts for new concrete, with surface mounting methods for masonry or existing concrete, and with welding or clamps for structural steel. Make pipe supports fabricated on the site of structural steel members with raw edges ground and dressed. Rest floor supports in areas with uncovered concrete floors on concrete pads not less than 2 inches high.

PART 3 E X E C U T I O N

3.01 INSTALLATION

A. Hang piping inside structures supported from the floor or racked adjacent to walls.

B. Provide inserts cast in concrete walls or slabs for hanging and supporting pipe. If materials not galvanized or cadmium plated, paint them with primer before installation.

C. Design fabricate, and install support components in general conformance with Sections 120 and 121 of ANSI B31.1, Power Piping, except as modified in this Section.

3.02 PIPE HANGERS AND SUPPORTS

A. Support, brace, and anchor interior piping to prevent movement in any direction because of pressure, temperature, flow, or water hammer, except at properly located expansion joints and fittings.

B. Provide two pipe guides on each side of expansion joints at which pipe movement occurs. The first guide shall be not more than 4-pipe diameters from the joint and the second not more than 14 diameters. Provide additional guides as required to maintain pipe alignment, spaced as required for the pipe size, fluid pressure and temperature inside the pipe, and as recommended by the expansion joint manufacturer or as shown.

C. Maximum support spacing and hanger rod sizes for metal pipe containing liquids are as follows:

Nominal Pipe Size (Inches)	Support Spacing (Feet)		Rod Diameter in Inches One Rod	Two Rods
1 and Smaller	7	3/8	3/8	
1-1/4 and 1-1/2	8	3/8	3/8	
2	10		3/8	3/8
2-1/2	11		1/2	3/8
3	12		1/2	3/8
4 and 5	14		1/2	3/8
6 and 8	17		1/2	3/8
10	17		5/8	1/2
12	17		3/4	1/2
14	17		3/4	5/8
16	17		7/8	5/8
18 and 20	17		1	3/4
24	17		1-1/8	7/8

D. For valves 4 inches and larger in unburied horizontal lines support the valve on both sides when located within 18 inches of the valve or meter. Provide additional supports where required so that piping loads do not place damaging stresses on supports, valves, and equipment. Where necessary, block up pipe at supports to permit installation of insulation.

E. Support unburied horizontal runs of rubber hose and non-metallic pipe for the entire length by means of troughs consisting of structural steel channels or angles supported at not more than 10-foot intervals.

F. Support piping not included in the foregoing tabulation as indicated or in accordance with the pipe manufacturer's recommendations, if not indicated.

G. Anchor buried pressure pipe at each fitting causing a change in direction of 10 degrees or more. Concrete thrust blocks or other restraining devices in any satisfactory combination may be used. Submit the details of the method proposed for use, together with design calculations, to the City Engineer before installation.

END OF SECTION

SECTION 15190

MECHANICAL IDENTIFICATION

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Identification of mechanical products installed under Division 15.

1.02 REFERENCES

A. ANSI/ASME A13.1 - Scheme for the Identification of Piping Systems.

1.03 SUBMITTALS

A. Submit product data and manufacturer's installation instructions under provisions of Section 01330 - Submittal Procedures.

B. Submit list of working, symbols, letter size, and color coding for mechanical identification.

C. Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.

PART 2 P R O D U C T S

2.02 ACCEPTABLE MANUFACTURERS

A. Seton.

B. W.H. Brady Company.

C. Approved equal.

2.03 MATERIALS

A. Color: Unless specified otherwise, conform with ANSI/ASME A13.1.

B. Plastic Nameplates: Laminated three-layer plastic with engraved black letters on light contrasting background color.

C. Plastic Pipe Markers: Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and fluid being conveyed.

PART 3 E X E C U T I O N

3.01 PREPARATION

A. Degrease and clean surfaces to receive adhesive for identification materials.

B. Prepare surfaces in accordance with Section 09901 - Protective Coatings, for stencil painting.

3.02 INSTALLATION

A. Plastic Nameplates: Install corrosive-resistant mechanical fasteners, or adhesive.

B. Plastic Tags: Install with corrosive-resistant chain.

C. Equipment: Identify heat transfer equipment with plastic nameplates.

D. Valves: Identify valves in main and branch piping with tags.

E. Piping: Identify piping, concealed or exposed, with plastic pipe markers. Tags may be used on small diameter piping. Identify service, flow direction, and pressure. Install in clear view and align with axis of piping. Locate identification not to exceed 20 feet on straight runs including risers and drops, adjacent to each valve and tee, at each side of penetration of structure or enclosure, and at each obstruction.

END OF SECTION

SECTION 15200

ECCENTRIC PLUG VALVES FOR BURIED SERVICE

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Eccentric plug valves for direct buried service.

1.02 MEASUREMENT AND PAYMENT

A. Unit Prices

1. No separate payment will be made for buried plug valves under this section. Include payment in Lump Sum with price breakdown included in the Schedule of Values.

2. Refer to Section 01270- Measurement and Payment, and Section 01292 - Schedule of Values.

B. Stipulated Price (Lump Sum). If the Contract is a Stipulated Price Contract, payment for work in this Section is included in the total Stipulated Price.

1.03 REFERENCES

A. ANSI B16.1 - Cast Iron Pipe Flanges and Flanged Fittings.

B. AWWA C517 - Resilient Seated Eccentric Plug Valves.

C. ASTM A126 - Gray Iron Castings for Valves, Flanges, and Pipe Fittings.

D. ASTM A536 Grade 65-45-12 - Ductile Iron Castings.

E. ASTM A193 - Alloy-Steel and Stainless Steel Bolting Materials for High Temperature Service.

F. ASTM A194 - Carbon and Alloy Steel Nuts for Bolts for High Pressure and High Temperature Service.

1.04 QUALITY ASSURANCE

A. Manufacturer's Qualifications

1. Valves and appurtenances provided under this Section shall be the standard product in regular production by manufacturers whose products have proven reliable in similar service for at least 5 years.

2. Insofar as possible all valves of the same specific type shall be the product of one manufacturer.

1.05 SUBMITTALS

A. Submit shop drawings and product data under provisions of Sections 01330 - Submittal Procedures and 15050 - Basic Mechanical Materials and Methods.

B. Shop Drawings

1. Submit for review detailed drawings, data and descriptive literature on valves and appurtenances, including:

a. Dimensions.

b. Size.

c. Materials of construction.

d. Weight.

e. Protective coating.

f. Actuator weight, where applicable.

g. Calculations for actuator torque, where applicable.

h. Wiring diagram, where applicable.

C. Manufacturer's Certifications

1. Submit manufacturer's certificates of compliance with ANSI, AWWA and other listed standards.

1.06 OPERATION AND MAINTENANCE DATA

A. Submit operation and maintenance data under provisions of Section 01730 - Operations and Maintenance Data.

B. Submit a detailed operation and maintenance manual for valves and appurtenances provided under this Section.

1.07 DELIVERY, STORAGE AND HANDLING

A. Have products delivered, stored and protected under provisions of Section 01600 - Material and Equipment.

B. Store valves and appurtenances off the ground in enclosed shelter.

PART 2 P R O D U C T S

2.01 BASIC REQUIREMENTS

A. Mark and identify valves in conformance with standards, these Specifications or to the manufacturer's standard.

B. Bolts, studs and nuts to be Type 316 stainless steel.

C. End connections of valves shall be flanged and drilled to ANSI Class 125 unless otherwise specified.

D. To exterior surfaces of valves, apply a shop coating in accordance with Section 09900 - Painting.

2.02 ECCENTRIC PLUG VALVES

A. Eccentric plug valves shall be the non-lubricated eccentric type with cast iron bodies and resilient-faced plugs in the bodies.

B. Operators: All valves for 4-inch and larger service shall have worm gear operators, nickel or stainless steel seats, and ANSI 125 psi flanged ends. Operators shall clearly indicate valve position. Operators on valves in submerged or buried service shall be lubricated and sealed to prevent entry of dirt and water into the operator.

C. Resilient facing shall be suitable for the intended service.

D. All shaft bearings shall be of stainless steel, furnished with permanently-lubricated bearing surfaces.

E. Valves up to and including 20 inches in size shall have an unobstructed port area of no less than 80 percent of the full pipe area, and not less than 70 percent for larger valves.

F. Eccentric plug valves shall be manufactured by Clow, De Zurik, Keystone, Val-Matic, or Victualic.

2.03 ACCESSORIES

A. 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.

PART 3 E X E C U T I O N

3.01 INSTALLATION

A. Install valves and specialties in accordance with manufacturer's written instructions to permit intended performance.

B. Eccentric plug valves shall be installed according to the following:

1. Position the valves with the stem in the horizontal direction.

2. In horizontal pipelines, position the vales so that the plug swings upward when opening to permit flushing of solids.

3. Orient the vales to prevent the valve bodies from filling up with solids when closed; however, orient the valves such that the pressure differential forces the plug against the seat in cases where the pressure differential across a closed valve will exceed 25 psi.

3.02 TESTING

A. Test valves using a hydrostatic pressure test in accordance with AWWA C-600.

B. Test valves and specialties in place. Correct defects in valves, specialties or connections.

END OF SECTION

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SECTION 15241

VIBRATION CONTROL

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Extent of vibration control work required by this section is indicated on drawings and schedules, and/or specified in other Division-15 sections.

B. Types of vibration control products specified in this section include the following:

1. Fiberglass Pads and Shapes.
2. Neoprene Pads.
3. Vibration Isolation Springs.
4. Pad-Type Isolators.
5. Plate-Type Isolators.
6. Double-Plate-Type Isolators.
7. Threaded Double-Plate-Type Isolators.
8. All-Directional Anchors.
9. Neoprene Mountings.
10. Spring Isolators, Free-Standing.
11. Spring Isolators, Housed.
12. Isolation Hangers.
13. Riser Isolators.
14. Flexible Pipe Connectors.

C. Vibration control products furnished as integral part of factory- fabricated equipment, are specified as part of equipment assembly in other Division-15 sections.

D. Refer to other Division-15 sections for equipment foundations, hangers, sealants, gaskets, and other work related to vibration control work.

E. Refer to other Division-15 sections for requirements of electrical connections to equipment isolated on vibration control products.

F. Refer to other Division-15 sections for requirements of duct connections to air handling equipment isolated on vibration control products.

1.02 MEASUREMENT AND PAYMENT

A. No separate payment will be made for work under this section. Include payment in the Lump Sum Base Bid Price.

1.03 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of vibration control products, of type, size, and capacity required, whose products have been in satisfactory use in similar service for not less than 5 years.

1. Except as otherwise indicated, obtain vibration control products from single manufacturer.

2. Engage manufacturer to provide technical supervision of installation of vibration control products.

1.04 SUBMITTALS

A. Submittals shall be in accordance with Section 01330 and the requirements below.

B. Product Data: Submit manufacturer's technical product data and installation instructions for each type of vibration control product. Submit schedule showing size, type, deflection, and location for each product furnished.

C. Shop Drawings: Submit manufacturer's assembly-type shop drawings indicating dimensions, weights, required clearances, and method of assembly of components. Detail bases, and show location of equipment anchoringpoints, coordinated with equipment manufacturer's shop drawings.

D. Maintenance Data: Submit maintenance data for each type of vibration control product. Include this data, product data, and shop drawings in maintenance manual; in accordance with requirements of Division 1.

PART 2 P R O D U C T S

2.01 ACCEPTABLE MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering vibration control products which may be incorporated in the work include, but are not limited to, the following:

B. Manufacturer: Subject to compliance with requirements, provide vibration control products of one of the following:

1. Amber/Booth Co.
2. Korfund Dynamics Corp.
3. Mason Industries, Inc.
4. Peabody Noise Control, Inc.
5. Vibration Eliminator Co., Inc.
6. Vibration Mountings and Controls, Inc.

2.02 VIBRATION CONTROL MATERIALS AND SUPPORTS UNITS

A. Fiberglass Pads and Shapes: Glass fiber of not more than 0.18 mil diameter, produced by multiple-frame attenuation process, molded with manufacturer's standard fillers and binders through 10 compression cycles at 3 times rated load bearing capacity, to achieve natural frequency of not more than 12 Hertz, in thicknesses and shapes required for use in vibration isolation units.

B. Neoprene Pads: Oil-resistant neoprene sheets, of manufacturer's standard hardness and cross-ribbed or waffled pattern.

C. Vibration Isolation Springs: Wound-steel compression springs, or high-strength spring alloy steel; with spring diameter not less than 0.8 of compressed height of spring at rated loads. Provide minimum additional travel to solid, equal to 50% of rated deflection. Provide spring wire with elastic limit stress exceeding at solid deflection.

D. Pad-Type Isolators: Except as otherwise indicated, provide manufacturer's standard pad-type isolation unit, fiberglass pads or shapes, or neoprene pads.

E. Plate-Type Isolators: Laminate pad-type isolator to steel plate.

F. Double-Plate-Type Isolators: Cement pad-type isolator to either side of 16-ga shim and cement assembly to load distribution steel plate.

1. Where required for anchorage of equipment, include threaded anchor bolt secured to plate and extending through unit, distance sufficient for anchorage of equipment as indicated.

2. Include 2 holes in plate for bolting unit to substrate.

G. Threaded Double-Plate-Type Isolators: Provide double-plate-type isolator, with threaded connection centered in one plate and oversized hole in other plate.

1. Except as otherwise indicated, include threaded insert extending through entire thickness of unit.

2. Include 2 bolts in plate opposite threaded plate, for bolting unit to substrate.

H. All-Directional Anchors: Provide all-directional acoustical pipe anchor consisting of telescopic arrangement of 2 sizes of steel tubing separated by minimum 1/2" thickness of heavy-duty neoprene and duck, or neoprene isolation material. Provide vertical restraints by similar material arranged to prevent vertical travel in either direction. Design for maximum 500 psi load on isolation materials, and provide for equal resistance in any direction. Equip anchor with threaded hole on top and 2 holes in base plate for bolting down; or provide welding provisions top and bottom, if indicated.

I. Neoprene Mountings: Provide neoprene mountings consisting of neoprene element bonded between 2 steel plates that are neoprene- covered to prevent corrosion. Provide minimum rated deflection of 0.35". Provide threaded hole in upper plate and 2 holes in base plate for securing to equipment and to substrate.

J. Spring Isolators, Free-Standing: Except as otherwise indicated, provide vibration isolation spring between top and bottom loading plates, and with pad-type isolator bonded to bottom of bottom loading plate. Include studs or cups to ensure centering of spring on plates. Include leveling bolt with lock nuts and washers, centered in top plate, arranged for leveling and anchoring supported equipment as indicated.

1. Include holes in bottom plate for bolting unit to substrate as indicated.

K. Spring Isolators, Housed: Except as otherwise indicated, provide vibration isolation spring between telescoping steel housings with top and bottom

loading plates, and with pad-type isolator bonded to bottom of loading plate. Include resilient inserts to separate and guide telescoping housings.

1. Equip top loading plate with equipment anchorages as indicated or as required for support and attachment.

2. Include pad-type isolator bonded to top of top loading plate, except on units with leveling bolts.

3. Include holes in bottom plate for bolting unit to substrate.

L. Isolation Hangers: Hanger units formed with brackets and including manufacturer's standard compression isolators of type indicated. Design brackets for 3 times rated loading of units. Fabricate units to accept misalignment of 15 degrees off center in any direction before contacting hanger box, and for use with either rod or strap type members, and including acoustical washers to prevent metal-to-metal contacts.

1. Provide vibration isolation spring with cap in lower part of hanger and rubber hanger element in top, securely retained in unit.

2. Provide neoprene element, with minimum deflection of 0.35", securely retained in hanger box.

3. Provide fiberglass pad or shape, securely retained in unit, with threaded metal top plate.

4. Provide hangers, pre-compressed to rated load to limit deflection during installation. Design so hanger may be released after full load is applied.

M. Riser Isolators: Suspend risers from, or support risers by, spring hangers or spring isolators. Wherever possible, anchor risers at central point with resilient anchors. Provide hanger or mounting deflection of 0.75" except in those expansion locations where additional deflection is required to limit deflection or load changes to plus or minus 25 degrees of initial deflection. Provide sliding guides held in position by resilient anchors, located between anchor points and end of piping, spaced as indicated.

N. Flexible Pipe Connectors:

1. For non-ferrous piping, provide bronze hose covered with bronze wire braid with copper tube ends or bronze flanged ends, braze-welded to hose.

2. For ferrous piping, provide stainless steel hose covered with stainless steel wire braid with NPT steel nipples or 150 psi ANSI flanges, welded to hose.

3. Flexible Pipe Connectors: Provide neoprene or EDPM construction consisting of multiple plies of nylon tire cord fabric and elastomer molded and cured in hydraulic rubber presses. Provide straight or elbow connector as indicated, rated at 125 psi at 220 deg. F.

PART 3 E X E C U T I O N

3.01 INSPECTION

A. Examine areas and conditions under which vibration control units are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.02 PERFORMANCE OF ISOLATORS

A. General: Comply with minimum static deflections recommended by ASHRAE, for selection and application of vibration isolation materials and units as indicated.

B. Manufacturer's Recommendations: Except as otherwise indicated, comply with manufacturer's recommendations for selection and application of vibration isolation materials and units.

3.03 APPLICATIONS

A. General: Except as otherwise indicated, select vibration control products in accordance with ASHRAE Handbook, 1995 Systems Volume, Chapter 43 "Sound and Vibration Control", Table 42, selection guide for vibration isolation. Where more than one type of product is offered, selection is Installer's option. Refer to Table 2 design guidelines for HVAC systems noise in unoccupied spaces for general RC (N) levels.

B. Piping: For piping connected to equipment mounted on vibration control products, install isolation hangers as indicated, and for first 3 points of support for pipe sizes 4" and less, for first 4 points of support for pipe sizes 5" through 8", and for first 6 points of support for pipe sizes 10" and over. A spring hanger consisting of a rectangular steel box, coil springs, spring cups, Neoprene

impregnated fabric washer, steel washer, and Neoprene insert designed to prevent metal to metal contact between the hanger rod and bottom of the hanger box. The hanger box shall be capable of supporting a load of 200% of rated load without noticeable deformation or failure.

3.04 VIBRATION ISOLATION ROOF CURBS

A. Description: Factory-assembled, fully enclosed, insulated, air- and watertight curb designed to resiliently support roof-mounted equipment and to withstand 125-mph wind impinging laterally against the side of the equipment. Design restraints to meet seismic requirements of authorities having jurisdiction.

B. Components: Upper support frame; lower support assembly; freestanding, unhoused, laterally stable steel springs; vertical and horizontal restraints.

1. Lower Support Assembly: Provide a means of attachment to the building structure and include a wood nailer stripe for attachment of roof material and 2 inches of rigid insulation on the inside of the assembly.

2. Spring Isolators: As indicated or scheduled. Include adjustment bolt to permit leveling of equipment after installation. Attach to lower assembly with a rubber isolation pad. Locate spring isolators so they are accessible for adjustment at any time during the life of the installation without interfering with the integrity of the roof.

3. Water Seal: Elastomeric seal conforming to UL Class A roofing materials, attached to the upper support frame, extending down past the wood nailer of the lower support assembly, and counter flashed over the roof materials.

3.05 INSTALLATION

A. General: Except as otherwise indicated, comply with manufacturer's instructions for installation and load application to vibration control materials and units. Adjust to ensure that units have equal deflection, do not bottom out under loading, and are not short-circuited by other contacts or bearing points. Remove space blocks and similar devices intended for temporary support during installation.

B. Install units between substrate and equipment as required for secure operation and to prevent displacement by normal forces, and as indicated.

C. Adjust leveling devices as required to distribute loading uniformly onto isolators. Shim units as required where substrate is not level.

D. Install inertia base frames on isolator units as indicated, so that minimum of 1" clearance below base will result when frame is filled with concrete and supported equipment has been installed and loaded for operation.

E. For air handling equipment, install thrust restraints as indicated, and also wherever thrust exceeds 10% of equipment weight.

F. Locate isolation hangers as near overhead support structure as possible.

G. Weld riser isolator units in place as required to prevent displacement from loading and operations.

H. Flexible Pipe Connectors: Install on equipment side of shutoff valves, horizontally and parallel to equipment shafts wherever possible.

3.06 ADJUSTING AND CLEANING

A. Upon completion of vibration control work, prepare report showing measured equipment deflections for each major item of equipment as indicated.

B. Clean each vibration control unit, and verify that each is working freely, and that there is no dirt or debris in immediate vicinity of unit that could possibly short-circuit unit isolation.

END OF SECTION

SECTION 15250

MECHANICAL INSULATION

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Item governs for furnishing and installing insulation for piping and ductwork subject to condensation.

1.02 MEASUREMENT AND PAYMENT

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

B. Refer to Section 01270 – Measurement and Payment.

1.03 QUALITY ASSURANCE

A. Installer's Qualifications: Firm with at least 5 years successful installation experience on projects with mechanical insulation similar to that required for this project.

B. Flame/Smoke Ratings: Provide composite mechanical insulation (insulation, jackets, coverings, sealers, mastics and adhesives) with flame-spread index of 25 or less, and smoke-developed index of 50 or less, as tested by ASTM E 84 (NFPA 255) method.

1. Exception: Outdoor mechanical insulation may have flame spread index of 75 and smoke developed index of 150.

1.04 SUBMITTALS

A. Submittals shall be in accordance with Section 01330 and the requirements below.

B. Product Data: Submit manufacturer's technical product data and installation instructions for each type of mechanical insulation. Submit schedule showing manufacturer's product number, k-value, thickness, and furnished accessories for each mechanical system requiring insulation.

C. Maintenance Data: Submit maintenance data and replacement material lists for each type of mechanical insulation. Include this data and product data in maintenance manual.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Delivery, Storage and Handling shall be in accordance with Section 01610-Basic Product Requirements and as specified herein. Deliver insulation, coverings, cements, adhesives, and coatings to site in containers with manufacturer's stamp or label, affixed showing fire hazard indexes of products.

B. Protect insulation against dirt, water, and chemical and mechanical damage. Do not install damaged or wet insulation; remove from project site. Do not install insulation.

PART 2 P R O D U C T S

2.01 ACCEPTABLE MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide products of one of the following:

1. Armstrong World Industries, Inc.
2. Certainteed Corp.
3. Knauf Fiber Glass GmbH.
4. Owens-Corning Fiberglas Corp.
5. Pittsburgh Corning Corp.
6. FGH Fabricators, Inc. KooiPhen K Phenolic Foam Insulation.

B. Adhesives shall be as manufactured by Minnesota Mining, Arabol, Benjamin-Foster, Armstrong, or Insulmastic, Inc., and shall have the same adhesive properties, fire rating, vapor seal, etc., as the types specified herein, subject to review by the City.

2.02 PIPING INSULATION MATERIALS

A. Fiberglass Piping Insulation: ASTM C 547, Class 1 unless otherwise indicated. (Indoor locations)

B. Cellular Glass Piping Insulation: ASTM C 552, Type II, Class 2.

C. Pipe and Round Duct Insulation: (Outdoor locations) Phenolic Foam insulation as manufactured by Pittsburgh Corning or Koolphen phenolic foam 2.2 #density as manufactured by FGH Fabricators, Inc.

D. Flexible Unicellular Piping Insulation: ASTM C 534, Type I.

E. Jackets for Piping Insulation: ASTM C 921, Type I (vapor barrier) for piping with temperatures below ambient, Type II (water vapor permeable) for piping with temperatures above ambient. Type I may be used for all piping at Installers option.

1. Encase pipe fittings insulation with one-piece pre-molded 16 MIL aluminum fitting covers, fastened as per manufacturer's recommendations.

2. Encase exterior piping insulation with 16 MIL aluminum jacket with "Z" closures for weather-proof construction.

F. Staples, Bands, Wires, and Cement: As recommended by insulation manufacturer for applications indicated.

G. Adhesives, Sealers, and Protective Finishes: As recommended by insulation manufacturer for applications indicated. White all service jacket "ASJ" vapor barrier with dual self-seal strips for all insulation except flexible unicellular.

2.03 DUCT INSULATION MATERIALS

A. Rigid Fiberglass Duct Insulation (Indoor application): ASTM C 612, Class 1.

B. Flexible Fiberglass Duct Insulation (Indoor application): ASTM C 553, Type I, Class B-4.

C. Foam Glass Duct Insulation (Outdoor application): ASTM C 240, Type I.

D. Flexible Unicellular Duct Insulation: ASTM C 534, Type II.

E. Jackets for Duct Insulation: ASTM C 921, Type I for duct with temperatures below ambient; Type II for duct with temperatures above ambient.

F. Jackets for outdoor Duct Insulation: Encase exterior duct insulation with 16 MIL aluminum jacket with "Z" closures for weather-proof construction.

G. Duct Insulation Accessories: Provide bands, wires, tape, anchors, corner angles and similar accessories as recommended by insulation manufacturer for applications indicated.

H. Mechanical Fasteners:

1. Gemco Type IH-A from Goodloe E. Moore, Inc., Danville, IL 800-331-1164.

2. Eckoustic-Kiip from Eckel Industries Inc., Cambridge, MA 617-491-3221.

3. INC Stick-Pin from Industrial Noise Control Inc. Addison, IL 312-620-1998.

I. Duct Insulation Compounds: Provide cements, adhesives, coatings, sealers, protective finishes and similar compounds as recommended by insulation manufacturer for applications indicated.

1. 15-141 from King Co., St. Louis, MO 314-772-9953.

2. Tuffbond from Goodloe E. Moore, Inc., Danville, IL 800-331-1164.

3. INC C-700 from Industrial Noise Control Inc., Addison, IL 312-620-1998.

J. J. All external duct wrap shall be 1-1/2" thick, 1.5 P.C.F. density minimum, and is required on all and supply air duct that is not internally insulated with R-5 per IEC - 2003.

2.04 EQUIPMENT INSULATION MATERIALS

A. Rigid Fiberglass Equipment Insulation: ASTM C 612, Class 2.

B. Flexible Fiberglass Equipment Insulation: ASTM C 553, Type I, Class B-4.

C. Cellular Glass Equipment Insulation: ASTM C 552, Type I.

D. Flexible Unicellular Equipment Insulation: ASTM C 534, TYPE II.

E. Jacketing Material for Equipment Insulation: Provide pre-sized glass cloth jacketing material, not less than 7.8 ounces per square yard, and metal jacket except as otherwise indicated.

F. Equipment Insulation Compounds: Provide adhesives, cements, sealers, mastics and protective finishes as recommended by insulation manufacturer for applications indicated.

G. Equipment Insulation Accessories: Provide bands, wire, wire netting, tape, corner angles, anchors and stud pins as recommended by insulation manufacturer for applications indicated.

PART 3 E X E C U T I O N

3.01 INSPECTION

A. Examine areas and conditions under which mechanical insulation is to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer. As a minimum the surface to be installed shall be clean, dry and above the ambient air dew point before and during insulation application.

3.02 PLUMBING PIPING SYSTEM INSULATION

A. Insulation Omitted: Omit insulation on chrome-plated exposed p1p1ng (except for handicapped fixtures), air chambers, unions, strainers, check valves, balance cocks, flow regulators, drain lines from water coolers, drainage piping located in crawl spaces or tunnels, buried piping, fire protection piping, and pre-insulated equipment.

B. Cold Piping:

1. Application Requirements: Insulate the following cold plumbing piping systems:

a. Potable cold water piping.

2. Insulate each piping system specified above with one of the following types and thicknesses of insulation for indoor applications:

a. Fiberglass: 2" thickness.

C. Hot Piping:

1. Application Requirements: Insulate the following hot plumbing piping systems:

   a. Potable hot water piping.

   b. Potable hot water re-circulating piping.

   c. Hot drain piping (where indicated).

2. Insulate each piping system specified above with one of the following types and thicknesses of insulation:

   a. Fiberglass: 1 1/2" thick for pipe sizes up to and including 6", 2" thick for pipe sizes over 6".

   b. Cellular Glass: 1-1/2" thick for pipe sizes up to and including 6", 2" thick for pipe sizes over 6".

3.03 HVAC PIPING SYSTEM INSULATION

A. Insulation Omitted: Omit insulation on hot p1p1ng within radiation enclosures or unit cabinets; on cold piping within unit cabinets provided piping is located over drain pan and on unions, flanges, strainers, flexible connections, and expansion joints.

1. Piping insulation shall be continuous through inside walls, sleeves, ceilings, and floor openings, except for fire rated walls. Packing around pipes with fireproof self-supporting insulating material, to provide full seal is Contractor's responsibility. Insulation on piping through fire-rated walls and floor shall be stopped, beveled, sealed and fire-stopped; refer to Details. At temperatures that are below the space dew point shall be continuous through sleeves and hangers.

2. Piping exposed to outside weather (installed on roof level) shall be covered with 0.02" thick smooth aluminum jacket utilizing longitudinal "zee" closures. Jacket shall be secured at both joints with 2" wide aluminum straps containing permanently plastic sealant. Straps shall be centered over butt joints of jackets. Provide 1/2" wide aluminum bands applied on 12" centers.

B. Chilled Water Piping:

1. Application Requirements: Insulate the following cold HVAC piping systems:

   a. HVAC make-up water piping.

   b. Air conditioner cooling coil condensate drain piping including FCUs.

2. Insulate each piping system specified above with following types and thicknesses of insulation:

3. " Koolphen phenolic foam 2.2 # density as manufactured by FGH Fabricators, Inc. It shall be applied in strict accordance with the manufacturer's recommendations after the pipe has been primed with one (1) coat of Foster No. 60-26 Primer or Pittcoat 300 Primer. It will be necessary to include expansion joints at regular intervals. Thickness shall be as follows:

Pipe sizes up to 1 "	1 1/2 "thick
Pipe sizes 1 " to 2 1/2"	2" thick
Pipe sizes 3" and over	2 1/2" thick

4. Fitting covers shall be built up of shaped segments of Koolphen phenolic foam 2.2 #density". These fitting covers shall be adhered in place using "Foster No. 30-35" vapor seals, then smoothly covered by a one-quarter inch (1/4") thick application of one coat white insulating cement. All this piping and fittings shall be finished with an eight-ounce canvas jacket neatly applied using Arabol adhesive.

5. Valves, fittings, etc., in congested areas around coil and heat exchanger equipment, etc., shall be insulated by building up fitting segments and pre-molded sections, plus white vapor seal mastic, plus Manville No. 301 finishing cement to smooth surfaces, plus canvas applied and sized for painting with fire resistant adhesive. In addition, all manufactured vapor barrier jacketing in mechanical rooms and finished spaces shall be finished with canvas applied and sized for painting with fire resistant adhesive.

6. No chilled water pipe supporting structures shall pierce the insulation except as anchor points as shown on the Drawings. At these points, the anchor member shall occur on the bottom of the piping to allow condensation to drain.

7. The application of the protective shields at rack and guide points in tunnels and in central chilling stations shall be as detailed on the accompanying Drawings.

8. Piping exposed to view, within the Central Plant Room and installed outdoors I and on roof level shall be finished above the insulation with canvas jacket of UL listed fabric of 8 oz. per square yard. Canvas joints and laps shall be glued and sealed with vapor seal mastic and then covered with 0.02" thick smooth aluminum jacket utilizing longitudinal "zee" closures.

C. Hot Piping (to 250 degrees F):

1. Application Requirements: Insulate the following hot low pressure HVAC piping systems (water piping up to 250 degrees F).

   a. HVAC hot water supply and return piping.

2. Insulate each piping system specified above with following types and thicknesses of insulation:

   a. Fiberglass: 1" thick for pipe sizes up to and including 1-1/2", 2" thick for pipe sizes 1-1/2" through 6", (for indoors locations only)

   b. Koolphen phenolic foam 2.2 #density": 1-1/2" thick for pipe sizes up to and including 1 1'2 ", 2" thick for pipe sizes 2" through 6", and larger. (for outdoors locations)

   c. All this piping and fittings shall be finished with an eight-ounce canvas jacket neatly applied using Arabol adhesive.

3. Piping exposed to view, within the Central Chiller Room and installed outdoors shall be finished above the insulation covered with 0.02" thick smooth aluminum jacket utilizing longitudinal "zee" closures.

3.04 DUCT SYSTEM INSULATION

A. Insulation Omitted: Do not insulate exhaust duct, or lined duct.

B. Cold Ducts: Temperatures below the space dew point shall have the insulation vapor barrier be continuous and unbroken through inside walls, sleeves and floor openings. Where connection is made to fire or fire/smoke damper in wall or floor the vapor barrier must extend to the wall or floor to prevent ambient air water vapor from condensing on the cold surfaces of the fire damper.

C. Duct Wrap: Fasten all longitudinal and circumferential laps with outward clinching staples 3" on center. On rectangular ducts over 24" wide, apply as above and hold insulation in place on bottom side with mechanical pins and clips on 12" centers.

D. Duct Wrap: Seal all joints, fastener penetrations and other breaks in vapor barrier with 3 inch wide strips of the same facing materials with factory applied vapor barrier adhesive, or 3 inch wide strips of white glass fabric embedded between two coats of vapor barrier mastic, Childers CP-30 or approved equal.

E. Cold Duct (Below Ambient Temperature):

1. Application Requirements: Insulate the following cold duct:

    a. Outdoor air intake duct between air entrance and fan inlet or HVAC unit inlet.

    b. HVAC supply duct between fan discharge, or HVAC unit discharge, and room terminal outlet.

        1) Insulate neck, backside, and bells of supply diffusers.

    c. HVAC return duct between room terminal inlet and return fan inlet, or HVAC unit inlet.

    d. HVAC plenums and unit housings not pre-insulated at factory or lined.

2. Insulate each duct system specified above with one of the following types and thicknesses of insulation:

    a. Rigid Fiberglass: 2" thick, 3.0 PCF density in machine, fan and equipment rooms or any other exposed indoor locations, or spaces without ceilings etc.

b. Flexible Fiberglass: 1 1/2" thick, 1.5 PCF density with foil faced continuous vapor barrier. This application is limited to concealed indoor locations. The insulation value shall be at least R-5 per IEC 2000 requirements.

c. Foamglass: two (2) layers of 1" thick insulation blocks or 2" thick Armstrong Type II Armaflex flexible elastomeric closed cell sheet insulation or approved equal. (For outdoors locations)

3. Ductwork exposed to view, any other exposed indoor locations, or spaces without ceilings, such as multi-purpose hall and cafeteria etc., installed in the mechanical rooms, AHU rooms, Central Plant room and installed outdoors shall be finished above the insulation with canvas jacket of UL listed fabric of 8 oz. per square yard. Canvas joints and laps shall be glued and sealed with vapor seal mastic such as Foster 30-30 vapor barrier. Only outdoor ducts shall be covered with 0.02" thick smooth aluminum jacket utilizing longitudinal "zee" closures.

3.05 EQUIPMENT AND MISCELLANEOUS PIPING INSULATION

A. Cold Equipment (Below Ambient Temperature):

1. Application Requirements: Insulate the following cold equipment:

a. Roof drain bodies and horizontal runs of storm drain piping.

b. Insulate back side of all ceiling mounted diffusers and plenums.

c. Traps receiving drain from drinking fountain.

2. Insulate each item of equipment specified above with one of the following types and thickness of insulation: Type of insulation for each service is indicated in installation section.

a. Foamglass: 2" thick for cold surfaces below ambient and above 35 degrees F.

b. Cellular Glass: 2" thick for surfaces below ambient and above 35 degrees F.

c. Elasteromic, closed cell sheet insulation such as Armstrong or equal.

B. Hot Equipment (Above Ambient Temperature):

1. Application Requirements: Insulate the following hot equipment:

a. Hot water coil tube bend on air terminal units.

b. Hot water compression tank (Indoor Locations).

2. Insulate each item of equipment specified above with one of the following types and thicknesses of insulation:

a. Fiberglass: 2" thick.

b. Flexible Unicellular: 2" thick. Do not use for equipment operating above 180 °F.

3.06 INSTALLATION OF PIPING INSULATION

A. General: Install insulation products in accordance with manufacturer's written instructions, and in accordance with recognized industry practices to ensure that insulation serves its intended purpose.

B. Install insulation on pipe systems subsequent to installation of heat tracing, painting, testing, and acceptance of tests.

C. Install insulation materials with smooth and even surfaces. Insulate each continuous run of piping with full-length units of insulation, with a single cut piece to complete run. Do not use cut pieces or scraps abutting each other.

D. Clean and dry pipe surfaces prior to insulating. Butt insulation joints firmly together to ensure a complete and tight fit over surfaces to be covered.

E. Maintain integrity of vapor-barrier jackets on pipe insulation, and protect to prevent puncture or other damage.

F. Cover valves, fittings and similar items in each p1p1ng system with equivalent thickness and composition of insulation as applied to adjoining pipe run. Install factory molded, precut or job fabricated units (at Installer's option) except where specific form or type is indicated.

G. Extend piping insulation without interruption through walls, floors and similar piping penetrations, except where otherwise indicated.

3.07 INSTALLATION OF DUCT INSULATION

A. General: Install insulation products in accordance with manufacturer's written instructions, and in accordance with recognized industry practices to ensure that insulation serves its indented purpose.

B. Install insulation materials with smooth and even surfaces.

C. Clean and dry duct prior to insulating. Butt insulation joints firmly together to ensure complete and tight fit over surfaces to be covered.

D. Maintain integrity of vapor-barrier on duct insulation, and protect it to prevent puncture and other damage,

E. Extend duct insulation without interruption through walls, floors and similar duct penetrations, except where otherwise indicated.

F. Duct wrap: Attach external duct wrap on top, sides and bottom of vertical duct and sides and bottom of horizontal duct with full cover coat of cement, duct dimensions up to 16 inches, provide stick clips or screws and cap for dimension over 16 inches, space 16 inches O.C., maximum. Provide canvas cover with two coats of suitable mastic for all wrapped exposed to view ducts. Finish shall be smooth and suitable for painting color selected by Architect.

G. Corner Angles: Except for hood exhaust duct insulation, install corner angles on external corners of insulation on duct in exposed finished spaces before covering with jacketing suitable for painting.

3.08 INSTALLATION OF EQUIPMENT INSULATION

A. General: Install equipment thermal insulation products in accordance with manufacturer's written instructions, and in compliance with recognized industry practices to ensure that insulation serves intended purpose.

B. Install insulation materials with smooth and even surfaces and on clean and dry surfaces. Redo poorly fitted joints. Do not use mastic or joint sealer as filler for gaping joints and excessive voids resulting from poor workmanship.

C. Maintain integrity of vapor-barrier on equipment insulation and protect it to prevent puncture and other damage.

D. Do not apply insulation to equipment while hot.

E. Apply insulation using the staggered joint method for both single and double layer construction, where feasible. Apply each layer of insulation separately.

F. Cover insulated surfaces with all-service jacketing neatly fitted and firmly secured. Lap seams at least 2". Apply over vapor barrier where applicable.

G. Do not insulate manholes, hand holes, cleanouts, ASME stamp, and manufacturer's nameplate. Provide neatly beveled edge at interruptions of insulation.

H. Provide removable insulation sections to cover parts of equipment that must be opened periodically for maintenance; include metal vessel covers, fasteners, flanges, frames and accessories.

I. Equipment Exposed to Weather: Protect outdoor insulation from weather by installation of weather-barrier mastic protective finish, and jacketing, as specified.

END OF SECTION

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SECTION 15410

PLUMBING PIPING & VALVES

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Pipe and pipe fittings.

B. Valves.

C. Sanitary sewer piping system.

D. Domestic water piping system.

1.02 MEASUREMENT AND PAYMENT

A. No separate payment will be made for work under this section. Include payment in the Lump Sum Base Bid Price.

1.03 REFERENCES

A. ANSI B31.1 -Power Piping.

B. ANSI B31.9- Building Service Piping.

C. ASME Sec. 9 - Welding and Brazing Qualifications.

D. ASME B16.1 -Cast Iron Pipe Flanges and Flanged Fittings Class 25, 125, 250 and 800.

E. ASME B16.3- Malleable Iron Threaded Fittings.

F. ASME B16.4- Cast Iron Threaded Fittings Class 125 and 250.

G. ASME B16.22 - Wrought Copper and Bronze Solder-Joint Pressure Fittings

H. ASTM A47- Ferritic Malleable Iron Castings.

I. ASTM A53 - Pipe, Steel, Black and Hot-Dipped Zinc Coated, Welded and Seamless.

J. ASTM A74- Cast Iron Soil Pipe and Fittings.

K. ASTM B32 - Solder Metal.

L. ASTM B42 - Seamless Copper Pipe.

M. ASTM B306- Copper Drainage Tube (DVW}.

N. AWWA C111- Rubber-Gasket Joints for Ductile Iron and Gray-Iron Pressure Pipe and Fittings.

O. AWWA C651- Disinfecting Water Mains.

P. CISPI 301 -Cast Iron Soil Pipe and Fittings for Hubless Cast Iron Sanitary Systems.

Q. CISPI 310- Joints for Hubless Cast Iron Sanitary Systems.

1.04 SUBMITTALS

A. Submit under provisions of Section 01330 - Submittals.

B. Product Data: Provide data on pipe materials, Pipe fittings, valves, and accessories. Provide manufacturers catalog information. Indicate valve data and ratings.

1.05 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Division I.

B. Record actual locations of valves.

1.06 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Division I.

B. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.

1.07 QUALITY ASSURANCE

A. Valves: Manufacturer's name and pressure rating cast or marked on valve body.

B. Welding Materials and Procedures: Conform to ASME Code and applicable state labor regulations.

C. Welders Certification: In accordance with ASME Sec 9.

D. Foreign pipe, fittings or valves must be manufactured per USA standards and must meet with all applicable ASTM standards.

E. Piping shall be labeled along entire length indicating size, class, material specification, manufacturers name and country of origin.

1.08 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum 5 years documented experience and must be a domestic manufacturer.

B. Installer: Company specializing in performing the work of this section with minimum 5 years documented experience.

1.09 REGULATORY RE QUIREMENTS

A. Perform Work in accordance with plumbing and building codes having jurisdiction.

B. Conform to applicable codes for the provision and installation of all required backflow prevention devices.

C. Provide certificate of compliance from authority having jurisdiction indicating approval of installation of backflow prevention devices .

1.10 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products to site under provisions of Division One.

B. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

C. Provide temporary protective coating on cast iron and steel valves.

D. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

E. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system. Tape will not be allowed as an acceptable end cover.

1.11 EXTRA MATERIALS

A. Furnish under provisions of Division One.

B. Provide two re-capping kits for each size valve.

PART 2 PRODUCTS

2.01 SANITARY SOIL, WASTE, STORM WATER, AND VENT PIPING, WITHIN BUILDING

A. Cast Iron Pipe (above Grade and vent pipe): ASTM A 74, Hubless, service weight.

1. Fittings: Cast iron, ASTM A 888 drainage pattern.

2. Joints: No hub, ASTM C 564 neoprene gaskets and standard stainless steel clamp and solid shield assemblies constructed of type 300 series stainless steel. Clamp assemblies shall conform to FM 1680 where required by the administrative authority.

B. PVC Pipe (Below Grade): Schedule 40 PVC, conform to ASTM D-1785 Soil and Waste Vent piping. Fittings shall be compatible material with solvent cement type joints.

PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311 drain, waste, and vent pipe patterns with solvent-cemented joints.

C. Soil and Waste Vent piping

1. For Piping 1-1/2 Inches and Smaller: Provide DWV copper or Schedule 40 galvanized pipe and fittings. For piping 2 inches and larger, use cast iron soil pipe and fittings, same as Above Slab Piping indicated above. Pipe must conform to ASTM A-74.

D. Copper Tubing: ASTM B 306, DWV, sizes 2" and smaller.

1. Fittings: ASME B 16.23 cast bronze, or ASME B16.29, wrought copper.

2. Joints: ASTM B 32, solder, Grade 50B.

2.02 DOMESTIC WATER PIPING, WITHIN BUILDING, ABOVE GRADE

A. Copper Tubing: ASTM B 88, Type L, hard drawn for domestic hot and cold water distribution.

1. Fittings: ASME B 16.18, cast bronze, or ASTM B 16.22 wrought copper alloy.

2. Joints: ASTM B 32, solder.

B. Building Entry.

1. Pipe and fitting material shall be ductile iron per ASTMA-377 -89, from building entry up to 5 feet from the building. Pipe material beyond 5 feet from the building shall be schedule 40 PVC or C900.

2. All piping fitting shall be per ASTM A-126 .

2.03 FLANGES AND UNIONS

C. Pipe size 2 inches and under:

1. Ferrous pipe: ANSI B16.39, 150 psig malleable iron threaded unions.

2. Copper tube and pipe: 150 psig bronze unions with soldered ends.

3. 3. Ferrous pipe: ANSI B16.5, 150 psig forged steel flanges; screwed neck, 1/16" thick pre-formed neoprene gaskets.

D. Pipe size 2-1/2 inches and larger:

1. Ferrous pipe: 150 psig forged steel slip-on flanges; weld neck, 1/16" thick pre-formed neoprene gaskets.

2. Copper tube and pipe: 150 psig slip-on bronze flanges; 1/16" thick pre-formed neoprene gaskets.

E. Dielectric Connections:

1. Pipe size 2 inches and under: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

2. Pipe size 2-1/2 inch and larger: flange, connection as above, with water impervious isolation barrier.

2.04 GATE VALVES

A. Manufacturers:

1. Nibco No. T-111 up to 2-1/2"; F-617-0 3" and over.

2. Other acceptable manufacturers offering equivalent products.

a. Crane No. 428 up to 2-1/2"; 465-1/2 3" and over.

b. Stockham No. B-100 up to 2-1/2"; G-623 3" and over.

c. Grinnell No. 3010 up to 2-1/2"; 6020A 3" and over.

d. Watts.

B. Up to and including 2-1/2" Inches: Bronze body, bronze trim, non-rising stem, handwheel, inside screw, solid wedge threaded ends.

C. Over 3" Inches: Iron body, bronze trim, rising stem, hand wheel, OS&Y, solid wedge, flanged ends.

D. Provide bronze tee or cast iron square nut operator for all valves installed below ground.

1. Valves 2-1/2" and smaller shall be equipped with ASTM B62 solid red bronze tee securely affixed to the valve stem.

2. Valves 3" and larger shall be equipped with a standard 2" square combination nut/socked securely affixed to the valve stem.

3. Provide owner with two extended tee handle operating wrenches for each type of valve head installed.

2.05 BALL VALVES

A. Manufacturers:

1. Nibco No. T-585-70

2. Other acceptable manufacturers offering equivalent products.

a. Crane No. 9302.

b. Stockham Model S-216.

c. Grinnell No. 3700.

d. Watts.

B. Up to and including 2 Inches: Bronze two piece body, stainless steel ball, Teflon seats and stuffing box ring, lever handle and balancing stops, threaded ends with union.

2.06 SOLDER

A. 95.5% tin, 4% copper, 0.5% silver.

B. Lead free, antimony free, zinc-free.

C. Silvabrite 100, by Engelhard Corporation or approved equal.

PART 3 E X E C U T I O N

3.01 EXAMINATION

A. Coordinate and verify excavations under provisions of Division Two.

B. Verify that all excavations are to the required grade, dry, and not over-excavated .

3.02 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Remove scale, oil and dirt, on inside and outside, before assembly.

C. Prepare piping connections to equipment with flanges or unions.

D. Install, clean bank sand backfill in trench to a minimum of 6 inches below pipe, and to cover all piping a minimum of 12 inches above pipe.

3.03 INSTALLATION

A. Install all materials in accordance with manufacturer's published instructions.

B. All exposed sewer and water pipe in toilet rooms or other finished areas of the building shall be chromium plated.

C. Provide non-conducting dielectric connections wherever jointing dissimilar metals.

D. Route piping in orderly manner, parallel and perpendicular to building column grid lines, unless indicated otherwise on drawings, and maintain gradients.

E. Install piping to conserve building space and not conflict with other trades or interfere with intended use of space.

F. Group piping whenever practical at common elevations.

G. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

H. Provide clearance for installation of insulation and access to valves and fittings.

I. Provide access doors where valves and operable fittings are not exposed. Access doors shall be of approved types set in locations pre-approved by submittal to the Architect.

J. Establish elevations of buried piping outside the building to ensure not less than 2 feet of cover, or maximum depth of frost penetration, which ever is the greater.

K. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.

L. Prepare pipe, fittings, supports, and accessories not pre-finished, ready for finish painting.

M. Excavate in accordance with Division II.

N. Backfill in accordance with Division II.

O. Install bell and spigot pipe with bell end upstream.

P. Maintain uniformity in the installation of piping materials and joining methods. Do not mix materials types.

Q. Install valves with stems upright or horizontal, not inverted.

R. Solder joints shall be wiped clean at each joint, remove excess metal while molten and flux residue when cooled.

3.04 APPLICATION

A. Use ball valves for pipe size up to and including 2" size and gate valve for 2 Y2" and larger for all domestic cold and hot water service. Install above ceiling shut off valves within 12" above ceiling in inverted position for easy access.

B. Install unions downstream of valves and at all equipment or apparatus connections.

C. Install brass male adapters each side of valves in copper piped system. Sweat solder adapters to tube prior to make-up of threaded connections.

D. Install gate valves for shut-off and to isolate all equipment items, distinct parts of systems, or vertical risers.

E. Each plumbing fixture shall have a shut-off valve on each hot water and cold water supply line.

F. Each plumbing water rough-in stub out shall be fitted with a shut off valve.

G. Install globe, ball or butterfly valves for throttling, bypass, or balancing (manual flow control) services.

H. Ball valves installed in insulated piping shall be fitted with extended lever operators of sufficient length to raise handle above the insulation jacket material. Where valve is used for throttling service valve handle shall be equipped with adjustable memory stop device .

3.05 ERECTION TOLERANCES

A. All drainage lines in the building shall have 1/4 inch to the foot, fall where possible and not less than 1/8 inch to the foot fall toward the main sewer. Pipe must be so laid that the slope will be uniform and continuous. Permission shall be secured from the Architect and Engineer before proceeding with any Work where existing conditions prevent the installation at minimum grade specified.

B. Slope all water piping and arrange to drain at low points. Provide loose key operated, polished chrome, sill cock flush to wall where fixture stop will not suffice for this requirement.

3.06 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

A. Prior to starting work, all domestic water systems shall be complete, thoroughly flushed clean and free of all foreign matter or erection residue.

B. Ensure PH of water to be treated is between 7.4 and 7.6 by adding alkali (caustic soda or soda ash) or acid (hydrochloric).

C. On building side of the main shut off valve, provide a 3/4" connection through which chlorine can be introduced into the water piping

D. Inject disinfectant, free chlorine in liquid, powder, tablet or gas form, in sufficient quantity to obtain 50 to 80 mg/L residual free chlorine solution throughout the entire domestic water piping systems.

E. Bleed water from outlets as required to ensure complete distribution and test for disinfectant residual at a minimum 15 percent of total outlets.

F. Maintain disinfectant in system for 24 hours.

G. If final disinfectant residual tests less than 25 mg/L, repeat treatment.

H. Flush disinfectant from system until residual equal to that of incoming water or 1.0 mg/L.

I. Take samples no sooner than 24 hours after flushing, from 5 percent of outlets and from water entry, and analyze in accordance with AWWA C651.

3.07 SERVICE CONNECTIONS

A. Provide new sanitary sewer service connecting to services or utility lines as shown on the civil drawings.

B. Before commencing work, field verify invert elevations required for sewer connections, confirm inverts and ensure that these can be properly connected with slope for drainage and cover as required.

C. Should points of connection vary from those indicated on the drawings contractor shall properly allow for this in the actual connections field fabricated.

3.08 RODDING SEWERS

A. All sanitary soil and waste lines, both in the building and out, shall be rodded out after completion of the installation.

B. This Work shall be done, as part of the contract, to make certain that all lines are clear, and any obstruction that may be discovered shall be removed

immediately. Rodding shall be accomplished by utilizing a rotary cutter which shall be full size of pipe being cleaned.

3.09 TESTING OF PIPING SYSTEM

A. Domestic Water: Pressure test at one and one half times the normal working pressure for 24 hours. Repair any discovered leaks and repeat test procedure. When the test is found to be acceptable, project manager will issue a written approval of test.

B. Sanitary and Storm Sewer: Seal open ends of pipe, test with smoke bomb for leaks prior to cover-up. Contractor to perform a smoke test sufficient to fill all waste and vent lines. This test is to be done after all sanitary fixtures are set but before city inspection. When the test is found to be acceptable, project manager will issue a written approval of test.

3.010 COMPLETE FUNCTIONING OF WORK

A. All work fairly implied as essential to the complete functioning of the systems shown on the Drawings and Specification shall be completed as part of the work of this Division unless specifically stated otherwise. It is the intention of the Drawings and Specification to establish the type and function of systems but not to set forth each item essential to the functioning of any system. In case of doubt as to the work intended or in the event of amplification or clarification thereof, the Contractor shall call upon the Architect for Supplementary Instructions and Drawings, etc.

END OF SECTION

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SECTION 15442

DRAINS, HYDRANTS, CLEANOUTS

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. This section provides requirements for furnishing and installing floor drains, roof drains, hydrants, hose bibbs, cleanouts, and trap primers.

1.02 MEASURMENT AND PAYMENT

A. No separate payment will be made for work under this section. Include payment in the Lump Sum Base Bid Price.

1.03 SUBMITTALS

A. Submittals shall be in accordance with Section 01330.

PART 2 P R O D U C T S

2.01 ACCEPTABLE MANUFACTURERS

A. J. R. Smith.

B. Zurn.

C. Josam.

D. Wade.

2.02 2.3 ACCEPTABLE MANUFACTURERS- CLEANOUTS

A. J. R. Smith.

B. Josam.

C. Wade.

D. Substitutions: Under provisions of Division One.

PART 3 E X E C U T I O N

3.01 INSTALLATION

A. Install in accordance with manufacturer's recommendations and as shown on the drawings.

END OF SECTION

SECTION 15810

THERMOSET FIBERGLASS-REINFORCED PLASTIC DUCTS

PART 1 G E N E R A L

1.01 DESCRIPTION

A. Drawings and general provisions of the Contract, including General Conditions and Division 1 Specification Sections, apply to this Section. This Section includes thermoset fiberglass-reinforced plastic (FRP) ductwork and accessories.

B. System Description

1. Work includes providing odor control ductwork to connect the new odor control fan system intakes and exhaust to existing ductwork at the new Fan Building and new ductwork at the Biotrickling Filter facility.

1.02 MEASUREMENT AND PAYMENT

A. Unless noted in the Bidsheet, no separate payment will be made for Work under this Section. Include payment for applicable work as noted on the Bidsheet.

B. Refer to Section 01270 – Measurement and Payment.

1.03 RELATED SECTIONS

A. Section 15990 – Testing, Adjusting, and Balancing of HVAC.

1.04 SUBMITTALS

A. Product Data:

1. Thermoset FRP duct materials
2. Duct fittings
3. Volume dampers
4. Access doors
5. Flexible connectors

6. Gaskets
7. Supports
8. Test ports
9. Drains
10. Vacuum hose and accessories

B. Indicate compliance to standards, structural loadings, chemical exposures, and environmental exposures referenced in this Section.

1.05 QUALITY ASSURANCE

A. Ductwork shall be in compliance with SMACNA's "Thermoset FRP Duct Construction Manual."

B. Ductwork shall be in compliance with ASTME84/NFPA 255. Ductwork system shall have a flame spread rating of 25 or less.

C. Ductwork shall be fabricated and installed by experienced and qualified mechanics who have a minimum of five years experience with the type of material and products specified herein.

D. Ductwork shall withstand the following structural design conditions:

1. Minimum Operating Static Pressure: 8-inch wg negative.
2. Operating Temperature Range: 20°F to 120°F.
3. Wind Load: 140 mph (ASCE 7-05, Category II)
4. Seismic Load: Design category "D", Seismic Importance Factor, I=1.0
5. Other: 200-lbf load at vacuum hose connection.

E. Ductwork shall withstand exposure to the following:

6. 200 ppm H_2S maximum, 100 ppb maximum mercaptans, and 100 ppb organic sulfides maximum, in an air stream saturated with water vapor from sanitary lift stations.
7. Ultraviolet radiation and ozone.

F. Ductwork system shall be in compliance with NFPA 91.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Duct and fittings shall be protected from damage during shipment and handling. Properly support during shipping and storage to avoid flex strains. Firmly fasten and pad components shipped to prevent shifting of the load or flexing of components while in transit.

B. Do not ship ducting by nesting small diameter components inside larger diameter components.

C. Flanged and open ends of ducting shall be covered to prevent entrance of dirt, water and debris.

D. The ductwork shall be received and unloaded at the site in accordance with the manufacturer's instructions. If ductwork is not to be installed immediately upon delivery, it shall be stored in a dry location and protected from extreme temperatures, moisture and accidental damage.

PART 2 P R O D U C T S

2.01 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified or approved equal.

2.02 THERMOSET FRP DUCTS

A. Manufacturers:

1. Spunstrand Inc.

2. Viron International

B. Glass-fiber-reinforced plastic with a minimum of 3/16-inch wall thickness. Duct diameters shown on the Drawings are nominal inside diameters.

C. Fabrication:

3. Straight, Rectangular-Duct Seams: Glass tape and resin reinforced.

4. Round Ducts: Molded on mandrel with continuous wound glass filaments.

5. Section and Fitting Connectors: Sleeves or belled ends, and epoxy.

D. Fitting Fabrication:

1. Round Elbows: F ive-piece, mitered construction with centerline radius at least one-and-a-half times the diameter.

2. Branch Connections to Main Ducts: 45-degrees from centerlines of main ducts.

3. Transitions: Minimum taper of 3:1 length change to diameter.

4. Offsets: 45-degrees from centerlines of straight ducts.

E. Flange Fabrication:

1. Adhered to ducts with epoxy.

2. Fabricated from 1/4-inch thick FRP at least 2-inches wide.

3. Gaskets: F ull face, 1/8-inch thick, flexible rubber, EPDM, or other material suitable for application and environment.

4. Flange Bolts, Nuts, and Washers: Type 316 stainless-steel.

F. Supports and Hangers:

1. Vertical Ducts: Structural channels and clamps under 1/2-inch flanges adhered with epoxy to outside of ducts.

2. Horizontal Ducts: Split rings and rod hangers.

3. Hanger types: Suspend duct attachments from building attachments with one of the following hanger types unless otherwise specified on the Drawings:

a. Type 316 stainless-steel metal straps, minimum of 3/16-by-3-inch wide.

b. Type 316 stainless-steel rods, 1/4-inch in diameter, threaded along entire length.

4. Drains: Formed drain pocket with 1-inch threaded pipe connection and plug valve.

5. Volume Dampers:

   a. Single blade, flanged inlet and outlet.

   b. Suitable for horizontal or vertical applications.

   c. Lockable positions to accommodate testing and balancing.

6. Access Doors:

   a. Dimensions: 6-inch x 6-inch.

   b. Gasket: PVC foam.

   c. Fasteners: Type 316 stainless-steel.

7. Flexible Connectors:

   a. Material: Hypalon.

   b. Length: 6-inches between both parts to be connected, with enough slack material to prevent vibration transmission when system is in operation.

   c. Clamps: Two Type 316 stainless-steel, gear-drive bands.

   d. Weight: 24-oz/yd^2.

   e. Thickness: 0.020-inches.

   f. Tensile Strength: 250-lb X 275-lb.

   g. Tear Strength: 13-lb X 13-lb.

8. Marking:

   a. Identify each duct component with the fabricator's name, resin, minimum thickness and date of manufacture.

   b. Use permanent marking. Seal decals and labels into laminate exterior with resin.

   c. For piece marking used for installation, use oil-based paint for easy removal.

9. Screens:

    a. Stainless-steel wire screens with two meshes per square inch shall be provided at each duct opening.

10. Vacuum Hose:

    a. Material: S mooth- bore, 30-mil thermoplastic rubber reinforced with a wire helix.

    b. Length: Minimum 5-feet.

11. Accessories.

    a. Clamps: Type 316 stainless-steel, gear-drive bands.

    b. Quick-connect couplings: Type 316 stainless steel

    c. Swivel Ball Joint: Type 316 stainless steel.

12. Finish coating: Apply to duct exterior. Coordinate finish color with City.

PART 3 E X E C U T I O N

3.01 INSTALLATION

A. Install ducts with fewest possible joints.

B. Install ducts, unless otherwise indicated, vertically and horizontally and parallel and perpendicular to building lines; avoid diagonal runs.

C. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

D. Install ducts with a minimum clearance of 1-inch from non-combustible materials and a minimum of 18-inches from combustible materials. Clearance from combustible materials may be reduced as indicated in NFPA 91.

E. Install ducts so that no metals penetrate duct system.

F. Install flanges at locations that facilitate replacement or removal of ductwork, equipment, and accessories as needed to accommodate periodic maintenance and at locations specified on the Drawings.

G. Slope ducts as specified on the Drawings.

1. Duct accessories installation:

a. Reinforce and support equipment and duct accessories for additional weight without damage to ducts.

b. Install volume-control dampers and operators on same sleeves or mounting plates and allow full 90-degree quadrant movement.

c. Install access panels or doors at locations specified on the Drawings and no more than 12-inches away from duct drain connections.

d. Connect ducts to equipment using stainless steel metal washers and screws or mechanical fasteners attached to flange extensions.

e. Install flexible connector at locations specified on the Drawings.

f. Install drains at the bottom of the lowest ducts and at locations specified on the Drawings.

g. Attach vacuum hose as indicated on the Drawings. Coordinate hose length with City's qualified plant operators. Installed hose shall not be stretched or compressed to the extent where ventilation rate is not achieved or hose becomes damaged.

h. Install test ports in ductwork at locations shown on the Drawings or as required for testing, adjusting, and balancing.

2. Attach hangers to joints and reinforcing channels that occur within required hanger spacing. Attach hangers to transmit load to sides and bottom channels and no more than 6 inches from sides of ducts.

3. Support equipment such as fume hoods, accessories, etc. independent of ducts.

4. Coatings: Apply to duct exterior. Coordinate finish color with City.

3.02 GROUNDING

A. Ground ductwork to dissipate potential accumulation of static electricity. Coordinate with applicable requirements of Division 16.

3.03 CLEANING

A. Vacuum-clean ducts prior to energizing system. Ducts shall be free of debris, tools, or other items that can obstruct air flow or damage exhaust fan.

3.04 TESTING & BALANCING

A. Refer to Section 15990 for testing, adjusting, and balancing procedures.

END OF SECTION

SECTION 15985

DDC CONTROLS

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Control Equipment and Hardware.

B. Control Software (where applicable).

1.02 MEASUREMENT AND PAYMENT

A. No separate payment will be made for work under this section. Include payment in the Lump Sum Base Bid Price.

1.03 GENERAL

A. General: The Conditions of the Contract and applicable requirements of Division 1 and Section 15010 govern this Section.

B. Description: Furnish, install and place in operation DOC Control System.

The system shall include the following:

1. A system of direct digital or electronic controls with electronic sensing, with electronic actuation and software-based control algorithms.

2. Control and interlock wiring.

3. Calibration, testing and acceptance.

1.04 REFERENCE STANDARDS

A. The latest edition of the following standards and codes in effect and amended as of supplier's proposal date, and any applicable subsections there of, shall govern design and selection of equipment and material supplied:

1. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE).

2. Applicable ANSI/ASHRAE Standard.

3. Uniform Building Code (UBC), including local amendments.

4. UL 864 and UL 916 Underwriters Laboratories Standard for Energy Management Equipment. Canada and the US.

5. National Electrical Code (NEC).

6. FCC Part 15, Subpart J

7. EMC Directive 89/336/EEC

8. IS0-9000 certified manufacturer

B. City, county, state, and federal regulations and codes in effect as of contract date.

C. Except as otherwise indicated the Contractor shall secure and pay for all permits, inspections, and certifications required for this work and arrange for necessary approvals by the governing authorities.

1.05 SUBMITTALS

A. Submittals shall be in accordance with Section 01330.

B. Drawings

1. The vendor shall submit engineered drawings, control sequence, and bill of materials for approval.

2. Drawings shall be submitted in the following standard sizes: 11" x 17" (ANSI B).

3. Ten complete sets (copies) of submittal drawings shall be provided.

4. Drawings shall be submitted with an electronic version available on floppy disk or CD-ROM, as specified.

C. System Documentation System documentation by the vendor shall include the following as a minimum:

1. System configuration diagrams in simplified block format.

2. All input/output object listings and an alarm point summary listing.

3. Electrical drawings that show all system internal and external connection points, terminal block layouts, and terminal identification.

4. Manufacturer's instructions and drawing for installation, maintenance, and operation of all purchased items.

5. Overall system operation and maintenance instructions-including preventive maintenance and troubleshooting instructions.

6. For all system elements-operator's terminal(s), network controller(s), local digital logic controllers, routers, repeaters, and converters etc.

7. Provide complete description and documentation of any proprietary services and/or objects used in the system.

1.06 SCHEDULING AND COORDINATION

A. The vendor shall provide a detailed project design and installation schedule with time markings and details for hardware items and software development phases.

B. The schedule shall show all the target dates for transmission of project information and documents and shall indicate timing and dates for system installation, debugging, and commissioning.

1.07 WARRANTY

A. A. Warranty shall cover all costs for parts, labor, associated travel, and expenses for a period of one year from completion of system acceptance.

B. Hardware and software personnel supporting this warranty agreement shall provide on-site or off-site service in a timely manner after failure notification to the vendor. The maximum acceptable response time to provide this service at the site shall be 24 hours.

C. This warranty shall apply equally to both hardware and software.

1.08 OPERATING AND MAINTENANCE MANUALS

A. Prepare 8 Y2 " inch x 11" three-ring binder containing the following items in "as-built" form in accordance with Section 01782:

1. "As-Built" Drawings indicating detailed schematics.

2. Technical data sheets on all system components with part number and supplier information.

3. Software documentation including application code and Sequence of Operation.

4. Listing of all connected points including physical address, location and all neomonics.

5. Operating instructions.

6. Maintenance instructions.

7. Color-coded floor plans indicating location of major system components and zones of control.

8. Complete trouble shooting procedures, diagrams and guidelines.

PART 2 P R O D U C T S

2.01 AUTOMATIC TEMPERATURE CONTROL SYSTEM

A. Furnish and install a complete system of Automatic Temperature Control. The temperature control system shall be provided with the electrical interconnections as required to accomplish control action as hereinafter specified.

B. All control devices and equipment shall be guaranteed to be free from defects in workmanship and materials, under normal use and service, for a period of one year from the Date of Substantial Completion. If, within one year from the Date of Substantial Completion, any of the equipment herein is proved to be defective, in workmanship of material, it shall be replaced or repaired, at no cost to the City.

C. After completion of the installation, the Automatic Control manufacturer shall regulate and adjust all thermostats, control valves and other equipment provided under this Contract; shall place them in complete operating condition, subject to the approval of the City and shall provide services incidental to the proper performance of the temperature control system under the guarantee outlined above.

D. All wiring in connection with the temperature control system and all mounting of electrical control devices shall be performed by the electrical contractor as noted under the electrical specifications.

E. All wiring in connection with the temperature control system and all mounting of electrical contractor devices shall be performed by the electrical contractor as noted under the electrical specifications.

F. Condensing Units: Shall be interlocked electrically, as required by manufacturer of the equipment furnished for the project. The condensing unit manufacturer shall submit to the control manufacturer a complete interlock wiring diagram showing all terminal connections for interlocking all equipment associated with the operations of the refrigeration machinery, including PE switches, etc. This interlock wiring diagram shall be incorporated into the composite wiring diagram to be furnished by the control manufacturer. The condensing unit manufacturer shall be responsible for the proper wiring and operation of his equipment.

G. Complete motor control and interlock wiring diagrams for the refrigeration machinery, condenser fans, air handling units, safety devices etc., incorporating thereon the electrical devices of the automatic control system, shall be prepared and submitted to the City for approval.

2.02 LOCAL DIGITAL LOGIC CONTROLLER

A. Digital local controllers units shall provide intelligent, stand alone control of HVAC system. Each unit shall have its own internal memory and will continue to operate all local control functions in the event of a failure to any Network controller. In addition, it shall be able to share information with and from the entire network for full control. Digital controller has its own on-board CPU, RAM, and ROM, laptop communication port, and network connection to the field bus. The Digital controller contains its own on-board 1/0 for complete standalone operation.

B. Digital local controller shall have capability to call out alarm conditions automatically. Alarm message and site description shall be sent to network controller. All Digital local controller connected to the local LAN shall be capable of calling out alarm messages through one or more shared modems connected to one or more of the network controllers on the local LAN.

C. Each local controller shall be capable of performing an optimum start. Optimum start calculation shall be based on outside air temperature, zone air

temperature, deviation from zones, daytime heating and cooling set points, and individual zone adaptive heating and cooling coefficients that are adjusted each day based on performance parameters of the individual zone.

D. Control programs shall be stored in memory. Each Digital controller shall have the intelligence to perform all control strategies, without communication to other controllers, for control functions not requiring data from other controllers.

E. Each Digital controller shall be able to have its program edited and/or modified either locally through a laptop computer or through a workstation connected to a Network controller. Each Digital controller shall complete its internal scan in less than one second. Each scan shall consist of updating of inputs, importing of data from other controllers, performing mathematical calculations and sequencing appropriate outputs for local loop control.

F. Connect all split DX units, supply fans, local temperature control system, filters differential pressure signal and operation of the outside air modulating damper with C02 sensors to this local digital logic controller and provide sequence of operation as indicated in this section.

2.03 ROOM THERMOSTAT

A. Low-voltage thermostat and sub base to control unit compressor and its evaporator fan. Thermostat shall be 7 day programmable with auto- changer, LED display, service filter indicator, adjustable heat I cool set point limiting, and in accordance with IEC - 2000 set back requirements.

B. Wall sensor shall use solid-state sensor identical to digital controller and shall be packaged in aesthetically pleasing enclosure. Sensor shall provide override function, warmer/cooler lever for set point adjustment and jack for plug-in for field adjustments. Override time shall be stored in controller and be adjustable on a zone-by-zone basis. Adjustment range for warmer/cooler lever shall also be stored in EEPROM on controller. All functions of digital display controller shall be available through wall sensor port.

2.04 DIFFERENTIAL AIR PRESSURE SWITCH

A. Furnish and install static air pressure differential switch to monitor status of fans and Packaged units and for dirty filter alarms. This information shall be relayed to the logic controller.

B. Provide a differential pressure switch with a set point trip adjustment over, at minimum, 80% of operating range with a dead band of not more than 10% of operating range. Operating range as suitable for the application.

C. For high duct static applications, manual reset shall be provided.

D. Over pressure input protection to a minimum five times rated input.

2.05 CONTROL RELAYS

A. Provide start/stop control relays rated for a minimum of ten (10) million mechanical operations and a minimum of 500,000 electrical operations.

B. Provide relays with dust proof housing.

C. Shock and vibration protection as necessary.

2.06 DAMPER ACTUATORS

A. Damper actuators shall be direct coupled to the damper shaft. Each actuator shall be selected with the proper spring to ensure consistent operation over the desired nominal operating span. The actuator assembly shall include the necessary hardware and brackets to allow proper mounting and connection to a standard Y:z" diameter damper shaft.

B. Dampers mounted in out door applications shall have sufficient weatherproof enclosures and shall be electrically activated.

C. Damper end switch: Furnish actuators with integral end switches where required to interlock damper operation with fans. Typically, fan shall not start unit damper is fully open. The end switches must be adjustable.

2.07 AUTOMATIC DAMPERS

A. Provide Automatic control dampers on all the 100% outside air supply units intake. Automatic control dampers shall be Ruskin CD60 or equal, construction as follows:

1. Frame - 16 gauge galvanized steel.

2. Blades- 15 gauge equivalent.

3. Seals - Vinyl edge seals and flexible metal jamb seals.

4. Bearing - Stainless steel sleeve.

PART 3 E X E C U T I O N

3.01 WORK PERFORMANCE

A. The mechanical s ubcontractor shall install all control valves, dampers, pressure taps, temperature sensing wells and related equipment.

B. The electrical subcontractor shall provide all power wiring to starters for operation in the hand position, power wiring to control panels and wiring associated with emergency shut-down from the smoke detectors.

3.02 INSTALLATION (GENERAL)

A. Install in accordance with manufacturer's instructions.

B. Provide all miscellaneous devices, hardware, software, interconnections installation and programming required to ensure a complete operating system in accordance with the sequences of operation.

3.03 LOCATION AND INSTALLATION OF COMPONENTS

C. Locate and install components for easy accessibility; in general, mount with minimum 3'-0" clear access space in front of units. Obtain approval on locations from City's representative prior to installation.

D. All instruments, switches, transmitters, etc., shall be suitably wired and mounted to protect them from vibration, moisture and high or low temperatures.

E. Identify all equipment and panels. Provide permanently mounted tags for all panels.

3.04 INTERLOCKING AND CONTROL WIRING

A. Provide all interlock and control wiring. All wiring shall be installed neatly and professionally, in accordance with Specification Division 16 and all national, state and local electrical codes.

B. Furnish and install all power, control interlock wiring (fire alarm interlocks, freeze protection, high and low static pressure limits, etc.), circuit breakers and appurtances required for a complete, functioning control system. Installation shall conform to Division 16. Power for the controls shall be obtained from the

nearest electrical panel having available capacity. Circuits for the control system shall be clearly marked at the panel directory and on the electrical record drawings.

1. The system shall consist of 2 areas of installation:

    a. Low Voltage Wiring: All low voltage wiring (24v or less) shall be no less that #16 conductor twisted pairs of stranded wire. All analog input points shall be shielded regardless of length. All low voltage wiring will be run concealed (out of sight) in areas outside of equipment and mechanical rooms. Within equipment and mechanical rooms and exposed areas, the low voltage cable will be run in EMT conduit with compression fittings for protection. All low voltage wiring above 8 feet that is concealed (out of sight) can be run without conduit. Control wiring run in air plenums will require the use of UL approved plenum rated cable. Provide grounding as required.

    b. Line Voltage Wiring: All line voltage wiring (greater than 24v) will be #12 THHN AWG or larger and will be run in EMT conduit with compression fittings.

C. All safety circuits (fire alarm, freeze protection, high and low static pressure, etc.). Shall be hard wired and perform their control safety functions independent of the logic controllers.

D. Permanently mark terminal blocks for identification. Protect all circuits to avoid interruption of service due to short-circuiting to other conditions. Line-protect all wiring that comes from external sources to the site from lightning and static electricity.

E. Label or code each field wire at each end. Permanently label or code each point of all field terminal strips to show the instrument or item served. Color-coded cable with cable diagrams may be used to accomplish cable identification.

F. Grounding shall be in accordance with NFPA 70. All ground wire shall be bare copper.

G. Provide wiring as required by functions as specified and as recommended by equipment manufacturers, to serve specified control functions.

H. Control wiring shall not be installed in power circuit raceways. Magnetic starters and disconnect switches shall not be used as junction boxes. Provide auxiliary junction boxes as required. Coordinate location and arrangement of all control equipment with the City's representative prior to rough-ins.

I. Provide auxiliary pilot duty relays on motor starters as required for control function.

J. Provide power for all control components from nearest electrical control panel or as indicated on the electrical drawings. Coordinate with electrical contractor. However, it is responsibility of control contractor to supply and install all or additional power wiring from the nearest available power source.

3.05 FIELD SERVICES

A. Prepare and start logic control system under provisions of this section.

B. Start-up and commission systems. Allow sufficient time for start-up and commissioning prior to placing control systems in permanent operation.

C. Provide City's Representative with spare parts list. Identify equipment critical to maintaining the integrity of the operating system.

3.06 DEMONSTRATION

A. Provide systems demonstration under provisions of Section 15010.

B. Demonstrate complete operating system to City's representative.

C. Provide certificate stating that control system has been tested and adjusted for proper operation.

PART 4 SEQUENCE OF OPERATION

4.01 SPLIT DX UNITS (AHU's 1, 2, 3, 5 & 6)

A. OCCUPIED MODE

When the AHU is in the occupied mode, the Supply Fan will operate continuously and the outside air damper will open. The cooling stages and the electric heat will be staged to maintain the space temperature setpoint.

B. UNOCCUPIED MODE

When the AHU is in the unoccupied mode, the Supply Fan wJ!1 be off, the outside air damper will close and the cooling and heating will be disabled.

C. NIGHT SETBACK

The unit will be placed in the Night Setback Mode any time a zone temperature exceeds the unoccupied space temperature set point. When the AHU is in the Night Setback Mode, the supply fan will operate continuously and the Outdoor Air Damper will be closed. Space temperature control will be the same as the occupied mode.

D. BUILDING AUTOMATION SYSTEM INTERFACE

The Building Automation System (BAS) shall send the AHU a space temperature setpoint. The BAS shall also send Start-up, Occupied, Unoccupied, Timed Override, Night setback, and Priority Shutdown commands.

The following set points will be monitored and alarmed at the AHU

controller and the BAS: Space Temperature

- OX Cooling (each stage)
- Electric Heat Stage
- Supply fan S/S
- Supply fan Status
- OA Damper

The following points will be operator adjustable and/or automatically reset by a BAS program:

- Start and stop schedule
- Space heating setpoint (occupied and unoccupied)
- Space cooling setpoint (occupied and unoccupied)

E. Re-circulating air units shall de-energize upon sensing products of combustion. Provide duct detectors in co-ordination with electrical contractor and interface with the building fire alarm system.

F. Local supply air unit and restroom exhaust fans shall be interlocked with the associated unit.

4 02 SPLIT OX UNIT (AHU- 4)

A. AHU - 4 will have a space temperature sensor to monitor the temperature of the Control Room. Any time the temperature rises above 80 degrees (adjustable) the unit will go into the occupied mode and maintain the space temperature as described above.

B. Manual override of the unit and setpoint adjustments will be controlled from the main panel.

END OF SECTION

SECTION 15990

TESTING, ADJUSTING, AND BALANCING OF HVAC

PART 1 G E N E R A L

1.01 DESCRIPTION

A. Drawings and Division 1 Specification Sections apply to this Section.

B. This Section includes testing, adjusting, and balancing of ventilation and odor control exhaust-air systems to produce design objectives, including the following:

1. Balancing airflow within exhaust-air systems for the entire odor control system (new biotrickling filter, three existing biotrickling filter units and two new GAC vessels), including submains, branches, and terminals, to indicated quantities according to specified tolerances.

2. Adjusting ventilation systems to provide indicated quantities.

3. Setting quantitative performance of ventilation equipment.

4. Reporting results of the activities and procedures specified in this Section.

5. Verifying control devices and safety devices function properly.

6. Negative pressure leakage testing of exhaust-air systems. No positive pressure leakage testing shall be performed while there are unsuitable materials in system.

1.02 MEASUREMENT AND PAYMENT

A. Unless noted in the Bidsheet, no separate payment will be made for Work under this Section. Include payment for applicable work as noted on the Bidsheet.

B. Refer to Section 01270 – Measurement and Payment

1.03 RELATED SECTIONS

C. Section 01330 - Submittal Procedures

A. Section 15810 – Thermoset Fiberglass-Reinforced Plastic Ducts

1.04 DEFINITIONS

A. Adjust. To regulate fluid flow rate and air patterns at the terminal equipment, such as to reduce fan speed or adjust a damper.

B. Balance. To proportion flows within the exhaust-air system, including submains, branches, and terminals, according to design quantities.

C. Draft. A current of air, when referring to localized effect caused by one or more factors of high air velocity, low ambient temperature, or direction of airflow, whereby more heat is withdrawn from a person's skin than is normally dissipated.

D. Procedure. An approach to and execution of a sequence of work operations to yield repeatable results.

E. Report Forms. Test data sheets for recording test data in logical order.

F. System Effect. A phenomenon that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.

G. System Effect Factors. Allowances used to calculate a reduction of the performance ratings of a fan when installed under conditions different from those presented when the fan was performance tested.

H. Terminal. A point where the controlled medium, such as fluid or energy, enters or leaves the distribution system.

I. Test. A procedure to determine quantitative performance of a system or equipment.

J. Testing, Adjusting, and Balancing Agent. The entity responsible for performing and reporting the testing, adjusting, and balancing procedures.

K. AABC. Associated Air Balance Council.

L. AMCA. Air Movement and Control Association.

M. NEBB. National Environmental Balancing Bureau.

N. SMACNA. Sheet Metal and Air Conditioning Contractors' National Association.

1.05 SUBMITTALS

A. Submittals shall conform to requirements of Section 01330 - Submittals.

B. Quality-Assurance Submittals. Within 30 days from the Contractor's Notice to Proceed, submit copies of evidence that the testing, adjusting, and balancing Agent and this Project's testing, adjusting, and balancing team members meet the qualifications specified in the "Quality Assurance" Article below.

C. Contract Documents Examination Report. Within 45 days from the Contractor's Notice to Proceed, submit copies of the Contract Documents review report as specified in Part 3 of this Section.

D. Strategies and Procedures Plan. Within 60 days from the Contractor's Notice to Proceed, submit copies of the testing, adjusting, and balancing strategies and step-by-step procedures as specified in Part 3 "Preparation" Article below. Include a complete set of report forms intended for use on this Project.

E. Certified Testing, Adjusting, and Balancing Reports. Submit 2 copies of reports prepared, as specified in this Section, on approved forms certified by the testing, adjusting, and balancing Agent.

F. Warranty. S ubmit two (2) copies of special warranty specified in the "Warranty" Article below.

1.06 QUALITY ASSURANCE

A. Agent Qualifications. Engage a testing, adjusting, and balancing agent certified by either AABC or NEBB.

B. Testing, Adjusting, and Balancing Conference. Meet with the pertinent parties on approval of the testing, adjusting, and balancing strategies and procedures plan to develop a mutual understanding of the details. Ensure the participation of testing, adjusting, and balancing team members, equipment manufacturers' authorized service representatives, controls Installer, and other support personnel as necessary. Provide 7 days' advance notice of scheduled meeting time and location.

1. Agenda Items: Include at least the following:

a. Submittal distribution requirements.

b. Contract Documents examination report.

c. Testing, adjusting, and balancing plan.

d. Work schedule and Project site access requirements.

e. Coordination and cooperation of trades and subcontractors.

f. Coordination of documentation and communication flow.

C. Certification of Testing, Adjusting, and Balancing Reports. Certify the testing, adjusting, and balancing field data reports. This certification includes the following:

1. Review field data reports to validate accuracy of data and to prepare certified testing, adjusting, and balancing reports.

2. Certify that the testing, adjusting, and balancing team complied with the approved testing, adjusting, and balancing plan and the procedures specified and referenced in this Specification.

3. Certify that the instruments utilized for this project were calibrated as per instrument manufacturer requirements.

D. Testing, Adjusting, and Balancing Reports. Use standard forms from AABC's "National Standards for Testing, Adjusting, and Balancing" or from NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems".

E. Instrumentation Type, Quantity, and Accuracy. As described in AABC's "National Standards for Total System Balance" or as described in NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems," Section II, "Required Instrumentation for NEBB Certification".

F. Instrumentation Calibration. Calibrate instruments at least every 6 months or more frequently if required by the instrument manufacturer.

G. Conform to pertinent sections of SMACNA "HVAC Systems Testing, Adjusting, and Balancing."

1.07 COORDINATION

A. Coordinate the efforts of factory-authorized service representatives for systems and equipment, controls installers, and other mechanics to operate ventilation and odor control systems and equipment to support and assist testing, adjusting, and balancing activities.

B. Notice. Provide 7 days' advance notice for each test. Include scheduled test dates and times.

C. Perform testing, adjusting, and balancing after leakage tests on exhaust-air systems have been satisfactorily completed.

1.08 WARRANTY

A. General Warranty. The national project performance guarantee specified in this Article shall not deprive the City of other rights the City may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents. Warranties shall conform to requirements of 00700 – General Conditions.

B. National Project Performance Guarantee. Provide a guarantee stating that AABC or NEBB will assist in completing the requirements of the Contract Documents if the testing, adjusting, and balancing Agent fails to comply with the Contract Documents. Guarantee includes the following provisions:

1. The certified Agent has tested and balanced systems according to the Contract Documents.

2. Systems are balanced to optimum performance capabilities within design and installation limits.

PART 2 P R O D U C T S – N O T U S E D
PART 3 E X E C U T I O N

3.01 EXAMINATION

A. Examine Contract Documents to become familiar with project requirements and to discover conditions in systems' designs that may preclude proper testing, adjusting, and balancing of systems and equipment.

B. Examine approved submittal data of odor control systems and equipment.

C. Examine project record documents described in Division 1.

D. Examine design data and contract documents, including ventilation and odor control systems descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about ventilation and odor control systems and equipment controls.

E. Examine equipment performance data, including fan curves. Relate performance data to project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system. Calculate system effect factors to reduce the performance ratings of air-handling equipment when installed under conditions different from those presented when the equipment was performance tested at the factory. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," Sections 7 through 10; or in SMACNA's "HVAC Systems--Duct Design," Sections 5 and 6. Compare this data with the design data and installed conditions.

F. Examine system and equipment installations to verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Specification Sections have been performed.

G. Examine system and equipment test reports.

H. Examine system and equipment installations to verify that indicated balancing devices, such as manual volume dampers, are properly installed, and their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.

I. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing.

J. Examine air-handling equipment to ensure bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation and properly grounded.

K. Verify pipe penetrations and other holes are sealed.

L. Verify ductwork is properly grounded.

M. Examine equipment for installation and for properly operating safety interlocks and controls.

N. Report deficiencies discovered before and during performance of testing, adjusting, and balancing procedures.

3.02 PREPARATION

A. Prepare a testing, adjusting, and balancing plan that includes strategies and step-by-step procedures.

B. Complete system readiness checks and prepare system readiness reports. Verify the following:

1. Permanent electrical power wiring is complete.

2. Equipment and duct access doors are securely closed.

3. Dampers are open.

4. Windows and doors can be closed so design conditions for system operations can be met.

3.03 GENERAL TESTING AND BALANCING PROCEDURES

A. Perform testing and balancing procedures on each system according to the procedures contained in this Section and AABC national standards or in NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems".

B. Cut ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing, close probe holes and patch with new materials identical to those removed.

C. Mark equipment settings with paint or other suitable, permanent identification material, including damper-control positions, fan-speed-control levers, and similar controls and devices, to show final settings.

3.04 FUNDAMENTAL AIR SYSTEMS' BALANCING PROCEDURES

A. Prepare test reports for fans, inlets, and outlets. Obtain manufacturer's inlet/outlet factors and recommended testing procedures. Crosscheck the summation of required inlet/outlet volumes with required fan volumes.

B. Prepare schematic diagrams of systems' "as-built" duct layouts.

C. Determine the best locations in main and branch ducts for accurate duct airflow measurements.

D. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

E. Verify motor starters are equipped with properly sized thermal protection.

F. Check dampers for proper position to achieve desired airflow path.

G. Check for airflow blockages.

H. Check condensate drains for proper connections and functioning.

I. Check for proper sealing of exhaust-air system components.

3.05 CONSTANT-VOLUME AIR SYSTEMS' BALANCING PROCEDURES

A. The procedures in this Article apply to constant-volume exhaust-air systems.

B. Adjust fans to deliver total design airflows within the maximum allowable rpm listed by the fan manufacturer.

1. Measure fan static pressures to determine actual static pressure as follows:

a. Measure outlet static pressure as far downstream from the fan as practicable and upstream from restrictions in ducts such as elbows and transitions.

b. Measure static pressure directly at the fan outlet or through the supply duct.

c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from flexible connection and downstream from duct restrictions.

2. Measure static pressure across fans.

3. Compare design data with installed conditions to determine variations in design static pressures versus actual static pressures. Compare actual system effect factors with calculated system effect factors to identify

where variations occur. Recommend corrective action to align design and actual conditions.

4. Adjust fan speed higher or lower than design with the approval of the City. Make required adjustments to pulley sizes, motor sizes, and electrical connections to accommodate fan-speed changes.

5. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure no overload will occur. Measure amperage in full cooling mode to determine the maximum required brake horsepower.

C. Adjust volume dampers for main duct, submain ducts, and branch ducts to design airflows within specified tolerances.

1. Measure static pressure at a point downstream from the balancing damper and adjust volume dampers until the proper static pressure is achieved.

a. Where sufficient space in submains and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal inlets and calculate the total airflow for that zone.

2. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submains and branch ducts to design airflows within specified tolerances.

D. Measure terminal inlets without making adjustments.

1. Measure terminal inlets using a direct-reading hood.

E. Adjust volume dampers serving terminal inlets for each branch to design airflows within specified tolerances of design values.

3.06 MOTORS

A. Motors, 1/2 HP and Larger. Test at final balanced conditions and record the following data:

1. Manufacturer, model, and serial numbers.

2. Motor horsepower rating.

3. Motor rpm.

4. Efficiency rating if high-efficiency motor.

5. Nameplate and measured voltage, each phase.

6. Nameplate and measured amperage, each phase.

7. Starter thermal-protection-element rating.

3.07 TEMPERATURE TESTING

A. Measure outside-air, wet- and dry-bulb temperatures.

3.08 TOLERANCES

A. Set odor control system airflow rates within the following tolerances.

1. Exhaust Fans: 0 to plus 5 percent.

2. Air Inlets: 0 to plus 5 percent.

3.09 REPORTING

A. Initial Construction-Phase Report. Based on examination of the Contract Documents as specified in "Examination" Article above, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to exhaust system and general construction to allow access for performance measuring and balancing devices.

B. Status Reports. As Work progresses, prepare reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced.

3.010 FINAL REPORT

A. General. Typewritten, or computer printout in letter-quality font, on standard bond paper, in 3-ring binder, tabulated and divided into sections by tested and balanced systems.

B. Include a certification sheet in front of binder signed and sealed by the certified testing and balancing agent.

1. Include a list of the instruments used for procedures, along with proof of calibration.

C. Final Report Contents. In addition to the certified field report data, include the following:

1. Fan curves.

2. Manufacturers' test data.

3. Field test reports prepared by system and equipment installers.

4. Other information relative to equipment performance, but do not include approved Shop Drawings and Product Data.

D. General Report Data. In addition to the form titles and entries, include the following data in the final report, as applicable:

1. Title page.

2. Name and address of testing, adjusting, and balancing Agent.

3. Project name.

4. Project location.

5. Contractor's name and address.

6. Report date.

7. Signature of testing, adjusting, and balancing Agent who certifies the report.

8. Summary of contents, including the following:

a. Design versus final performance.

b. Notable characteristics of systems.

c. Description of system operation sequence if it varies from the Contract Documents.

9. Nomenclature sheets for each item of equipment.

10. Data for air terminals, including manufacturer, type, size, and fittings.

11. Notes to explain why certain final data in the body of reports vary from design values.

12. Test conditions for fans performance forms, including the following:

    a. Settings for exhaust-air dampers.

    b. Fan drive settings, including settings and percentage of maximum pitch diameter.

    c. Other system operating conditions that affect performance.

E. System Diagrams. Include schematic layouts of air systems. Present with single-line diagrams and include the following:

    a. Quantities of exhaust airflows.

    b. Duct and inlet sizes.

F. Fan Test Reports. For exhaust fans, include the following:

1. Fan Data: Include the following:

    a. System identification.

    b. Location.

    c. Make and type.

    d. Model number and size.

    e. Manufacturer's serial number.

    f. Arrangement and class.

    g. Sheave make, size in inches (mm), and bore.

    h. Sheave dimensions, center-to-center and amount of adjustments in inches (mm).

2. Motor Data: Include the following:

    a. Make and frame type and size.

b. Horsepower and rpm.

c. Volts, phase, and hertz.

d. Full-load amperage and service factor.

e. Sheave make, size in inches (mm), and bore.

f. Sheave dimensions, center-to-center and amount of adjustments in inches (mm).

g. Number of belts, make, and size.

3. Test Data: Include design and actual values for the following:

a. Total airflow rate in cfm (L/s).

b. Total system static pressure in inches wg (Pa).

c. Fan rpm.

d. Discharge static pressure in inches wg (Pa).

e. Suction static pressure in inches wg (Pa).

G. Air-Terminal-Device Reports. For exhaust system inlets include the following:

1. Unit Data: Include the following where applicable:

a. System and air-handling unit identification.

b. Location and zone.

c. Test apparatus used.

d. Area served.

e. Air-terminal-device make.

f. Air-terminal-device number from system diagram.

g. Air-terminal-device type and model number.

h. Air-terminal-device size.

i. Air-terminal-device effective area in sq. ft. ((sq. m)).

2. Test Data: Include design and actual values for the following:

a. Airflow rate in cfm (L/s).

b. Air velocity in fpm (m/s).

c. Preliminary airflow rate as needed in cfm (L/s).

d. Preliminary velocity as needed in fpm (m/s).

e. Final airflow rate in cfm (L/s).

f. Final velocity in fpm (m/s).

g. Indoor space temperature in deg F (deg C).

H. Instrument Calibration Reports. For instrument calibration, include the following:

1. Report Data: Include the following:

a. Instrument type and make.

b. Serial number.

c. Application.

d. Dates of use.

e. Dates of calibration.

END OF SECTION

SECTION 16010

BASIC ELECTRICAL REQUIREMENTS

PART 1 G E N E R A L

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 inspectors, the wastewater inspectors, and the Project Manager prior to starting the 7-day test or scheduling training.

2. Contractor shall give a minimum of two days notice to the Inspectors that the installation is ready for inspection and two days notice to the Project Manager.

3. Concealed work shall be inspected and approved by code inspectors and wastewater inspectors 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:

1. Plant Location Houston, Texas

2. Plant Type and Size

3. Plant Site Elevation

4. Seismic Zone Zone 0

5. Wind Velocity 90 mph

6. 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

7. Rainfall:

   - Annual 45 inches
   - Design 3.4 inches/hour, 8.4 inches/24 hours

8. Design Relative Humidity: 98%

9. Station Barometric Pressure:

   - Average Annual 29.5 inches Hg Absolute.

10. Utility Water Systems: Design Pressure Design Temp.

    - River Water _____ PSI _____ degrees F
    - Well Water _____ PSI _____ degrees F
    - City Water _____ PSI _____ degrees F

11. Electric Power Supply Characteristics (Available to Contractor):

	Voltage	Phase	Hz	Wire	Delta or Wye
1					
2					
3					

PART 2 P R O D U C T S

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

1. 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 E X E C U T I O N

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.

B. Conductor voltage drop shall not exceed 2 percent for feeders and 3 percent for branch circuits.

3.03 DEMONSTRATION

A. Test the electrical system to specification requirements and to demonstrate correct installation and operation of equipment. O & M Manual shall be furnished prior to testing for reference during testing and corrections for final O & M.

B. Before 7-days test, demonstrate the system to the wastewater inspectors and the Project Manager. Show the system to be fully operational. All alarms, safeties, 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

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SECTION 16060

ELECTRICAL DEMOLITION

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Electrical demolition.

1.02 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. 305 - Temporary Wiring

2. City of Houston Electrical Code.

1.03 SUBMITTALS

A. Annotate existing drawings to sequence the demolition of systems, equipment removal and temporary hook-ups.

B. Schedule with Project Manager for required shut-downs to accommodate system demolition and installation of temporary facilities.

1.04 QUALITY ASSURANCE

A. Verify field measurements and circuiting arrangements are as shown on Drawings.

B. Verify that abandoned wiring and equipment serve only abandoned facilities.

C. Demolition drawings are based on casual field observation and existing record documents. Report discrepancies to City Engineer before disturbing existing installation.

D. By beginning demolition, installer accepts existing conditions and warrants that he will maintain service to equipment and items not scheduled or indicated for removal, and that he will return to the City all items and systems in good operating condition.

PART 2 P R O D U C T S

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. The temporary electrical wiring and facilities shall be designed and constructed in strict compliance with NEC - Article No. 305 and the City of Houston Electrical Code.

PART 3 E X E C U T I O N

3.01 PREPARATION

A. Disconnect electrical systems in walls, floors, and ceilings scheduled for removal.

B. Coordinate utility service outages with utility company to provide continuous service to operating equipment.

C. Provide temporary wiring and connections to maintain existing systems in service during construction. When work must be performed on energized equipment or circuits, notify City of Houston Utility Operations and get approval. Use personnel experienced in such operations.

D. Existing Electrical Service: 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 one week before partially or completely disabling system. Minimize outage duration.

E. Adding Load to Existing Electrical System: Perform a load analysis to assure that the existing power distribution system (MCC, service, conductors, panel, breakers, feeders, branch circuits, etc.) is not overloaded if additional load is added to existing equipment.

F. Existing electrical conduit and wire may not be reused to feed new equipment except by written authorization from the City of Houston.

3.02 DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK

A. Remove, relocate, and extend existing installations to accommodate new construction.

B. Remove abandoned wiring to source of supply.

C. Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes. This includes all associated support and anchoring systems. Cut conduit flush with walls and floors, and patch surfaces.

D. Disconnect abandoned outlets and remove devices. Remove abandoned outlets if conduit servicing them is abandoned and removed. Provide blank cover for abandoned outlets which are not removed.

E. Disconnect and remove abandoned panelboards and distribution equipment.

F. Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.

G. Repair adjacent construction and finishes damaged during demolition and extension work.

H. Maintain access to existing installations which remain active. Modify installation or provide access panel as appropriate.

I. Extend existing installations using materials and methods as specified for new work.

3.03 DISPOSAL AND SALVAGE

A. Salvage electrical and instrumentation equipment and wiring size four and larger removed from existing facilities for City's reuse.

B. Material and equipment which can be reused or salvaged remains the property of the City of Houston. Equipment to be retained by the City of Houston shall be delivered to a specified location by the Contractor.

C. Materials and equipment which cannot be reused or salvaged will be removed and disposed by the Contractor.

3.04 CLEANING AND REPAIR

A. Clean and repair existing materials and equipment which remain or are to be reused.

B. Panelboards: Clean exposed surfaces and check tightness of electrical connections. Replace damaged circuit breakers and provide closure plates for vacant positions. Provide typed circuit directory showing revised circuiting arrangement.

3.05 INSTALLATION

A. Install relocated materials and equipment under the provisions of Section 02220 - Demolition.

B. Electrical installations and materials shall conform to the current issue of the following standard and codes: American National Standards Institute/National Fire Protection Association (ANSI/NFPA), No. 70 - National Electrical Code (NEC), City of Houston Electrical Code, and material and workmanship.

C. All material shall be free of defects and in safe working condition which will meet electrical classification and functional requirements.

D. Testing shall be made during the course of construction or at the completion of the job. These tests shall be made by the electrical contractor. The contractor shall furnish all test equipment.

E. The job will not be complete until work has been inspected and trial start up has been successfully completed.

END OF SECTION

SECTION 16111

CONDUIT, FITTINGS, AND BODIES

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Conduit, fittings, and bodies.

1.02 REFERENCES

A. American National Standards Institute (ANSI):

1. ANSI C 80.1 - Rigid Steel Conduit - Zinc Coated.

2. ANSI C 80.4 - Fittings for Rigid Metal Conduit.

B. Federal Specifications:

1. W-C-58 C - Conduit Outlet Boxes, Bodies Aluminum and Malleable Iron.

2. W-C-1094 - Conduit and Conduit Fittings Plastic, Rigid.

3. WW-C-566 C - Flexible Metal Conduit.

4. WW-C-581 D - Coatings on Steel Conduit.

C. National Electrical Manufacturers Association (NEMA):

1. NEMA RN 1 - Polyvinyl-Chloride Externally Coated Galvanized Rigid Steel Conduit and Electrical Metallic Tubing.

2. NEMA TC 2 - Electrical Plastic Tubing (EPT) and Conduit (EPC-40 and EPC-80).

3. NEMA TC 3 - PVC Fittings for Use with Rigid PVC Conduit and Tubing.

D. National Fire Protection Association (NFPA), ANSI/NFPA 70 - National Electrical Code (NEC).

E. Underwriters' Laboratories (UL):

1. UL 1 - Flexible Metal Electrical Conduit.

2. UL 6 - Rigid Metal Electrical Conduit.

3. UL 514 B - Fittings for Conduit and Outlet Boxes.

4. UL 651 - Schedule 80 Rigid PVC Conduit.

5. UL 651 A - Type EB and A Rigid PVC Conduit and HDPE Conduit.

6. UL 886 - Electrical Outlet Boxes and Fittings for Use in Hazardous Locations.

F. City of Houston Electrical Code.

1.03 SUBMITTALS

A. Make submittals following 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 of products.

5. Code compliance certificate.

6. Conformance certificate.

1.04 QUALITY ASSURANCE

A. Rigid steel conduit shall pass the bending, ductility, and thickness of zinc coating tests described by ANSI C 80.1.

B. Flexible conduit shall pass the tension, flexibility, impact, and zinc coating test described by UL 1.

C. Nonmetallic conduit and fittings shall pass the test requirements of NEMA TC 2, UL 651 and 651 A and Federal Specification W-C-1094 A.

1.05 DELIVERY STORAGE AND HANDLING

A. Package conduit in 10-foot bundles maximum with conduit and coupling thread protectors suitable for indoor and outdoor storage. Package fittings in manufacturer's standard quantities and packaging suitable for indoor storage. Package plastic-coated rigid conduit, fittings, and bodies in such a manner as to protect the coating from damage during shipment and storage.

B. Store conduit above ground on racks to prevent corrosion and entrance of debris.

C. Protect plastic conduit from sunlight.

PART 2 P R O D U C T S

2.01 ACCEPTABLE MANUFACTURERS

A. Rigid Steel Conduit:

1. Allied Tube and Conduit.
2. Triangle Wire and Cable, Inc.
3. Wheatland Tube Company.

B. PVC Coated Steel Conduit:

1. Occidental Coating Company (O-Cal Blue).
2. Robroy Industries, Inc.
    a. Rob-Roy Red
    b. Plasti-Bond Red
    c. Perma-Cote Green

C. PVC Rigid Conduit:

1. Cantex.
2. Carlon Industries, Inc.

D. Conduit Fittings and Bodies:

1. Appleton Electric.

2. Crouse-Hinds.

3. Killark Electric Manufacturing Company.

4. O-Z/Gedney.

E. Liquidtight Flexible Conduit:

1. Anamet, Inc.

2. Electriflex Company.

3. Triangle Wire and Cable, Inc.

2.02 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 support system for power, control, and instrument cables or any combination thereof.

B. Conduit and Fittings:

1. Rigid Steel Conduit and Fittings.

a. Rigid steel conduit and rigid steel conduit bends, nipples, and bodies shall be hot-dipped galvanized and shall comply with the latest ANSI C 80.1, UL 6, Federal Specification WW-C-581 D, and NEC Article 346-15.

b. Mild steel tubing shall be used for conduit, nipples, and couplings, and shall be free of defects on both the inner and outer surfaces.

c. Fittings and bodies and covers for rigid steel conduit shall be steel or cast-iron and shall comply with ANSI C 80.4, UL 514 B, and Federal Specification W-C-58 C.

2. PVC-Coated Rigid Steel Conduit and Fittings

a. PVC-coated conduit, fittings, bodies, and covers shall 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 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.

3. Liquidtight Flexible Metal Conduit and Fittings

a. Use liquidtight flexible metal conduit manufactured in accordance with UL 1 and Federal specification WW-C-566 C.

b. Fittings used with liquidtight flexible metal conduit shall be the PVC-coated type. Thoroughly ground the conduit to the fittings and through the fittings to the box or enclosure to which it is attached.

c. Couplings and fittings for use in hazardous areas shall comply with UL 886, NEC Article 501-4 (a&b), and Federal Specification W-C-586 C.

4. PVC Conduit and Fittings. Use PVC conduit, bends, and fittings, which comply with NEMA TC 2, W-C-A, and NBC Article 347-17 for above ground and underground installation. Conduit shall be Schedule 80.

PART 3 E X E C U T I O N

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 PVC-coated conduits in all outdoor locations, inside valve vaults and wet wells, lift station drypits, areas that are not air-conditioned, and in all other corrosive and wet environments. Install PVC-coated conduit in strict accordance with manufacturer's instructions. Use installers certified by the manufacturer.

B. Install rigid galvanized steel (RGS) conduits in dry, inside, air-conditioned locations only.

C. Install PVC conduits in reinforced duct banks or encased in concrete slabs. For stub-ups, use PVC coated rigid steel elbows as required in Section 16402.

D. 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, trip hazard, or interfere with normal plant operating and maintenance procedures. A minimum overhead clearance of 8 feet shall be maintained in passageways. All conduits installed across walkways shall have concrete or aluminum trip plates installed.

E. Installation and support of conduit shall be from steel or concrete structures in accordance with the standard detail drawings. Furnish necessary conduit straps, clamps, fittings and support for the conduit in accordance with the standard details.

F. Identify conduit at termination points like MCC, light fixtures, control panels, receptacles, panels, and junction boxes.

G. Not more than 3 equivalent 90 degree bends will be permitted between outlets. Provide bonded expansion fittings at building expansion joints.

H. Install conduit runs so that they are mechanically secure, mechanically protected from physical harm, electrically continuous, and neat in

appearance. The interiors of conduit shall provide clean, smooth raceways through which conductors may be drawn without damage to the insulation. Make threaded connections wrench tight.

I. Cut conduit square with a power saw or a rotary type conduit cutter designed to leave a flat face. Do not use plumbing pipe cutters for cutting conduit. Ream the cut ends of conduit with a reamer, designed for the purpose to eliminate rough edges and burrs. 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 and paint threads before connections are made. Use non-corrosive Carbozinc No. 11 as manufactured by the Carboline Company, coal tar enamel or zinc rich epoxy primer on the threads of steel conduit before connections are made.

J. Use strap wrenches only to tighten joints in plastic coated rigid steel conduit. Replace all conduit and fittings with damage to the plastic coating, such as cuts, nicks and threader chuck jaw marks. Use a solvent, or the same patching material to seal around the edges of conduit fitting covers.

K. Make changes in direction of conduit using elbows or fittings. Do not use pull boxes to make direction changes unless specifically designated otherwise.

L. Field fabricated bends shall be free of indentations or elliptical sections. The radius of the bend shall not be less than 6 times the smallest diameter of the raceway.

M. Protect all conduit terminations from mechanical injury. Prevent the entry of moisture and foreign matter into the conduit system by properly capping terminations.

N. Avoid trapped runs of conduit, if possible. When they are necessary, provide drainage using a "tee" condulet equipped with a drain. Conduit is likely to pass through areas with a temperature differential of 20 F or more. Seal penetrations with a proper seal fitting at the wall or barrier between such areas. For conduit passing through walls separating pressurized areas from non-pressurized areas, install sealing fittings at the wall on the non-pressurized side.

O. Fit 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. Unless

otherwise indicated on 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. Bonding strap connections shall be protected by minimum 40 mils PVC coating.

P. Where rigid galvanized conduit terminates in sheet metal enclosures, fit the conduit with double locknuts and bushings. Sheet metal enclosures made of stainless steel or aluminum located outside or in any other wet, damp, or corrosive areas shall be furnished with PVC-coated threaded hubs. Restrict side penetrations to the lower one third of the enclosure. Where PVC-coated rigid conduit is used, PVC-coated rigid threaded hubs will be used.

Q. Provide flexible Liquidtight metallic conduit where necessary to allow for movement or to localize sound or vibration, at transformers, at motors and any other rotating equipment. Flexible metal conduit shall be used as fixture whips only.

R. Seal all openings or holes where conduits pass through walls or floors. When passing through a firewall or floor, use a fire-rated seal per the typical detail included in the Drawings. Certain walls, as indicated on the drawings, require environmental (air-tight) seals; seal as indicated on the Drawings.

S. Install explosion-proof seals in conduit runs crossing or entering a hazardous classified area (as shown on Drawings). Install type CSBE removable sealing fittings to seal pump cables between wet well and first junction box. If a junction box is not used, install the CSBE seals at the wet well and the control panel.

T. All transitions in PVC-coated conduit size shall be accomplished with PVC-coated RECs or manufactured reducing condulets. RE bushings shall not be used.

U. Parallel runs of conduit may be supported by structural steel racks. When two or more racks are arranged one above the other, provide vertical separation of not less than 12 inches between racks, unless otherwise indicated on Drawings. Space conduits on the racks at least enough to provide 1/4-inch clearance between hubs on adjacent conduits at terminations and to allow room for fittings.

V. Fill conduit racks no more than 75 percent of their capacity, providing usable space for future conduit. To ensure this, conduits leaving the rack horizontally shall be offset up or down so that future conduits may be installed in the space remaining. Construct conduit racks to permit access for wire or cable pulling at all pull points, even when future conduits are added to fill the racks.

W. Where conduit racks are supported on rods from beam clamps or by some other non-rigid suspension system, install rigid supports at no more than 50-foot intervals to give lateral stability to the rack.

X. Conduit racks or hangers must in no way interfere with machinery (or its operation), piping, structural members, process equipment, or access to anticipated future equipment. Refer to architectural, structural, equipment layout and piping drawings to ensure that this requirement is met. Label high voltage conduit with the circuit phase-to-phase voltage by means of a firmly attached tag or label of approved design at each conduit termination, on each side of walls or barriers pierced and at intervals not exceeding 200 feet along the entire length of the conduit.

Y. Support conduit sizes 2 inches and larger at spacings not exceeding 10 feet and conduit sizes 1-1/2 inches and smaller at spacings not exceeding 8 feet.

Z. The means of fastening conduit to supports shall be: by one hole malleable iron conduit straps secured by wood screws to wood and by bolts with expansion anchors to concrete or masonry; by "Korn" clamps or U-bolts to other surfaces. Use "clamp backs" when strapping conduits to walls, column faces, or other such surfaces.

AA. Support conduit runs with conduit clamps, hangers, straps and metal framing channel attached to structural steel members. Conduits of 1-1/2 inch size or less may be supported by one-hole conduit straps on concrete, tile or steel work, but for larger size conduit, 2-hole straps shall be used. Use clamps of galvanized malleable iron for rigid galvanized conduit and stainless steel for PVC-coated conduit. Metal framing channel straps used for PVC-coated conduit shall be type 316 stainless steel.

BB. Install conduits supported form building walls with at least 1/4-inch clearance from the wall to prevent the accumulation of dirt and moisture behind conduit.

CC. All Conduits embedded in concrete lift station deck shall be PVC-coated rigid.

END OF SECTION

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SECTION 16120

600-VOLT BUILDING WIRE AND CABLE

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Specifications for 600-volt building wire and cable.

1.02 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 B 3: Soft or Annealed Copper Wires

2. ASTM B 8: 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)

E. City of Houston Electrical Code

1.03 SUBMITTALS

A. Make submittals following Section 01330 - Submittal Procedures.

1. Manufacturer's cut sheets, catalog data

2. Instruction for handling and storage

3. Dimensions and weight

4. Conformance certificate

1.04 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.

1.05 DELIVERY, STORAGE AND HANDLING

A. Ship wire and cable on manufacturer's standard reel sizes unless otherwise specified. Where cut lengths are specified, mark reel footage accordingly. Each reel shall contain one continuous length of cable. Provide impact protection by wood lagging or suitable barrier across the traverse of the reel. Provide moisture protection by using manufacturer's standard procedure or heat shrinkable self-sealing end caps applied to both ends of the cable.

PART 2 P R O D U C T S

2.01 ACCEPTABLE MANUFACTURERS

A. American Insulated Wire Corporation

B. Carol Cable Company, Inc.

C. General Cable Company

D. Okonite Company

E. Rome Cable Company

F. Triangle Wire and Cable, Inc.

2.02 MATERIALS AND EQUIPMENT

A. Design. Provide cable designated as THWN/THHN stranded single conductor type and UL 83 and UL 1063 listed, rated 600 volts and certified for continuous operation at maximum conductor temperature of 90 C in dry

locations and 75 C in wet locations in conduit. MTW stranded will be used in control panels.

B. Conductors. Provide conductors which are Class B, concentric stranded, annealed uncoated copper with physical and electrical properties complying with ASTM B 3 and ASTM B 8 and Part 2 of ICEA S-61-402.

C. Insulation. Each conductor shall be PVC insulated and nylon jacketed to meet the requirements of Part 3 of ICEA S-61-402. The insulation thickness shall match the dimensions listed in Table 310-13 of the National Electrical Code (NEC) for type THHN and THWN 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. The single conductor color coding shall be as follows:

System Voltage	A	B	C	Neutral
120/208 Volt 3Ph/4w	Black	Red	Blue	White
120/240 Volt 3Ph/4w	Black	Orange	Blue	White
277/480 Volt 3Ph/4w	Brown	Purple	Yellow	Grey

Motor Control	1 ..... Black
	2 ..... Red
	3 ..... Blue
Ground	..... Green

PART 3 E X E C U T I O N

3.01 PREPARATION

A. Complete the cable raceway systems and underground duct banks before installing cables.

B. Verify sizing of raceways and pullboxes to ensure proper accommodation for the cables.

C. Check the length of the cable raceway system against the length of cable on the selected reel.

D. Clean conduits of foreign matter before cables are pulled.

3.02 INSTALLATION

A. Wiring Methods

1. Use wiring methods indicated on Drawings.

2. In general, use THHN/THWN stranded building wire for lighting, power and control wiring where conductors are enclosed in raceways like in above ground conduit system or in underground duct banks, or inside control panels.

3. Do not use solid conductors.

4. Use conductors not smaller than No. 12 AWG stranded for general lighting circuits.

5. Use conductors not smaller than No. 14 AWG stranded for control circuits, except when part of a multiconductor cable or internal panel wiring.

6. In general, do not splice conductors unless approved by the City Engineer.

7. Splices associated with taps for lighting and control circuits are allowed without approval.

8. Make splices in accessible junction boxes.

B. Single Conductor in Conduit and Ductbank

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 wire pulling compounds approved by cable manufacturers to reduce friction. Lubricants must not be harmful to the conductor insulation. Mixtures containing soap or detergent shall not be used.

C. Single Conductor in Cable Tray

1. Do not install single conductor building wire and cable in cable tray.

2. For single conductor tray installation, see Section 16122 - 600 Volt Power Cable.

D. Preparation for Termination

1. Make 600-volt power cable terminations and splices with heat shrinkable sleeves and seals.

2. Terminal lugs and connectors for all sizes of conductors shall be crimp-on type.

3. For size 1/0 AWG and larger, crimp-on lugs shall have the long barrel with 2-hole tongues except in places where termination space is limited.

E. Tests

1. In general, test insulation integrity of the wiring system before terminating.

2. Make sure to disconnect sensitive electronic equipment before testing insulation.

3. Use a 500 VDC megohmmeter and perform the wire system insulation test in accordance with the operating instructions.

F. Termination. After the 600-volt wiring system has been tested with satisfactory results, reconnect wire.

END OF SECTION

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SECTION 16121

600-VOLT CONTROL CABLE

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. 600-volt control cable.

1.02 REFERENCES

A. American Society for Testing and Materials (ASTM):

1. ASTM B 3 - Soft or Annealed Copper Wires.

2. ASTM B 8 - Concentric-Lay-Stranded Copper Conductors, Hard, Medium Hard, Soft.

3. ASTM B 33 - Tinned Soft or Annealed Copper Wire for Electrical Purposes.

4. ASTM B 174 - Bunch-stranded Copper Conductors for Electrical Conductors.

B. Institute of Electrical and Electronics Engineers (IEEE), IEEE 383-2.5: IEEE Standard for Type Test of Class IE Electric Cables, Field Splices, and Connections for Nuclear Power Generating Stations.

C. Insulated Cable Engineers Association (ICEA):

1. ICEA S-61-402 - Thermoplastic-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy (NEMA WC-5).

2. ICEA S-66-524 - Cross-Linked-Thermosetting-Polyethylene-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy (NEMA WC-7).

3. ICEA S-68-516 - Ethylene-Propylene-Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy (NEMA WC-8).

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), No. 70 - National Electrical Code (NEC) , Chapter No.3 - Wiring Methods and Materials, Article 725 - Class 1, Class 2, and Class 3 Remote Control, Signaling, and Power-Limited Circuits.

1.03 SUBMITTALS

A. Make submittals following Section 01330 - Submittal Procedures.

1. Completed engineer's data sheets.

2. Completed manufacturer's data sheets.

3. Manufacturer's cut sheets, catalog data.

4. Installation, terminating and splicing procedure.

5. Instruction for handling and storage.

6. Dimensions and weight.

7. Conformance certificate.

1.04 QUALITY ASSURANCE

A. Tests.

1. Cable shall be tested at the factory to confirm that the cable complies with requirements of Part 6 of ICEA S-61-402, S-66-524 or S-68-516. Refer to data sheet for additional test requirements.

2. Where applicable, the cable shall meet the requirements of the vertical tray flame test as described in IEEE 383-2.5.

1.05 DELIVERY STORAGE AND HANDLING

A. Ship cable on manufacturer's standard reel sizes, unless otherwise specified. Where cut lengths are specified, mark reel footage accordingly. Each reel shall contain one continuous length of cable. Reels shall be of the type specified on the data sheets. Provide impact protection by wood lagging or suitable barrier across the

traverse of the reel. Provide moisture protection by manufacturer's standard procedure or heat shrinkable self-sealing end caps applied to both ends of the cable.

PART 2 P R O D U C T S

2.01 ACCEPTABLE MANUFACTURERS

A. Alpha Wire Corporation

B. Belden Division, Cooper Industries, Inc.

C. Cablec Continental Cables Company

D. General Cable Company

E. Manhattan Electric Cable Corporation

F. Okonite Company

2.02 MATERIALS AND EQUIPMENT

A. Design. Provide cable with the following design characteristics. The cable shall consist of multiple conductors. The cable assembly shall be UL listed, flame, oil and sunlight resistant, and certified for continuous operation at the temperature specified on the 600-Volt Control Cable Data Sheets in wet or dry locations while installed in underground duct, conduit, or cable tray. The number and size of conductors supplied in each cable shall correspond to the quantities specified on the 600-Volt Control Cable Data Sheets.

B. Conductors. Provide conductors which are concentric or bunch-stranded, annealed tinned copper with physical and electrical properties conforming to ASTM B 3, ASTM B 8 or ASTM B 33 or ASTM B 174 and Part 3 of ICEA S-61-402, S-66-524, or S-68-516 unless otherwise specified on the 600-Volt Control Cable Data Sheets.

C. Insulation. Each conductor shall be insulated as specified on the 600-Volt Control Cable Data Sheets complying to the requirements of Part 3 of ICEA S-61-402, S-66-524 or S-68-516. The average insulation thickness shall not be less than the dimensions shown in Section 3.2, Table 3-1 of ICEA S-61-402, S-66-524 or S-68-516 for 600 volt insulation unless otherwise specified on the 600-Volt Control Cable Data Sheets. The minimum insulation thickness shall not be less than 90 percent of the value given in the table.

D. Drain Wire. Provide drain wire Class B, seven-stranded, tin-coated copper in accordance with ASTM B 3, ASTM B 8, or ASTM B 33 and as specified on the 600-Volt Control Cable Data Sheets.

E. Shielding. Cable shielding shall consist of laminated, nonburning, mylar-backed aluminum tape applied helically around conductors with the aluminum side in continuous contact with the drain wire unless otherwise specified on the 600-Volt Control Cable Data Sheet. The tape shall be wrapped around the conductors with a 25 percent minimum overlap unless otherwise specified on the 600-Volt Control Cable Data Sheets.

F. Jacket.

1. When control cables are to be enclosed in conduit, ducts or in other raceway systems, the cables shall be of the non-metallic type and shall be covered by an overall nonmetallic jacket, as specified on the 600-Volt Control Cable Data Sheets, which complies with the requirements of Section 4.4 of ICEA S-66-524 or S-68-516, Section 4.3 of ICEA S-61-402, or Table 21-5 of Part 21 of UL 83.

2. Multi-conductor cables shall have a jacket thickness which complies with Table 4-7 of Part 4 of ICEA S-66-524, Table 4-5 of Part 4 of ICEA S-68-524, or Table 4-6 of Part 4 of ICEA S-61-402 unless otherwise specified on the 600-Volt Control Cable Data Sheets.

G. Armor. Where control cables are to be exposed, as in cable tray, cable channel or other cable support systems, the cables shall be protected by an interlocked metal tape armor made of galvanized steel which meets the requirements of paragraph 4.5 of ICEA S-68-516 or S-66-524 unless otherwise specified on the 600-Volt Control Cable Data Sheets. An over-all jacket shall be provided as specified in the Data Sheets.

H. Conductor Identification. Identify individual conductors by method as specified on the 600-Volt Control Cable Data Sheets in conformance with Appendix L of ICEA S-66-524, Part 5 of ICEA S-68-516, or Appendix I of ICEA S-61-402.

I. Cable Marking. Print cable marking information on the jacket of each cable at 2-foot intervals. Use a permanent printing method with a color sharply contrasting the jacket color. See the 600-Volt Control Cable Data Sheets for the minimum information required.

PART 3 E X E C U T I O N

3.01 PREPARATION

A. When control wiring requires installation in cable tray and other cable support systems, use the 600-Volt Multiconductor Control Cable.

B. Complete cable raceway systems, underground duct banks, and cable support systems before installing cables.

C. Verify sizing of raceways and pullboxes to ensure proper accommodation for the cables.

D. Check the length of the cable raceway system against the length of cable on the selected reel.

E. Do not install or work on PVC insulated or jacketed cables in temperatures below 32 F.

F. Clean conduits of all foreign matter before cables are pulled in.

G. Provide at least 30 percent spare conductors.

3.02 INSTALLATION

A. Cable in Conduit and Ductbank.

1. Install cables in accordance with the manufacturer's instructions and the National Electrical Code (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 wire pulling compounds approved by cable manufacturers to reduce friction. Lubricants must not be harmful to the conductor insulation or cable jacket. Mixtures containing soap or detergent shall not be used.

B. Cable in Tray

1. Install armored cable in cable tray.

2. 600-Volt Control Cable may be installed in cable tray with 600-volt power cables.

3. Install cables in trays in a neat and orderly manner. Tie cables to the rungs at approximate 15-foot intervals by use of cable ties.

C. Termination

1. Do not splice conductors unless approved by the Project Manager. For termination use crimp-on type, ring tongue, non-insulated, tin-plated copper lugs.

2. Mark wiring on both ends with circuit numbers or loop tag numbers. Heat shrink wire markers after the ring tongue terminal has been installed. Extend the marker over the crimp-on base of the terminal.

D. Tests

1. Test insulation integrity and conductor continuity before connecting the cables.

2. Use a 500 VDC megohmmeter and perform the cable insulation test in accordance with the operating instructions.

E. Termination. After the 600-volt control cable has been tested with satisfactory results, terminate the cable at both ends to designated terminal points.

END OF SECTION

DATA SHEET 1 of 3

IDENTIFICATION

CLIENT _____ MANUFACTURER _____
PROJECT _____ MODEL NO. _____
JOB NO. _____ SIZE _____
PLANT LOCATION _____ SERIAL NO. _____
ITEM NO. _____ INQUIRY NO _____
SERVICE _____ P.O. NO. _____
NO. ITEMS REQUIRED _____

NOTE: [ ] INDICATES INFORMATION TO BE COMPLETED BY MANUFACTURER

OPERATING DATA

VOLTAGE _____ FREQUENCY _____ AMBIENT TEMP (^{o}C) _____
INSTALLATION ENVIRONMENT _____

CONSTRUCTION

CONDUCTORS

SIZE (AWG or KCMIL): _____
ARRANGEMENT: _____ SINGLE CONDUCTOR __ OTHER _____
_____ MULTI-CONDUCTOR _____ NO. OF CONDUCTORS
MATERIAL: _____ BARE COPPER _____ TIN-COATED COPPER
_____ SOLID _____ STRANDED
SINGLE CONDUCTOR: _____ JACKETED _____ NON-JACKETED
MULTI-CONDUCTOR _____ JACKETED _____ NON-JACKETED (TRIPLEXED ONLY)
_____ ARMORED _____ ARMORED W/OUTER JACKET
_____ GROUND WIRES IN INTERSTICES: _____ COPPER _____ ALUMINUM
CONDUCTOR CLASS PER _____ ASTM STANDARD
SPECIAL REQUIREMENTS: _____

INSULATION

TYPE: _____ CROSS LINKED POLYETHYLENE _____ CHLOROSULFONATED POLYETHYLENE
_____ POLYVINYL CHLORIDE _____ ETHYLENE-PROPYLENE RUBBER
_____ POLYETHYLENE _____ OTHER _____
THICKNESS (MILS OR MM) _____
COLOR: _____
TEMPERATURE RATING: _____ 60^{o}C - 75^{o}C (WET-DRY) _____75^{o}C - 90^{o}C (WET-DRY)
_____ 90^{o}C (WET-DRY) _____ OTHER _____
DRAIN WIRE: SIZE _____ STRANDED ___ SOLID _ BARE COPPER _____TIN-COATED COPPER
SPECIAL REQUIREMENTS: _____

SHIELDING

TYPE SHIELDING: _____ BRAIDED _____ CONDUCTIVE PLASTIC
_____ CONDUCTIVE COTTON _____ SPIRAL-SERVED _____ CORRUGATED
_____ MYLAR FILM - ALUMINUM FOIL _____ POLYESTER FILM-ALUMINUM FOIL
_____ COPPER TAPE _____ OTHER _____
POLYESTER FILM-ALUMINUM LOCATION _____ INSIDE _____ OUTSIDE
_____ PAIR SHIELD ISOLATED
` _____ SEPARATOR _____ FILLED

ITEM NO. _____

DATA SHEET 2 of 3

SHIELD COMBINATION

OVERSHIELD: _____ POLYESTER FILM ALUMINUM
_____ BRAID _____ SERVED _____ OTHER _____

BRAID SHIELD: _____ TYPE STRANDS _____ % COVERAGE _____ TINNED
_____ BARE __ COPPER _____ ALUMINUM
_____ OTHER _____

OVERALL TYPE: _____ POLYESTER _____ PAPER . OTHER: _____

JACKET

TYPE: _____ POLYVINYL CHLORIDE _____ POLYETHYLENE
_____ HEAVY DUTY NEOPRENE _____ CHLOROSULFONATED POLYETHYLENE
_____ NYLON _____ OTHER _____

THICKNESS (MILS OR MM) _____
COLOR: _____ BLACK _____ OTHER _____
SPECIAL REQUIREMENTS: _____

ARMORING

TYPE: _____ INTERLOCKED (POSITIVE) _____ OTHER _____
MATERIAL: _____ GALVANIZED STEEL _____ ALUMINUM
_____ OTHER _____
COVERING: _____ POLYVINYL CHLORIDE _____ OTHER _____
COLOR: _____ BLACK _____ OTHER _____
SPECIAL REQUIREMENTS: _____

MARKING

CONDUCTOR IDENTIFICATION

SINGLE CONDUCTOR: _____
MULTI-CONDUCTOR: _____

CABLE MARKING

REQUIRED: _____ MANUFACTURER _____ CONDUCTOR SIZE
_____ NO. OF CONDUCTORS _____ VOLTAGE RATING
_____ UL LABEL _____ NEC TYPE
_____ TEMPERATURE RATING _____ MONTH/YEAR OF MANUFACTURE
_____ INSULATION _____ FOOTAGE MARKERS
_____ OTHER _____

FACTORY TESTING/DOCUMENTATION

_____ PHYSICAL _____ _____ FLAME TESTS (PER IEEE 383 - 2.5)
_____ _____
_____ ELECTRICAL _____ OTHER TESTS _____
_____ MEGGER _____
_____ OTHER _____ _____
_____ _____
_____ _____

ITEM NO._____

DATA SHEET 3 of 3

QUALITY ASSURANCE

_____ NO ADDITIONAL REQUIREMENTS _____ ATTACHED SPECIFICATION _____

PACKAGING

_____ DOMESTIC _____ EXPORT

SHIPPING

REEL TYPE: _____ RETURNABLE _ NON-RETURNABLE _____ LENGTH PER REEL _____

ADDITIONAL REQUIREMENTS: _____

[ ]**MANUFACTURER DATA**

CABLE DIMENSION (O.D. IN.) _____ SHIPPING TIME _____
CABLE CROSS-SECTIONAL AREA _____ OTHER _____
CABLE WEIGHT (LBS/FT) _____
CABLE MIN BENDING RADIUS _____
TENSILE STRENGTH _____
GROSS WEIGHT/REEL (LBS) _____
TOTAL CUBIC FEET/REEL _____
SHORT CIRCUIT WITHSTAND CURVES _____
CABLE TESTING REQUIREMENTS _____

NOTES

ITEM NO. _____

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SECTION 16122

600-VOLT POWER CABLE

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. 600-volt power cable.

1.02 REFERENCES

A. American Society for Testing and Materials (ASTM).

1. ASTM B 3: Soft or Annealed Copper Wires.

2. ASTM B 8: Concentric-Lay-Stranded Copper Conductors, Hard, Medium Hard, Soft.

3. ASTM B 33: Tinned Soft or Annealed Copper Wire for Electrical Purposes.

B. Institute of Electrical and Electronics Engineers (IEEE), IEEE 383-2.5: IEEE Standard for Type Test of Class IE Electric Cables, Field Splices, and Connections for Nuclear Power Generating Stations.

C. Insulated Cable Engineers Association (ICEA).

1. ICEA S-61-402: Thermoplastic-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy (NEMA WC-5).

2. ICEA S-66-524: Cross-Linked-Thermosetting-Polyethylene-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy (NEMA WC-7).

3. ICEA S-68-516: Ethylene-Propylene-Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy (NEMA WC-8).

D. Underwriters' Laboratories (UL).

1. UL 44: Rubber Insulated Wires and Cables.

2. UL 83: Thermoplastic Insulated Wire and Cables.

E. National Fire Protection Association (NFPA), No. 70 - National Electrical Code (NEC), Chapter No.3 - Wiring Methods and Materials.

F. City of Houston Electrical Code.

1.03 SUBMITTALS

A. Make submittals following Section 01330 - Submittal Procedures:

1. Completed engineer's data sheets

2. Completed manufacturer's data sheets

3. Manufacturer's cut sheets, catalog data

4. Installation, terminating and splicing procedure

5. Instruction for handling and storage

6. Dimensions and weight

7. Conformance certificate.

1.04 QUALITY ASSURANCE

A. Tests.

1. Cable shall be tested at the factory to confirm that the cable complies with requirements of Part 6 of ICEA S-61-402, S-66-524 or S-68-516. Refer to data sheet for additional test requirements.

2. Where applicable, the cable shall meet the requirements of the vertical tray flame test as described in IEEE 383-2.5.

1.05 DELIVERY STORAGE AND HANDLING

A. Ship cable on manufacturer's standard reel sizes unless otherwise specified. Where cut lengths are specified, mark reel footage accordingly. Each reel shall contain one continuous length of cable. Reels shall be of the type specified on the data sheets. Provide impact protection by wood lagging or suitable barrier across the traverse of the reel. Provide moisture protection by manufacturer's standard procedure or heat shrinkable self-sealing end caps applied to both ends of the cable.

PART 2 P R O D U C T S

2.01 ACCEPTABLE MANUFACTURERS

A. American Insulated Wire Company

B. Cablec Continental Cables Company

C. General Cable Company

D. Okonite Company

E. Pirelli Cable Corporation

F. Rome Cable Corporation

G. Triangle Wire and Cable, Inc.

2.02 MATERIALS AND EQUIPMENT

A. Design. Provide cable with the following design characteristic. Cable shall be UL 44 or UL 83 listed, rated 600 volts and certified for continuous operation at the temperature as specified on the 600 Volt Power Cable Data Sheets while installed in underground duct, conduit, or cable tray. Cables shall be single-conductor or multi-conductor (with ground) as specified on the data sheets.

B. Conductors. Provide conductors which are Class B, concentric stranded, annealed copper coated, unless otherwise specified on the data sheets, with physical and electrical properties conforming to ASTM B 3, ASTM B 8 or ASTM B 33 and Part 2 of ICEA S-61-402, S-66-524, or S-68-516. The number and size of conductors supplied in each cable shall correspond to the quantities specified on the data sheets.

C. Insulation. Insulate each conductor as specified on the 600 Volt Power Cable Data Sheets to meet the requirements of Part 3 of ICEA S-61-402, S-66-524 or S-68-516. The insulation thickness shall match the dimensions listed in Section 3.2, Table 3-1 of ICEA S-61-402, S-66-524 or S-68-516, as specified on the data sheets.

D. Jacket.

1. When power cables are to be enclosed in conduit, ducts or in other raceway systems, multiconductor power cables shall be of the non-

metallic type and shall be covered by an overall nonmetallic jacket as specified on the Data Sheets, which complies with the requirements of Section 4.4 of ICEA S-66-524 or S-68-516, Section 4.3 of ICEA S-61-402, or Table 21-5 of Part 21 of UL 83.

2. Single-conductor cables shall have a jacket thickness which meets the requirements of Table 4-4 of Part 4 of ICEA S-66-524, Table 4-2 of Part 4 of ICEA S-68-516, or Table 4-2 or 4-6 of Part 4 of ICEA S-61-402. Multi-conductor cables shall have a jacket thickness which complies with Table 4-7 of Part 4 of ICEA S-66-524, Table 4-2 of Part 4 of ICEA S-68-516, Table 4-5 of Part 4 of ICEA S-68-516, or Table 4-6 of Part 4 of ICEA S-61-402, unless otherwise specified on the data sheets.

E. Armor. When power cables are to be exposed in a cable tray, cable channel or other cable support systems, the multiconductor power cables shall be protected by an interlocked metal armor made of galvanized steel which meets the requirements of paragraph 4.5 of ICEA S-68-516 or S-66-524 unless otherwise specified on the data sheets. An over-all jacket shall be provided as specified in the data sheets.

F. Cable Marking. Print cable marking information on the overall cable jacket at 2-foot intervals. Use a permanent printing method and color sharply contrasting with the jacket color. Identify individual conductors as specified on the data sheets in conformance with Part 5 of ICEA S-61-402, S-66-524, and S-68-516.

PART 3 E X E C U T I O N

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 F.

3.02 INSTALLATION

A. Cable in Conduit and Ductbank.

1. Clean conduits of foreign matter before cables are pulled.

2. 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.

3. Pull cables into conduits using wire pulling compounds approved by cable manufacturers to reduce friction. Lubricants must not be harmful to the conductor insulation. Mixtures containing soap or detergent shall not be used.

B. Cable in Tray.

1. Install medium voltage (5 kv and 15 kv) and 600V cables in separate trays or separated cables by a barrier in a single tray in accordance with NEC 318-6(f).

2. Install cables in trays in a neat and orderly manner. Tie cables to the tray rungs at approximate 15-foot intervals by use of cable ties.

3. Only one layer of 3-conductor No. 4/0 AWG and larger 600-volt power cables are allowed in a cable tray per NEC 318-9(a).

4. Using cable ties, make a triplex of single conductors used for 3-phase systems. Install in cable tray in accordance with NEC 318-10.

C. Preparation for Termination.

1. Make up 600-volt power cable terminations and splices with heat shrinkable sleeves and seals.

2. Use crimp-on terminal lugs and connectors for all sizes of conductors.

3. Use crimp-on lugs with long barrel and 2-hole tongues, except in places where terminations space is limited.

D. Tests.

1. Before connecting the cables, test insulation integrity.

2. Use a 500 VDC megohmmeter and perform the cable insulation test in accordance with the operating instructions.

E. Termination.

1. After the 600-volt cable has been tested with satisfactory results, terminate the cable at both ends to designated terminal points.

2. Tighten connection bolts with a torque wrench to specified torque levels.

END OF SECTION

DATA SHEET 1 of 3

IDENTIFICATION

CLIENT _____ MANUFACTURER _____
PROJECT _____ MODEL NO. _____
JOB NO. _____ SIZE _____
PLANT LOCATION _____ SERIAL NO. _____
ITEM NO. _____ INQUIRY NO. _____
SERVICE _____ P.O. NO. _____
QUANTITY REQUIRED _____

OPERATING DATA

VOLTAGE _____ FREQUENCY _____ AMBIENT TEMP (^{o}C) _____
INSTALLATION ENVIRONMENT _____

CONSTRUCTION

CONDUCTORS

SIZE (AWG or MCM): _____
ARRANGEMENT: _____ SINGLE CONDUCTOR OTHER _____
_____ MULTI-CONDUCTOR _____ NO. OF CONDUCTORS
MATERIAL: _____ COPPER _____ ALUMINUM _____ TINNED COPPER
_____ JACKETED _____ NON-JACKETED
_____ GROUND WIRES IN INTERSTICES: _____ COPPER _____ ALUMINUM
ASTM STANDARD: _____
SPECIAL REQUIREMENTS: _____

INSULATION

TYPE: ___CROSS-LINKED-THERMOSETTING-POLYETHYLENE ___CHLOROSULFONATED POLYETHYLENE
___ POLYVINYL CHLORIDE _____ ETHYLENE-PROPYLENE RUBBER
___ POLYETHYLENE _____OTHER _____
COLOR: _____
TEMPERATURE RATING: _____ 60^{o}C - 75^{o}C (WET-DRY) _____75^{o}C - 90^{o}C (WET-DRY)
_____ 90^{o}C (WET-DRY) _____ OTHER _____
INSULATING RATING: _____ 100% _____ 133% _____ 173% _____ OTHER _____
ICEA STANDARD: _____
SPECIAL REQUIREMENTS: _____

JACKET

TYPE: _____ POLYVINYL CHLORIDE _____ POLYETHYLENE
_____ HEAVY DUTY NEOPRENE _____ CHLOROSULFONATED POLYETHYLENE
_____ NYLON _____ OTHER: _____
COLOR: _____ BLACK _____ OTHER: _____
ICEA STANDARD: _____
SPECIAL REQUIREMENTS: _____

ITEM NO. _____

600-VOLT POWER CABLE

DATA SHEET 2 of 3

ARMORING

TYPE: _____ INTERLOCKED (POSITIVE) _____ OTHER _____
MATERIAL: _____ GALVANIZED STEEL _____ ALUMINUM
_____ OTHER _____
COVERING: _____ POLYVINYL CHLORIDE _____ OTHER _____
COLOR: _____ BLACK _____ OTHER _____
ICEA STANDARD: _____
SPECIAL REQUIREMENTS: _____

MARKING

CONDUCTOR IDENTIFICATION

SINGLE CONDUCTOR: _____
MULTI-CONDUCTOR: _____

CABLE MARKING

REQUIRED: _____ MANUFACTURER _____ CONDUCTOR SIZE
_____ NO. OF CONDUCTORS _____ VOLTAGE RATING
_____ UL LABEL _____ NEC TYPE
_____ TEMPERATURE RATING _____ MONTH/YEAR MANUFACTURE
_____ OTHER _____

TESTING

_____ PHYSICAL _____ FLAME TESTS (PER IEEE 383 - 2.5)
_____ ELECTRICAL _____ OTHER TESTS _____
_____ MEGGER
_____ OTHER _____

QUALITY ASSURANCE

_____ NO ADDITIONAL REQUIREMENTS _____ ATTACHED SPECIFICATION _____

PACKAGING

_____ DOMESTIC _____ EXPORT

SHIPPING

REEL TYPE: _____ RETURNABLE _____ NON-RETURNABLE _____ LENGTH PER REEL _____

ADDITIONAL REQUIREMENTS: _____

ITEM NO. _____

DATA SHEET 3 of 3

MANUFACTURER DATA

CABLE DIMENSION (O.D. IN.) _____ SHIPPING TIME _____
CABLE CROSS-SECTIONAL AREA _____ OTHER _____
CABLE WEIGHT (LBS/FT) _____
CABLE MIN BENDING RADIUS _____
TENSILE STRENGTH _____
GROSS WEIGHT/REEL (LBS) _____
TOTAL CUBIC FEET/REEL _____
SHORT CIRCUIT WITHSTAND CURVES _____

NOTES

ITEM NO. _____

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SECTION 16126

INSTRUMENTATION CABLE

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Specifications for instrumentation cable.

1.02 REFERENCES

A. American Society for Testing and Materials (ASTM).

1. ASTM B3: Soft or Annealed Copper Wires.

2. ASTM B8: Concentric-Lay-Stranded Copper Conductors, Hard, Medium Hard, Soft.

3. ASTM B33: Tinned Soft or Annealed Copper Wire for Electrical Purposes.

B. Institute of Electrical and Electronics Engineers (IEEE), IEEE 383-2.5: IEEE Standard for Type Test of Class IE Electric Cables, Field Splices, and Connections for Nuclear Power Generating Stations.

C. Insulated Cable Engineers Association (ICEA).

1. ICEA S-61-402: Thermoplastic-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy (NEMA WC-5).

2. ICEA S-66-524: Cross-Linked-Thermosetting-Polyethylene-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy (NEMA WC-7).

3. ICEA S-68-516: Ethylene-Propylene-Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy (NEMA WC-8).

D. Underwriters' Laboratories (UL).

1. UL 44: Rubber Insulated Wires and Cables.

2. UL 83: Thermoplastic Insulated Wire and Cables.

E. American National Standards Institute/National Fire Protection Association (ANSI/NFPA), NFPA No. 70 - National Electrical Code (NEC), Chapter No. 3 - Wiring Methods and Materials, Article 725 - Class 1, Class 2, and Class 3 Remote Control, Signaling, and Power-Limited Circuits.

1.03 SUBMITTALS

A. Submit the following under the provisions of Section 01330 – Submittal Procedures:

1. Completed engineer's data sheets from this specification or manufacturer's data sheets, cut sheets, and catalog data.

2. Installation, terminating and splicing procedure (including bending radius and pulling tension data).

3. Instruction for handling and storage.

4. Dimensions and weight.

1.04 QUALITY ASSURANCE

A. Tests

1. Cable shall be tested at the factory to confirm that the cable complies with requirements of ICEA Section 7.7.9 of S-66-524 or 7.5.9 of S-68-516. Refer to data sheet for additional test requirements.

2. Where applicable, the cable shall meet the requirements of the vertical tray flame test as described in IEEE 383-2.5.

1.05 DELIVERY, STORAGE AND HANDLING

A. Ship cable on manufacturer's standard reel sizes unless otherwise specified. Where cut lengths are specified, mark reel footage accordingly. Each reel shall contain one continuous length of cable. Reels shall be of the type specified on the data sheets. Provide impact protection by wood lagging or suitable barrier across the traverse of the reel. Provide moisture protection by manufacturer's standard procedure or heat shrinkable self-sealing end caps applied to both ends of the cable.

PART 2 P R O D U C T S

2.01 MANUFACTURERS

A Alpha Wire Corporation

B. Belden Division, Cooper Industries, Inc.

C. Cablec Continental Cables Company

D. General Cable Company

E. Manhattan Electric Cable Corporation

F. Okonite Company

2.02 MATERIALS AND EQUIPMENT

A. Design. Provide cable with the following design characteristics. The cable shall consist of multiple conductors. The cable assembly shall be UL listed, flame, oil and sunlight resistant, and certified for continuous operation at the temperature specified on the Instrumentation Cable Data Sheets in wet or dry locations while installed in underground duct, conduit, or cable tray. The number and size of conductors supplied in each cable shall correspond to the quantities specified on the Instrumentation Cable Data Sheets. Each conductor shall be individually insulated. Pairs and triads shall have conductors which are twisted together with a drain wire, shielded, and covered with a jacket. Multi-pair/triad cables shall consist of the required number of electrically isolated, shielded pairs or triads, which are bundled together and covered by an overall jacket as specified on the Instrumentation Cable Data Sheets.

B. Conductors. Provide conductors which are Class B, concentric stranded, annealed tinned copper whose physical and electrical properties comply with ASTM B3, B8 or B33 and Part 2 of ICEA S-61-402, S-66-524, or S-68-516, unless otherwise specified on the Instrumentation Cable Data Sheets.

C. Insulation. Each conductor shall be insulated as specified on the Instrumentation Cable Data Sheets in compliance the requirements of Part 3 of ICEA S-61-402, S-66-524, or S-68-516. The average insulation thickness shall not be less than the dimensions shown in Table 7-32 or 7.5.1 of ICEA S-66-524 or S-68-516 for 600-volt insulation unless otherwise specified on the Instrumentation Cable Data Sheets. The minimum insulation thickness shall not be less than 90 percent of the value given in the table.

D. Drain Wire. Provide drain wire which is Class B, seven-stranded, tin-coated copper in accordance with ASTM B3, B8, or B33 and as specified on the

Instrumentation Cable Data Sheets. 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 unless otherwise specified on the Instrumentation Cable Data Sheet. Wrap the tape around each twisted pair or triad with a 25 percent minimum overlap unless otherwise specified on the Instrumentation Cable Data Sheets.

F. Jacket. The physical and electrical properties of the jacket used to cover single or multi-pair or triad cables shall meet the requirements of section 7.7.7 or ICEA S-66-524 or section 7.5.6 of ICEA S-68-516. Jacket material is specified on the Instrumentation Cable Data Sheets. The jacket thickness shall be equal to the dimensions shown in Table 7-33 or 7.5.2 of ICEA S-66-524 or S-68-516. The jacket material is specified on the Instrumentation Cable Data Sheets. The jacket thickness shall be equal to the dimensions shown in Table 7-33 or 7.5.2 of ICEA S-66-524 or S-68-516.

G. Armor. Where requested, use instrumentation cables protected by an interlocked metal tape armor coating made of galvanized steel which meets the requirements of paragraph 4.5 of ICEA S-68-516 or S-66-524, unless otherwise specified on the Instrumentation Cable Data Sheets.

H. Conductor Identification. Use individual conductors in single-pair and single-triad cables which are color coded black and white; and black, white and red, respectively. Multi-pair-triad cables shall have one conductor in each pair or triad colored white, and all other conductors are color coded in sequence according to Table L-2 of Appendix 2 of ICEA S-66-524, and as specified on the Instrumentation Cable Data Sheets.

I. Cable Marking. Print cable marking information on the jacket of each cable at 2-foot intervals. Use a permanent printing method with color sharply contrasting the jacket color. See the Instrumentation Cable Data Sheets for the minimum information required.

PART 3 E X E C U T I O N

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 30 percent spare conductors or pairs.

3.02 INSTALLATION

A. Cable in Conduit and Ductbank

1. Install cables in accordance with the manufacturer's instructions and NEC Article 725 - Class 1, Class 2, and Class 3 Remote Control, Signaling and Power Limited Circuits. Do not exceed maximum wire tension, maximum insulation pressure and minimum bending radius.

2. Pull cables into conduits using adequate lubrication to reduce friction. Lubricants must not be harmful to the conductor insulation or cable jacket.

3. Conduits carrying low level signal cables shall be PVC-coated rigid steel.

B. Cable in Tray. Install instrument and signal cable in cable tray only when the tray is dedicated for this type cable and cables are approved for tray installation.

C. Termination

1. Do not splice conductors. For termination use crimp-on type ring tongue non-insulated tin plated copper lugs.

2. For shielded control cable, terminate the shield and ground it at one end only, preferably at the control panel end for instrument and communication cable and at the supply end for electronic power cables.

3. If splicing is required, maintain shield continuity by jumpering the ground shield across connection point where it is broken at junction boxes, or other splice points. Insulate these points from ground.

4. Mark wiring on both ends with circuit numbers or loop tag numbers. Heat shrink wire markers after the ring tongue terminal has been installed. Extend the marker over the crimp or base of the terminal.

D. Tests

1. Before connecting the cables, test insulation integrity and conductor continuity.

2. Use a 500 VDC megohmmeter and perform the cable insulation test in accordance with the operating instructions.

E. Termination. After the 600-volt cable has been tested with satisfactory results, the cable can be terminated at both ends to their designated terminal points.

END OF SECTION

INSTRUMENTATION CABLE

DATA SHEET 1 of 4

IDENTIFICATION

CLIENT _____ MANUFACTURER _____
PROJECT _____ MODEL NO. _____
JOB NO. _____ SIZE _____
PLANT/LOCATION _____ SERIAL NO. _____
ITEM NO. _____ INQUIRY NO. _____
SERVICE _____ P.O. NO. _____
QUANTITY REQUIRED _____

NOTE: [ ] INDICATES INFORMATION TO BE COMPLETED BY MANUFACTURER

ENVIRONMENTAL CONDITIONS

TEMPERATURE RANGE: MAX _____ °C, MIN _____ °C
INSTALLATION: _____ ENCLOSED _____ OUTDOORS _____ INDOORS _____
_____ UNDERGROUND _____ UNDERWATER _____
EXPOSURE: _____ MOISTURE _____ DIRT _____ OZONE _____
_____ RADIATION _____ CHEMICALS:(PLEASE LIST) _____
SOILS: (PLEASE LIST) _____ ELECTROSTATIC INTERFERENCE _____
ELECTROMAGNETIC INTERFERENCE DISTURBANCES _____ RODENTS _____
OTHER: _____

PHYSICAL REQUIREMENTS

FLEXIBILITY: _____ VERY FLEXIBLE _____ FLEXIBLE _____ NOT CRITICAL
RESISTANCE TO: _____ ABRASION _____ IMPACT _____ CRUSH
_____ DEFORMATION _____ CUT THROUGH . COLD FLOW
TERMINATION METHOD: _____

STRIPPABILITY: _____ MANUAL
_____ AUTOMATIC EQUIPMENT TYPE _____

ELECTRICAL REQUIREMENTS

_____ FREQUENCY (HZ) _____ CROSS TALK (ISOLATION IN DB AT FREQ)
_____ CURRENT (MILLIAMP) _____ DC RESISTANCE (OHMS/1000 FT)
_____ CAPACITANCE (PFD) _____ VOLTAGE BREAKDOWN (VOLTS/MILL)
_____ ATTENUATION (DB/100 FT) _____ INSULATION RESISTANCE (MEGOHMS/1000 FT)
ADDITIONAL REQUIREMENTS: _____

ITEM NO. _____

INSTRUMENTATION CABLE

DATA SHEET 2 of 4

CONSTRUCTION

CONDUCTORS

SIZE (AWG): ___
_____ COPPER _____ STEEL _____ TINNED
_____ BARE _____ SOLID _____ COPPER COATED
_____ STRANDED _____ SILVER COATED
NUMBER OF CONDUCTORS: _____ NUMBER OF PAIRS _____
NUMBER OF TRIADS _____
ADDITIONAL REQUIREMENTS: _____

INSULATION

RUBBER: _____ SBR _____ NATURAL _____ SYNTHETIC _____ BUTYL _____ POLYBUTADIENE
_____ NEOPRENE _____ NBR _____ EPR/EPT
_____ CHLORSULFONATED POLYETHYLENE _____ SILICONE
PLASTIC: _____ PVC ____ LOW-DENSITY POLYETHYLENE _____ CELLULAR POLYETHYLENE ____ TEFLON
_____ HIGH-DENSITY POLYETHYLENE _____ POLYPROPYLENE _____ POLYURETHANE
_____ NYLON _____ OTHER: _____
VOLTAGE RATING: _____ AC _____ DC WALL THICKNESS _____
LAY LENGTH PER INCH OF PAIRS: _____ LAY _____ TWIST
DRAIN WIRE: _____ SIZE _____ STRANDED __ SOLID _____ BARE COPPER _____ TIN-COATED COPPER
COLOR _____
TEMPERATURE RATING: _____ 60° - 75°C (WET-DRY) __ 75°C - 90°C (WET-DRY)
_____ 90°C (WET-DRY) _____ OTHER: _____
SPECIAL REQUIREMENTS: _____

SHIELDING

TYPE SHIELDING: _____ BRAIDED _____ CONDUCTIVE PLASTIC
_____ CONDUCTIVE COTTON _____ SPIRAL-SERVED
_____ MYLAR FILM-ALUMINUM FOIL ___ POLYESTER FILM-ALUMINUM FOIL
_____ OTHER: _____
POLYESTER FILM-ALUMINUM LOCATION: _____ INSIDE _____ OUTSIDE _____ PAIR SHIELD ISOLATED
_____ SEPARATOR _____ FILTER

SHIELD COMBINATION

OVERSHIELD: _____ POLYESTER FILM-ALUMINUM ___ BRAID _____ SERVED
_____ OTHER: _____
BRAID SHIELD: _____ TYPE STRANDS _____% COVERAGE __ TINNED
_____ BARE _____ COPPER _____ ALUMINUM
OVERALL TYPE: _____ POLYESTER _____ PAPER ___ OTHER: ____

JACKET

TYPE: _____ POLYVINYL CHLORIDE _____ POLYETHYLENE
_____ HEAVY DUTY NEOPRENE _____ CHLOROSULFONATED POLYETHYLENE
_____ NYLON _____ OTHER: _____

ITEM NO. _____

DATA SHEET 3 of 4

JACKET (Cont)

THICKNESS (MILS OR MM) _____
COLOR: _____ BLACK _____ OTHER: _____
SPECIAL REQUIREMENTS: _____

ARMORING

TYPE: _____ INTERLOCKED (POSITIVE) OTHER: _____
MATERIAL: _____ GALVANIZED STEEL _____ ALUMINUM _____
_____ OTHER: _____
COVERING: _____ POLYVINYL CHLORIDE _____ OTHER: _____
COLOR: _____ BLACK _____ OTHER: _____
SPECIAL REQUIREMENTS: _____

MARKING

CONDUCTOR IDENTIFICATION

SINGLE-CONDUCTOR: _____
MULTI-CONDUCTOR: _____

CABLE MARKING

REQUIRED: _____ MANUFACTURER _____ CONDUCTOR SIZE
_____ NO. OF CONDUCTORS _____ VOLTAGE RATING
_____ UL LABEL _____ NEC TYPE
_____ TEMPERATURE RATING _____ MONTH/YEAR OF MANUFACTURE
_____ OTHER: _____

FACTORY TESTING/DOCUMENTATION

_____ PHYSICAL _____ _____ FLAME TESTS (SPECIFY STANDARDS) _____
_____ ELECTRICAL _____ OTHER TESTS: _____
_____ MEGGER
_____ OTHER: _____ _____
_____ _____
_____ _____

QUALITY ASSURANCE

_____ NO ADDITIONAL REQUIREMENTS _____ ATTACHED SPECIFICATION _____

PACKAGING

_____ DOMESTIC _____ EXPORT

SHIPPING

REEL TYPE: ____ RETURNABLE _ NON-RETURNABLE _____ LENGTH PER REEL _____
ADDITIONAL REQUIREMENTS: _____

ITEM NO. _____

INSTRUMENTATION CABLE

DATA SHEET 4 of 4

1. [ ] **MANUFACTURER DATA**
2. CABLE DIMENSION (O.D. IN.) _____ SHIPPING TIME _____
3. CABLE CROSS-SECTIONAL AREA _____ OTHER _____
4. CABLE WEIGHT (LBS/FT) _____
5. CABLE MIN BENDING RADIUS _____
6. TENSILE STRENGTH _____
7. GROSS WEIGHT/REEL (LBS) _____
8. TOTAL CUBIC FEET/REEL _____
9. SHORT CIRCUIT WITHSTAND CURVES _____
10. CABLE TESTING REQUIREMENTS _____
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12. **NOTES**
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ITEM NO. _____

SECTION 16131

DEVICE, PULL AND JUNCTION BOXES

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Specifications for device, pull, and junction boxes.

1.02 REFERENCES

A. American National Standards Institute/National Electrical Manufacturers Association (ANSI/NEMA).

1. FB1 - Fittings and Support for Conduits and Cable Assemblies

2. 250 - Enclosures for Electrical Equipment (1000 volts maximum)

B. American National Standards Institute/National Fire Protection Association (ANSI/NFPA), NFPA70 - National Electrical Code (NEC) - Article 314 - Outlet Device, Pull and Junction Boxes, Conduit Bodies and Fittings.

C. Underwriters Laboratories (UL):

1. 50 - Safety Cabinets and Boxes

2. 508 - Safety Industrial Control Equipment

3. 514B - Safety Fittings for Conduit and Outlet Boxes

4. 886 - Safety Outlet Boxes and Fittings for Use in Hazardous Areas

1.03 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

1.04 DELIVERY, STORAGE AND HANDLING

A. Pack and crate boxes to permit ease of handling and to provide protection from damage during shipping, handling and storage.

PART 2 P R O D U C T S

2.01 ACCEPTABLE MANUFACTURERS

A. Sheet Metal Boxes

1. Hoffman Industrial Products

2. Pauluhn Electric Manufacturing Company

3. Hennessy

4. Tanco

5. Tejas

6. Circle A.W.

B. Cast Device Boxes

1. Appleton Electric Company

2. Crouse-Hinds, Division of Cooper Industries

3. Killark Electric Manufacturing Company

2.02 MATERIALS AND EQUIPMENT

A. Sheet Metal Boxes

1. Provide UL-approved junction boxes and pull boxes manufactured from stainless steel sheet metal and meeting requirements of NEMA 4X for corrosive and wet area, NEMA 250 and NEC Article 314.

2. Provide boxes with a stainless steel continuous hinge, closure hasps and all- stainless steel hardware. Junction boxes shall be mounted so the door opens to the right or to the left.

3. Furnish the door with neoprene gasket and provision for padlock.

B. Device Boxes

1. Provide UL-approved boxes designed and manufactured to house electrical devices like receptacles and switches, and in conformance with NEMA FB1 and NEC Article 314.

2. Supply boxes that are hot-dip galvanized on cast iron suitable for corrosive and wet atmosphere.

C. Hardware

1. Mounting Hardware: Stainless steel

2. Conduit Connectors: Watertight as manufactured by Myers Hubs, or equal.

PART 3 E X E C U T I O N

3.01 PREPARATION

A. Review the drawings and determine how many boxes of each kind are required and check if supplied quantity is sufficient.

3.02 INSTALLATION

A. Boxes described in this specification shall be used both in dry and wet, corrosive areas, both inside and outside locations.

B. Install boxes in accordance with NEC Article 314 in locations indicated on the Drawings. Junction boxes shall be mounted so the door opens to the right or to the left.

C. Install junction and pull boxes in readily accessible places to facilitate wire pulls, maintenance and repair. Junction boxes shall be sized for the number and size of conduits that enter the junction box.

D. Plug unused conduit openings.

E. Make conduit connections to sheet metal boxes with watertight conduit connectors.

F. Label boxes with phenolic nameplates as required in Section 16195.

END OF SECTION

SECTION 16140

WIRING DEVICES

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Specifications for wiring devices including:

1. Receptacles.

2. Wall switches.

3. Wall plates and cover plates.

1.02 REFERENCES

A. American National Standards Institute/National Electrical Manufacturers Association (ANSI/NEMA):

1. NEMA WD1 - General Purpose Wiring Devices.

2. NEMA WD6 - Dimensional Requirements.

B. Federal Specifications (WC-596F).

C. American National Standards Institute/National Fire Protection Association (NFPA):

1. NFPA No. 70 - National Electrical Code (NEC), Articles 210 Branch Circuits, 250 Grounding and 410, Paragraphs 56, 57 and 58.

1.03 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.

1.04 DELIVERY, STORAGE AND HANDLING

A. Pack and crate devices to permit ease of handling and protect from damage during shipping, handling and storage.

PART 2 P R O D U C T S

2.01 ACCEPTABLE MANUFACTURERS

A. Bryant Electric

B. Crouse-Hinds, Arrow Hart Division

C. Hubbel Inc. Wiring Devices Division

D. Leviton Manufacturing Company

E. Pass & Seymour/Legrand.

2.02 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 (orange for isolated-ground receptacles) back and side wiring provisions and green-colored grounding screws.

C. Receptacles:

1. Duplex-type receptacles: Rated 20 amps at 120 volts.

2. Contacts: Brass or phosphor bronze.

3. Receptacle grounding system: Extend to the mounting strap unless isolated ground is indicated or required.

4. GFI or GFCI (ground fault circuit interrupter) receptacles: Provide feed-through type with test and reset button.

D. Wall Switches:

1. Toggle switches: Rated 20 amps at 120/277 volts AC rated for both resistive and inductive loads.

2. Contacts: Silver cadmium oxide construction to prevent sticking, welding and excessive pitting.

E. Cover Plates:

1. In outdoor, corrosive and wet areas, provide cover plates of heavy duty plastic, gasketed with hinged covers that remain waterproof while still in use and stainless steel hardware.

2. All other plates: Type 302 stainless steel.

PART 3 E X E C U T I O N

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

SECTION 16160

CABINETS AND ENCLOSURES

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Specifications for cabinets and enclosures for housing of control panels and motor controls.

1.02 REFERENCES

A. National Electrical Manufacturers Association (NEMA).

1. 250 - Enclosures for Electrical Equipment (1000 volts maximum).

a. NEMA 3 - Enclosures for outdoor use primarily to provide a degree of protection against wind-blown dust, rain, and sleet; undamaged by formation of ice on the enclosure.

b. NEMA 12 - Enclosures for indoor use primarily to provide a degree of protection against dust, falling dirt, and dripping non-corrosive liquids.

B. American National Standards Institute/National Fire Protection Association (ANSI/NFPA), NFPA 70 - National Electrical Code (NEC), Article 312 - Cabinets, Cutout Box, and Meter Socket Enclosures.

C. Underwriters Laboratories (UL), UL 50 - Safety for Cabinets and Boxes.

1.03 SUBMITTALS

A. Submit the following under provisions of Section 01330 – Submittal Procedures:

1. Manufacturer's cut sheets and catalog data

2. Instruction for handling and storage

3. Installation instructions

4. Dimensions and weights

1.04 DELIVERY, STORAGE AND HANDLING

A. Have cabinets and enclosures packed and crated to permit ease of handling and to provide protection from damage during shipping, handling and storage.

PART 2 P R O D U C T S

2.01 ACCEPTABLE MANUFACTURERS

A. The EMF Company

B. Hennessey Products, Inc.

C. Hoffman Industrial Products

D. Pauluhn Electric Manufacturing Company

E. Weigman Company

F. Rose Enclosure

G. N.E.M.A. Enclosure Mfg. Co.

H. Rittal

2.02 MATERIALS AND EQUIPMENT

A. Sheet Metal Boxes

1. Provide enclosures manufactured in accordance with NEMA 250 and NEC Article 312. Fabricate outdoor NEMA 3 panels from 0.125- inch thick type 5052 H32 aluminum or 14 gauge, 316 stainless steel for installation in areas that are not air conditioned. NEMA 12 indoor panels for installation in air conditioned areas shall be painted steel.

2. Dimensions and special features are shown on the Drawings.

3. Construct outdoor enclosures with continuously welded seams ground smooth.

4. Additional material thickness and bracing requirements shall be determined by the manufacturer to provide the strength required by the

standard listed. The bracing shall be provided in such a way as to minimize the protrusion into the wiring and the equipment spaces.

5. Install the door with a stainless steel continuous hinge, stainless steel padlock handle with gasket and stainless steel hardware. Junction boxes shall be mounted so the door opens to the right or to the left.

6. Furnish the door with oil-resistant neoprene gasket attached with oil-resistant adhesive and held in place with aluminum retaining strips.

7. Use a single, 3/4-inch minimum, door handle that provides a 3-point latching through latch rods with rollers. Provide rollers with at least 3/4-inch diameter.

8. Gasketed overlapping doors may be used instead of a center post.

9. Provide heavy duty lifting eyes of suitable material.

10. Fabricate the enclosure with a stud-mounted panel inside. Make panels from 12-gauge steel painted with white enamel finish.

11. Equip both NEMA 12 and NEMA 3 enclosures with thermostatically controlled space heaters and corrosion inhibitors. Provide heaters rated for 240V for 120V operation.

12. Weld mounting feet to the enclosure if called for on the Drawing.

13. Include a high impact plastic data pocket in the enclosure.

14. Provide ground connections on the enclosures to enable grounding of the enclosure with a No. 2 AWG conductor.

15. Equip free-standing outdoor cabinets with inner and outer door restraint bars to prevent door swing during windy conditions.

16. Supply indoor enclosures with filtered passive air intake and exhaust openings, 4-inch square in the side near the top and near the bottom of the adjacent side panel.

B. Hardware

1. Mounting Hardware: Stainless steel

2. Conduit Connectors: Watertight as manufactured by Myers Hubs, or equal.

2.03 TESTING

A. Test cabinets and enclosures in accordance with UL 50 so unit qualifies for a UL label.

PART 3 E X E C U T I O N

3.01 PREPARATION

A. Review Drawings and determine how many enclosures of each kind are required and check if supplied quantity is sufficient.

B. Check the mounting pads or foundations for proper mounting dimensions and features, including grounding conductor stub-up.

3.02 INSTALLATION

A. Use enclosures described in this specification only above grade.

B. Install enclosures in accordance with NEC Article 312 in locations as indicated on the Drawings.

C. Install enclosures in readily accessible locations to facilitate general operations, wire pulls, maintenance and repair.

D. Plug unused conduit openings.

E. Make conduit connections to the enclosures with watertight conduit connectors.

F. Identify all components in cabinets with phenolic nameplates as required in Section 16195.

G. Use pre-printed tubular heat-shrink type wire and cable markers to label each end of all conductors.

END OF SECTION

SECTION 16161

PANELBOARDS

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Specifications for panelboards.

1.02 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 408 - Switchboards and Panelboards.

1.03 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

1.04 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.

PART 2 P R O D U C T S

2.01 ACCEPTABLE MANUFACTURERS

A. Sheet Metal Boxes

1. Cutler-Hammer Products

2. General Electric

3. Siemens Energy and Automation

4. Square D Company

5. Westinghouse Electric

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.

3. Do not exceed 42 available single pole branch circuits in any one panelboard.

4. Perform a load analysis to assure the panel rating is not overloaded when new loads are added to existing panels.

B. Rating

1. Voltage rating, current rating, number of phases, number of wires and number of poles are indicated on Drawings.

2. Branch circuit breaker interrupting capacity shall be minimum 10,000 ampere RMS symmetrical for 208V; 25,000 ampere RMS symmetrical for 480V.

C. Circuit Breakers: Molded case, bolt-on thermal magnetic type with number of poles and trip ratings as shown on the Drawings. Provide ground fault interrupters with trip rating where shown on the Drawings.

D. Bus System

1. Bus Bars: 98 percent conductivity copper. Provide a solid neutral bar in 4-wire panelboards. Include ground bus in all panels. Provide split-bus panels where shown on Drawings.

2. Main: Circuit breaker or main lugs only as indicated on the 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 snaplatch and lock.

2. Trim: Surface or flush as required. Enclose panelboards located outdoors, in other wet and corrosive areas, or in non air conditioned areas in NEMA 4X weatherproof stainless steel enclosures. Enclose indoor panelboards installed in air conditioned areas 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 E X E C U T I O N

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 408.

B. Mount panelboards 6'-0" (to top of cabinet) above finished floor or grade. 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. Mounting hardware shall be type 316 stainless steel.

C. 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

SECTION 16165

DISCONNECT SWITCHES

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Specifications for disconnect switches including:

1. Fusible disconnect switches

2. Non-fusible disconnect switches

3. Circuit breaker type disconnect switches

4. Fuses

5. Circuit breakers

1.02 REFERENCES

A. American National Standards Institute/National Electrical Manufacturers Association (ANSI/NEMA)

1. NEMA AB1: Molded Case Circuit Breakers

2. NEMA KS1: Enclosed Switches

B. Underwriters Laboratories (UL)

1. UL 98: Standard for safety enclosed switches and Dead Front Switches

2. UL 198C: High Interrupting Capacity Fuses, Current Limiting type

3. UL 198E: Class R Fuses

C. American National Standards Institute/National Fire Protection Association (ANSI/NFPA), NFPA No. 70 - National Electrical Code (NEC), Chapter 4.

1.03 SUBMITTALS

A. Submit the following under provisions of Section 01330 – Submittal Procedures:

1. Manufacturer's cut sheets and catalog data
2. Switch internal arrangement
3. Breaker or fuse characteristic curves
4. Instructions for handling and storage
5. Installation instructions
6. Dimensions and weights

1.04 DELIVERY, STORAGE AND HANDLING

A. Have disconnect switches packed and crated to permit ease of handling and to provide protection from damage during shipping, handling and storage.

PART 2 P R O D U C T S

2.01 ACCEPTABLE MANUFACTURERS

A. Disconnect Switches and Circuit Breakers:

1. Cutler-Hammer Products
2. General Electric
3. Siemens Energy and Automation
4. Square D Company
5. Westinghouse Electric

B. Fuses

1. Bussman Division, Cooper Industries
2. Gould Shawmut
3. Littelfuse Incorporated

2.02 MATERIALS AND EQUIPMENT

C. Disconnect Switches

1. Characteristics: Horsepower rated, 600-volt, heavy-duty type with an interlocked door, positive quick-make, quick-break mechanism and visible blades.

2. Use switches and components designed, manufactured and tested in accordance with NEMA AB1, NEMA KS1, UL 98, and NEC Chapter 4.

3. Enclose switch in a NEMA 12 type enclosure for indoor, air-conditioned applications and NEMA 4X (type 316 stainless steel) in outdoor locations, non air-conditioned areas, or other wet or corrosive areas.

4. Provide switches with provisions for padlocking the operating lever in OFF position and door in closed position.

5. Select switches having the number of poles and general size conforming to the Drawings.

6. Conform to fusible, non-fusible or circuit breaker type switch requirements as shown on Drawings and required by the NEC, or one-line diagrams.

7. Provide an auxiliary contact, shown on the Drawings.

8. Select fuses or circuit breakers with current interrupting duty as calculated for the points of switch application or as indicated on the Drawings or one-line diagrams.

D. Fuses. Unless otherwise noted on Drawings, for fuses used in disconnect switches, provide the dual-element, time-delay type with the maximum interrupting rating of 200,000 amperes, conforming to the NEC.

E. Circuit Breakers. When circuit breakers are used in disconnect switches, provide the thermal-magnetic type with current interruption ratings as required at the point of application.

F. Conduit Connectors: Watertight as manufactured by Myers Hubs, or equal.

PART 3 E X E C U T I O N

3.01 PREPARATION

A. Review the Drawings and verify that the disconnect switches are correct for the applications.
B. Make sure that the correct fuses or breakers are being used regarding size and short circuit interrupting capability.

C. Prepare adhesive labels on the inside door of each switch indicating UL fuse class and size or breaker type and size for replacement.

3.02 INSTALLATION

A. Install the disconnect switches in accordance with and NEC Chapter 4. Disconnect switches shall be mounted in sight of or within 25’ of motors and rotating equipment.

B. Mount switches 6'-6" (to top of cabinet) above finished floor or grade.

C. In wet and corrosive areas, including outdoor locations, install switches on spacers to provide a space of approximate 1/4-inch between the back of cabinet and the 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.

E. Disconnect shall be labeled as required in Section 16195.

END OF SECTION

SECTION 16170

GROUNDING AND BONDING

PART 1 G E N E R A L

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 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.

1.03 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

1.04 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.

1.05 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. 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 P R O D U C T S

2.01 ACCEPTABLE MANUFACTURERS

A. Cable

1. American Insulated Wire Company
2. Cablec Continental Cables Company
3. General Cable Company
4. Okonite Company
5. Pirelli Cable Corporation
6. Rome Cable Corporation
7. Triangle Wire and Cable, Inc.

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 loop of No. 4/0 AWG, Class C stranded, bare copper cable. Small groups of isolated equipment may be grounded by a No. 2 AWG minimum insulated conductor connected to the main loop. Generally, taps shall be sized as follows:

a.	Main ground loop or grid	#4/0 minimum
b.	Switchgear, motor control centers and power transformers	#4/0
c.	Motors 200 hp and above	#4/0
d.	Power panels - AC and DC	#2/0
e.	Control panels and consoles	#2
f.	Building columns	#4/0
g.	Fencing posts	#2/0

3. Where single conductor insulated grounding conductors are called for, use 600-volt insulation. Use ground conductors identified with green insulation or green tape marking.

4. 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.

5. Utilize flexible copper braid across hinged chain link or fence gates to bond the movable portion to the grounded fence post.

PART 3 E X E C U T I O N

3.01 PREPARATION

A. Complete site preparation and soil compaction before trenching and driving ground rods for the underground grid.

B. Verify from Drawings the exact location of stub-up points for grounding of equipment, fences and building or steel structures.

3.02 CONSTRUCTION CRITERIA

A. The main ground loop at a depth of at least 30 inches below earth surface. Connect the ground loop to ground rods and to tap connections to form a complete system as indicated on the electrical Drawings. The Contractor shall give special attention to the grounding of service equipment, structures and fences to comply with the NEC, local authorities and the serving utility company.

B. Electrical equipment, buildings, tanks, and other structures and equipment shall be grounded as indicated on the Drawings. Where ground rods are required, the rods shall be 10 feet long, 3/4 inch diameter, copper-clad steel ground rods. Rods shall be driven vertically, and the top of the rods shall be a minimum of 18 inches below finished grade, or as specified on the Drawings. Ground wells will be provided for all driven rods.

C. 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 and equipment grounding conductor run with the power supply or control circuit conductors or shall be grounded as shown on the Drawings.

D. Ground medium voltage motors, in addition to the grounding conductors in the motor feeder cable, with a separate No. 4/0 AWG cable to motor frame.

E. 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.

F. Do not ground the insulated bearing pedestals of large motors.

G. Connect ladder-type cable trays to the grounding electrode system.

H. Install a warning ribbon approximately 12 inches below finished grade directly above the ground grid.

I. Connect fence posts of chain link and metal fences to the main ground loop at least every 50 feet. Install bonding straps to gates.

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 Drawings.

3. Make grounding connections to electrical equipment, vessels, mechanical equipment and ground rods in accordance with the 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 them with PVC non-metallic conduit as indicated on the Drawings.

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 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. Ground fences, fence posts and gates to the underground grid as shown on the Drawings.

D. Power System Grounding

1. Solidly ground the secondary neutral of the main power supply transformer either to the ground grid or through an impedance. See 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 Wells

1. Provide access (test wells) for testing the ground grid system at one or several ground rod locations. Make test wells of a pipe surrounding the rod and connections with a cover placed on top at grade level. See Drawings for details.
2. Install a test well at the service entrance pole to serve as the service entrance grounding electrode.

G. Test

1. Perform ground resistance tests after underground installation and connections to building steel are complete, unless otherwise noted on applicable 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.

H. Inspection. Inspection of the grounding system by the Project Manager and the local Code Inspector must take place before the grid trenches are backfilled.

END OF SECTION

SECTION 16171

LOW VOLTAGE ELECTRIC MOTOR

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Specification for low voltage motors. See Specification 11311, Submersible Wastewater Pumps, for motors integral with submersible wastewater pumps.

1.02 RELATED WORK

A. Specification Section 16195, Electrical Identification.

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 – Submittal Procedures:

1. Outline drawings

2. Complete motor data

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. Code data reports

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

B. 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).

C. Provide instructions as necessary to preserve the integrity of the storage preparation after the equipment arrives at the jobsite.

D. Coat exterior machined surfaces with a suitable rust preventative.

E. 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.

F. Provide threaded openings with steel caps or solid-shank steel plugs. Do not use nonmetallic plugs or caps.

G. When sleeve bearings are furnished, block the rotor to prevent axial and radial movement.

H. When space heaters are furnished, make heater leads accessible without disturbing the shipping package. Tag the leads for identification.

PART 2 P R O D U C T S

2.01 MANUFACTURERS

A. General Electric.

B. Reliance Electric.

C. Siemens.

D. Toshiba.

E. U.S. Motors.

F. Westinghouse

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 classified electrical hazardous and nonclassified 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 200 hp. Use driven equipment specifications to supplement this specification and identify special project requirements.

D. Motors purchased with this specification will drive pumps, compressors, fans, agitators, conveyors and other similar equipment. 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.

F. Motors, electrical components and installation shall be suitable for the hazardous area classification (class, group, and division) and shall meet the requirements of ANSI/UL 674 and the NEC.

G. Make motors suitable for operation in an outdoor corrosive and wet environment.

H. When motors are furnished with the driven equipment as a package, motors shall also meet the requirements of the driven equipment specification.

I. Design motors for operation at a temperature of up to 40^{o}/104^{o}F 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.

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, and for continuous or intermittent operation under any extreme environmental condition.

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 as shown in ASHRAE/IES Standard 90.1 - 1989, Table 5-1 and ANSI/NEMA MG-1-1998 Table 12-10. Provide motors commonly referred to as “Premium Efficiency” in the Industry.

2.04 ENCLOSURES AND FRAMES

A. Provide motors with NEMA totally enclosed, fan-cooled (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. 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, nonsparking 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. Design motor for 60 Hz power at the nominal operating voltages listed below.

1. 115/230V, single-phase (3/4 hp and smaller).

2. 460V, three-phase (one horsepower and larger).

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 horsepower, speed, torque and special operating requirements from the requirements of the 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. Provide three-phase single speed motors with three leads.

F. For two-speed motors provide two windings.

G. Motors shall have a 1.15 service factor (SF) rating.

H. Motor insulation shall be a minimum of Class F epoxy nonhygroscopic material with temperature rise limited to Class B design rise of 90^{o}C by resistance method at 1.15 SF.

I. 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.

J. Motors shall be suitable for the number of full-voltage starts as required by ANSI/NEMA MG 1-12.50 as a minimum.

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 main terminal box location shall be determined by the Contractor. Locate terminal box for space heaters (when supplied) on the same side as the line terminal box.

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. Arrange space heaters to provide 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^{o}C and shall be approved for the specified hazardous area classification.

B. Provide winding thermal protection, when required, in accordance with ANSI/UL 547 and consisting of differential heat sensing devices embedded in each motor winding. The devices shall be sensitive to both overtemperature and rate of temperature rise.

2.08 BEARINGS AND LUBRICATION

A. Grease or oil-lubricated anti-friction ball or roller bearings are preferred within the application limits. Sleeve-type bearings may be acceptable when recommended by the manufacturer for a particular application. Sealed grease-lubricated bearings are acceptable only for fractional horsepower motors in noncritical service.

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. Bearings for all direct--connected and belted service motors shall have an L_{10} rating life in accordance with ANSI/AFBMA 9, of at least 40,000 hours.

D. Size bearing housing for grease-lubricated bearings adequately to minimize need for frequent lubrication. Design bearing housing to prevent loss of grease from the bearing cavity and to prevent entry of foreign material into the bearings. Provide housing for grease-lubricated bearings with two plugged openings accessible from the exterior of the motor, one for receiving a pressure grease fitting, and the other to serve as a drain and vent during greasing.

E. Provide oil-lubricated bearing housings 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.

F. 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.

G. 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 (NOT REQUIRED)

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. Hollow-shaft vertical motors are acceptable for all applications when the thrust is in the direction to engage the coupling.

C. Hollow-shaft vertical motors coupled to a sectional drive shaft with screwed joints shall have special couplings described as follows:

1. Provide motors, except the explosionproof type, with self-releasing couplings designed to disconnect motor from driven equipment and permit lengthening of drive shaft upon reversal of rotation.

2. Provide explosionproof motors with nonreversing couplings of spark-resisting construction, designed to prevent reverse rotation.

D. Design vertical motor thrust bearings conservatively to carry maximum axial thrusts (up and down) imposed by driven equipment.

E. Vertical motors shall preferably have oil-lubricated, top and bottom bearings.

F. Vertical motor bases shall be NEMA Type P.

G. Provide vertical motors with a positive, nonreversing, corrosion-resistant ("anti-ratchet") mechanism.

H. Provide vertical motors with fan-end splash shields.

2.10 SLIDING BASE AND SOLE PLATE REQUIREMENTS (NOT REQUIRED)

A. Motors for adjustable belt and chain drives, 1 hp larger, shall be provided with slide rails, or a double-screw adjusting heavy duty sliding based. Fractional horsepower motors shall have slotted holes. Fabricate sliding base from heavy steel to withstand vibration and corrosive environment and paint it the same color with the same paint system as the motor.

B. Mating surfaces shall be ± 0.0002 in./ft and finished to 250 microinches, and shall be protected during shipping.

C. Motors without sliding bases and that will not be directly mounted on equipment bases shall be equipped with sole plates. Sole plates shall be set into Owner's foundation and the motor shall be mounted onto the plate.

2.11 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 1-12.05A as measured in accordance with ANSI/NEMA MG 1-12.07.

2.12 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.

2.13 FINISH

A. Motors shall be primed and finished using the motor manufacturer's standard epoxy painting system.

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.

2.14 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.

B. Noise level requirements may be also covered by a separate noise requirements specification included with the driven equipment specification.

PART 3 E X E C U T I O N

3.01 PREPARATION

A. Verify dimensions of motor foundation with sole plates or slide rails in place.

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. 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.

C. Couple motor up with driven machine.

D. Record motor nameplate data.

3.02 IDENTIFICATION

A. See Specification 16195.

END OF SECTION

SECTION 16175

LOW VOLTAGE VARIABLE FREQUENCY DRIVES

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. This section covers AC voltage source, Pulse Width Modulated (PWM) type Variable Frequency Drives (VFDs) for general or high performance constant or variable torque loads as shown on the project drawings or noted in project motor list.

1.02 REFERENCES STANDARDS

A. Each variable frequency drive shall be designed, constructed, and tested in accordance with the applicable standards listed below.

1. Institute of Electrical and Electronic Engineering (IEEE). Standard 51-1992, IEEE Guide for Harmonic Content and Control.

2. Underwriters Laboratories (UL). UL508

3. National Electrical Manufacture's Association (NEMA). ISC 6, Enclosures for Industrial Controls and Systems.

4. International Electrotechnical Commission (IEC). IEC 801-2, 801-4, 255-4.

5. National Fire Protection Association (NFPA 70), National Electrical Code (NEC).

1.03 RELATED DOCUMENTS.

A. Project motor list to contain application description, environmental descriptions for variable frequency drive, and motor information (if available). Drawings for the project are provided if applicable.

1.04 SUBMITTALS

A. Submit product data, shop drawings and samples (if samples are requested by the City Engineer) under provisions of Section 01330 - Submittal Procedures.

1. Submit in complete packages grouped to permit review of related items as outlined in these specifications.

2. Bind submittals in three-ring binders with complete indexing and tab dividers. Completely tag and label equipment information to correspond with Drawings.

3. Review of Submittals will be for conformance to Contract Documents and for application to specified functions.

B. Product Data: Submit descriptive product literature including manufacturer's specifications for each component specified.

C. Drawings

1. Name of manufacturer.

2. Types and model numbers.

3. Rated drive power.

4. Percent efficiency at 100 percent speed and 100 percent load.

5. Front and side views with overall dimensions and weights shown; and nameplate legends.

6. Schematics, including interlocks.

7. Parameter list.

8. Minimum operating speed per motor.

9. Wiring diagrams, including all internal and external devices and terminal blocks.

10. List of diagnostic indicators.

11. List of spare drives and/or parts to be furnished.

D. Quality Control Submittals

1. Factory Test Reports: Drives supplier to provide typical factory test description. Drives are to be 100% tested at the factory prior to shipment. All drives are to be powered with a motor load.

2. Field Reports: Drives commissioned in the field by the contractorr manufacturers are to include start-up report. The report will include installation overview, application description, drive wiring description, and parameter settings as programmed for the application. Comments on drive performance as commissioned shall be also noted in the field report.

E. Operations and Maintenance (O&M) Data.

1. Submit operation and maintenance data notebook in accordance with Section 01782 - Operations and Maintenance Data.

2. Information and drawings submitted must reflect the final installed condition. Revise documents requiring updates following testing and start-up.

3. In addition to the content specified in Section 01782 - Operation and Maintenance Data, provide the following information:

   a. Name, address and telephone number of the VFD supplier's local service representative.

   b. Complete list of supplied system hardware parts with full model numbers referred to system part designations, including spare parts and test equipment provided.

   c. Copy of approved submittal information and system shop drawings as specified in Paragraph 1.3, Submittals, with corrections made to reflect actual system as tested, delivered and installed at the site. Provide half-size blackline reproductions of all shop drawings larger than 11 inches x 17 inches.

   d. Start-up software.

   e. Parameter list and drive software configuration file.

   f. Manufacturer's hardware, software, installation, assembly and operations manuals for the VFD. Provide all manuals in PDF format DVD-RW.

F. Project Record Documents

1. Submit record documents under provisions of Section 01785 - Project Record Documents.

2. Insert half-size blackline prints of wiring diagrams and parameter lists applicable to each drive unit in a clear plastic envelope and store in a suitable print pocket or holder inside each drive panel.

1.05 QUALITY ASSURANCE

A. Manufacturer's Qualifications: The VFD shall be designed and manufactured to a quality management system in according with ISO 9001 and ISO 14001. The VFD shall be supplied by a manufacturer who has considerable experience in the design and manufacturing of VFD of the ratings specified for a period of at least ten (10) years.

1.06 DELIVERY, STORAGE AND HANDLING

A. The construction/installation manager is to protect the inverter against physical shocks and vibration during transport or storage. The equipment shall also be protected against water (rainfall) and excessive temperatures. Installation after a prolonged period of storage may require reform of the capacitors in the inverter. Consult manufacturer for details.

B. Check for damage upon receiving products on site.

C. Store products in a clean, dry area; maintain temperature in accordance with NEMA ICS 1.

1.07 ENVIRONMENTAL REQUIREMENTS

A. Maintain area free of dirt and dust during and after installation of products.

B. Provide temporary heating and air conditioning units and equipment required to maintain environmental conditions specified for VFDs.

PART 2 P R O D U C T S

2.01 VARIABLE FREQUENCY DRIVE (VFD)

A. Manufacturer and Model: Siemens Energy & Automation model MicroMaster MM440; ABB model ACS550, or approved equal.

B. Service Ratings: Provide variable frequency controllers suitable for operating variable or constant torque loads. Controllers shall be sized for at least 10% larger than the motor. Controllers shall meet or exceed the ratings listed below:

1. Rated input voltage: 200 – 240 volts, 400-500, or 500-600 volts plus or minus 10 percent, three phase. Rated frequency: 60 hertz plus or minus 2 percent.

2. Drives must comply with IEEE 519 by means of either active front end technology or use of multiphase 18 pulse technology.

3. VFD power range to be available from 1 to 600HP where VFD shares common programming, human interface, and options. Product family to be available in 8 mechanical sizes as follows:

4. Motor nameplate voltage: 230, 460, or 575 volts, three phase 60 hertz (as specified on motor list).

5. Displacement power factor: between 1.0 and 0.95, lagging, over entire range of operating speed and load.

6. Operating ambient temperature: 32 to 122 degrees F or 0 to 50 degrees Provide HVAC system to keep drives functional within the listed temperature ranges.

7. Minimum efficiency at full load: 96 - 97 percent.

C. Configuration

1. Variable frequency drive to have modular construction to allow for maximum configuration flexibility.

2. Inputs and outputs for the VFD to shall be a minimum of six programmable digital inputs. Two fully programmable analog outputs, and three fully programmable relay outputs.

3. Drive shall be capable of switching frequencies of 4, 8 and 12 kHz.”

4. Complete inverter and motor protection.

5. Product to provide simple commissioning macro to program the VFD for the application, motor data, and control information. In addition, the drive to provide automatic calibrate routine to optimize motor electrical characteristics within the VFD.

D. Features and Performance

1. Latest IGBT technology and Digital microprocessor control

2. PID control loop for process control shall be provided with automatic tuning routine.

3. Fast, repeatable digital input response time with NPN/PNP Source-Sink control adaptability. As a minimum, the drive shall provide at least three programmable digital inputs for control of these typical inverter functions:

   a. On Fwd

   b. Fault reset

   c. Direction

4. As a minimum, the drive shall provide three digital outputs for signal indication of any one of these functions:

   a. Inverter running

   b. Inverter frequency 0.0 hertz.

   c. Motor direction in reverse

   d. Fault indication

5. PC interface port with all required hardware and software for configuration and monitoring.
6. Programmable acceleration/ deceleration, 0 s to 650s with Multi-curve, adjustable ramp smoothing.

7. Flying restart.

8. Automatic restart following power failure or fault.

9. Fast current limit (FCL) for trip free operation.

10. Provide the following short circuit and input protective features:

    a. Solid-state instantaneous over-current trip set at minimum

       265 percent.

    b. Under voltage protection.

    c. Transient surge protection.

d. Transistor over temperature and over current protection.

e. Current limit circuit to automatically phase back output current and frequency to prevent excessive currents from damaging motor insulation (frequency output rollback).

f. Microprocessor fault/memory chip error.

g. DC bus over voltage trip.

11. Provide the following output protective features:

a. Inverse time motor overload protection, UL approved for motor protection, (I squared T trip).

b. Thermal sensor detection, thermistor or thermostat for motor overtemperature.

c. Protection against opening or shorting of motor leads.

d. Critical frequency avoidance circuit. Minimum three (3) set points selective from 0 to maximum frequency. Bandwidth of set points to be adjustable.

12. RS485 communications interface is to provide monitoring and setting of all operating and fault parameters within the VFD. In addition, the RS485 interface shall be capable of monitoring digital input status of the VFD while providing direct access to the relay outputs and the analog outputs of the drive.

13. The following conditions shall cause an orderly drive shutdown and lockout:

a. Overcurrent at start-up

b. Instantaneous over current

c. Over temperature of VFD or external fault

d. Motor over temperature

e. Ground fault in motor output circuit

f. Over voltage during shut down

g. Motor I squared T trip

14. The drive shall record and display the last four (4) faults that occurred in the drive. The drive shall also display the last warning message experienced by the inverter.

15. The drive shall provide two 0 to 20-milliamp analog output signals proportional to the output frequency, output current, frequency setpoint, motor RPM, bus voltage.

16. The drive shall have the capability to perform an automatic motor calibration test and adjust its internal settings automatically without any special tools or instruments.

17. The drive shall have the capability to be reset to factory conditions via parameter change.

1.02 Advanced Operator Panel

A. Manufacturer and Model: Siemens Energy & Automation MicroMaster AOP; or approved equal.

B. The manufacturer of the VFD to provide digital keypad/display capable of controlling the drive and setting the drive parameters. The digital display will have a minimum of 4 line by 16-character LCD panel that is backlit for easy readability. The LCD device for the VFD will be capable of bus master operation with multiple AC drives of the same family. Broadcast messages shall be possible. The operator panel shall have the capability to store up to 3 different parameter sets. A minimum of 5 languages to include English as one of option that will be available in the device. The panel can normally display:

1. Frequency in hertz.

2. Drive status

3. Output voltage.

4. Motor speed.

5. Output current.

C. The digital keypad shall allow operators to enter exact numerical settings in English engineering units. These parameters shall be adjustable for specific project application requirements on site. All setup operations and adjustments

will be digital, stored in non-volatile (EEPROM) memory. As a standard feature, these variables shall be protected from unauthorized tampering, revision, or adjustment by password code. The digital keyboard shall have six keys to provide easy programming of the drive. These keys shall include:

1. Up and down arrow keys to increase or decrease output frequency or data values.

2. Run and stop keys for starting and stopping in the manual mode.

3. Program key to enter the program mode and adjust parameters.

4. Programmable Maintenance Assist Application

5. Protocol Assist Application

D. Include Operator Panel Door Mounting Kit if door mounting is specified.

1.03 Profibus Networking Interface

A. Profibus-DP Network Communication Module to be mounted on front of VFD.

1.04 Programming Interface

A. PC connection kit with drive module and communication cable to be provided.

PART 3 E X E C U T I O N

3.01 INSTALLATION

A. Verify that mounting surface is suitable for controller installation.

B. Do not install controller until building environment can be maintained within the service conditions required by the manufacturer.

3.02 RELATED INSTALLATION REQUIREMENTS

A. Inspect completed installation for physical damage, proper alignment, anchorage, and grounding.

B. The manufacturer shall have the capability and personnel to assist in the start-up, training, service and maintenance of the equipment.

C. Provide bypass contactor to perform emergency operation when dive is not functional.

THE FOLLOWING ITEMS SHOULD BE CHECKED FOR COORDINATION DURING DESIGN:

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Coordinate this specification with other specifications including the following related Sections:

Division 11
Division 13
Division 16

****

END OF SECTION

SECTION 16195

ELECTRICAL IDENTIFICATION

PART 1 G E N E R A L

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 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

1.03 SUBMITTALS

A. Submit the following under the provisions of Section 01330 Submittal Procedure:

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

1.04 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 P R O D U C T S

2.01 ACCEPTABLE MANUFACTURERS

A. Almetek Industries Incorporated
B. Brady U.S.A. Incorporated
C. Ideal Electric Company
D. Raychem Corporation
E. 3M Electrical Products Division
F. Thomas & Bett
G. Tyton Corporation

2.02 MATERIALS AND EQUIPMENT

A. Nameplates and Labels

1. Provide an identification tag for each item of electrical and instrumentation equipment showing its item number and service or application. Use the description shown on the electrical 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.

3. Generally, provide large pieces of equipment with engraved nameplates; provide additional nameplates at pushbuttons and other local devices; as detailed. Provide identification for all other electrical and instrumentation equipment, devices, or enclosures, such as MCC's, panelboards, disconnect switches, capacitors, relays, and dedicated receptacles 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 compartment), 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, the service location number, and the MCC number with compartment number when applicable. Nameplates will normally be mounted adjacent to the motor at the motor pushbutton when one is furnished.

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. and compartment).

8. Type panelboard directories and insert them inside the panelboard doors.

9. Place a large nameplate no less than 3"x5" on control panels, relay panels, junction boxes, or enclosures with electrical devices mounted

inside or on the outside of the enclosure indicating the purpose of the cabinet.

10. Provide a nameplate on MCC motor starter doors duplicating motor nameplate data.

B. Wire and Cable Markers

1. Use pre-printed tubular heat-shrink type wire and cable markers at each end of all conductors.

2. Select markers manufactured so that the heat-shrink process makes the imprint permanent and solvent-resistant.

3. Use markers that are self-extinguishing, conforming to U.L. Standard No. 224 for print performance, heat shock, and flammability.

4. Provide marker material that is flexible, radiation cross-linked polyolefin with 3 to 1 shrink ratio, rated 600 volts, and white in color.

C. Conduit Markers

1. Provide conduit markers made of stainless steel tags approximately 2 inches x 1 inch x 19 gage.

2. Stamp the caption on the tag and have it black filled.

3. Punch tags for tie fasteners. Fasten tags to the conduits with stainless steel braided wire.

D. Cable Tray Markers

1. For high visibility and contrast, use cable tray markers that are yellow with black legend.

2. Use markers made of vinyl impregnated cloth, suitable for exposure to corrosive, wet, and abrasive environment.

3. Make markers of pre-cut individual letters or numbers with pressure sensitive adhesive backing.

4. Size legend characters to 4 inches high on a total marker height of approximately 5 inches, suitable for applying to 6-inch side rails of a cable tray.

E. Underground Warning Tape

1. Provide 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.

F. 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 or as indicated on the drawings

4. Size labels either 5 inches x 3-1/2 inches or 10 inches x 7 inches, as indicated on the Drawings.

PART 3 E X E C U T I O N

3.01 PREPARATION

A. Degrease and clean surfaces where adhesive labels will be applied.

B. Drill 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 tags accordingly.

3.02 INSTALLATION

A. Install nameplates and labels in accordance with the manufacturer's instructions and the Drawings.

B. Apply wire and cable markers in accordance with manufacturer's instructions using a heat gun with properly sized nozzle for the application. Tag the wires at both ends with the same notation.

C. Tag conduits at junction boxes, pull boxes, and at other termination points.

D. Identify cable trays at the time of installation with the alphanumeric number shown on the Drawings. Label cable trays on the outside rail. 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.

E. Identify underground conduits, cables, or duct banks using the underground warning tape. The underground grounding grid, including the laterals. Also use underground warning tape. Install one tape per trench at 12 inches below grade or as indicated on the Drawings. For wide trenches or duct banks, install one warning tape per 24 inch width.

F. Apply the 5 inches by 3-1/2 inches warning labels to disconnect switches, panelboards, terminal boxes, and similar devices in accordance with manufacturer's instruction and the Drawings. Apply the 10 inches x 7 inches warning labels to larger control panel enclosures, motor control centers, and to entrance doors to buildings containing electrical power and control equipment.

END OF SECTION

SECTION 16402

UNDERGROUND DUCT BANKS

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Underground electrical duct banks.

1.02 REFERENCES

A. National Fire Protection Association (NFPA): No. 70 - National Electrical Code (NEC) Appendix B.

1.03 SUBMITTALS

A. Catalog cut sheets of the ducts and spacers.

1.04 DELIVERY, STORAGE AND HANDLING

A. Have duct spacers and associated hardware packed and crated to avoid damage during shipment and handling.

B. Clearly mark packages or crates stating that the material is for electrical duct banks only.

PART 2 P R O D U C T S

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 80 rigid PVC conduit. Refer to Section 16111 - Conduit, Fittings and Bodies.

B. Spacers. Secure conduit with non-magnetic, universal, interlocking-type spacers for both horizontal and vertical duct arrangements.

C. Concrete. Use steel reinforced, red concrete as duct encasement. Refer to Section 03100 Concrete Formwork.

PART 3 E X E C U T I O N

3.01 PREPARATION

A. Verify from Drawings and field survey that the location of ductbanks does not interfere with any existing or new underground facilities.

B. Verify that materials are on site in proper condition and that sufficient quantity is on hand for the work.

C. Verify that trenches are in the correct places and prepared with sufficient depth and width to accommodate the duct banks, reinforcing rod, and concrete.

D. Be prepared for inspection of the duct banks before reinforcing rod is installed.

E. Before pouring concrete, verify that the ducts are free of debris and properly installed in the support and spacer systems and that the ducts are properly fitted together and firmly held in place by the hold down hardware.

F. Provide 24-hour notice to Project Manager, Wastewater Inspectors and the Local Code Inspector for cover-up inspection before pouring electrical conduit ductbanks.

3.02 INSTALLATION

A. Use the size and types of conduit as indicated on the Drawings for the various duct banks required for the project.

B. Make duct bank installations and penetrations through foundation walls watertight.

C. Assemble duct banks using non-magnetic saddles, spacers and separators. Position separators to provide 2-inch minimum concrete separation between the outer surfaces of the conduits.

D. Provide a 3-inch minimum concrete covering on both sides, top and bottom of concrete envelopes around conduits. Add red dye at the rate of 10 pounds

per cubic yard to concrete used for envelopes for easy identification during subsequent excavation.

E. Firmly fix ducts in place during pouring of concrete. Carefully spade and vibrate the concrete to ensure filling of spaces between ducts.

F. Make bends with sweeps of radius not less than 6 times the smallest diameter of the raceway.

G. Make a transition from non-metallic to pvc-coated metallic rigid conduit where duct banks enter structures or turn upward for continuation above grade.

H. Make bends of 30 degrees or more using rigid galvanized steel.

I. Reinforce duct banks throughout, where indicated on the Drawings.

1. Unless otherwise noted on the Drawings, reinforce with No. 5 longitudinal steel bars placed at each corner and along each face at a maximum parallel spacing of 12 inches on centers, and No. 5 tie-bars transversely placed at 18-inch maximum longitudinal intervals.

2. Maintain a maximum clearance of 2 inches from bars to the edge of the concrete encasement.

J. Where ducts enter structures such as handholes, manholes, pullboxes, or buildings, terminate the ducts in suitable end bells, insulated L-bushings, Meyers hubs or couplings on steel conduits. Tag conduit entering pull boxes with stamped, stainless steel tags. Identify as designated in cable and conduit schedule.

K. Do not backfill with material containing large rock, paving materials, cinders, large or sharply angular substances, corrosive material, or other materials which can damage or contribute to corrosion of ducts or prevent adequate compaction of fill.

L. Install a bare stranded copper duct bank ground in each duct bank envelope. Make ground electrically continuous throughout the entire duct bank system. Connect ground to switchgear and MCC ground buses and to steel conduit extensions of the underground duct system.

M. After completion of the duct bank and prior to pulling cable, pull a mandrel, not less than 12 inches long and with a cross section approximately one-fourth inch less than the inside cross section of the duct, through each duct. Then pull a rag swab or sponge through to remove any particles of earth,

sand or gravel that may have been left in the duct. Repull the rag or sponge swab until the swab emerges clean.

N. Use hemp rope to pull conductors into PVC conduit. Do not use nylon or wire cable for this purpose.

O. Install a warning ribbon approximately 12 inches below finished grade over underground duct banks. Refer to Section 16195 - Electrical Identification.

P. For manholes and pull boxes below grade, install wire racks to support cables properly around the perimeter and keep them dry.

Q. For manholes and pull boxes below grade, construct a french drain, or other drainage as detailed on the Drawings.

END OF SECTION

SECTION 16461

DRY-TYPE TRANSFORMERS

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Specifications for dry-type transformers for the following applications:

1. Motor drive isolation

2. Shielded isolation

3. Non-linear loads

4. General purpose

1.02 REFERENCES

A. American National Standards Institute/National Electrical Manufacturers Association (ANSI/NEMA)

1. ANSI No. C89.2: Transformers

2. NEMA ST 1: Specialty Transformers

3. NEMA ST-20: Dry-Type Transformers for General Applications

B. Underwriters Laboratories (UL): UL 506 - Standard for Safety Specialty Transformers.

C. American National Standards Institute/National Fire Protection Association ANSI/NFPA): NFPA No. 70 -National Electrical Code (NEC); Article 450 - Transformers and Transformer Vaults.

1.03 SUBMITTALS

A. Submit the following under provisions of Section 01330 – Submittal Procedures:

1. Outline dimensions, support points and unit weight.

2. Electrical characteristics, including impedance and tap configuration.

3. Insulation type, rated temperature rise, and total insulation system.

4. Test reports, for transformers 300 KVA and above, indicating losses at 25, 50, 75 and 100 percent rated load and sound levels.

5. Connection diagrams.

6. Catalog data.

7. Operation and maintenance data.

1.04 QUALITY ASSURANCE

A. Tests. Run manufacturer's test on transformers in accordance with Underwriters Laboratories (U.L.) Standard No. UL-506.

1.05 DELIVERY, STORAGE AND HANDLING

A. Have transformers individually packed and crated to permit ease of handling and to provide protection from damage during shipping, handling and storage.

PART 2 P R O D U C T S

2.01 ACCEPTABLE MANUFACTURERS

A. ACME Transformer

B. Cutler-Hammer

C. General Electric

D. Hevi-Duty

E. Westinghouse Electric

F. Square D Company

2.02 MATERIALS AND EQUIPMENT

A. Use dry-type transformers for lighting system or other general purpose applications, motor drive isolation, shielded isolation and non-linear load requirements.

B. Provide transformers with copper windings.

C. Select transformers designed and constructed in accordance with NEMA ST-1, NEMA ST-20 and the NEC Article 450.

D. For applications up to 30 KVA, use transformers that are encapsulated, non-ventilated type with 115 degree C temperature rise and 185 degree C insulation class.

E. Provide transformers with full capacity winding taps a minimum of two 2-1/2 percent above and two 2-1/2 percent below normal voltage.

F. For applications of 30KVA and above use transformers that are the drip-proof ventilated type for indoor mounting only.

G. Use transformers with sound levels in accordance with NEMA ST-20.

H. Basic impulse level (BIL) shall be 10KV for transformers less than 300 KVA, 30KV for transformers 300KVA and larger.

I. Ground core and coil assembly to enclosure by means of a visible flexible copper strap.

J. Provide transformers with lifting eye bolts or brackets.

K. Provide transformer nameplates of stainless steel, marked in accordance with NEC Article 450-11. Fasten nameplate to the transformers with stainless steel screws or rivets.

L. Refer to the one-line diagram or the Drawings for transformer size, volt and wire configuration.

M. Special purpose transformers shall be as follows:

1. Motor drive isolation transformers: designed for 3-phase SCR controlled, variable speed motor voltages with bracing to withstand stresses associated with motor drives.

2. Shielded isolation transformers shall be designed for power inputs to microprocessors and computers that require additional protection from electrical disturbances with the use of grounded electrostatic shielding.

3. Non-linear transformers shall be designed to withstand the heating effects caused by harmonics resulting from non-linear, non-sinusoidal loads. Use K-rated transformers for non-linear loads.

PART 3 E X E C U T I O N

3.01 PREPARATION

A. Verify dimensions of housekeeping pads or other support structures to ensure proper fit.

B. Verify raceway and wiring drawings that are prepared for the transformers and check them against the manufacturer's information.

C. Verify that the protective devices planned for the transformers are in accordance with NEC Article 450.

3.02 INSTALLATION

A. Install transformers plumb and level and in accordance with manufacturer's instructions and the NEC Article 450.

B. Use flexible conduit for connection to transformer case. Make conduit connections to side panel of enclosure.

C. Mount transformers on isolation pads as required to isolate transformer noise from the buildings structure.

D. Wire transformer primary and secondary in accordance with the nameplate instructions and the designated voltages as shown on the one-line diagram.

END OF SECTION

SECTION 16480

MOTOR CONTROL CENTER

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Specification for low voltage motor control center (MCC) factory installed inside a prefabricated building as defined in Specification 16015.

1.02 REFERENCES

A. American National Standards Institute/National Electrical Manufacturers Association (ANSI/NEMA)

1. ICS 1: General Standards for Industrial Control and Systems

2. ICS 2: Industrial Control Devices, Controllers and Assemblies

3. ICS 4: Terminal Blocks for Industrial Use

B. American National Standards Institute/Underwriters Laboratories, Inc. (ANSI/UL)

1. 467: UL Standard for Safety, Grounding and Bonding Equipment

2. 489: UL Standard for Safety, Molded-Case Circuit Breakers and Circuit-Breaker Enclosures

3. 506: UL Standard for Safety, Specialty Transformers

4. 845: UL Standard for Safety, Motor Control Centers

C. American National Standards Institute/National Fire Protection Association (ANSI/NFPA): 70 National Electrical Code (NEC).

1.03 SUBMITTALS

A. Submit the following under the provisions of Section 01330 – Submittal Procedures:

1. Outline drawings with elevations

2. Equipment arrangement drawings

3. Anchor 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

12. Assembly/disassembly sizes and weights

13. Nameplate data

14. Performance/acceptance test report

15. Operation and maintenance data

1.04 QUALITY ASSURANCE

A. Tests. Perform tests in accordance with ANSI/NEMA ICS 2-322.22. Test each MCC as described in ANSI/UL 845. Make available upon request certified temperature and short-circuit test data, and a certificate of circuit breaker conformance with ANSI C37.16. Have tests and inspections performed and evaluated by qualified personnel. Document and correct deficiencies observed during the testing process prior to shipment.

1.05 DELIVERY, STORAGE AND HANDLING

A. Upon completion of the manufacture and assembly of the MCC and before crating for shipment, have parts that are disassembled match marked to facilitate installation in the field. Pack and crate parts in such a way to permit ease of handling.

B. Equip MCC shipping sections with lifting facilities so that may be easily unloaded and handled, either by crane or forklift.

C. Do not exceed 120 inches in length for shipping sections. Have equipment packed, crated, and rigidly braced to protect it from damage during shipment, handling, and outdoor storage. Make provision to energize the space heater of each shipping section during storage at the jobsite. Make a connection point readily available without uncrating the equipment and clearly tag each shipping section to locate the connection and identify the electrical service required.

PART 2 P R O D U C T S

2.01 ACCEPTABLE MANUFACTURERS

A. Allen-Bradley

B. Cutler-Hammer/Westinghouse

C. General Electric

D. Powell Electrical Manufacturing Company

E. Siemens Energy and Automation, Inc.

F. Square D Company

G. Toshiba

2.02 MATERIALS AND EQUIPMENT

A. Design. Provide an MCC with the following design characteristics:

1. The MCC construction and wiring shall be NEMA Class I, Type B as specified in ANSI/NEMA ICS-2-322.08 and ICS-2-322.10. Provide an MCC designed for 3-phase, 60 Hz, 480-Volt service with main horizontal and vertical bus ampacities and short circuit bracing as specified on the one-line diagram.

2. Furnish an MCC designed to operate in service conditions described in NEMA ICS 1 and as shown on the one-line diagram.

3. Supply motor starters suitable for full voltage starting unless otherwise noted on the one-line diagram.

4. Construct the MCC of one or more vertical sections bolted together to form a free standing assembly, designed to permit future additions, changes, or regrouping of units.
5. Provide motor control units of the combination type, consisting of a motor circuit protector (MCP), a magnetic starter and a control power transformer. Size the MCP and starter in accordance with manufacturer's recommendation for the starter and motor size indicated on the one-line diagram.

6. When power factor correction capacitor is called for, connect its wiring to the line side of the overload relay with a set of fuses, a circuit breaker, or other acceptable means to serve as overload protection for the wiring and capacitor.

7. Manufacture main breaker (if used) and feeder breakers of the molded case, thermal-magnetic type to be mounted and wired in accordance with ANSI/UL 489.

8. If called for on the one-line-diagram, locate the lighting panelboard, transformer and transformer feeder breaker in the same vertical section. Supply a transformer with 115 degrees C temperature rise, installed in accordance with ANSI/UL 506.

B. Construction. Construct the MCC of self-supporting and fully enclosed metal clad section for mounting of motor starters, circuit breakers and necessary accessories including bus bars, control transformers, control switches, ground bus, and control wiring, as specified in this section and shown on the one-line diagram.

C. Enclosures

1. Construct each MCC enclosure to be fully metal enclosed, dead front, free standing, and NEMA 12 suitable for indoor service as defined in ANSI/UL 845 or NEMA 3R suitable for outdoor installation when indicated on the one-line diagram. Fabricate enclosure of sheet steel not less than 14 gauge with rear and end covers not less than 16 gauge; with adequate strength to withstand stresses imposed by short circuit current, shipping, handling, installation, and operation, without distortion or damage.

2. Construct frames of the enclosure structure with continuous steel barriers, extending from the front to the rear of each compartment for the controller units, buses and power cables.

3. Provide enclosures of suitable size for reduced voltage starting auto transformers and associated wiring, if required.

D. Vertical Sections

1. Make the structure 20 inches deep. Nominal vertical section dimensions are 20 inches wide by 90 inches high. Design each vertical section to accommodate not more than six NEMA Size 1 combination motor control units mounted one above the other in front-mounted arrangement.

2. Provided horizontal wiring space at the top and the bottom of each vertical section, which will line up with adjacent sections to form continuous raceways through the entire length of the MCC. In addition, in standard sections include vertical wireways with hinged doors for unit wiring. Provide grommets at points wiring must cross cut-outs.

3. Use section structure designed for top or bottom cable entry as indicated on the one-line diagram. Provide adequate ventilation and heating facilities for each section to keep the maximum temperature rise and humidity within the acceptable limits.

E. Incoming Feed

1. Terminate incoming feeder cables in a main breaker or main lugs. Use top feed to main breakers whether either top or bottom MCC cable entry is specified.

2. The MCC will be fed from one 480V source, unless otherwise stated. Provide the necessary space for adequate bending radius and spreading room to properly train and terminate the cables specified on the Drawings. Where large (350 MCM and above) or parallel cables are used as feeders, provide a separate termination compartment along side the main breaker for cable entry.

3. Provide a separate compartment with a hinged front access door and suitable space for terminations for incoming cables. Provide compression type lugs in the quantity shown on the diagram. Allow space for a cable bending radius not less than ten times the diameter of the cable. The cable size is shown on the one-line diagram. Install current transformers and phase monitor coils in this compartment on fixed horizontal mounting brackets. Do not loosely place coils around feeder cables.

4. Furnish surge arresters as specified in Section 13446 - Primary Instrumentation Devices, located downstream from the main breaker or lugs. Mount surge arresters in an isolated, completely enclosed cubicle.

5. When shown on the one-line diagram, install a voltmeter and an ampere-meter with switches in the incoming feed section. Provide meters of the switchboard type with one percent accuracy, 4-1/2 inch diameter face with a minimum of 240 degree direct reading scale.

F. Combination Starter Unit

1. Provide a standard combination motor starter unit which consists of a motor circuit protector (MCP), a magnetic motor starter, and an overload relay. Install starter and circuit protective device and control power transformer in a plug-in unit. The ratings of the components are shown on the one-line diagram.

2. Provide motor starters conforming to NEMA standards for the horsepower of the motors with which they are to be used and which are suitable for full voltage, across-the-line starting. Select starters with pickup and dropout voltages of not greater than 85 percent and 60 percent of rated voltage, respectively. Do not use a starter smaller than NEMA Size 1.

3. For NEMA size 4 and larger, provide vacuum-type contactors.

4. Select overload relays designed so that any attempt for reset immediately after operation cannot result in damage to the unit. Provide running protection for the motor and all other series components, based upon the tripping characteristics of the overload relay.

5. Utilize motor overload relays of the solid state type with adjustable overload, phase unbalance and phase failure sensitivity.

6. Starters shall have a minimum of one NC and one NO auxiliary contacts in addition to the seal-in contact.

7. Have reversing contactors and 2-speed starters both mechanically and electrically interlocked to prevent both contactors from being engaged at one time.

8. Provide an MCP of the magnetic type with a fault interrupting capability suitable for the complete starter unit.

9. Provide each combination starter unit with its own control power transformer with Class B insulation and 120 volt secondary.

10. Place fuses on the secondary side of control power transformers with one dual element fuse. Have control transformers separately fused on the primary side with two dual element fuses.

11. Unless otherwise called for on the one-line diagram, the minimum rating of the control power transformer, for the various sizes of starters, shall be as follows:

NEMA Size 1	75 VA
NEMA Size 2	150 VA
NEMA Size 3	250 VA
NEMA Size 4	500 VA

12. Connect the control power transformer so that it is de-energized when the circuit breaker is opened.

G. Reduced Voltage Starters

1. If reduced voltage starters are specified, provide the closed transition auto-transformer type.

2. Construct each reduced voltage auto-transformer starter unit with a molded-case circuit breaker in combination with a closed transition type auto-transformer starter with 50 percent, 65 percent, and 80 percent taps. Set the starter on the 65 percent tap. The starter shall have three phase overload relays and shall be ambient temperature compensated with manual reset. Include a thermal switch wired to protect the auto-transformer from overheating. Control timing of the starting period by an adjustable accelerating relay.

3. Provide heavy duty, NEMA type, autotransformers sized for a minimum of 125 percent of the motor load.

H. Terminal Blocks

1. Provide terminal blocks conforming to NEMA/ANSI ICS 4 type rated 600 volts, with screw type terminals to accommodate non-insulated ring tongue wire lugs for No. 18 through No. 10 size wire for field connection.

2. Use a sufficient number of terminal blocks so circuits for 480-volt and 120-volt service can be wired to a separate group of terminal blocks, making power and control circuit readily identified for safety during maintenance.

3. Wire auxiliary contacts to terminal blocks.

I. Units

1. Equip each unit compartment with barriers to isolate it from adjacent devices in the control center and prevent communication of faults from one compartment to another.

2. Provide draw-out type units. Provide means in the vertical section for supporting and aligning units during their removal or replacement.

3. Install an individual front door on each unit compartment. Make each door interlocking with the circuit disconnect so that the door may not be opened while the circuit disconnect is in a closed position. Provide a means for overriding this interlock.

4. Use padlocking arrangements that permit locking circuit disconnect in the open position with a minimum of three padlocks when the door is closed.

5. Arrange components so that removal of a starter or breaker unit does not require removal of its door, or the removal of an adjacent unit.

6. Place unit wiring diagrams in the print pocket on the inside of each unit door.

7. Furnish units designated as future or spare complete with guide rails, separator bars, doors, and operating hardware required to permit completion of the unit by the addition of a combination starter or feeder breaker unit.

8. For any unused space that is not suitable for the addition of a plug-in unit, fabricate and install a plain bolted sheet metal cover.

9. Identify electrical components, such as relays, breakers, terminal strips, and starters, with laminated nameplates as required in Section 16195.

10. Each motor starter door shall have a laminated nameplate duplicating the motor's nameplate rating information. At a minimum the motor

nameplate information should include: HP, Phase, Hertz, Enclosure type, frame, code, RPM, volts, Amps, insulation class, max amb., duty cont., service factor, bearings, serial or ID number, P/N or Model number, and manufacturer.

J. Buses and Connections

1. Extend the main horizontal copper bus across the assembly to form a complete continuous bus. Support it in at least two places in each vertical section using glass-reinforced, polyester-type insulators which are impervious to moisture and adverse atmospheric conditions.
2. Fabricate buses from tin plated copper bars. Use buses designed to operate at individual rate full load current without exceeding a 50 degrees C temperature rise at 40 degrees C ambient temperature as defined in ANSI/UL 845. The continuous current rating of the main and branch buses shall be as stated on the one-line diagram.

3. Bolt connections to main and branch buses. Make joints and contact surfaces free of burrs and irregularities.

4. Provide tin-plated, compression-type cable connectors (NEMA 2-hole) for each bus bar in the main feed cubicle. Select connectors of adequate size and quantity for the feeder cables.

5. Make provision for extension in both directions for future sections.

6. Install both main and branch buses so they are phased in the order A-B-C from front-to-rear, top-to-bottom, and left-to-right as viewed from the front of the MCC.

7. Have a copper ground bus extend the full length of the MCC near the bottom, with provision for extension into future sections. It shall be amp rated at a minimum of 25 percent of horizontal power bus. Provide compression lugs on each end of the ground bus for connection of the grounding copper conductor. Permanently ground the non-current carrying metal parts of equipment within each MCC through the ground bus in accordance with ANSI/UL 467. Terminate ground cables to the ground bus by means of the connectors.

K. Wireways

1. Provide each section with horizontal wiring space at both the top and bottom. Make wiring spaces line up with adjacent sections to form a continuous wireway for the entire length of the MCC.

2. In addition, provide each section with a wireway space at least 4 inches wide between the units and side unit wiring. Secure the wireway with a tight fitting hinged access door of formed sheet metal. Furnish wire straps in the vertical wireway to group individual conductors. Tie wires securely in place for a neat, orderly installation.

3. Completely enclose both horizontal and vertical wireways and isolate them from exposure to any live parts.

4. Use control wiring that is a minimum No. 14-AWG copper, 600 volts, Type TA, TBS or SIS as defined in ANSI C37.30.6.
5. For current transformer wiring, use No. 10 AWG copper which is otherwise, the same as control wiring.

6. Power and control cables may enter the MCC only at bottom. Provide suitable opening in bottom of MCC for cable entry. Collect power and control cables neatly in separate bundles.

7. Make wires continuous between terminals and other connections, without splices.

8. Identify wiring at both ends with same number, machine printed on heat shrink type sleeves as specified in Section 16195 - Electrical Identification.

L. Control Devices

1. Provide pushbuttons, selector switches and indicating lights which are of the oil tight, heavy duty type with industrial application quality.

2. Provide indicating lights which are push-to-test LED type with transformer and 100,000 hour lamp life.

M. Power Quality Meter (PM1)

1. Subject to compliance with the Contract Documents, the following Manufacturers are acceptable:

   a. GE Multilin PQMII Power Quality Meter

   b. Schweitzer 735

   c. Approved Equal

2. 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.

3. General

   a. All circuit boards shall have a harsh environment conformal coating to resist H2S gas and other corrosive agents, including humidity.

4. Monitoring and Metering

   a. Metering Functions with accuracy of 0.2 percent for A & V and 0.4 percent for power parameters

      1) A, V, VA, W, VAR, KWH, KVARH, KVAH, PF, Hz

      2) W, VAR, A, VA Demand

      3) A, V Unbalance

   b. Power Analysis Functions.

      1) Total Harmonic Distortion

      2) Individual harmonics

      3) Waveform capture

      4) Historical data

      5) Minimum and maximum metered values complete with time and date

      6) Record of last 40 events

      7) Two independent data logs

N. User Interface and Programming

1. Integrated keypad to access actual values and setpoints.

   a. 2 - line, 40 character illuminated display for use with keypad. The display shall have:

      1) Variable scrolling rates.

2) Front mounted LEDs to display alarms, communication status, relay status, simulation mode, self test failure, and setpoint access status.

3) Relay reset button to clear alarm and auxiliary conditions.

2. The meter shall have one alarm output relay with Form C contacts.

3. Relay output shall be through alarm, auxiliary and pulse output functions.

4. The meter shall provide a user configurable pulse output based on KWH, KVARH or KVAH.

5. The meter shall provide a pulse input for demand synchronization.

6. The meter shall include a simulation mode capability for testing the functionality and meter response to programmed conditions without the need for external inputs.

7. The relay shall include a power systems option consisting of harmonic analysis, triggered trace memory waveform capture, event record and data logger functions.

O. Control Power:

1. Range of available control power: DC: 88-300 VDC; AC: 70-265 VAC, 48 to 62 Hz.

2. LO Range: DC: 20-60 VDC; AC: 20-48 VAC, 48 to 62 Hz.

P. Communication

1. For remote monitoring, the following communication ports shall be provided:

a. One (1) Industry Standard port for meter and relay programming using a laptop computer.

b. One (1) RS-485 port.

c. One (1) integral 10/100BaseT Ethernet port . The connection shall support Modbus TCP, Ethernet IP and SNMP. Where an integral port is not available, provide a media protocol converter as specified herein.

d. The manufacturer shall factory enter the proper IP Address for such connection. Upon request by the Contractor, the Owner/Engineer will provide the proper Internet Protocol Address (IP Address), to be configured by the equipment manufacturer.

2. The protocol interface shall implement the following:

a. All data shall be available and/or mirrored within the Modbus 4x or "Holding Register" memory area.

b. Register 4x00001 shall exist and be readable to allow simple, predictable "comm tests".

3. The media protocol converter shall meet the following criteria:

a. The converter shall support 10/100Base-T Ethernet. The serial port speed (baud rate) shall support 230kbps. The protocol shall support Modbus TCP, Ethernet IP, DF1, and Modbus RTU/ASCII. Protocol shall be Web Browser configurable.

b. Operating limits shall be 0-60 degrees C, with humidity range minimum of 5-90 percent. Shock capability on the serial port shall be ESD +15 kV air GAP meeting IEC 1000-4-2. Power requirements shall be 9-30VDC at 0.5A minimum.

c. The converter shall have LED status for serial, signals, power, and Ethernet.

d. The converter housing shall be UL 1604, Class 1 Div 2, DIN Rail mountable. The converter shall have DB-9M port connection, with screw terminals, to the input.

e. Converter shall be Digi One IAP, or approved equal.

Q. Space Heaters: Install thermostat controlled electric space heaters to prevent condensation of moisture in the control centers. The rated voltage of these heaters shall be double the voltage applied. Make thermostats adjustable, and set to cut out when the temperature rises to an ambient of 30 degrees C (240 volt rated space heaters operated on 120 volt which power is derived from a local panelboard).

R. Nameplates

1. Use engraved phenolic with black lettering and white background for nameplates on individual units as well as the main nameplate for the assembly.

2. Make MCC compartment nameplates 1" x 3" with approximately 1/4 inch high lettering. Make MCC main nameplates 8" x 2" with 1 inch high lettering. Secure nameplates with self tapping stainless steel metal screws.

3. Provide a blank nameplate for spare compartments.

4. Word nameplate captions as indicated on the one-line diagram.

5. Label all components in the MCC with phenolic nameplates as required in Section 16195.

S. Finish

1. Thoroughly clean the inside and outside of the MCC of foreign matter, excessive oxide, scale, weld spatter, and flux. Repair fabricating scars and rough edges by welding and grinding before painting, followed by heat treatment, if required by the governing code or standard.

2. Give a finish coat of manufacturer's standard enamel for compartment doors, cover plates, and structural parts of the MCC. Do not apply paint or filler until repairs, tests, and final shop inspection are completed.

PART 3 E X E C U T I O N

3.01 PREPARATION

A. Verify dimension of the housekeeping pad and the embedded leveling channels and conduit stub-ups.

3.02 INSTALLATION

A. Install the motor control center in accordance with the manufacturer's published instructions.

B. Torque bus bar bolts to manufacturer's recommendations and tighten nuts and bolts on the steel structure to ensure structural integrity.

C. Adjust the magnetic setting on motor circuit protectors in accordance with motor inrush currents (nameplate data).
D. Select and install motor starter overload relay heater coils based on motor nameplate data.

E. Touch up scratches and verify data on nameplates.

F. Install warning labels on Motor Control Centers as required in Section 16195, 2.02, F.

END OF SECTION

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SECTION 16486

MECHANICAL EQUIPMENT MANUFACTURER'S PROVIDED CONTROL PANELS (MEMs)

PART 1 G E N E R A L

1.01 SCOPE OF WORK

A. Furnish and install functional control panels to manually or automatically operate control systems as specified in the detailed requirements of this Section, and as described in the Process Equipment Division Specifications.

B. All submittals for, process equipment panels specified under this Section, shall be submitted as a part of the Process Equipment manufacturer's submittal under the Process Equipment Division submittals.

1.02 RELATED WORK

A. Section 16010 Electrical – Basic Electrical Requirements

B. Section 13446 – Primary Instrumentation Devices

C. Section 13440 – Process Control System

1.03 SUBMITTALS

A. Submittals shall be made in accordance with the requirements of Division 1, Process Equipment Division and as specified herein.

B. Provide systems engineering to produce coordination curves, showing coordination between existing and new breakers and/or fuses submitted, such that protective device coordination is accomplished. Such curves and settings shall be included as a part of these submittals.

C. Submittals shall also contain information on related equipment to be furnished under this Specification but described in the related Sections listed in the Related Work paragraph above. Incomplete submittals not containing the required information on the related equipment will also be returned unreviewed.

D. The mechanical equipment manufacturer shall create all equipment shop drawings, including all wiring diagrams, in the manufacturer's Engineering department. All equipment shop drawings shall bear the mechanical equipment manufacturer's logo, drawing file numbers, and shall be maintained on file in the mechanical equipment manufacturer's archive file

system.

E. Submit to the Owner/Engineer, shop drawings and product data, for the following:

1. The mechanical equipment manufacturer shall use his control systems engineering department to produce custom unit elementary drawings. Drawings shall be on the mechanical equipment manufacturer's drawing sheets, and shall include all schematics for control logic as described in the Process Equipment Specifications, and any associated control schematics shown on the Engineer's Drawings for this project. Show interwiring and interlocking between components and to remotely mounted devices. Include and identify all connecting equipment and remote devices on the schematics. The notation "Remote Device" will not be acceptable. Show wire and terminal numbers. Indicate special identifications for devices as required by the mechanical equipment manufacturer or as may be shown on the Drawings.

2. Equipment outline drawings showing elevation, plan and interior views, front panel arrangement, dimensions, weight, shipping splits, conduit entrances and anchor bolt pattern. Indicate all options, special features, ratings and deviations from this Section.

3. Power and control schematics including external connections. Show wire and terminal numbers and color-coding.

4. Instruction and replacement parts books, including manufacturer's part numbers and selections of component ratings, and CT and PT ratios.

5. As-built final drawings.

6. Documentation that the panel assembly facility is a UL-508 certified facility.

7. Facsimile of the UL label that is to be applied to the completed panel.

8. Furnish complete Bill of Materials indicating manufacturer's name and part numbers.

9. Manufacturer's cut sheets for every component used in the panel assembly adequately marked to show the items being included. The manufacturer's name shall be clearly visible on the each cut sheet submitted.

10. Assembly ratings including:

a. Short-circuit rating

b. Voltage

c. Continuous current

11. Major component ratings including:

a. Voltage

b. Continuous current

c. Interrupting ratings

12. Cable terminal sizes.

13. Instruction and renewal parts books.

F. Factory Tests. Submittals shall be made for factory tests specified herein.

G. Field Test Reports. Submittals shall be made for field tests specified herein.

H. Operation and Maintenance Manuals.

1. Operation and Maintenance Manuals shall include the following information:

a. Manufacturer's contact address and telephone number for parts and service.

b. Instruction books and/or leaflets

c. Recommended renewal parts list

d. Record Documents for the information required by the Submittals paragraph above.

I. The manufacturer shall submit for approval, a training agenda for all training specified herein. Training agenda shall not be submitted until final approval of the Operation and Maintenance Manual.

1.04 REFERENCE CODES AND STANDARDS

A. All products and components shown on the Drawings and listed in this specification shall be designed and manufactured according to latest revision of the following standards (unless otherwise noted):

1. NEMA Standard ICS 2 – 2000 Industrial Control and Systems
2. NFPA 70 – National Electrical Code (NEC)
3. NFPA 70E – Standard For Electrical Safety in the Workplace
4. NFPA 79 – Electrical Standard for Industrial Machinery
5. UL 508/508A – Industrial Control Enclosures

B. All equipment components and completed assemblies specified in this Section of the Specifications shall bear the appropriate label of Underwriters Laboratories.

1.05 QUALITY ASSURANCE

A. The manufacturer of the control panels shall have produced similar 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.

B The control panels shall be assembled in a UL-508 certified facility. A submittal of documentation certifying that the panel fabrication facility is a UL-508 certified facility, is required. A UL label shall be affixed to the inside of the external door by the panel fabrication assembly. Submit a facsimile of the UL label in the submittal information.

C. All components and material shall be new and of the latest field proven design and in current production. Obsolete components or components scheduled for immediate discontinuation shall not be used.

D. Control panels submitted shall fit within the space shown on the Drawings. Equipment which does not fit within the space is not acceptable.

E. For the equipment specified herein, the manufacturer shall be ISO 9001 2000 certified.

1.06 JOBSITE DELIVERY, STORAGE AND HANDLING

A. Prior to jobsite delivery, the Contractor shall have successfully completed all submittal requirements, and present to the Owner/Engineer upon delivery of the equipment, an approved copy of all such submittals. Delivery of incomplete constructed equipment, onsite factory work, or failed factory tests will not be permitted.

B. Equipment shall be handled and stored in accordance with manufacturer's instructions. Two (2) copies of these instructions shall be included with the

equipment at time of shipment, and shall be made available to the Contractor and Owner/Engineer.

C. 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.

D. Equipment shall be installed in its permanent finished location shown on the Drawings within seven (7) calendar days of arriving onsite. If the equipment cannot be installed within seven (7) calendar days, the equipment shall not be delivered to the site, but stored offsite, at the Contractor's expense, until such time that the site is ready for permanent installation of the equipment.

E. Where space heaters are provided in equipment, provide temporary electrical power and operate space heaters during storage, and after equipment is installed in permanent location, until equipment is placed in service.

1.07 WARRANTY

A. The Manufacturer shall warrant the equipment to be free from defects in material and workmanship for the same length of time as the associated mechanical equipment, but not less than 1 year from date of final acceptance of the equipment. Within such period of warranty the Manufacturer shall promptly furnish all material and labor necessary to return the equipment to new operating condition. Any warranty work, requiring shipping or transporting of the equipment, shall be performed by the Manufacturer, at no expense to the Owner.

PART 2 P R O D U C T S

2.01 MATERIAL MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following material Manufacturers are acceptable:

1. General Electric Co.

2. Eaton / Cutler-Hammer

3. Square D Co.

4. Allen Bradley

B. The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features and functions.

Materials listed above are not relieved from meeting these Specifications in their entirety.

C. The mechanical equipment manufacturer shall be responsible for providing all required controls and apparatus as specified utilizing the specified components herein.

D. The mechanical equipment manufacturer may optionally, provide a Control Panel which he manufactures "in house" using his standard design, equipment and components which he normally maintains in his factory stock. He shall provide the ratings and functionality specified. Subcontracted panels, regardless of manufacturer, will not be acceptable for this option. Such panels shall be designed and built by the mechanical equipment manufacturer. Panel submittals shall include mechanical equipment manufacturer's part numbers for control panel components.

E. A request for use of this option shall be made at the time of equipment submittals, and the Manufacturer shall submit sufficient proof of stock information and functionality for the Owner/Engineer to determine compliance with the Specifications.

F. If the Manufacturer does not maintain a Parts Inventory of all components supplied for this project, or if he cannot provide all of the functions and ratings specified for this equipment, such options and equipment will not be approved.

G. Panels offered, not meeting the option specified above, shall be manufactured in accordance with the requirements of this Specification, meeting all of the electrical and instrumentation requirements, and construction specified herein.

2.02 RATINGS

A. The service voltage shall be as specified and as shown on the Drawings. The overall short circuit withstand and interrupting rating of the equipment and devices shall be equal to or greater than the overall short circuit withstand and interrupting rating of the feeder device immediately upstream of the Control Panel, but not less than 22,000 amperes RMS symmetrical at 480/277 Volts. This includes all circuit breakers and combination motor starters. Systems of motor controllers employing series connected ratings for main and feeder devices shall not be used. Motor starter units shall be tested and UL 508A labeled for the specified short circuit duty in combination with the motor branch circuit protective device.

B. There shall be selective device coordination between the Main Breaker, Feeder Breakers and control circuit protective devices. When using a circuit

breaker or fuses as a main protective device, the instantaneous trip levels of the main protective device shall be higher than the available fault current to the control panel. If fuses are utilized in the control panel design, the protective devices for 3 phase loads shall contain single phase protection of such equipment. If a fault occurs in the circuit of one load of a design with a backup load, the feeder protective device shall not remove both loads from the control system.

C. Use ground fault sensing on grounded wye systems.

D. The complete control panel assembly shall be UL certified and carry a UL listing for "Industrial Control Panels".

E. The control panel shall meet all applicable requirements of the National Electrical Code.

F. The control panel enclosure shall be NEMA rated as specified herein.

G. Motor controllers, including associated devices, shall be designed for continuous operation at rated current in a 40 degree C ambient temperature.

H. For additional ratings and construction notes, refer to the mechanical equipment specifications and the Drawings.

I. The Manufacturer shall produce and install on each panel, an Arc Flash Warning Label listing the various Flash Hazard Protection Boundaries, calculated from NFPA 70E, Annexes, as listed below:

1. Flash Hazard Protection Boundary.

2. Limited Approach Boundary.

3. Restricted Boundary.

4. Prohibited Boundary.

5. Incident Energy Level.

6. Required Personal Protective Equipment Class.

7. Type of Fire Rated Clothing.

J. Provide an Arc Flash Warning Label, printed in color and affixed to the front of each panel provided.

K. Shown below is a typical label. Size of each label shall be not less than 8 inches wide and 6 inches tall.

2.03 CONSTRUCTION

A. General

1. Submit actual layout and location of equipment and components; current ratings of devices, bus bars, components; protective relays, voltage ratings of devices, components and assemblies; and other required details.

2. Control units shall be arranged as shown on the Drawings.

3. Except for VFD components, where the equipment contains a programmable logic controller (PLC) or a uninterruptible power supply (UPS), the equipment manufacturer shall furnish factory installed, a dedicated Point of Utilization Device (SPD), as specified in Section 16196, Individual Control Panel and Related Equipment Protection (Type 3).

4. Where Kirk-Key arrangements are used, the Kirk keyed interlocks shall be Kirk HD Series (Heavy Duty) 316 Series of 316 stainless steel, or approved equal.

5. Nameplates

a. External

1) Nameplates shall be engraved, laminated impact acrylic, matte finish, not less than 1/16-in thick by 3/4-in by 2-1/2-in, Rowmark 322402. Nameplates shall be 316 SS screw mounted to all enclosures except for NEMA 4 and 4X. Nameplates for NEMA 4 and 4X enclosures shall be

attached with double faced adhesive strips, TESA TUFF TAPE 4970, .009 X ½", or equal. Prior to installing the adhesive nameplates, the metal surface shall be thoroughly cleaned with 70% alcohol until all residue has been removed. Epoxy adhesive or foam tape is not acceptable.

2) There shall be a master nameplate that indicates supply voltage equipment ratings, short circuit current rating, manufacturer's name, shop order number and general information. Cubicle nameplates shall be mounted on the front face, on the rear panel and inside the assembly, visible when the rear panel is removed.

3) Provide permanent warning signs as follows:

a) "Danger- High Voltage- Keep Out" on all doors.

b) "Warning- Hazard of Electric Shock - Disconnect Power Before Opening or Working On This Unit" on main power disconnect or disconnects.

b. Internal

1) Provide the panel with a UL 508A label.

2) 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.

c. Special

1) Identification nameplates shall be white with black letters, caution nameplates shall be yellow with black letters, and warning nameplates shall be red with white letters.

6. Control Devices and Indicators

a. All operating control devices, indicators, and instruments shall be securely mounted on the panel door. All controls and indicators shall be 30mm, corrosion resistant, NEMA 4X/13, anodized aluminum or reinforced plastic. Booted control devices are not acceptable. 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 and electrical equipment requirements.

b. Indicator lamps shall be LED type. For all control applications, indicator lamps shall incorporate a push-to-test feature. Lens colors shall be as follows:

1) Red for ON, Valve OPEN, and Breaker CLOSED.

2) Green for OFF, Valve CLOSED and Breaker OPEN.

3) Amber for FAIL.

4) Blue for READY

5) White for POWER ON.

c. Mode selector switches (HAND-OFF-AUTO, LOCAL-OFF-REMOTE, etc) shall have the number of positions and contact arrangements, as required. Each switch shall have an extra dry contact for remote monitoring.

d. Pushbuttons, shall be as follows:

1) Red for STOP, Valve OPEN, Breaker CLOSE and mushroom Red for EMERGENCY STOP.

2) Green for START, Valve CLOSE and Breaker OPEN.

3) Black for RESET.

e. Furnish nameplates for each device. All nameplates shall be laminated plastic, black lettering on a white background, attached with stainless steel screws. Device mounted nameplates are not acceptable.

f. The manufacturer shall not remove, reuse, alter, or replace original equipment nameplates or equipment tags associated with equipment or components supplied by the manufacturer's suppliers and sub-suppliers.

g. Control and Instrument Power Transformers

1) Control power transformers shall be provided. Transformer shall be sized for the entire load, including space heaters, plus 25% spare capacity, and shall be not

less than 100VA.

2) Control power transformers shall be 120 volt grounded secondary. Primary side of the transformer shall be fused in both legs. One leg of the transformer secondary shall be solidly grounded while the other leg shall be fused.

7. A failure alarm with horn and beacon light shall be provided when required or specified. Silence and Reset buttons shall be furnished. Alarm horn and beacon shall be by Federal Signal; Crouse-Hinds, or equal, NEMA 4X for all areas except for NEMA 7 areas, which shall be NEMA 7/4X cast aluminum.

8. Provide a six digit, non-resettable elapsed time meter shall be installed on the face of each motor starter. Meter shall be as specified in Section 16195.

B. Enclosures

1. General

a. Each enclosure shall incorporate a removable back panel, and side panels, on which control components shall be mounted. Back panel shall be secured to the enclosure with collar studs for wall mounted enclosures, and 316 SS hardware for free standing enclosures.

b. All free standing enclosures shall be provided with feet of the same construction as the enclosure.

b. The enclosure door shall be interlocked with the main circuit breaker by a panel mounted cable driven operating mechanism.

c. Back panel shall be tapped to accept all mounting screws. Self-tapping screws shall not be used to mount any components.

d. All enclosure doors shall have bonding studs. The enclosure interior shall have a bonding stud.

e. Each enclosure shall be provided with a documentation pocket on the inner door.

f. Enclosures shall not have holes or knockouts.

g. Provide manufacturer's window kits where shown on the

Drawings.

h. All panels installed outdoors shall have a factory applied, suitable primer and final coat of weatherproof white paint.

i. All enclosures shall be padlockable.

2. NEMA 7/4X

a. Class 1, Division 1, Groups A, B, C, and D, or as defined in NFPA 70). Boxes shall be constructed as follows:

1) Copper free cast aluminum body and cover

2) Stainless steel hinges

3) Watertight neoprene gasket

4) Stainless steel cover bolts

5) All penetrations shall be factory drilled and tapped.

b. Manufacturers

1) Cooper Crouse Hinds Type EJB, Style C

2) Appleton Electric Type AJBEW

3) Approved Equal

3. NON METALLIC

a. Chemical Rooms. NEMA 4X constructed as follows:

1) PVC or Fiberglass reinforced polyester body and door.

2) UV inhibitors

3) Luggage type quick release latches

4) Foam-in-place gasketed doors

b. Manufacturers

1). Hoffman Polypro

2) Hubbell-Wiegmann Non-Metallic

3) Approved Equal

4. ALUMINUM

a. NEMA 4X Aluminum

1) Type 5052 aluminum, body and door

2) Stainless steel continuous hinge

3) Foam in-place gasket

4) Single point quarter turn latches (20"x24" and below). All others 3-point latch

b. Manufacturers

1) Hoffman Comline

2) EMF Company

3) NEMA Enclosures Company

4) Hammond Company

5) Approved Equal

5. NEMA 12

a. NEMA 12 Aluminum

1) Type 5052 aluminum, body and door

2) Stainless steel continuous hinge

3) Foam in-place gasket

4) Single point quarter turn latches (20"x24" and below). All others 3-point latch

b. Manufacturers

1) Hoffman Comline

2) EMF Company

3) NEMA Enclosures Company

4) Hammond Company

5) Approved Equal

6. Not Defined

a. Where an enclosure is not otherwise defined or shown on the Drawing

1) NEMA 4X 316 Stainless Steel

2) Type 316 stainless steel, body and door

3) Stainless steel continuous hinge

4) Foam in-place gasket

5) Single point quarter turn latches (20"x24" and below). All others 3-point latch

b. Manufacturers

1) Hoffman Concept Series

2) EMF Company

3) NEMA Enclosures Company

4) Hammond Company

5) Approved Equal

7. NEMA 1 or NEMA 1A boxes shall not be used.

8. Malleable iron boxes shall not be used.

C. Environmental Conditioning

1. Condensation Control

a. A self-contained enclosure condensation heater with thermostat and fan shall be mounted inside the control panel, if panel is mounted outdoors or in a non-air-conditioned space.

1) Enclosure heaters shall be energized from 120 volt, single-phase power supply and sized to prevent condensation within the enclosure.

2) Locate enclosure heaters to avoid overheating electronic hardware or producing large temperature fluctuations on the hardware.

3) Enclosure heaters shall have an internal fan for heat distribution and shall be controlled with adjustable thermostats. The thermostat shall have an adjustment range of 40 degrees Fahrenheit to 90 degrees Fahrenheit. Provide a circuit breaker or fused disconnect switch within the enclosure.

4) Enclosure heaters shall be Hoffman type DAH or equal.

b. Strip heaters may be provided if they are 240 volt rated, powered at 120 volts AC and do not have a surface temperature higher than 60°C. Strip heaters and thermostats shall be as manufactured by Chromalox or equal.

1) Strip heaters shall be Chromalox, Type OT, 1.5-in wide, 240 Volts, single phase, 150 watts, energized at 120 volts, with rust resisting iron sheath, Catalog No. OT-715, Product Code No. 129314, or equal. Provide sufficient wattage in heaters to prevent condensation should the interior temperature of the enclosure drop below the dew point.

2) A control thermostat mounted inside the control Panel shall be Chromalox, Type WR, single stage, Catalog No. WR-80, Product Code No.263177, or equal.

3) The strip heater terminals shall be guarded by a protective terminal cover.

4) High temperature connecting lead wire shall be used between the thermostat and the heater terminals. Wire shall be No. 12 AWG stranded, nickel-plated copper with Teflon glass insulation and shall be the product of Chromalox, Catalog No. 6-CFI-12, Product Code No. 263783, or equal.

c. Each panel shall have a ½" stainless steel condensate drain, installed on a stainless steel conduit hub, HGTZ Series, T&B or equal, in the bottom of the enclosure. Drain shall be O-Z Gedney DBB-50SS, or equal.

2. Corrosion Control

a. Provide corrosion protection in each control panel with a corrosion-Inhibiting vapor capsule as manufactured by Northern Instruments; Model Zerust VC, or Hoffman Engineering; Model A-HCI, or equal.

3. Panel Interior Ambient Control

a. The manufacturer shall provide ambient temperature control within the panel to maintain internal temperatures below the maximum operating temperatures of the panel components. an ambient temperature range of -20° C to 40°C.

b. The manufacturer shall provide panel internal heat rise calculations to show that the panel internal temperatures will be maintained below the maximum operating temperatures of the panel components.

c. The calculation shall show all the internal and external heat gain loads, the expected internal temperature rise in degrees C above the specified ambient, If the specified temperature range cannot be met, an air conditioning system shall be provided with sufficient capacity to maintain the temperature within the specified limits. Panels, for which the calculated heat rise exceeds 40° C., shall have an air conditioning system, sized as required to reduce the heat rise to 40° C. or less, without violating the NEMA rating of the enclosure.

d. The air conditioner shall have the following features:

1) Use CFC-free R134a refrigerant.

2) Have fully gasketed flanges on all four mounting edges for a watertight seal that maintains NEMA 4X rating of the panel.

3) Thermostatic low temperature control to provide energy efficient operation and prevents over-cooling.

4) EMI/RFI suppressor to minimize transient spikes during compressor on/off cycling.

5) Separated blower-driven evaporator and condenser air systems for closed loop cooling.

6) UL listed.

7) Stainless steel enclosure.

8) Internal corrosion resistant coating.

9) Low ambient kit.

10) Short cycle protector.

11) The air conditioning unit shall be Hoffman, Thermo Electric or approved equal.

4. Enclosure Fans

a. Fans shall be furnished for soft start starters and VFDs, as required by the manufacturer, to provide air circulation and cooling. Fans shall be controlled by a temperature switch. The fan shall operate only when the drive is "ON" and for a cool-down period after the drive has stopped Otherwise the fan shall not run when the drive is "OFF". Louvers, if provided, shall have externally removable filters. The filter shall be metallic and washable.

b. Fan motors shall be protected by an input circuit breaker. Metal squirrel cage ball bearing, three phase fan motors with 10-year design life shall be used in the drive design. Plastic muffin fans are not acceptable. Fan power shall be obtained from a tap on the main control power transformer.

c. A "loss of cooling" fault shall be furnished. In the event of clogged filters or fan failure, the drive shall produce an alarm and then, in a predetermined time, be shut down safely without electronic component failure by the temperature switch.

d. Redundant fans shall be provided in the drive design as backup in the event of fan failure.

D. Internal Wiring

1. Power and control wiring shall be tinned stranded copper, minimum size No. 14 AWG, with 600 Volt, 90 degree C, flame retardant, Type MTW thermoplastic insulation. Line side power wiring shall be sized for the full rating or frame size of the connected device.

2. Analog signal wires shall be 600 Volt Class, insulated stranded tinned copper, twisted shielded #16 AWG pair.

3. All interconnecting wires between panel mounted equipment and external equipment shall be terminated at numbered terminal blocks. Field wiring shall not be terminated directly on any panel-mounted device.

4. All wiring shall be tagged and coded with an identification number as shown on the Drawings. Coding shall be typed on a heat shrinkable tube applied to each end showing origination and destination of each wire. The marking shall be permanent, non-smearing, solvent-resistant type similar to Raychem TMS-SCE, or equal.

5. All wiring shall be enclosed in PVC wire trough with slotted side openings and removable cover. Plan wire routing such that no low twisted shielded pair cable conducting analog 4-20 mA signals or low voltage analog signals are routed in the same wire trough as conductors carrying discrete signals or power.

6. All control panel wiring shall use the following color code.

    a. Black: AC power at line voltage

    b. Red: switched AC power

    c. Orange: May be energized while the main disconnect is in the off position

    d. White: AC neutral

    e. Orange/white stripe or white/orange stripe: separate derived neutral

    e. Red/white stripe or white/red stripe: switched neutral

    f. Green or green w/ yellow tracer: ground/earth ground

    g. Blue: Ungrounded DC power

    h. Blue/white stripe or white/blue stripe: DC grounded common

    i. Brown: 480V AC 3 phase - phase A

    j. Orange: 480V AC 3 phase - phase B

    k. Yellow: 480V AC 3 Phase - phase C

    l. Purple: common for analog signal wiring

m. Brown: positive leg of an analog signal

E. Field Installed Internal Wiring

1. Field installed interior wiring shall be neatly grouped by circuit and bound by plastic tie wraps. Circuit groups shall be supported so that circuit terminations are not stressed. In addition, low signal wiring (millivolt and milliamp) shall be bundle separately from the rest of the control wiring.

2. All field wiring shall be tagged and coded with an identification number. Coding shall be typed on a heat shrinkable tube applied to each end of the wire. The marking shall be a permanent, non-smearing, solvent-resistant type similar to Raychem TMS-SCE, or equal

3. In general, all conduit entering or leaving equipment shall be stubbed up into the bottom of the enclosure directly below the area in which the conductors are to be terminated. Conduits shall not enter the side unless approved in writing by the Owner/Engineer.

F. Terminal Blocks

1. Terminal blocks shall be DIN-rail-mounted one-piece molded plastic blocks with tubular-clamp-screw type and end barriers. Terminal blocks shall be rated for 600 volts except for control and instrumentation circuits, or 4-20 mA analog signal conductors.

2. Provide 600 volt rated terminal blocks for any conductor carrying any voltage over 120 volts to ground.

3. Provide 600 volt rated strap screw terminal blocks for any power conductors carrying over 20 amps, at any voltage. Terminals shall be double sided and supplied with removable covers to prevent accidental contact with live circuits.

4. Power conductors carrying over 20 amps, at any voltage shall be terminated to strap-screw type terminal blocks with crimp type, pre-insulated, ring-tongue lugs. Lugs shall be of the appropriate size for the terminal block screws and for the number and size of the wires terminated. Do not terminate more than one conductor in any lug, and do not land more than two conductors under any strap-screw terminal point.

5. Terminals shall have permanent, legible identification, clearly visible with the protective cover removed. Each terminal block shall have 20 percent spare terminals, but not less than two spare terminals.

6. Use the manufacturer's provided bridge connectors to interconnect terminal blocks terminating common or ground conductors.

7. Twisted shielded pair or triad cables shall have each individual conductor and shield drain wire landed on individual terminal blocks. Use the manufacturer's provided bridge connectors to interconnect terminal blocks terminating the shield drain wire conductors.

8. Control circuits, 120 volts and below, and 4-20 mA analog signal conductors shall be terminated with manufacturer's recommended insulated connectors.

9. Provide an AC ground bar bonded to the panel enclosure (if metal) with 20 percent spare terminals.

10. Provided ground terminal blocks for each twisted-shielded pair drain wire.

2.04 SERVICE ENTRANCE DEVICE

A. Where the Control Panel is rated and used as a service entrance panel, the manufacturer shall furnish factory installed in the Control Panel, a dedicated (SPD) (Type 2), permanently connected, Surge Protective Device on the load side of the service entrance device, as specified in Section 16196 Low Voltage AC Surge Protective Devices (SPDs).

2.05 MAIN CIRCUIT PROTECTIVE DEVICE

A. Unless otherwise shown on the Drawings, the main circuit protective device shall be a molded case (MCCB), 3 Pole, 600 Volt, fixed type, manually operated with stored energy closing mechanism. Trip device shall be solid state with adjustable long time pickup, and delay; adjustable short time pickup and delay; short time i2t switch;adjustable ground fault pickup and delay, and ground fault delay and pickup trips for selective tripping.

B. 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. Where panels are shown or specified with inner and outer doors, disconnecting handles and controls shall be located on the inner door.

2.06 MOTOR CONTROLLERS

A. Manufacturers

1. Subject to compliance with the Contract Documents, the following

Manufacturers are acceptable:

a. Cutler Hammer

b. General Electric Co.

c. Allen Bradley

d. Square D

2. The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety.

B. General

1. Provide the NEMA size starter, circuit breaker trip ratings, control power transformers and thermal overload heater element ratings matched to the motors and control equipment actually supplied, in compliance with the NEC and the manufacturer's heater selection tables. All variations necessary to accommodate the motors and controls as actually furnished shall be made without extra cost to the Owner.

2. Furnish lugs for incoming wiring. Allow adequate clearance for bending and terminating of cable size and type specified.

3. A NEMA rated magnetic motor starter shall be furnished for each motor. Each motor starter shall be provided with a motor circuit protector, or circuit breaker, and equipped to provide undervoltage release and overload protection on all three phases. The short circuit protective device shall have an adjustable magnetic trip range up to 1400 percent of rated continuous current and a trip test feature. MCPs shall be labeled in accordance with UL489. NEMA starter sizes and breaker trip ratings shall be as required for the horsepower indicated, but shall be in no case less than NEMA Size 1. If the manufacturer of the equipment utilizing the motor, supplies a motor horsepower larger than that shown on the Drawings, the Contractor shall supply a motor starter sufficient in size to control the motor supplied.

4. 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 each motor. Disconnects mechanisms shall be located inside the enclosure such that the main circuit breaker handle is the only device interlocked with

the panel door.

5. Each motor starter shall have a 120 volt operating coil unless otherwise noted.

6. Overload relays shall be standard Class 20, ambient compensated, manually reset by pushbutton located on front of the starter door. A normally closed contact shall be directly used in the start circuit and a normally open contact shall be wire to a terminal board for overload alarm.

7. All interfaces between control panel and remote devices shall be isolated via an interposing relay. Interposing relays shall have contacts rated for 250 VAC and 10 Amps continuous. Relays shall be Control Relays as specified herein.

C. Magnetic Motor Starters

1. Motor starters shall be 2 or 3 pole, single or 3 phase as required, 60 Hertz, 600 volt, magnetically operated, full voltage non reversing. NEMA sizes shall be as required for the horsepower shown on the Drawings.

2. Each motor starter shall have a 120 volt operating coil, and control power transformer. Starters shall have motor overload protection in each phase. Auxiliary contacts shall be provided as shown on the Drawings. A minimum of one N.O. and one N.C. auxiliary contacts shall be provided in addition to the contacts required.

3. Overload relays shall be adjustable, ambient compensated and manually reset.

4. Built in control stations and indicating lights shall be furnished where shown on the Drawings.

5. All wires shall be terminated on terminal blocks and shall be tagged.

6. Provide as built wiring diagram and post it in a protective cover inside the cell.

D. Contactors

1. Contactors shall be a circuit breaker and contactor, 600 Volt, 3 Pole, 60 Hz, magnetically operated. NEMA size shall be as required for the kilowatt ratings required for the equipment provided, but shall be not less than NEMA size 1.

2. Contactors shall have a 120 Volt operating coil and control power transformer. Furnish the control power transformer with extra capacity for the unit heater fan.

E. Control Relays

1. Control relays shall be 300 volt, industrial rated, plug-in socket type, housed in a transparent polycarbonate dust cover, designed in accordance with UL Standard 508 for motor controller duty. Continuous contact rating shall be 10 amperes resistive, ¼ HP at 120 VAC, operating temperature minus 10 to plus 55 degrees C. Provide spare N.O. & N.C. contacts. Relays shall be Potter & Brumfield KRP Series or equal with neon coil indicator light. Timing relays shall be 300 Volt, solid state type, with rotary switch to select the timing range.

F. Elapsed Time Meter

1. A six digit, non-resettable elapsed time meter shall be installed on the face of each motor starter. Meter shall be as specified in Section 16195.

2.07 LOGIC DEVICES

A. Programmable Logic Controller

1. Where the control panel contains a programmable logic controller (PLC) for programming of the control logic, the manufacturer shall provide the address list, and an Ethernet interface to connect to the Owner's plant monitoring system for monitoring of the PLC's operation.

2. Provide a scripted program file for each PLC.

B. Operation Interface Terminal

1. Where the control panel contains an Operation Interface Terminal for interfacing to the control logic, the manufacturer shall provide the address list, and an Ethernet and serial interface to connect to the related PLC for monitoring and control of the PLCs operation.

2. Provide a scripted application and fully documented setup for each OIT.

2.08 INSTRUMENTATION DEVICES

A. Level Switches

1. Where Level Switches are specified herein or shown on the Drawings, refer to Section 13446 Prmary Instrumentation Devices for the required devices.

B. Programmable Logic Controllers (PLCs)

1. Where PLCs are specified herein or shown on the Drawings, refer to Section 13500 Programmable Logic Controllers (PLCs) for the required devices.

C. Operator Interface Terminals (OITs)

1. Where OITs are specified herein or shown on the Drawings, refer to the Instrumentation Divisions for the required devices.

2.09 REMOTE MONITORING AND CONTROL INTERFACE

A. General: All control and interconnection points from the equipment to the plant control and monitoring system shall be brought to a separate connection box. No field connections shall be made directly to the equipment control devices. Functions to be brought out shall be as specified in the Instrumentation Divisions.

B. Discrete control or status functions shall be form C relays with contacts rated at 120 volts AC. Analog signals shall be isolated from each other.

C. Equipment functions to be directly interfaced to the Plant Control and Monitoring System, shall be designed for operation with an Ethernet Connection.

D. The equipment manufacturer shall factory enter the proper IP Address for such connection. Upon request by the Contractor, the Owner/Engineer will provide the proper Internet Protocol Address (IP Address), to be configured by the equipment manufacturer.

E. Refer to the Instrumentation Divisions for monitored parameters.

F. Communication

1. For remote monitoring, one of the following communication capabilities shall be provided:

a. One (1) integral 10/100BaseT Ethernet port supporting Modbus TCP, Ethernet IP and SNMP protocols.

b. One (1) media protocol converter, interfacing the provided equipment to a 10/100BaseT Ethernet port supporting Modbus

TCP, Ethernet IP and SNMP.

2. The protocol interface shall implement the following:

   a. All data shall be available and/or mirrored within the Modbus 4x or "Holding Register" memory area.

   b. Register 4x00001 shall exist and be readable to allow simple, predictable "comm tests".

3. The media protocol converter shall meet the following criteria:

   a. The converter shall support 10/100Base-T Ethernet. The serial port speed (baud rate) shall support 230kbps. The protocol shall support Modbus TCP, Ethernet IP, DF1, and Modbus RTU/ASCII. Protocol shall be Web Browser configurable.

   b. Operating limits shall be 0-60 degrees C, with humidity range minimum of 5-90 percent. Shock capability on the serial port shall be ESD +15 kV air GAP meeting IEC 1000-4-2. Power requirements shall be 9-30VDC at 0.5A minimum.

   c. The converter shall have LED status for serial, signals, power, and Ethernet.

   d. The converter housing shall be UL 1604, Class 1 Div 2, DIN Rail mountable. The converter shall have DB-9M port connection, with screw terminals, to the input.

   e. Converter shall be Digi One IAP, or approved equal.

2.10 SPARE PARTS

A. Provide the following spare parts for each control panel in the quantities specified:

1. One-half dozen replacement fuses, all types and sizes

2. One replacement lamp, of each color, for pilot lights

3. One of each color replacement lens caps for pilot lights

4. One starter coil for each NEMA size furnished

5. One, 3-pole set of replacement overload heaters of each size range used

6. One, 3-pole set of starter contacts of each NEMA size used.

7. One can of aerosol touch-up paint.

B. Spare parts shall be boxed or packaged for long term storage. Identify each item with manufacturer's name, description and part number on the exterior of the package.

2.11 FACTORY TESTING

A. The entire control panel shall be completely assembled, wired, and adjusted at the factory and shall be given the manufacturer's routine shop tests and any other additional operational test to insure the workability and reliable operation of the equipment.

B. Factory test equipment and test methods shall conform with the latest applicable requirements of ANSI, IEEE, UL, and NEMA standards.

C. The operational test shall include the proper connection of supply and control voltage and, as far as practical, a mockup of simulated control signals and control devices shall be fed into the boards to check for proper operation.

D. Factory test equipment and test methods shall conform to the latest applicable requirements of ANSI, IEEE, UL, and NEMA standards, and shall be subject to the Owner/Engineer's approval.

PART 3 E X E C U T I O N

3.01 INSTALLER'S QUALIFICATIONS

A. Installer shall be specialized in installing this type of equipment, with minimum 5 years documented experience. Experience documentation shall be submitted for approval prior to beginning work on this project.

3.02 EXAMINATION

A. Examine installation area to assure there is enough clearance to install the equipment.

B. Housekeeping pads shall be included for the floor mounted motor controllers as detailed on the Drawings with the exception of motor controllers which are to be installed adjacent to an existing unit. Housekeeping pads for these (if used) should match the existing installation.

C Check concrete pads and baseplates for uniformity and level surface.

D. Verify that the equipment is ready to install.

E. Verify field measurements are as instructed by manufacturer.

3.03 INSTALLATION

A. The Contractor shall install all equipment per the manufacturer's recommendations and Contract Drawings.

B. Conduit hubs for use on raceway system pull and junction boxes shall be watertight, threaded aluminum, insulated throat, stainless steel grounding screw, as manufactured by T&B H150GRA Series, or equal.

C. Conduits entering a Control Panel, shall not enter the enclosure through the top.

D. Install required safety labels.

3.04 RACEWAY SEALING

A. Where raceways enter junction boxes or control panels containing electrical or instrumentation equipment, entrances shall be sealed with 3M 1000NS Watertight Sealant, or approved equal.

B. This requirement shall be strictly adhered to for all raceways in the conduit system.

3.05 FIELD QUALITY CONTROL

A. Inspect installed equipment for anchoring, alignment, grounding and physical damage.

B. Check tightness of all accessible electrical connections. Minimum acceptable values are specified in manufacturer's instructions.

C. Provide one set of as-built panel drawings laminated, in each panel pocket.

3.06 FIELD ADJUSTING

A. Adjust all circuit breakers, switches, access doors, operating handles for free mechanical and electrical operation as described in manufacturer's instructions.

3.07 FIELD TESTING

A. Perform all electrical field tests recommended by the manufacturer. Disconnect all connections to solid-state equipment prior to testing.

B. Megger and record phase to phase and phase to ground insulation resistance. Megger, for 1 minute, at minimum voltage of 1000 VDC. Measured Insulation resistance shall be at least 100 megohms. In no case shall the manufacturer's maximum test voltages be exceeded.

C. Test each key interlock system for proper functioning.

D. Test all control logic before energizing the motor or equipment.

3.08 CLEANING

A. Remove all rubbish and debris from inside and around the motor controllers. 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.

3.09 EQUIPMENT PROTECTION AND RESTORATION

A. Touch-up and restore damaged surfaces to factory finish, as approved by the manufacturer. If the damaged surface cannot be returned to factory specification, the surface shall be replaced.

3.10 MANUFACTURER'S CERTIFICATION

A. A qualified factory-trained manufacturer's representative shall certify in writing that the equipment has been installed, adjusted, including all settings designated in the Power System Study, and tested in accordance with the manufacturer's recommendations.

B. The Contractor shall provide three (3) copies of the manufacturer's representative's certification.

3.11 TRAINING

A. Provide manufacturer's services for training of plant personnel in operation and maintenance of the soft start starters furnished under this Section.

B. The training for each type of equipment shall be for a period of not less than one (1) eight hour day.

C. The cost of training program to be conducted with Owner's personnel shall be included in the Contract Price. The training and instruction, insofar as practicable, shall be directly related to the system being supplied.

D. Provide detailed O&M manuals to supplement the training course. The manuals shall include specific details of equipment supplied and operations specific to the project.

E. The training session shall be conducted by a manufacturer's qualified representative. Training program shall include instructions on the assembly, motor starters, protective devices, metering, and other major components.

F. The Owner reserves the right to videotape the training sessions for the Owner's use.

END OF SECTION

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SECTION 16487

ELECTRICAL CONTROL PANELS (OEMs)

PART 1 G E N E R A L

1.01 SCOPE OF WORK

A. Furnish and install functional control panels to manually or automatically operate control systems as specified in the detailed requirements of this Section, and logic and schematics as shown on the Electrical Drawings.

B. Submittals for Electrical Control Panels, not clearly specified as Control Panels by the Electrical or Mechanical equipment manufacturer, shall be submitted under this Section of the Specifications. Control panels specified in the Process Equipment Division or Mechanical Equipment Division, shall not be submitted under this Section. Control Panels for those Divisions, shall meet the requirements of Section 16486 Mechanical Equipment Manufacturer's Control Panels, and shall be submitted as a part of the Mechanical Equipment manufacturer's submittals or Process Equipment Division Submittals. Control panels specified for the Instrumentation Division shall be submitted as a part of the Instrumentation Division submittals.

1.02 RELATED WORK

A. Section 16010 Basic Electrical Requirements

B. Section 16196 Low Voltage Surge Protective Devices (SPDs)

1.03 SUBMITTALS

A. Submittals shall be made in accordance with the requirements of Division 1, Section 16000 and as specified herein.

B. Provide systems engineering to produce coordination curves, showing coordination between breakers and/or fuses submitted, such that protective device coordination is accomplished. Such curves and settings shall be included as a part of these submittals.

C. Submittals shall also contain information on related equipment to be furnished under this Specification but described in the related Sections listed in the Related Work paragraph above. Incomplete submittals not containing the required information on the related equipment will also be returned unreviewed.

D. The original equipment manufacturer shall create all equipment shop drawings, including all wiring diagrams, in the manufacturer's Engineering department. All equipment shop drawings shall bear the original equipment manufacturer's logo, drawing file numbers, and shall be maintained on file in the original equipment manufacturer's archive file system. Photocopies of the Engineer's ladder schematics are unacceptable as shop drawings.

E. Submit to the Owner/Engineer, shop drawings and product data, for the following:

1. Product data sheets and catalog numbers for overcurrent protective devices, motor starters, control relays, control stations, meters, pilot lights, etc. The manufacturer's name shall be clearly visible on the each cut sheet submitted. List all options, trip adjustments and accessories furnished specifically for this project. Clearly mark each sheet to indicate which items apply and/or those items that do not apply.

2. Provide control systems engineering to produce custom unit elementary drawings showing interwiring and interlocking between components and to remotely mounted devices. Include and identify all connecting equipment and remote devices on the schematics. The notation "Remote Device" will not be acceptable. Show wire and terminal numbers. Indicate special identifications for electrical devices per the Drawings.

3. Equipment outline drawings showing elevation, plan and interior views, front panel arrangement, dimensions, weight, shipping splits, conduit entrances and anchor bolt pattern. Indicate all options, special features, ratings and deviations from this Section.

4. Schematic diagram, including manufacturer's selections of component ratings, and CT and PT ratios.

5. Power and control schematics including external connections. Show wire and terminal numbers, and color-coding.

6. Instruction and replacement parts books.

7. As-built final drawings.

8. Documentation that the panel assembly facility is a UL-508 certified panel shop.

9. Facsimile of the UL label that is to be applied to the completed panel.

10. Furnish complete Bill of Materials indicating manufacturer's name and part numbers.

11. Manufacturer's cut sheets for every component used in the panel assembly adequately marked to show the items being included. The manufacturer's name shall be clearly visible on the each cut sheet submitted.

F. Operation and Maintenance Manuals.

1. Operation and maintenance manuals shall include the following information:

a. Manufacturer's contact address and telephone number for parts and service.

b. Instruction books and/or leaflets

c. Recommended renewal parts list

d. Record Documents for the information required by the Submittals paragraph above.

G. The manufacturer shall submit for approval, a training agenda for all training specified herein. Training agenda shall not be submitted until final approval of the Operation and Maintenance Manual.

1.04 REFERENCE CODES AND STANDARDS

A. All products and components shown on the Drawings and listed in this specification shall be designed and manufactured according to latest revision of the following standards (unless otherwise noted):

1. NEMA Standard ICS 2 – 2000 Industrial Control and Systems

2. NFPA 70 – National Electrical Code (NEC)

3. NFPA 70E – Standard For Electrical Safety in the Workplace

4. NFPA 79 – Electrical Standard for Industrial Machinery

5. UL 508/508A – Industrial Control Enclosures

B. All equipment specified in this Section of the Specifications shall bear the appropriate label of Underwriters Laboratories.

1.05 QUALITY ASSURANCE

A. The manufacturer of this equipment shall have produced similar equipment for a minimum period of five (5) years. When requested by the Owner/Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.

B. The control panels shall be assembled in a UL-508 certified facility. A submittal of documentation certifying that the panel fabrication facility is a UL-508 certified facility, is required. A UL label shall be affixed to the inside of the external door by the panel fabrication assembly. Submit a facsimile of the UL label in the submittal information.

C. All components and material shall be new and of the latest field proven design and in current production. Obsolete components or components scheduled for immediate discontinuation shall not be used.

D. For the equipment specified herein, the manufacturer shall be ISO 9001 2000 certified.

E. Equipment components and devices shall be UL labeled wherever UL standards exist for such equipment. The completed control panel shall be UL Labeled in accordance with UL 508 and 508A and other applicable UL standards. The panel shall also be UL labeled for the environment in which it is to be placed. A UL label shall be affixed to the inside of the external door by the panel fabrication assembly. Submit a facsimile of the UL label in the submittal information.

1.06 JOBSITE DELIVERY, STORAGE AND HANDLING

A. Prior to jobsite delivery, the Contractor shall have successfully completed all submittal requirements, and present to the Owner/Engineer upon delivery of the equipment, an approved copy of all such submittals. Delivery of incomplete constructed equipment, onsite factory work, or failed factory tests will not be permitted.

B. Equipment shall be handled and stored in accordance with manufacturer's instructions. Two (2) copies of these instructions shall be included with the equipment at time of shipment, and shall be made available to the Contractor and Owner/Engineer.

C. 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.

D. Equipment shall be installed in its permanent finished location shown on the Drawings within seven (7) calendar days of arriving onsite. If the equipment cannot be installed within seven (7) calendar days, the equipment shall not

be delivered to the site, but stored offsite, at the Contractor's expense, until such time that the site is ready for permanent installation of the equipment.

E. Where space heaters are provided in equipment, provide temporary electrical power and operate space heaters during storage, and after equipment is installed in permanent location, until equipment is placed in service.

1.07 WARRANTY

A. The Manufacturer shall warrant the equipment to be free from defects in material and workmanship for 1 year from date of final acceptance of the equipment. Within such period of warranty the Manufacturer shall promptly furnish all material and labor necessary to return the equipment to new operating condition. Any warranty work requiring shipping or transporting of the equipment shall be performed by the Manufacturer, at no expense to the Owner.

PART 2 P R O D U C T S

2.01 MATERIAL MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following material Manufacturers are acceptable:

1. General Electric Co.

2. Eaton / Cutler-Hammer

3. Square D Co.

4. Allen Bradley

B. The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features and functions. Materials listed above are not relieved from meeting these Specifications in their entirety.

2.02 RATINGS

A. The service voltage shall be as specified and as shown on the Drawings. The overall short circuit withstand and interrupting rating of the equipment and devices shall be equal to or greater than the overall short circuit withstand and interrupting rating of the feeder device immediately upstream of the Control Panel, but not less than 22,000 amperes RMS symmetrical at 480/277 Volts, This includes all circuit breakers and combination motor

starters. Systems of motor controllers employing series connected ratings for main and feeder devices shall not be used. Motor starter units shall be tested and UL 508A labeled for the specified short circuit duty in combination with the motor branch circuit protective device.

2.03 CONSTRUCTION

A. General

1. Refer to Drawings for: actual layout and location of equipment and components; current ratings of devices, bus bars, components; protective relays, voltage ratings of devices, components and assemblies; and other required details.

2. Control units shall be arranged as shown on the Drawings.

3. Nameplates

a. External

1) Nameplates shall be engraved, laminated impact acrylic, matte finish, not less than 1/16-in thick by 3/4-in by 2-1/2-in, Rowmark 322402. Nameplates shall be 316 SS screw mounted to all enclosures except for NEMA 4 and 4X. Nameplates for NEMA 4 and 4X enclosures shall be attached with double faced adhesive strips, TESA TUFF TAPE 4970, .009 X ½", or equal. Prior to installing the adhesive nameplates, the metal surface shall be thoroughly cleaned with 70% alcohol until all residue has been removed. Epoxy adhesive or foam tape is not acceptable.

2) There shall be a master nameplate that indicates supply voltage equipment ratings, short circuit current rating, manufacturer's name, shop order number and general information. Cubicle nameplates shall be mounted on the front face, on the rear panel and inside the assembly, visible when the rear panel is removed.

3) Provide permanent warning signs as follows:

a) "Danger- High Voltage- Keep Out" on all doors.

b) "Warning- Hazard of Electric Shock - Disconnect Power Before Opening or Working On This Unit" on main power disconnect or disconnects.

b. Internal

1) Provide the panel with a UL 508A label.

2) 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.

c. Special

1) Identification nameplates shall be white with black letters, caution nameplates shall be yellow with black letters, and warning nameplates shall be red with white letters.

4. Control Devices and Indicators

a. All operating control devices, indicators, and instruments shall be securely mounted on the panel door. All controls and indicators shall be 30mm, corrosion resistant, NEMA 4X/13, anodized aluminum or reinforced plastic. Booted control devices are not acceptable. 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 and electrical equipment requirements.

b. Indicator lamps shall be LED type. For all control applications, indicator lamps shall incorporate a push-to-test feature. Lens colors shall be as follows:

1) Red for ON, Valve OPEN, and Breaker CLOSED.

2) Green for OFF, Valve CLOSED and Breaker OPEN.

3) Amber for FAIL.

4) Blue for READY

5) White for POWER ON.

c. Mode selector switches (HAND-OFF-AUTO, LOCAL-OFF-REMOTE, etc) shall be as shown on the Drawings. Units shall have the number of positions and contact arrangements, as required. Each switch shall have an extra dry contact for remote

monitoring.

d. Pushbuttons shall be as follows:

1) Red for STOP, Valve OPEN, Breaker CLOSE and mushroom Red for EMERGENCY STOP.

2) Green for START, Valve CLOSE and Breaker OPEN.

3) Black for RESET.

e. Furnish nameplates for each device. All nameplates shall be laminated plastic, black lettering on a white background, attached with stainless steel screws. Device mounted nameplates are not acceptable.

5. Control and Instrument Power Transformers

a. Control power transformers shall be provided where shown on the Drawings. Transformer shall be sized for the entire load, including space heaters, plus 25% spare capacity, and shall be not less than 100VA.

b. Control power transformers shall be 120 volt grounded secondary. Primary side of the transformer shall be fused in both legs. One leg of the transformer secondary shall be solidly grounded while the other leg shall be fused.

6. A failure alarm with horn and beacon light shall be provided when required or specified. Silence and reset buttons shall be furnished. Alarm horn and beacon shall be by Federal Signal; Crouse-Hinds, or equal, NEMA 4X for all areas except for NEMA 7 areas, which shall be NEMA 7/4X cast aluminum.

7. Where specified or shown on the Drawings, a six digit, non-resettable elapsed time meter shall be installed on the face of each motor starter. Meter shall be as specified in Section 16195.

B. Enclosures

1. General

a. Each enclosure shall incorporate a removable back panel, and side panels, on which control components shall be mounted. Back panel shall be secured to the enclosure with collar studs for wall mounted enclosures, and 316 SS hardware for free standing enclosures.

b. All free standing enclosures shall be provided with feet of the same construction as the enclosure.

c. The enclosure door shall be interlocked with the main circuit breaker by a panel mounted cable driven operating mechanism.

d. Back panel shall be tapped to accept all mounting screws. Self-tapping screws shall not be used to mount any components.

e. All enclosure doors shall have bonding studs. The enclosure interior shall have a bonding stud.

f. Each enclosure shall be provided with a documentation pocket on the inner door.

g. Enclosures shall not have holes or knockouts.

h. Provide manufacturer's window kits where shown on the Drawings.

i. All panels installed outdoors shall have a factory applied, suitable primer and final coat of weatherproof white paint.

j. All enclosures shall be padlockable.

2. NEMA 7/4X

a. Class 1, Division 1, Groups A, B, C, and D, or as defined in NFPA 70). Boxes shall be constructed as follows:

1) Copper free cast aluminum body and cover

2) Stainless steel hinges

3) Watertight neoprene gasket

4) Stainless steel cover bolts

5) All penetrations shall be factory drilled and tapped.

b. Manufacturers

1) Cooper Crouse Hinds Type EJB, Style C

2) Appleton Electric Type AJBEW

3) Approved Equal

3. NON METALLIC

    a. Chemical Rooms. NEMA 4X constructed as follows:

        1) PVC or Fiberglass reinforced polyester body and door.

        2) UV inhibitors

        3) Luggage type quick release latches

        4) Foam-in-place gasketed doors

    b. Manufacturers

        1) Hoffman Polypro

        2) Hubbell-Wiegmann Non-Metallic

        3) Approved Equal

4. ALUMINUM

    a. NEMA 4X Aluminum

        1) Type 5052 aluminum, body and door

        2) Stainless steel continuous hinge

        3) Foam in-place gasket

        4) Single point quarter turn latches (20”x24” and below). All others 3-point latch

    b. Manufacturers

        1) Hoffman Comline

        2) EMF Company

        3) NEMA Enclosures Company

        4) Hammond Company

        5) Approved Equal

5. NEMA 12

    a. NEMA 12 Aluminum

1) Type 5052 aluminum, body and door

2) Stainless steel continuous hinge

3) Foam in-place gasket

4) Single point quarter turn latches (20”x24” and below). All others 3-point latch

b. Manufacturers

1) Hoffman Comline

2) EMF Company

3) NEMA Enclosures Company

4) Hammond Company

5) Approved Equal

6. Not Defined

a. Where an enclosure is not otherwise defined or shown on the Drawing

1) NEMA 4X 316 Stainless Steel

2) Type 316 stainless steel, body and door

3) Stainless steel continuous hinge

4) Foam in-place gasket

5) Single point quarter turn latches (20”x24” and below). All others 3-point latch

b. Manufacturers

1) Hoffman Concept Series

2) EMF Company

3) NEMA Enclosures Company

4) Hammond Company

5) Approved Equal

7. NEMA 1 or NEMA 1A boxes shall not be used.

8. Malleable iron boxes shall not be used.

C. Internal Wiring

1. Power and control wiring shall be tinned stranded copper, minimum size No. 14 AWG, with 600 Volt, 90 degree C, flame retardant, Type MTW thermoplastic insulation. Line side power wiring shall be sized for the full rating or frame size of the connected device, and as shown on the Drawings.

2. Analog signal wires shall be 600 Volt Class, insulated stranded tinned copper, twisted shielded #16 AWG pair.

3. All interconnecting wires between panel mounted equipment and external equipment shall be terminated at numbered terminal blocks. Field wiring shall not be terminated directly on any panel-mounted device.

4. All wiring shall be tagged and coded with an identification number as shown on the Drawings. Coding shall be typed on a heat shrinkable tube applied to each end showing origination and destination of each wire. The marking shall be permanent, non-smearing, solvent-resistant type similar to Raychem TMS-SCE, or equal.

5. All wiring shall be enclosed in PVC wire trough with slotted side openings and removable cover. Plan wire routing such that no low twisted shielded pair cable conducting analog 4-20 mA signals or low voltage analog signals are routed in the same wire trough as conductors carrying discrete signals or power.

6. All control panel wiring shall use the following color code.

a. Black: AC power at line voltage

b. Red: switched AC power

c. Orange: May be energized while the main disconnect is in the off position

d. White: AC neutral

e. Orange/white stripe or white/orange stripe: separate derived neutral

e. Red/white stripe or white/red stripe: switched neutral

f. Green or green w/ yellow tracer: ground/earth ground

g. Blue: Ungrounded DC power

h. Blue/white stripe or white/blue stripe: DC grounded common

i. Brown: 480V AC 3 phase - phase A

j. Orange: 480V AC 3 phase - phase B

k. Yellow: 480V AC 3 Phase - phase C

l. Purple: common for analog signal wiring

m. Brown: positive leg of an analog signal

D. Field Installed Internal Wiring

1. Field installed interior wiring shall be neatly grouped by circuit and bound by plastic tie wraps. Circuit groups shall be supported so that circuit terminations are not stressed. In addition, low signal wiring (millivolt and milliamp) shall be bundle separately from the rest of the control wiring.

2. All field wiring shall be tagged and coded with an identification number. Coding shall be typed on a heat shrinkable tube applied to each end of the wire. The marking shall be a permanent, non-smearing, solvent-resistant type similar to Raychem TMS-SCE, or equal

3. In general, all conduit entering or leaving equipment shall be stubbed up into the bottom of the enclosure directly below the area in which the conductors are to be terminated, or from the top if shown on the Drawings. Conduits shall not enter the side unless approved in writing by the Owner/Engineer.

E. Terminal Blocks

1. Terminal blocks shall be DIN-rail-mounted one-piece molded plastic blocks with tubular-clamp-screw type and end barriers. Terminal blocks shall be rated for 600 volts except for control and instrumentation circuits, or 4-20 mA analog signal conductors.

2. Provide 600 volt rated terminal blocks for any conductor carrying any voltage over 120 volts to ground.

3. Provide 600 volt rated strap screw terminal blocks for any power conductors carrying over 20 amps, at any voltage. Terminals shall be double sided and supplied with removable covers to prevent accidental contact with live circuits.

4. Power conductors carrying over 20 amps, at any voltage shall be terminated to strap-screw type terminal blocks with crimp type, pre-insulated, ring-tongue lugs. Lugs shall be of the appropriate size for the terminal block screws and for the number and size of the wires terminated. Do not terminate more than one conductor in any lug, and do not land more than two conductors under any strap-screw terminal point.

5. Terminals shall have permanent, legible identification, clearly visible with the protective cover removed. Each terminal block shall have 20 percent spare terminals, but not less than two spare terminals.

6. Use the manufacturer's provided bridge connectors to interconnect terminal blocks terminating common or ground conductors.

7. Twisted shielded pair or triad cables shall have each individual conductor and shield drain wire landed on individual terminal blocks. Use the manufacturer's provided bridge connectors to interconnect terminal blocks terminating the shield drain wire conductors.

8. Control circuits, 120 volts and below, and 4-20 mA analog signal conductors shall be terminated with manufacturer's recommended insulated connectors.

9. Provide an AC ground bar bonded to the panel enclosure (if metal) with 20 percent spare terminals.

10. Provided ground terminal blocks for each twisted-shielded pair drain wire.

2.04 SPARE PARTS

A. Provide the following spare parts for each control panel in the quantities specified:

1. One box- replacement fuses, all types and sizes used

2. One replacement lamp, of each color, for pilot lights

3. One of each color replacement lens caps for pilot lights

4. One can of aerosol touch-up paint.

B. Spare parts shall be boxed or packaged for long term storage. Identify each item with manufacturer's name, description and part number on the exterior of the package.

2.05 FACTORY TESTING

A. The entire control panel shall be completely assembled, wired, and adjusted at the factory and shall be given the manufacturer's routine shop tests and any other additional operational test to insure the workability and reliable operation of the equipment.

B. Factory test equipment and test methods shall conform with the latest applicable requirements of ANSI, IEEE, UL, and NEMA standards.

C. The operational test shall include the proper connection of supply and control voltage and, as far as practical, a mockup of simulated control signals and control devices shall be fed into the boards to check for proper operation.

D. Factory test equipment and test methods shall conform to the latest applicable requirements of ANSI, IEEE, UL, and NEMA standards, and shall be subject to the Owner/Engineer's approval.

PART 3 E X E C U T I O N

3.01 INSTALLER'S QUALIFICATIONS

A. Installer shall be specialized in installing this type of equipment with minimum 5 years documented experience. Experience documentation shall be submitted for approval prior to beginning work on this project.

3.02 EXAMINATION

A. Examine installation area to assure there is enough clearance to install the equipment.

B. Housekeeping pads shall be included for the floor mounted motor controllers as detailed on the Drawings with the exception of motor controllers which are to be installed adjacent to an existing unit. Housekeeping pads for these (if used) should match the existing installation.

C. Check concrete pads and baseplates for uniformity and level surface.

D. Verify that the equipment is ready to install.

E. Verify field measurements are as instructed by manufacturer.

3.03 INSTALLATION

A. The Contractor shall install all equipment per the manufacturer's recommendations and Contract Drawings.

B. Conduit hubs for use on raceway system pull and junction boxes shall be watertight, threaded aluminum, insulated throat, stainless steel grounding screw, as manufactured by T&B H150GRA Series, or equal.

C. Conduits entering a control Panel or box containing electrical equipment, shall not enter the enclosure through the top.

D. Install required safety labels.

3.04 RACEWAY SEALING

A. Where raceways enter junction boxes or control panels containing electrical or instrumentation equipment, all entrances shall be sealed with 3M 1000NS Watertight Sealant, or approved equal.

B. This requirement shall be strictly adhered to for all raceways in the conduit system.

3.05 FIELD QUALITY CONTROL

A. Inspect installed equipment for anchoring, alignment, grounding and physical damage.

B. Check tightness of all accessible electrical connections. Minimum acceptable values are specified in manufacturer's instructions.

C. Provide one set of as-built panel drawings laminated, in each panel pocket.

3.06 FIELD ADJUSTING

A. Adjust all circuit breakers, switches, access doors, operating handles for free mechanical and electrical operation as described in manufacturer's instructions.

B. The Power Monitoring and Protective Relays shall be set in the field by a qualified representative of the manufacturer, retained by the Contractor, in accordance with settings designated in a coordinated study of the system as required in Section 16105 Power System Study. All such settings, including the application of arc flash labels, shall have been made and Approved by the Owner/Engineer, prior to energizing of the equipment.

3.07 FIELD TESTING

A. Perform all electrical field tests recommended by the manufacturer. Disconnect all connections to solid-state equipment prior to testing.

B. Megger and record phase to phase and phase to ground insulation resistance. Megger, for 1 minute, at minimum voltage of 1000 VDC. Measured Insulation resistance shall be at least 100 megohms. In no case shall the manufacturer's maximum test voltages be exceeded.

C. Test each key interlock system for proper functioning.

D. Test all control logic before energizing the motor or equipment.

3.08 CLEANING

A. Remove all rubbish and debris from inside and around the motor controllers. 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.

3.09 EQUIPMENT PROTECTION AND RESTORATION

A. Touch-up and restore damaged surfaces to factory finish, as approved by the manufacturer. If the damaged surface cannot be returned to factory specification, the surface shall be replaced.

3.10 MANUFACTURER'S CERTIFICATION

A. A qualified factory-trained manufacturer's representative shall personally inspect the equipment at the jobsite and shall certify in writing that the equipment has been installed, adjusted, and tested, in accordance with the manufacturer's recommendations, including all settings designated in the Power System Study.

B. The Contractor shall provide three (3) copies of the manufacturer's representative's certification.

3.11 TRAINING

A. Provide manufacturer's services for training of plant personnel in operation and maintenance of the soft start starters furnished under this Section.

B. The training for each type of equipment shall be for a period of not less than one (1) eight hour day.

C. The cost of training program to be conducted with Owner's personnel shall be included in the Contract Price. The training and instruction, insofar as

practicable, shall be directly related to the system being supplied.

D. Provide detailed O&M manuals to supplement the training course. The manuals shall include specific details of equipment supplied and operations specific to the project.

E. The training session shall be conducted by a manufacturer's qualified representative. Training program shall include instructions on the assembly, motor starters, protective devices, metering, and other major components.

F. The Owner reserves the right to videotape the training sessions for the Owner’s use.

END OF SECTION

SECTION 16488

VALVE AND GATE ELECTRIC ACTUATORS

PART 1 G E N E R A L

1.01 SCOPE OF WORK

A. The Contractor shall furnish and install Electric Valve and Gate Actuators for valves and gates, together with appurtenances, complete and operable as specified herein, as shown on the Contract Drawings and described in the Process Equipment and Mechanical Equipment Division Specifications.

B. All equipment described herein shall be submitted and furnished as an integral part of equipment specified elsewhere in the Process and Mechanical Equipment Divisions of these Specifications.

C. The valve Manufacturer shall take total responsibility for the valve and actuator combination as a single unit, providing any additional information, as may be required to the actuator Manufacturer, for a complete working unit.

1.02 RELATED WORK

A. Section 16000 Electrical – Basic Electrical Requirements

B. Section 16165 Disconnect Switches

C. Process Equipment Division Valve and Gate Specifications

D. Mechanical Equipment Division Valve and Gate Specifications

E. The valve/gate Manufacturer shall provide to the valve actuator Manufacturer, all information for sizing and design as described in AWWA Standard C542-09, Sec. 4.3.

1.03 SUBMITTALS

A. Submittals for equipment specified herein shall be made as a part of equipment furnished under other Sections. Individual submittals for equipment specified herein will not be accepted and will be returned un-reviewed.

B. Submit to the Owner/Engineer, shop drawings and product data, for the following:

1. A separate individual schematic for each valve or gate, bearing the

valve identification number, shall be submitted for each operator on the project. Identify the inputs and outputs for each valve operator. No typical sheets will be accepted.

2. The Valve and Gate equipment Manufacturer shall use his control systems engineering department to produce custom unit elementary drawings. The shop drawings shall provide a composite drawing of the valve/gate actuator assembly for each unit provided. Drawings shall be on the mechanical equipment Manufacturer's drawing sheets, and shall include all schematics for control logic as described in the Process Equipment Specifications, and any associated control schematics shown on the Engineer's Drawings for this project. Show interwiring and interlocking between components and to remotely mounted devices. Include and identify all connecting equipment and remote devices on the schematics. The notation "Remote Device" will not be acceptable. Show wire and terminal numbers. The submitted schematics shall clearly indicate terminal numbers corresponding to the input/output terminal numbers shown on the Engineer's schematics. Indicate special identifications for devices as required by the mechanical equipment Manufacturer or as may be shown on the Drawings.

3. Equipment outline drawings showing elevation, plan and interior views, dimensions, weight, shipping splits, conduit entrances and anchor bolt pattern. Indicate all options, special features, ratings and deviations from this Section.

4. Instruction and replacement parts books, including Manufacturer's part numbers.

5. As-built final drawings.

6. Furnish complete Bill of Materials indicating Manufacturer's name and part numbers.

7. Manufacturer's cut sheets for every actuator, adequately marked to show the items being included. The Manufacturer's name shall be clearly visible on the each cut sheet submitted.

8. Assembly ratings including:

   a. Short-circuit rating.

   b. Voltage.

   c. Continuous current.

9. Major component ratings including:

    a. Voltage.

    b. Continuous current.

    c. Interrupting ratings.

10. Cable terminal sizes.

11. Instruction and renewal parts books.

D. Factory Tests. Submittals shall be made for factory tests specified herein.

E. Field Test Reports. Submittals shall be made for field tests specified herein.

F. Operation and Maintenance Manuals shall include the following information:

1. Manufacturer's contact address and telephone number for parts and service.

2. Instruction books and/or leaflets

3. Recommended renewal parts list

4. Record Documents for the information required by the Submittals paragraph above.

G. The manufacturer shall submit for approval, a training agenda for all training specified herein. Training agenda shall not be submitted until final approval of the Operation and Maintenance Manual.

1.04 REFERENCE CODES AND STANDARDS

A. All products and components shown on the Drawings and listed in this specification shall be designed and manufactured according to latest revision of the following standards (unless otherwise noted):

1. AWWA C542-09 Electric Motor Actuators for Valves and Slide Gates

2. ANSI/NEMA MG1 – Motors and Generators

3. NEMA Standard ICS 2 – 2000 Industrial Control and Systems

4 National Electrical Code. Article 500

5. ANSI/NFPA 70 – National Electrical Code (NEC)

6. UL 50 – UL Standard for Safety Enclosures for Electrical Equipment, Non-Environmental Considerations.

7. NFPA 70E – Standard For Electrical Safety in the Workplace

8. NFPA 79 – Electrical Standard for Industrial Machinery

B. All equipment components and completed assemblies specified in this Section of the Specifications shall bear the appropriate label of Underwriters Laboratories.

1.05 QUALITY ASSURANCE

A. The Manufacturer of the motorized actuators shall have produced similar equipment for a minimum period of five years. When requested by the Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.

C. All components and material shall be new and of the latest field proven design and in current production. Obsolete components or components scheduled for immediate discontinuation shall not be used.

D. For the equipment specified herein, the Manufacturer shall be ISO 9001 2000 certified.

1.06 JOBSITE DELIVERY, STORAGE AND HANDLING

A. Prior to jobsite delivery, the Contractor shall have successfully completed all submittal requirements, and present to the Owner/Engineer upon delivery of the equipment, an approved copy of all such submittals. Delivery of incomplete constructed equipment, onsite factory work, or failed factory tests will not be permitted.

B. Equipment shall be handled and stored in accordance with Manufacturer's instructions. Two (2) copies of these instructions shall be included with the equipment at time of shipment, and shall be made available to the Contractor and Owner / Engineer.

C. Shipping groups shall be designed to be shipped by truck, rail, or ship. Accessories shall be packaged and shipped separately.

D. Where space heaters are provided in equipment, provide temporary electrical power and operate space heaters during storage and after equipment is installed in permanent location, until equipment is placed in service.

E. The recommended storage practice information shall be placed on the outside of the actuator or shipping container as delivered to the jobsite or to

the Owner by the Contractor.

1.07 WARRANTY

A. The Valve and Gate Manufacturer shall warrant the equipment to be free from defects in material and workmanship for the same length of time as the associated valve or gate, but not less than 2 years from date of final acceptance of the valve and gate equipment. Within such period of warranty the valve or gate Manufacturer shall promptly furnish all material and labor necessary to return the equipment to new operating condition. Any warranty work, requiring shipping or transporting of the equipment, shall be performed by the Manufacturer, at no expense to the Owner.

PART 2 P R O D U C T S

2.01 MANUFACTURER

A. Subject to compliance with the Contract Documents, the following Actuator Manufacturers are acceptable:

1. EIM
2. Limitorque
3. Auma
4. Rotork
5. Approved Equal
6. Rotork IQ Series

B. 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.

2.02 RATINGS

A. Electric actuators furnished as a part of this Section shall comply with AWWA C542-09 and UL 429.

B. Actuators for Open/Close service shall be designed for an Open/Close cycle of not less than 6 cycles per hour.

C. Actuators for Modulating service shall be designed for AWWA Class 3—600

starts per hour, minimum.

2.03 GENERAL

A. Applications

1. Multiturn Applications: The electric motor actuator for multiturn applications shall include as one integral unit, the electric motor, reduction gearing, drive coupling, torque switches, position limit switches, gear case and auxiliary handwheel. The valve or slide gate shall be self-locking.

2. Quarter-turn Applications: The electric motor actuator for quarter-turn applications shall include as one integral unit, the electric motor, reduction gearing, drive coupling between the final drive gear and valve stem, torque switches, position limit switches, gear case and auxiliary handwheel. The valve and actuator combination shall be self-locking.

B. Gears: Reduction shall be accomplished by means of spur, helical, bevel, or worm gears. Spur, helical, and bevel gears shall be made of steel. Worm wheel gear teeth shall be made of bronze. The worm shall be hardened steel. The use of nonmetallic or aluminum gears in the power train is unacceptable.

C. Bearings: Gears and shafting shall be supported on antifriction bearings. Where thrust is a consideration, roller or axial-thrust-needle bearings (to accept thrust) shall be provided.

D. Lubrication: Gearing and bearings shall be grease or oil lubricated. Seals shall be provided at shaft penetrations of the gear case to prevent the leakage of lubricant regardless of position. Lubricants shall be suitable for year-round service based on prevailing ambient temperature conditions: normal ambient temperature limits are considered to be 0 degrees F to 150 degrees F.

E. Handwheel: The actuator shall be equipped with a handwheel for manual operation, connected so that operation by the motor shall not cause the handwheel to rotate, and operation of the handwheel shall not cause the motor to rotate. If power is returned to the motor while the handwheel is in use, the design shall prevent transmission of the motor torque to the handwheel. The handwheel shall require a maximum input force of 60 ft lb on the rim/spoke for seating and unseating load. When unseated, the handwheel shall require a maximum input force of 40 ft lb on the rim/spoke at any point through the travel for running load.

F. Motor: The electric motor shall be NEMA Class F insulated, with a duty rating

of at least 15 minutes at 104 degrees F (40 degrees C). Motors shall be capable of operating through one complete cycle, open-close-open or close-open-close, under the maximum specified operating conditions without overheating when voltage to the motor is within +/- 10 percent of the specified voltage. Motor shall be specifically designed and built for electric actuator service. Motor housing shall be at a minimum of NEMA Type 4X, NEMA Type 6 for submersible locations and NEMA Type 7 for hazardous locations. Commercially available motors shall not be used.

G. Motor Protection

1. The motor shall be de-energized in the event of a stall condition, when attempting to move a valve.

2. The motor shall be de-energized in the event of an over-torqued condition.

3. The motor shall have thermal protective devices imbedded in the motor windings to de-energize the motor in case of overheating.

4. The motor shall have single phase protection.

H. Enclosures, for each actuator shall be as listed in the Table at the end of this Specification.

2.04 ELECTRICAL GENERAL

A. The actuators shall be suitable for use on a nominal 460 volts, 3 phase, 4 wire, 60 Hertz, power supply, unless otherwise shown on the Drawings.

B. Electrical components shall be NEMA rated. IEC or dual rated NEMA/IEC will not be accepted.

C. The overall short circuit withstand and interrupting rating of the actuator shall be equal to or greater than the overall short circuit withstand and interrupting rating of the feeder device immediately upstream of the actuator, but not less than 22,000 amperes RMS symmetrical at 480/277 Volts.

D. Other ratings shall be as specified in the Mechanical Equipment Division Valve and Gate Specifications.

2.05 ELECTRICAL CONSTRUCTION

A. Control Components

1. Reversing contactors, electrically interlocked.

2. Internal control power supply.

3. The actuator shall include a device that shall cause the motor to run with the correct rotation, regardless of connection sequence of the power supply.

B. Wiring

1. Internal wiring shall be high temperature, insulated stranded cable, sized for control and power.

2. All external wiring shall terminate in terminal blocks or removal plug and socket heads for power and control.

C. Controls

1. All actuators shall be furnished with integral actuators / motor controls.

2. Each actuator shall have the following local controls constructed of corrosion resistant plastic:

a. A Local / Remote selector switch.

b. An OPEN pushbutton.

c. A CLOSE pushbutton.

d. A STOP pushbutton.

e. An OPEN (red) indicating light.

f. A CLOSED (green) indicating light.

3. The local controls shall be arranged so that the direction of travel can be reversed without the necessity of stopping the actuator.

4. All local controls shall be located in a separate enclosure located external to the actuator enclosure, and at an elevation above existing grade.

2.06 EXTERNAL CONTROL INTERFACE

A. Modulating Service

1. Provision for the following interface signals shall be as follows, and as shown on the Drawings:

	Modulating Signals	
To Valve	Position Command (ZC)	4 - 20 ma (% Open)
From Valve	Position Indication (ZI)	4 - 20 ma (% Open)
From Valve	In Remote (YL)	Dry Contact
From Valve	Full Open Status (ZSH)	Dry Contact
From Valve	Full Closed Status (ZSL)	Dry Contact
From Valve	Valve Fail (XA)	Dry Contact

B. Open / Close Service

1. Provision for the following interface signals shall be as follows, and as shown on the Drawings:

	Open / Close Signals	
To Valve	Open Command (ZCH)	Wetted Contact
To Valve	Close Command (ZCL)	Wetted Contact
From Valve	Full Open Status (ZSH)	Dry Contact
From Valve	Full Closed Status (ZSL)	Dry Contact
From Valve	In Remote (YL)	Dry Contact
From Valve	Valve Fail (XA)	Dry Contact
From Valve	Position Indication (ZI)	4 - 20ma (% Open)

C. Contact Ratings

1. Discrete contact ratings shall be 5 A at 120VAC, 24VDC, or as shown on the Drawings.

D. Interface Terminals

1. Separate Interface Terminal Strips with point identifications, shall be provided as shown on the Drawings

2.07 SPECIAL TOOLS

A. There shall be furnished 2 complete sets of tools, adjusting and setting

devices for each type of Actuator furnished.

2.08 FACTORY TESTING

A. Proof-of-Design Tests

1. The Manufacturer shall perform a Proof-of-Design Test, in accordance with AWWA C542-09 Sec. 5.2, for each actuator housing size furnished. If the Manufacturer has previously performed the test on a same size actuator, the Manufacturer may optionally furnish a certified copy of the approved results.

B. Performance Tests

1. Each actuator shall be performance-tested prior to shipment. If any component of the actuator fails during testing, the function shall be corrected or repaired as required and the actuator retested.

2. Each actuator shall be tested at the specified application torque and rpm.

3. Each actuator shall be performance-tested, in accordance with C542-09 Sec. 5.3, to verify conformity to specified operating conditions including:

a. Voltage, phase and frequency

b. Stroke time (seconds) or output speed (rpm).

c. Seating (or maximum dynamic) torque.

d. Seating load amps.

e. Torque-switch and limit-switch function.

4. Each actuator shall be cycled through at least two strokes (open – close and close – open) under no load. Specified seating (or maximum dynamic) torque shall be applied in both directions at each end of travel. Actual stroke time shall be within ±10 percent of the specified stroke time. Limit-switch and torque-switch function shall be verified in both directions. Torque switches shall be demonstrated to limit torque output to a minimum of 120 percent of the seating torque at the maximum setting. Amperes at running and seating loads are to be monitored and shall not exceed the actuator Manufacturer’s submitted ratings.

5. Test Reports

a. Each Test Report shall include the following at a minimum:

1) Actuator housing or frame size, and model number.

2) Actuator serial number.

3) Power, voltage, phase and frequency.

4) Closed: Stroke time or actuator output speed (rpm), seating, (or maximum dynamic) torque, and seating (or maximum dynamic) amps.

5) Open: Stroke time or actuator output speed (rpm), dynamic torque, and dynamic amps.

b. Certified Performance Test Reports shall be submitted to the Owner/Engineer for approval prior to shipment. Shipment shall not be made without all tests Approved.

PART 3 E X E C U T I O N

3.01 EXAMINATION

A. Examine installation area to assure there is enough clearance to install the equipment.

B. Verify that the equipment is ready to install.

C. Verify field measurements are as instructed by Manufacturer.

3.02 INSTALLATION

A. The Contractor shall install all equipment per the Manufacturer's recommendations and Contract Drawings.

B. Conduit hubs, for use on entrances to the actuator, shall be watertight, threaded aluminum, insulated throat, stainless steel grounding screw, as manufactured by T&B H150GRA Series, or equal.

C. Conduits entering an actuator Control Panel, shall not enter the enclosure through the top.

D. Install required safety labels.

3.03 ACTUATOR SEALING

A. Where raceways enter the actuator, the connection shall be watertight and the raceway shall be sealed with 3M 1000NS Watertight Sealant, or approved equal.

B. This requirement shall be strictly adhered to for all actuator entrances.

3.04 FIELD QUALITY CONTROL

A. Inspect installed equipment for anchoring, alignment, grounding and physical damage.

B. Check tightness of all accessible electrical connections. Minimum acceptable values are specified in Manufacturer's instructions.

3.05 FIELD ADJUSTING

A. The Actuator Manufacturer’s Field Service Representative shall adjust all components, for free mechanical and electrical operation, as described in manufacturer's instructions.

3.06 FIELD TESTING

A. The Actuator Manufacturer’s Field Service Representative shall perform all electrical field tests recommended by the manufacturer.

B. Test all control logic before energizing the motor or equipment.

3.07 CLEANING

A. Remove all rubbish and debris from inside and around the motor controllers. 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.

3.08 EQUIPMENT PROTECTION AND RESTORATION

A. Touch-up and restore damaged surfaces to factory finish, as approved by the manufacturer. If the damaged surface cannot be returned to factory specification, the surface shall be replaced.

3.09 MANUFACTURER’S CERTIFICATION

A. The Actuator Manufacturer’s Field Service Representative shall certify in writing that the equipment has been installed, adjusted, including all settings designated in the Power System Study, and tested in accordance with the manufacturer's recommendations.

B. The Contractor shall provide 3 copies of the manufacturer's field representative's certification.

3.10 TRAINING

A. The Actuator Manufacturer’s Field Service Representative shall provide services for training of plant personnel in operation and maintenance of the actuators furnished under this Section.

B. The training for each type and manufacturer of actuator shall be for a period of not less than four hours.

C. The cost of training program to be conducted with Owner's personnel shall be included in the Contract Price. The training and instruction, insofar as practicable, shall be directly related to the system being supplied.

D. Provide detailed O&M manuals to supplement the training course. The manuals shall include specific details of equipment supplied and operations specific to the project.

E. The training session shall be conducted by a manufacturer's qualified Field Service Representative. Training program shall include instructions on the assembly, motor starters, protective devices, metering, and other major components.

F. The Owner reserves the right to videotape the training sessions for the Owner’s use.

END OF SECTION

VALVE AND GATE ELECTRIC ACTUATORS

EQUIPMENT TAG	VALVE TYPE	LOCATION SUBJECT TO SUBMERGENCE (DEPTH & TIME), ENCLOSURE	CONTROL TYPE (O/C or Modulating)	NOTES COMM, WITNESS TEST, ETC

SECTION 16510

LIGHTING FIXTURES

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Specification for:

1. Fluorescent lighting fixtures
2. High intensity discharge (HID) lighting fixtures
3. Emergency lighting fixtures
4. Exit fixtures
5. Incandescent lighting fixtures
6. Photo cells

1.02 REFERENCES

A. American National Standards Institute/National Fire Protection Association (ANSI/NFPA)

1. No. 70 - National Electrical Code (NEC)

a. Article 410 - Lighting Fixtures, Lampholders, Lamps and Receptacles

b. Article 500 - Hazardous (classified) locations

c. Article 700 - Emergency Systems

2. No. 101 - Life Safety Code

B. American National Standards Institute (ANSI)

1. C78.379 - Electric Lamps - Incandescent and High Intensity discharge Reflector Lamps - Classification of Beam Patterns.

2. C82.1 - Ballasts for Fluorescent Lamps - Specifications.

3. C82.4 - Ballasts for High-Intensity-Discharge and Low-Pressure Sodium Lamps (Multiple-Supply Type).

C. American National Standards Institute/Illuminating Engineering Society (ANSI/IES): The IES Handbook shall be used as a basis for design and construction of lighting systems.

D. American Society of Heating, Refrigeration and Air-Conditioning Engineers, Inc./Illuminating Engineering Society (ASHRAE/IES): ASHRAE/IES 90.1 - 1989 - Energy Efficient Design of new Buildings Except Low-Rise Residential Buildings.

E. American National Standards Institute/Underwriters Laboratories (ANSI/UL).

1. UL1570 - Fluorescent Lighting Fixtures.

2. UL1571 - Incandescent Lighting Fixtures.

3. UL1572 - High Intensity Discharge Lighting Fixtures.

4. UL844 - Fixtures for Hazardous Areas.

5. IES LM-79-2008 and LM-80-2008 for LED fixtures

1.03 SUBMITTALS

A. Submit the following under the provisions of Section 01330 – Submittal Procedures:

1. Outline dimensions, support points and unit weight.

2. Operation and maintenance data.

3. Complete test report with photometric curves.

4. Storage, handling, and installation recommendation.

5. Connection diagrams.

6. Catalog data.

1.04 QUALITY ASSURANCE

A. Tests. Run manufacturer's tests on lighting fixtures in accordance with applicable Underwriters Laboratories (U.L.) Standards 1570, 1571 and 1572.

1.05 DELIVERY, STORAGE AND HANDLING

A. Have lighting fixtures individually packed to permit ease of handling and to provide protection from damage during shipping, handling and storage.

PART 2 P R O D U C T S

2.01 ACCEPTABLE MANUFACTURERS

A. Benjamin Div., Thomas Industries

B. Crouse-Hinds, Div. of Cooper Industries

C. G.E. Lighting System

D. Guth Lighting

E. Holophane Company, Inc.

F. Hubbell Lighting, Inc.

G. Killark Electric Mfg. Company

H. Lithonia Lighting

I. Pauluhn Electric

J. Wide-Lite Corporation

K. Dual-Lite Company

2.02 REQUIREMENTS

A. Provide lighting fixtures in accordance with the lighting plan Drawings, Lighting Fixture Schedules and this specification.

B. High-Intensity Discharge (HID) Fixtures

1. Provide fixtures that are High Pressure Sodium (HPS) type.

2. Select fixtures which are enclosed and gasketed with mogul base porcelain lamp socket.

3. Use ballast high power factor type with taps for 120V, 208V and 277V input voltage, conforming to ANSI Standard C82.4.

4. Refer to Drawings or fixture schedules specific types, sizes and mounting hardware.

C. Emergency Fixtures / Exit Fixtures

1. In working areas such as dry wells, or valve vaults with two or more levels, rooms which do not exit directly outside, or rooms with multiple means of egress, exit signs and lighting are required for safe evacuation of workers.

2. Provide Dual Light AS-160-BCI wall-mounted, sealed beam, battery powered packs with dual heads where emergency illumination is required.

3. In areas where exit signs and emergency lighting is needed, utilize Dual Light ESRWW-RGI packs to provide both.

D. LED Fixtures

1. All LED fixtures shall include a L-70 chart of luminaire lumen loss by hours of operation.

2. All LED luminaires shall include an IES LM-79-2008 compliance certificate.

3. All LED luminaires shall comply with IES LM-80-2008.

E. Photo Cells

1. Provide a photo cell to control outdoor fixtures unless otherwise indicated on the lighting plans.

2. Use a photo cell that is either the plug-in twist-locking type or the wire-in swivel-top type, both with similar features and operating characteristics.

3. Provide a photo cell that is enclosed in a UV-resistant rain-tight polypropylene housing with the cell being a 0.75 square inch cadmium sulfide surface passivated and a single pole, single throw normally closed bi-metallic switch.

PART 3 E X E C U T I O N

3.01 PREPARATION

A. Check the types and quantity of fixtures to be mounted in the area to be illuminated and verify that materials are on hand.

B. Pick out the correct bulbs for the fixtures along with the necessary accessories and mounting hardware.

3.02 INSTALLATION

A. Install fixtures in accordance with manufacturer's instructions, NEC Articles 410, 500 and 700 as applicable, and the Drawings.

B. Wire up fixtures in accordance with the Drawings and ensure proper switching, circuiting and balanced loads.

C. Make sure proper grounding and bonding are provided for fixtures and raceways.

D. Install specified lamps in each fixture.

E. When applicable, aim and adjust fixtures in accordance with directions as indicated on the Drawings.

F. Energize and test fixtures for proper operation.

G. Check the illumination level with a light meter and ensure that sufficient light is reaching areas where tasks are performed and that egress paths are properly illuminated during emergency situations.

END OF SECTION

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SECTION 16640

CATHODIC PROTECTION FOR PIPELINES

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Requirements for impressed current cathodic protection systems on water and sewer pipelines using rectifiers and deep anodes.

B. Requirements for sacrificial anode cathodic protection on water and sewer pipelines using prepackaged, magnesium anodes.

1.02 RELATED SECTIONS

A. Section 15640 - Joint Bonding and Electrical Isolation.

B. Section 15641 - Corrosion Control Test Stations.

1.03 UNIT PRICES

A. This item will be measured and paid for as a lump sum item for the job.

B. Payment will be full compensation for all labor, equipment, materials and supervision for the installation of the cathodic protection system, complete in place including rectifier systems with deep anode groundbed and junction boxes, sacrificial anodes, power feed hookups, and all excavation, backfill, field welding, connections, adjustments, testing, cleanup, and other related work necessary for construction as shown on the drawings and specified herein.

1.04 REFERENCES

A. ASTM C94 - Ready Mixed Concrete

B. ASTM D-1248 - Polyethylene Plastics Molding and Extrusion Material

C. AWWA M9 Manual - Concrete Pressure Pipe

D. NEC 70 - National Electrical Code

E. CSA – Canadian Standards Association, Standard C22.2, No. 66 and No. 107

F. City of Houston Electrical Code

G. NACE RP-0169 - Recommended Practice, Control of External Corrosion on Underground or Submerged Metallic Piping Systems.

H. NACE RP-0572 - Recommended Practice for Design, Installation, Operation and Maintenance of Impressed Current Deep Groundbeds.

I. NEMA TC6 - PVC and ABS Plastic Utilities Duct for Underground Installation.

J. NEMA TC9 - Fittings for ABS and PVC Plastic Utilities Duct for Underground Installation.

K. NEMA 4 - TYPE 3R ENCLOSURES

L. UL 83 - Thermoplastic-Insulated Wires

M. UL 467 - Bonding and Grounding Equipment

N. UL 486A - Wire Connectors and Soldering Lugs for Use with Copper Conductors

1.05 SUBMITTALS

A. General: Submittals shall conform to the requirements of Section 01330 – Submittal Procedures.

B. Design Drawings and Computations: All computations and drawings shall be prepared by or under the direct supervision of a Professional Engineer, registered in the State of Texas with a minimum of ten years experience in cathodic protection design.

C. Catalog Cuts: Manufacturer's catalog cuts shall be submitted for each item. The catalog cuts shall include the manufacturer's name and shall provide sufficient information to show that the materials meet the requirements of the drawings and specifications. Where more than one item or catalog number appears on a catalog cut, clearly identify the item proposed.

D. Logs: The City of Houston representative shall be given a minimum of 48 hours notice prior to drilling the anode bore. Copies of detailed geological and resistance logs of each deep anode bore shall be typed by Contractor and submitted to the City of Houston representative.

E. Rectifier Operation and Maintenance Manual: The rectifier manufacturer shall include a complete operation and maintenance manual with each rectifier shipped to the job site. In addition to operating instructions, the manual shall include a circuit diagram and spare parts list. The rectifier shall be operated under full load conditions at the factory and shall be thoroughly inspected and tested by the manufacturer prior to delivery to the job site. Results of this testing shall be reported on a manufacturer's quality control form and shall be included in the operation manual. The rectifier manufacturer shall reference each operating manual by rectifier model number and individual serial number.

F. Report: Submit six (6) operating, monitoring and maintenance reports for the cathodic protection systems. Included shall be all test data as required by Section 3.07, paragraph D. The manuals shall include operating instructions, maintenance data, product data and test procedures.

G. Drawings: As-built drawings of the cathodic protection installation shall be maintained by the Contractor during installation and construction. Drawings shall be revised to show exact locations of all rectifiers, anodes, wiring, connections and terminal boxes. All items of equipment and material shall be properly identified. The original as-built drawings shall be submitted to the City of Houston representative.

1.06 QUALITY CONTROL

A. Provide manufacturer's certification that all components of the cathodic protection system meet the requirements of the drawings and specifications. The certification shall reference the applicable section of the specifications and the applicable standard detail.

B. All materials, fabrication and installations are subject to inspection and testing by the City of Houston or its designated representative.

C. The drawings for the cathodic protection system are diagrammatic and shall not be scaled for exact locations unless scales are explicitly stated on the specific drawing. Field conditions, non-interference with other utilities or mechanical and structural features shall determine exact locations. Contractor shall note other existing utilities in the area and shall not damage these utilities during excavation. Any damaged utilities shall be repaired to the satisfaction of the City of Houston at the Contractor's expense.

PART 2 A N O D E S

2.01 SACRIFICIAL ANODES - MAGNESIUM

A. Magnesium Anodes: High potential magnesium anodes shall be used. The metallurgical composition of the magnesium anodes shall be as follows:

Element	Percent Composition
Aluminum	0.01 Maximum
Manganese	0.50 to 1.3
Copper	0.02 Maximum
Nickel	0.001 Maximum
Iron	0.03 Maximum
Other - (each)	0.05 Maximum
Other - (total)	0.30 Maximum
Magnesium	Balance

B. Magnesium Anode Current Capacity: Magnesium anodes shall have a current capacity of no less than 500 amp-hours per pound of magnesium.

C. Anode Backfill Material: Use chemical backfill material around all galvanic anodes. Backfill provides a reduced contact resistance to earth, provides a

uniform environment surrounding the anode, retains moisture around the anode, and prevents passivation of the anode.

1. All galvanic anodes shall come prepacked in a backfill material conforming to the following composition:

   a. Ground hydrated gypsum: 75 percent

   b. Powdered bentonite: 20 percent

   c. Anhydrous sodium sulfate: 5 percent.

2. The backfill shall have a grain size such that 100 percent is capable of passing through a 20 mesh screen and 50 percent is retained by a 100 mesh screen.

3. The backfill mixture shall completely surround the anode within a cotton bag.

4. For standard cast magnesium ingots, the weight of backfill required shall be as follows:

Anode Weight (Pounds)	Backfill Weight (Pounds)	Total Weight (Pounds)
9 15	24	
1725	42	
2050	70	
3238	70	
4848	96	

D. Anode Lead Wires:

1. Standard lead wires for a galvanic anode shall be a 20-foot length of No. 12 AWG solid copper wire equipped with TW or THW insulation.

2. All anode lead wires shall be color coded green when terminated in test stations.

E. Lead Wire Connection to Magnesium Anode:

1. Magnesium anodes shall be cast with a galvanized steel core with the weight of the core not to exceed 0.10 pounds per linear foot.

2. One end of the anode shall be recessed to expose the core for the lead wire connection.

3. The lead wire shall be silver-soldered to the core and the connection fully insulated by filling the recess with an electrical potting compound.

2.02 SACRIFICIAL ANODES - ZINC

A. Zinc Anodes: Use high purity zinc anodes. The metallurgical composition of the zinc anodes shall be conformed to ASTM B-418, Type II and the following:

Element	Percent Composition
Aluminum	0.005 Maximum
Cadmium	0.003 Maximum
Iron	0.0014 Maximum
Lead	0.003 Maximum
Zinc	Balance

B. Zinc Anode Current Capacity: Zinc anodes shall have a current capacity of no less than 335 amp-hours per pound of zinc.

C. Anode Backfill Material: Use chemical backfill material around all galvanic anodes. Backfill provides a reduced contact resistance to earth, provides a uniform environment surrounding the anode, retains moisture around the anode, and prevents passivation of the anode.

1. All galvanic anodes shall come prepackaged in a backfill material conforming to the following composition:

   a. Ground hydrated gypsum: 75 percent

   b. Powdered bentonite: 20 percent

   c. Anhydrous sodium sulfate: 5 percent.

2. The backfill shall have grain a size such that 100 percent is capable of passing through a 20 mesh screen and 50 percent is retained by a 100 mesh screen.

3. The backfill mixture shall completely surround the anode within a cotton bag.

4. For standard cast zinc ingots, the weight of backfill required shall be as follows:

Anode Weight (Pounds)	Backfill Weight (Pounds)	Total Weight (Pounds)
30 40	70	
45 55	100	
60 70	130	

D. Anode Lead Wires: The lead wire for the zinc anodes shall be a 20-foot length of No. 12 AWG solid copper wire equipped with TW of THW insulation.

E. Lead Wire Connection to Zinc Anode:

1. Zinc anodes shall be cast with a 1/4-inch diameter galvanized steel core.

2. One end of the core shall extend beyond the anode for the lead wire connection.

3. The lead wire shall be silver-soldered to the core and the connection fully insulated.

2.03 IMPRESSED CURRENT ANODES

A. Description: Use high silicon-chromium-iron anode centrifugally cast in tubular form in accordance with the following specifications.

1. Anode Alloy: The anode shall consist of Durichlor 51, high silicon, chromium iron. This alloy shall be made in accordance with ASTM A518-86, Grade 3 with nominal percentages as follows:

Chemical Composition

Element	Composition, Weight %
Carbon	0.70 - 1.10
Maganese	1.50, max
Silicon	14.20 - 14.75
Chromium	3.25 - 5.00
Molybdenum	.20, max
Copper	0.50, max

2. Casting Method: Centrifugally cast anodes in tubular form with a hollow, straight walled design. Bowing and malformation tolerances shall be no greater than 1/4" over the seven foot anode length. Anode designs which include enlargement of the outside diameter, at the center or elsewhere, or constrictions of a venturi type of the inside wall shall not be allowed.

The anode body shall have solid walls of a uniform thickness with an open cylindrical interior. Static casting methods, such as sand, die or metal mold techniques, shall not be allowed in order to avoid the risk of shrink cavities and internal stresses caused by non-uniform wall thickness.

Use of extraneous materials such as chaplets, spacers or chills to center the anode mold shall not be permitted. Any slag deficiencies shall be restricted to one end of the casting only allowing for simple inspection techniques to ascertain metal density and absence of slag inclusions.

3. Mechanical and Physical Properties: The mechanical and physical properties of the anode shall be as follows:

Tensile Strength (1/2" dia. bar) psi.	15,000
Compressive Strength, psi.	100,000
Hardness, Brinell	520
Density, gr/ml	7.0
Melting Point, °F	2300
Specific Resistance, micro-ohms-cm (20°C)	72
Coefficient of expansion, 32° to 212° F	7.33 X 10^6

4. Size: Anode castings shall conform to the following sizes:

Type	Weight (pounds)	O.D. (inches)	Length (feet)
TA-2	46	2.19	7
TA-3	63	2.66	7
TA-4	85	3.75	7
TA-5	110	4.75	7

Anodes shall be TA-2 unless otherwise noted on the drawings.

B. Anode Lead Wire Connection:

1. The lead wire for an impressed current anode shall be a No. 8 AWG seven stranded copper conductor equipped with a fluorinated polymer insulation. The lead wire shall be of sufficient length to reach the anode terminal box without splicing additional wire.

2. The anode lead wire shall be attached at the center of the anode. The center connection shall have minimum pull-out strength of one and one-half times the breaking strength of the No. 8 AWG lead wire or 788 pounds.

3. The electrical contact resistance as measured across the lead wire-to-connector junction shall not exceed 0.004 ohms.

C. Impressed Current Anode Backfill: Calcined fluid petroleum coke shall be used to backfill impressed current anodes. Anode backfill shall conform to the following:

1. Typical Chemical Analysis:

Component	Percent Composition
Carbon	91.77

Sulfur	5.85
Ash	2.23
Silicon	0.26
Iron	0.02
Volatiles	0.07
Moisture	0.00

2. Physical Properties.

Bulk Density, pounds/cubic foot	74
Specific Gravity	2.00
Porosity, percent	40.8

3. Particle Analysis.

Sieve	Percent Retained
16 mesh	0.0
28 mesh	7.15
35 mesh	86.40
80 mesh	2.30
100 mesh	3.30

2.04 MISCELLANEOUS DEEP ANODE GROUNDBED HARDWARE

Miscellaneous components of a deep anode groundbed shall include the following:

A. Surface Casing: Equip the deep anode bed with an 8-inch diameter, 10 foot long PVC surface casing.

B. Anode Bed Cover: Cap the casing. Set cover assembly in a 3-foot-square by 6-inch-thick Portland cement concrete slab.

C. Venting Facilities:

1. Use plastic vent pipe from the bottom anode to the surface for dissipating gases to the atmosphere.

2. The plastic vent pipe shall be 1-inch diameter with 1/8-inch holes drilled on 6-inch centers in the area of the anodes. Do not drill holes in the vent pipe above the anodes.

3. Extend the plastic vent pipe above grade, screen the vent outlet, and install in an inverted manner.

2.05 RECTIFIERS

Cathodic protection rectifiers shall be air cooled, tap adjust Super Custom model as manufactured by Good-All Electric or approved equal conforming to NEMA MR-20-1958 and listed in CSA File No. 45382.

A. D-C Output Ratings: Rate rectifiers as shown on the drawings. Rectifiers shall be capable of supplying continuous, full rated output at an ambient temperature of 45° C, in full sunlight with an expected life in excess of 10 years.

B. A-C Input Ratings: Full rated d-c output shall be obtained, with an input voltage ±10 percent of the nominal rated input.

C. Cooling: Cooling shall be by natural air convection. Cabinets shall be vented for natural air convection and shall be screened against insects.

D. Voltage Adjustments: The output voltage shall be adjustable by means of not less than 25 approximately equal steps of secondary taps from 5 percent of rated voltage to full-rated voltage.

E. Rectifying Elements: Rectifying elements shall be silicon diodes sized as follows:

1. Diode voltage shall be rated at 400 volts minimum for rectifier outputs up to 100 VDC, and 800 volts minimum for rectifiers with outputs from 100 to 200 VDC.

2. Diodes shall be configured into a full-wave bridge assembly. Diodes shall be sized to carry a minimum average current of one half of rated rectifier output.

3. Heat sinks shall be sized to keep diode junction temperatures less than 100° C at rated output and maximum ambient temperature.

4. Diodes shall be overload protected by means of semiconductor fuses, located in the transformer secondary leg to the diode bridge assembly.

5. Diodes shall be equipped with supplemental Metal Oxide Varistor (M.O.V.) surge arrestors at the diode bridge assembly sized to provide protection against secondary over-voltage surges.

F. A-C Circuit Breakers: Input overload and short circuit protection shall be provided by magnetic trip circuit breakers. The circuit breaker shall be sized to hold 100 percent of rated load. It may trip between 101 percent and 125 percent of rated load and must trip at 125 percent and above.

G. Surge Protection: Separate AC and DC surge protection shall be provided by means of high energy Metal Oxide Varistors rated at 500 joules on D.C. output and 750 joules on the A.C. output.

H. Electrical Panels: Electrical panels shall be minimum thickness of 1/4" NEMA "XX" laminated phenolic, rated for Class "B" operation (105° C maximum). Rectifiers rated at 100 amperes D.C. or higher shall be equipped with panels constructed from a minimum sheet thickness of 1/4" "UTR" fiberglass reinforced laminate rated for Class "F" operation (155° C). Rectifier front panel identifications shall be permanently silk-screened onto the panel.

I. Connection Hardware: All electrical hardware shall be copper or high conductivity brass, suitably sized, and finished in electroless nickel plating for superior corrosion resistance. All connections shall be tightly secured with lock washers and nuts torqued to manufacturer's recommended specifications.

J. Enclosures:

1. Enclosures shall be constructed from a minimum 12 gauge wiped coat mill galvanized steel, finished in 3 - 5 mils polyester fusion bonded powder coating.

2. Hinges and cabinet assembly bolts shall be of stainless steel.

3. Enclosures shall be equipped with a pad-lockable draw latch. Latch shall be manufactured from 12 gauge steel, finished in zinc-dichromate plating. Draw latch shall accommodate a 3/8 inch shackle padlock.

4. Enclosures (or rectifier frame) shall be equipped with a grounding lug sized to accommodate up to a No. 6 AWG conductor.

5. Separate conduit knockouts shall be provided for AC and DC; conveniently located and adequately sized for input and output conduit connectors.

6. Cabinet shall be furnished with suitable channel brackets for wall or pole mounting. Optionally available floor stands shall be available upon request.

7. Rectifier shall be equipped with slide-out frame and hinged door for access to the front and a minimum of one side of the cabinet.

K. Rectifier Instrumentation.

1. Rectifier shall be equipped with separate analog ammeter and voltmeter.

2. Meters shall be a minimum of 3-1/2" size, with a minimum scale length of 2-7/8".

3. Meters shall be 0 - 50 millivolts full scale deflection, taut-band movement with four-to-one swamping (i.e. internal meter resistance comprised of 25% winding resistance and 75% fully temperature compensated dropping resistor for wide temperature range performance).

4. Meter accuracy shall be $\pm$ 2% full scale deflection at 25° C., temperature compensated to 0.085% per degree C.

5. Rectifier meters shall be scaled to have rated output no less than 70%, or greater than 85% of full scale deflection.

6. Meter shunts shall be panel-mounted Holloway type "SW" style, with an accuracy of ±0.25%.

L. Transformers: Transformers shall meet UL 506, Specialty Transformers and the following:

1. Transformer designed as full isolation with separate isolated primary and secondary windings with a minimum efficiency of 95%.

2. Transformer secondary shall be equipped with a minimum of 25 steps of secondary voltage adjustment (5-COARSE, 5-FINE). Tap adjustment shall be by means of tap bars.

3. Transformer materials and construction shall be rated for Class "H" operation (180° C). Insulation materials shall be further enhanced by dipping in thermosetting varnish and baking.

4. Transformer shall be rated for a minimum dielectric strength of 2250 volts applied for one minute between the windings, and the core.

M. Potential Monitoring Connections: Two, five-way binding posts shall be provided on the front of the rectifier instrument panel. One will be labeled “Reference” and one will be labeled “Structure”.

N. Miscellaneous:

1. All rectifiers shall be capable of operating on either 115 or 230 volt, single phase, 60 hertz A.C. input.

2. Cathodic Protection Rectifier shall be 100% quality control tested as outlined in this specification.

3. During manufacture, the rectifier shall be subjected to frequent visual and performance testing to insure a high degree of quality acceptance level.

4. Rectifiers shall be subjected to 100% testing of the following rectifier electrical parameters:

a. A.C. input voltage, current, apparent power and true power.

b. D.C. output current, voltage and power.

c. A.C. power factor.

d. A.C. to D.C. conversion efficiency.

e. Output ripple.

f. Correct operation of optional features such as interrupters, filters, etc.

5. A final overall visual inspection shall be given each rectifier prior to packaging.

2.06 JUNCTION BOX

A. Enclosure: The anode junction box shall be a NEMA 4X fiberglass enclosure with multiple positive terminals, 0.01 ohm type RS Holloway shunts, and a minimum 3/16" thick, NEMA Grade "XX" phenolic panel. For size and terminal configurations, see Drawings.

B. Positive Cable: Positive cable from the junction box to the transformer-rectifier shall be single conductor, seven strand copper with medium density, high molecular weight polyethylene (HMW/PE) insulation. The polyethylene shall conform to ASTM D 1248, Type I, Class C, Grade 5.

2.07 NEGATIVE CABLES

A. Cables: Rectifier negative cables shall be single conductor, seven-strand copper with medium density, HMW/PE insulation. The polyethylene shall conform to ASTM D 1248, Type I, Class C. Grade.

B. Test Lead: The test lead shall be No. 12 AWG, solid copper wire with white, TW or THW insulation and shall be of sufficient length to extend from the protected structure to the rectifier without splicing.

2.08 PERMANENT REFERENCE ELECTRODE

A. The electrode shall be equipped with No. 14 AWG stranded copper wire with blue HMW/PE insulation of suitable length to extend from the pipeline to the rectifier without splicing.

B. The reference electrode shall be copper/copper sulfate, Permacell Plus, double membrane, ceramic cell in a geomembrane package as manufactured by Corrpro Companies, Inc.

2.09 THERMITE WELD EQUIPMENT

A. Charges and Molds: Cadweld molds and charges shall be used. Charges and mold size shall be as specified by Erico for the specific surface configuration.

B. Limitation: For high strength steel pipelines, use only 15 gram Cadweld charges.

C. Weld Coating: Coating for welds shall be Kop-Coat as manufactured by Carboline.

D. Weld Cap: The coated weld shall be covered with a plastic weld cap.

2.10 AC POWER SERVICE

A. Products: All AC power components shall meet local power company requirements.

B. Meter Base: Meter base shall be 120/240-volt, single phase, 100-ampere.

C. Disconnect Swith: Disconnect switch shall be a heavy-duty, two-pole, NEMA 3, rain tight, rated at 120/240 volts, 30 amperes. Supply with circuit breakers sized for 100 to 135 percent of the AC current flow at maximum rectifier output.

D. Ground Rod: Ground rod shall conform to the requirements of the utility company having jurisdiction.

E. Ground Wire and Clamp: Ground wire shall be bare, No. 6 AWG solid copper wire. Use a bronze, bolt-on ground rod clamp.

F. Service Pole: Service pole for rectifier shall be a 25-foot, Class 5, treated wood pole.

PART 3 C A T H O D I C P R O T E C T I O N S Y S T E M I N S T A L L A T I O N

3.01 INSTALLATION OF SACRIFICIAL ANODES

A. Location: Install sacrificial anodes at locations where the anodes will operate at maximum effectiveness.

B. Placement: Install anodes in native soil, in a vertically augured hole as shown on the drawings. If a vertical installation of the anodes is not feasible, the anodes may be installed horizontally.

C. Augured Hole: The hole diameter shall easily accommodate the anode.

D. Backfilling: After the hole is augured, lower the packaged anode into the hole and firmly tamp the soil around the package so that it is in intimate contact with the package.

E. Lead Wire: Run lead wires from the anodes underground at a minimum depth of 36 inches. Connect the wires through a test station as indicated on the drawings.

F. Handling: Handle galvanic anodes carefully to avoid damaging anode materials and wire connections.

3.02 INSTALLATION OF DEEP ANODE GROUNDBEDS

A. Permits: The drilling and installation of the deep anode systems shall only be accomplished by a qualified well driller who is recognized as a fully experienced specialist in the installation of deep anode cathodic protection systems. The deep anode system installer shall have a minimum of 5 years

experience installing deep anode systems with a minimum of 10 successful deep well anode installations. The Contractor is required to obtain and submit all applications for well drilling permits required by any City, County or State agency.

B. Field Location: Verification of actual field conditions, location of underground structures, and physical separation from other structures or utilities shall be the responsibility of the Contractor. Location of the anode wells are approximate. Exact placement shall be determined and verified in the field by the Contractor and the representative of the City of Houston.

C. Anode Hole Drilling: The anode hole shall be 8 inches diameter by 200 feet deep. Perform drilling with rotary bit equipment designed specifically for this purpose. Use standard techniques (i.e. trough and vacuum truck) to capture and contain the drilling fluids, mud and cuttings at the top of the hole. Select the type and consistency of drilling fluids to be consistent with soil characteristics. Level the drilling rig to provide a round, straight and plumb anode hole.

D. Temporary Well Casing: Drilling of the holes may require the installation of temporary well casings. Remove all temporary casings by the end of the job.

E. Anode Hole Geological Logs: As the hole is drilled, maintain a record describing the depth and type of the geological formations encountered. Submit typed copies of the log as required by Section 1.05.C.

F. Anode Hole Resistance Log: An electric log of the hole shall be recorded using one of the anodes. The anode lead wire shall have been previously marked in five foot increments. The anode lead wire shall be marked for a distance equaling or exceeding the maximum anticipated depth of the hole. As the anode is lowered into the hole, a resistance log shall be performed by impressing a minimum 12 volt DC current between the anode and a very well grounded structure such as the local AC power neutral network. Nilsson type soil resistance meters shall not be used to perform this test. A recommended 12 volt DC power source is a heavy duty lead acid automobile battery. Lower the anode into the hole at ten foot increments, hold in place, and measure the voltage and current output of the DC current source. Record the data, type and submit as required under Section 1.05.C.

G. Vent Pipe Installation: Install the vent pipe in the hole with the first anode. Cap the bottom of the vent pipe. Cap the top of the vent pipe throughout the anode and coke breeze backfill installation procedure to prevent intrusion of foreign material. Do not allow drilling mud to enter in the vent pipe.

H. Anode Installation: The anode well shall contain ten (10) tubular cast iron anodes spaced at 10 foot intervals on centers. Center the anodes in the hole using anode centralizers. Install the anodes by lowering them individually into the hole by the lead wire. Mark the lead wires for the nominal anode depth. Record the final depth with the first anode in the hole (i.e. the bottom anode) identified as anode number one (1). Do not damage the anode lead during handling or lowering into the hole. Under no circumstances shall the anode

lead wires be clamped or pinched around another object while lowering the anodes into the hole. If the insulation for any anode lead wires are cut, broken, or nicked during this operation or at any other time, the complete anode shall be rejected and shall be removed from the job site immediately. Contractor shall replace all damaged anodes at no additional expense to the City of Houston.

I. Anode Column Coke Backfill: The coke backfill shall be slurried above-grade and then pumped into the hole after the anodes are installed. Pump the coke from the bottom of the hole up using a pipe that is the length of the anode hole. Do not use the vent pipe to pump the coke. Raise the pipe as the anode column is filled with coke. Remove the pipe from the hole after the coke installation operation is completed. Use a sufficient amount of backfill such that the coke breeze column extends a minimum of five feet above the top of the uppermost anode. Install the coke backfill uniformly with no voids around the anodes.

J. Vent Pipe: Terminate the 1-inch diameter internal vent pipe with a gooseneck fitting. Leave the top end of the vent pipe open to allow gases from the anode hole to exit.

K. Precautions: Take all necessary precautions to avoid entrance of foreign matter into the hole, movement of soil strata, or collapsing of the hole during the progress of the work. Should movement of soil strata or collapse of the drilled hole interfere with proper completion of the anode groundbed, recover the wires, anodes and vent pipe and ream or redrill the hole at no cost to the City.

L. Mud And Cuttings: Dispose of drilling mud, cuttings and other waste in accordance with the methods and procedures of the best recognized practices and comply with the rules and regulations of the State, City and County.

3.03 INSTALLATION OF CATHODIC PROTECTION RECTIFIERS

A. Codes: The installation shall conform to National Electrical Codes (NEC) and be in compliance with all City of Houston and Houston Lighting and Power codes and standards.

B. Mounting: Pole mount cathodic protection rectifiers. The pole may be omitted and the rectifier mounted on a building wall or other available permanent structure, if approved by the Engineer. Install rectifiers at a minimum height of 4 feet above final grade.

C. Identification: Equip rectifiers with permanent engraved nameplates to identify the units as "Cathodic Protection Rectifier, Property of City of Houston, In Case of Emergency Call 713-748-4461."

D. Conduit: Enclose all wiring to the rectifier shall be contained in rigid galvanized steel conduit when run above grade.

1. Use insulating bushings at the ends of all conduits.

2. Extend steel conduit 12 inches below grade.

E. Electrical Service: Provide AC electrical service for each rectifier unit. The Contractor is responsible for furnishing and installing the necessary wiring, conduits, wires, meter sockets, splice boxes and equipment to the service connection as required by Houston Lighting and Power.

G. Completion: The installation shall not be considered complete until the AC and DC wiring is complete and the rectifier is capable of operating at full rated load. Install AC power such that the rectifier can be activated for test purposes. Leave the power off after test.

3.04 INSTALLATION OF WIRE AND CABLE

A. Depth: Install all underground wires and cables at a minimum of 36 inches below final grade with a minimum separation of 6 inches from other underground structures.

B. Conduit: Enclose all positive and negative cables, and anode lead wires in rigid galvanized steel conduit when above-grade.

1. Use insulating bushings at the ends of all conduits.

2. Extend conduit 12 inches below grade.

3.05 INSTALLATION OF ANODE LEAD JUNCTION BOXES

A. Location: Install anode lead junction boxes immediately adjacent to the rectifier with the bottom of the boxes at a minimum height of 2 feet above grade.

B. Concrete Pad: Set junction anode lead box supports (post or unistrut) in a Portland cement concrete anchor. The concrete anchor shall be a minimum of 12 inches in diameter and no less than 24 inches deep. Extend the concrete surface approximately 3 inches above grade.

C. Conduit: Enclose all cathodic protection wiring between the junction box and the rectifier in rigid, galvanized steel conduit. Use insulating bushings at the ends of all conduits to prevent damage to wire insulation.

3.06 NEGATIVE CABLE AND TEST LEAD ATTACHMENT

A. Attach negative cables and test lead to the pipe by thermite welding.

B. Clean and dry the pipe to which the negative cables and test lead are to be attached.

C. Use a grinding wheel to remove all coating, mill scale, oxide, grease and dirt from the pipe over an area approximately 3 inches square. Clean the surface to bright metal.

D. The wires to be thermite welded to the pipe shall have approximately 1 inch of insulation removed from each end, exposing clean, oxide-free copper for welding.

E. Using the proper size thermite weld mold as recommended by the manufacturer, place the wire between the graphite mold and the prepared metal surface. All wires No. 12 AWG size shall use a copper sleeve crimped over the wire.

F. Place the metal disk in the bottom of the mold.

G. Remove the cap from the weld charge container. Pour the contents into the mold. Squeeze the bottom of the weld charge container and spread ignition powder over the charge.

H. Close the mold cover and ignite the starting powder with a flint gun. Hold the mold firmly in place until all of the charge has burned and the weld has cooled slightly.

I. Remove the thermite weld mold and gently strike the weld with a hammer to remove the weld slag. Pull on the wire to assure a secure connection. If the weld is not secure or the wire breaks, repeat the procedure.

J. If the weld is secure, coat all bare metal and weld metal with Kop-Coat. Cover the coated weld with a plastic weld cap.

3.07 PERMANENT REFERENCE CELL

A. Location: When not shown on the Drawings, locate the permanent reference cell near the negative structure connection.

B. Placement: Remove the permanent reference cell from the shipping package and place below the springline and one foot away from the pipeline. Make certain that the reference electrode is completely surrounded by the special backfill material in the geomembrane package.

C. Backfill the reference electrode with six inches of select native soil and compact by hand. Moisten the soil, if necessary, for good compaction.

D. Wiring: Run continuous lengths of the blue reference cell wiring, and the white test lead to the rectifier unit in the same trench as the negative cable. Do not nick or otherwise damage the wire insulation.

3.08 POST INSTALLATION TESTING OF THE CATHODIC PROTECTION SYSTEMS

A. General: Inspect, energize, and adjust the cathodic protection as soon as possible after the equipment has been installed.

B. Energization: The energizing of the cathodic protection system shall be performed by a Corrosion Engineer hired by the Contractor to achieve compliance with the referenced corrosion control standards set forth by NACE and/or AWWA.

C. Notice: Prior to native state and polarized potential testing, the Contractor shall give a minimum of 48 hours notice to the City of Houston to facilitate observation of the tests by a City Representative.

Contact: City of Houston
Graphics and Engineering Management Section
306 McGowen
Houston, TX 77006

Mr. Wayne Dessens, P.E. or
Mrs. Tiffany Pham, P.E.

Telephone: (713) 525-9928

D. Method: The Corrosion Engineer shall:

1. Measure native state pipe-to-soil potentials at all test stations, permanent reference cells, electrical isolation devices, and locations of exposed pipe prior to energizing the cathodic protection system

2. Measure casing-to-soil potentials and foreign line potentials, prior to energizing the cathodic protection system.

3. Energize the cathodic protection system and adjust the DC current output such that the pipe-to-soil potentials near the cathodic protection current source (either transformer-rectifier or sacrificial anodes) is approximately -1000 millivolts to a copper sulfate electrode (CSE). Record the DC voltage and current of the power supply.

4. Allow sufficient time for the pipeline to polarize.

5. Using a current interrupter, cycle the power supply “On” and “Off”.

6. Record “On” and “Instant Off” potentials at all water pipeline test stations, permanent reference cells, electrical isolation devices, locations of exposed pipe, casings and foreign pipelines.

7. For steel and ductile iron pipe, adjust the cathodic protection power supplies to satisfy the criteria of a minimum 100 millivolts of polarization or an “Instant Off” potential at least as negative as -850 millivolts CSE.

8. For concrete cylinder pipe, adjust the cathodic protection power supplies to achieve a minimum 100 millivolt of polarization without any "Instant Off" potentials more negative than -1000 millivolts CSE.

9. Record all final adjustments of the DC power supplies.

10. Verify that all electrical isolation devices are operating properly including flange isolators, and casing spacers.

11. Verify that interference does not exist with foreign pipelines. Perform joint tests and mitigate any interference detected.

E. After initial energization and after rectifiers have been adjusted as necessary for compliance with NACE RPO169-92, perform a walk-through inspection with Project Manager to verify that all corrosion control components have been installed in accordance with project drawings and specifications.

F. A punch list of outstanding work identified during walk-through inspection shall be made. Once Contractor has completed all work on punchlist, pipeline will be allowed to polarize for 30 days before final testing. Final testing and adjustment shall be performed after 30-day polarization period. Deficiencies discovered during final testing shall be repaired at Contractor's expense and at no additional cost to City of Houston. Should additional testing be required after final testing, cost of additional testing shall be paid by Contractor and will be charged at a rate of $1,500.00 per day.

G .Equipment: All cathodic protection testing instruments shall be in proper working order and calibrated according to factory specifications.

H. Report: A written report shall be submitted in accordance with Section 1.05, Submittals. Included shall be all test data, resistance and geologic logs, the rectifier O&M Manual and the As-Built Drawings.

END OF SECTION

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SECTION 16641

CATHODIC PROTECTION FOR EXISTING TANK BOTTOMS

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Requirements for impressed current cathodic protection systems for the bottom (soil side) of steel water storage tanks that are constructed at grade level.

B. Specifications for manually controlled transformer - rectifiers, deep anodes and permanent reference electrodes.

1.02 RELATED SECTIONS

A. Section 15640 - Joint Bonding and Electrical Isolation.

B. Section 16640 - Cathodic Protection for Pipelines.

C. Section 16642 - Cathodic Protection for Water Tank Interiors (ICCP).

D. Section 16643 – Cathodic Protection for Water Tank Interiors (Sacrificial).

E. Section 16644 – Cathodic Protection for Clarifiers

1.03 UNIT PRICES

A. This item will be measured and paid for as a lump sum item for the job.

B. Payment will be full compensation for all labor, equipment, materials and supervision for the installation of the cathodic protection system, complete in place including rectifier systems with deep anode groundbed and junction boxes, reference cells, power feed hookups, and all excavation, drilling, backfill, field welding, connections, adjustments, testing, cleanup, and other related work necessary for construction as shown on the drawings and specified herein.

1.04 REFERENCES

A. ASTM C94 - Ready Mixed Concrete.

B. ASTM D-1248 - Polyethylene Plastics Molding and Extrusion Material.

C. NEC 70 - National Electrical Code.

D. City of Houston Electrical Code.

E. NACE RP-0193 - External Cathodic Protection of On-Grade Metallic Storage Tank Bottoms.

F. NACE RP-0169 - Recommended Practice, Control of External Corrosion on Underground or Submerged Metallic Piping Systems.

G. NACE RP-0572 - Recommended Practice for Design, Installation, Operation and Maintenance of Impressed Current Deep Groundbeds.

H. NEMA TC6 - PVC and ABS Plastic Utilities Duct for Underground Installation.

I. NEMA TC9 - Fittings for ABS and PVC Plastic Utilities Duct for Underground Installation.

J. NEMA 4 - Type 3R Enclosures.

K. UL 83 - Thermoplastic-Insulated Wires

L. UL 467 - Bonding and Grounding Equipment

M. UL 486A - Wire Connectors and Soldering Lugs for Use with Copper Conductors

1.05 SUBMITTALS

A. Submittals shall conform to the requirements of Section 01330 – Submittal Procedures.

B. Drawings and Computations: All computations and drawings shall be prepared by or under the direct supervision of a Professional Engineer, registered in the State of Texas with a minimum of ten years experience in cathodic protection design.

C. Catalog Cuts: Manufacturer's catalog cuts shall be submitted for each item. The catalog cuts shall include the manufacturer's name and shall provide sufficient information to show that the materials meet the requirements of the drawings and specifications. Where more than one item or catalog number appears on a catalog cut, clearly identify the item proposed.

D. Logs: The City of Houston Representative shall be given a minimum of 48 hours notice prior to drilling the anode bore. Copies of detailed geological and resistance logs of each deep anode bore shall be typed by Contractor and submitted to the City of Houston representative.

E. Rectifier Operation and Maintenance Manual: The rectifier manufacturer shall include a complete operation and maintenance manual with each rectifier shipped to the job site. In addition to operating instructions, the manual shall include a circuit diagram and spare parts list. The rectifier shall be operated under full load conditions at the factory and shall be thoroughly inspected and tested by the manufacturer prior to delivery to the job site. Results of this testing shall be reported on a manufacturer’s quality control form and shall be included in the operation manual. The rectifier

manufacturer shall reference each operating manual by rectifier model number and individual serial number.

F. Operating and Maintenance Manual: Submit six (6) operating, monitoring and maintenance manuals for the cathodic protection systems. The manuals shall include operating instructions, maintenance data, product data and test procedures.

G. As-built drawings of the corrosion control test stations shall be maintained by the Contractor during installation and construction. Drawings shall be revised to show exact locations of all wiring, connections and terminal boxes. All items of equipment and material shall be properly identified. The original as-built drawings shall be submitted to the City of Houston representative.

1.06 QUALITY CONTROL

A. Provide manufacturer's certifications that all components of the cathodic protection systems meet the requirements of the drawings and specifications. The certification shall reference the applicable section of the specifications and the applicable standard details.

B. The drawings for the cathodic protection systems are diagrammatic and shall not be scaled for exact locations unless scales are explicitly stated on the specific drawing. Field conditions, non-interference with other utilities or mechanical and structural features shall determine exact locations. Contractor shall note other existing utilities in the area and during excavation, shall not damage these utilities. Any damaged utilities shall be repaired to the satisfaction of the City of Houston at the Contractor's expense.

C. All materials, fabrication and installations are subject to inspection and testing by the City of Houston or its designated representative.

PART 2 A N O D E S

2.01 IMPRESSED CURRENT ANODES

A. Description: The anode alloy shall be high silicon, chromium, iron, centrifugally cast in tubular form in accordance with the following specifications.

1. Anode Alloy: The anode shall consist of Durichlor 51, high silicon, chromium iron. This alloy shall be made in accordance with specification ASTM A518-86, Grade 3 with nominal percentages as follows:

Chemical Composition

Element	Composition, Weight %
Carbon	0.70 - 1.10
Manganese	1.50, max

Silicon	14.20 - 14.75
Chromium	3.25 - 5.00
Molybdenum	.20, max
Copper	0.50, max

2. Casting Method: Anodes shall be centrifugally cast in tubular form and shall have a hollow, straight walled design. Bowing and malformation tolerances shall be no greater than 1/4" over the seven foot anode length. Anode designs which include enlargement of the outside diameter, at the center or elsewhere, or constrictions of a venturi type of the inside wall shall not be allowed.

   The anode body shall have solid walls of a uniform thickness with an open cylindrical interior. Static casting methods, such as sand, die or metal mold techniques, shall not be allowed in order to avoid the risk of shrink cavities and internal stresses caused by non-uniform wall thickness.

   Use of extraneous materials such as chaplets, spacers or chills to center the anode mold shall not be permitted. Any slag deficiencies shall be restricted to one end of the casting only allowing for simple inspection techniques to ascertain metal density and absence of slag inclusions.

3. Mechanical and Physical Properties: The mechanical and physical properties of the anode shall be as follows:

   Tensile Strength (1/2" dia. bar) psi. 15,000
   Compressive Strength, psi. 100,000
   Hardness, Brinell 520
   Density, gr/ml 7.0
   Melting Point, °F 2300
   Specific Resistance, micro-ohms-cm (20°C) 72
   Coefficient of expansion, 32° to 212° F ..... 7.33×10^{6}

4. Size:

   Anode castings shall conform to the following sizes:

Type	Weight (pounds)	O.D. (inches)	Length (feet)
TA-2	46	2.19	7
TA-3	63	2.66	7
TA-4	85	3.75	7
TA-5	110	4.75	7

5. Anodes shall be TA-2 unless otherwise noted on the drawings.

B. Anode Lead Wire Connection:

1. The lead wire for an impressed current anode shall be a No. 8 AWG seven stranded copper conductor equipped with HMWPE insulation. The lead wire shall be of sufficient length to reach the anode terminal box without splicing additional wire.

2. The anode lead wire shall be attached at the center of the anode. The center connection shall have a minimum pull-out strength of one and one-half times the breaking strength of the No. 8 AWG lead wire or 788 pounds.

3. The electrical contact resistance as measured across the lead wire-to-connector junction shall not exceed 0.004 ohms.

C. Impressed Current Anode Backfill: Calcined fluid petroleum coke shall be used to backfill impressed current anodes. Anode backfill shall conform to the following:

1. Typical Chemical Analysis.

Component	Percent Composition
Carbon	91.77
Sulfur	5.85
Ash	2.23
Silicon	0.26
Iron	0.02
Volatiles	0.07
Moisture	0.00

2. Physical Properties.

Bulk Density, pounds/cubic foot	74
Specific Gravity	2.00
Porosity, percent	40.8

3. Particle Analysis.

Sieve	Percent Retained
16 mesh	0.0
28 mesh	7.15
35 mesh	86.40
80 mesh	2.30
100 mesh	3.30

2.02 MISCELLANEOUS DEEP ANODE GROUNDBED HARDWARE

Miscellaneous components of a deep anode groundbed shall include the following:

A. PVC Casing: The deep anode bed shall be equipped with a Schedule 40 PVC casing.

1. The casing shall be 8 inches in diameter and 20 feet in length.

2. The casing shall extend 6 inches above grade.

B. Anode Bed Cover: The casing shall be terminated with a PVC cap. The cover assembly shall be set in a 3-foot-square by 6-inch-thick Portland cement concrete slab.

C. Venting Facilities:

1. Plastic vent pipe shall be used from the bottom anode to the surface for dissipating gases to the atmosphere.

2. The plastic vent pipe shall be 1 inch diameter with 1/8-inch holes drilled on 6-inch centers in the area of the anodes. The vent pipe above the anodes shall not be drilled.

3. The plastic vent pipe shall extend above grade and the vent outlet shall be screened and installed in an inverted manner.

2.03 RECTIFIERS

Cathodic protection rectifiers shall be air cooled, tap adjust Super Custom model as manufactured by Good-All Electric or approved equal conforming to NEMA MR-20-1958 and listed in the CSA File No. 45382.

A. D-C Output Ratings: Rectifiers shall be rated at 30 volts, 12 amps DC unless otherwise noted on the drawings. Rectifiers shall be capable of supplying continuous, full rated output at an ambient temperature of 45° C, in full sunlight with an expected life in excess of 10 years.

B. A-C Input Ratings: Full rated d-c output shall be obtained, with an input voltage $\pm$10 percent of the nominal rated input.

C. Cooling: Cooling shall be by natural air convection. Cabinets shall be vented for natural air convection and shall be screened against insects.

D. Voltage Adjustments: The output voltage shall be adjustable by means of not less than 25 approximately equal steps of secondary taps from 5 percent of rated voltage to full-rated voltage.

E. Rectifying Elements: Rectifying elements shall be silicon diodes sized as follows:

1. Diode voltage shall be rated at 400 volts minimum for rectifier outputs up to 100 VDC, and 800 volts minimum for rectifiers with outputs from 100 to 200 VDC.

2. Diodes shall be configured into a full-wave bridge assembly. Diodes shall be sized to carry a minimum average current of one half of rated rectifier output.

3. Heat sinks shall be sized to keep diode junction temperatures less than 100° C at rated output and maximum ambient temperature.

4. Diodes shall be overload protected by means of semiconductor fuses, located in the transformer secondary leg to the diode bridge assembly.

5. Diodes shall be equipped with supplemental Metal Oxide Varistor (M.O.V.) surge arrestors at the diode bridge assembly sized to provide protection against secondary over-voltage surges.

F. A-C Circuit Breakers: Input overload and short circuit protection shall be provided by magnetic trip circuit breakers. The circuit breaker shall be sized to hold 100 percent of rated load. It may trip between 101 percent and 125 percent of rated load and must trip at 125 percent and above.

G. Surge Protection: Separate AC and DC surge protection shall be provided by means of high energy Metal Oxide Varistors rated at 500 joules on D.C. output and 750 joules on the A.C. output.

H. Electrical Panels: Electrical panels shall be minimum thickness of 1/4" NEMA "XX" laminated phenolic, rated for Class "B" operation (105° C maximum). Rectifiers rated at 100 amperes D.C. or higher shall be equipped with panels constructed from a minimum sheet thickness of 1/4" "UTR" fiberglass reinforced laminate rated for Class "F" operation (155° C). Rectifier front panel identifications shall be permanently silk-screened onto the panel.

I. Connection Hardware: All electrical hardware shall be copper or high conductivity brass, suitably sized, and finished in electroless nickel plating for superior corrosion resistance. All connections shall be tightly secured with lock washers and nuts torqued to manufacturer's recommended specifications.

J. Enclosures:

1. Enclosures shall be constructed from a minimum 12 gauge wiped coat mill galvanized steel, finished in 3 - 5 mils polyester fusion bonded powder coating.

2. Hinges and cabinet assembly bolts shall be of stainless steel.

3. Enclosures shall be equipped with a pad-lockable draw latch. Latch shall be manufactured from 12 gauge steel, finished in zinc-dichromate plating. Draw latch shall accommodate a 3/8 inch shackle padlock.

4. Enclosures shall be equipped with a grounding lug sized to accommodate up to a No. 6 AWG conductor.

5. Separate conduit knockouts shall be provided for AC and DC; conveniently located and adequately sized for input and output conduit connectors.

6. Cabinet shall be furnished with suitable channel brackets for wall or pole mounting. Optionally available floor stands shall be available upon request.

7. Rectifier shall be equipped with slide-out chassis and hinged door for access to the front and a minimum of one side of the cabinet.

K. Rectifier Instrumentation.

1. Rectifier shall be equipped with separate analog ammeter and voltmeter.

2. Meters shall be a minimum of 3-1/2" size, with a minimum scale length of 2-7/8".

3. Meters shall be 0 - 50 millivolts full scale deflection, taut-band movement with four-to-one swamping (i.e. internal meter resistance comprised of 25% winding resistance and 75% fully temperature compensated dropping resistor for wide temperature range performance).

4. Meter accuracy shall be $\pm$ 2% full scale deflection at 25° C., temperature compensated to 0.085% per degree C.

5. Rectifier meters shall be scaled to have rated output no less than 70%, or greater than 85% of full scale deflection.

6. Meter shunts shall be panel-mounted Holloway type "SW" style, with an accuracy of $\pm$0.25%.

L. Transformers: Transformers shall meet UL 506, Specialty Transformers and the following:

1. Transformer designed as full isolation with separate isolated primary and secondary windings with a minimum efficiency of 95%.

2. Transformer secondary shall be equipped with a minimum of 25 steps of secondary voltage adjustment (5-COARSE, 5-FINE). Tap adjustment shall be by means of tap bars.

3. Transformer materials and construction shall be rated for Class "H" operation (180° C). Insulation materials shall be further enhanced by dipping in thermosetting varnish and baking.

4. Transformer shall be rated for a minimum dielectric strength of 2250 volts applied for one minute between the windings, and the core.

M. Current Interrupters: The rectifier shall include a built-in current interrupter rated in accordance with the capacity of the rectifier unit. The interrupter shall be equipped with a solid-state timer with independently adjustable "On"

and "Off" times. Interrupter shall be equipped with a switch to enable the operator to operate the rectifier in an interrupt or continuous mode of output.

N. Miscellaneous:

1. All rectifiers shall be capable of operating on either 115 or 230 volt, single phase, 60 hertz A.C. input.

2. Cathodic Protection Rectifier shall be 100% quality control tested as outlined in this specification.

3. During manufacture, the rectifier shall be subjected to frequent visual and performance testing to insure a high degree of quality acceptance level.

4. Rectifiers shall be subjected to 100% testing of the following rectifier electrical parameters:

   a. A.C. input voltage, current, apparent power and true power.

   b. D.C. output current, voltage and power.

   c. A.C. power factor.

   d. A.C. to D.C. conversion efficiency.

   e. Output ripple.

   f. Correct operation of optional features such as interrupters, filters, etc.

5. A final overall visual inspection shall be given each rectifier prior to packaging.

2.04 ELECTRICAL CONNECTIONS

A. Cables: Rectifier positive and negative cables, and sacrificial anode collector cables shall be seven stranded copper conductors with high molecular weight polyethylene (HMWPE) insulation.

B. Connectors: Connectors used to splice sacrificial anode lead wires to a collector cable shall be solid copper crimpits, Model YC-C as manufactured by Burndy or approved equal.

C. Sealant: Splices between sacrificial anode lead wires and collector cables shall be sealed with vinyl mastic pads, Model 2200 as manufactured by 3M or approved Equal.

2.05 PERMANENT REFERENCE ELECTRODES

A. The electrode shall be equipped with No. 14 AWG stranded copper wire with black HMWPE insulation of suitable length to extend from the center of the tank to the terminal board of the test station.

B. The electrode shall have a design life of 15 years and a stability of 5 millivolts under a 3.0 microamp load.

C. The reference electrode shall be copper/copper sulfate Permacell, Model IHRP-802 as manufactured by Harco Technologies or approved equal.

2.06 TEST STATION LEAD WIRES

A. Test station lead wires of all sizes shall have TW of THW insulation.

B. All terminal boards shall be wired by the installer as shown on the drawings.

2.07 THERMITE WELD EQUIPMENT

Materials required for thermite welding and coating of the welds are described in the following sections.

A. Charges and Molds: Weld charges and mold size shall be specified by the manufacturer for the specific surface configuration. Care shall be taken during installation to be sure correct charges are used. Welding charges and molds shall be the product of a manufacturer regularly engaged in the production of such materials.

B. Weld Coating: Coating for all welds shall be Kop-Coat as manufactured by Carboline or approved equal. The coated weld shall be covered with a plastic weld cap.

PART 3 E X E C U T I O N

3.01 INSTALLATION OF DEEP ANODE GROUNDBEDS

A. Permits: The drilling and installation of the deep anode systems shall only be accomplished by a qualified well driller who is recognized as a fully experienced specialist in the installation of deep anode cathodic protection systems. The deep anode system installer shall have a minimum of 5 years experience installing deep anode systems with a minimum of 10 successful deep well anode installations. The Contractor is required to submit all applications and obtain all well drilling permits required by any City, County, State agency.

B. Field Location: Verification of actual field conditions, location of underground structures, and physical separation from other structures or utilities shall be the responsibility of the Contractor. Location of the anode wells are approximate. Exact placement shall be determined and verified in the field by the Contractor and the representative of the City of Houston.

C. Anode Hole Drilling: The anode hole shall be 8 inches in diameter by 200 feet deep. Drilling shall be accomplished with rotary bit equipment designed

specifically for this purpose. Driller shall use standard techniques (i.e. trough and vacuum truck) to capture and contain the drilling fluids, mud and cuttings at the top of the hole. The driller shall select the type and consistency of drilling fluids to be consistent with soil characteristics. The drilling rig shall be leveled to provide a round, straight and plumb anode hole.

D. Temporary Well Casing: Drilling of the holes may require the installation of temporary well casings. All temporary casings shall be removed by the driller by the end of the job.

E. Anode Hole Geological Logs: As the hole is drilled, the driller shall maintain a detailed, formal record describing the depth and type of the geological formations encountered. Typed copies of the log shall be submitted as required by 1.05.C.

F. Anode Hole Resistance Log: An electric log of the hole shall be recorded using one of the anodes. The anode lead wire shall have been previously marked in five foot increments. The anode lead wire shall be marked for a distance equaling or exceeding the maximum anticipated depth of the hole. As the anode is lowered into the hole, a resistance log shall be performed by impressing a minimum 12 volt DC current between the anode and a very well grounded structure such as the local AC power neutral network. Nilsson type soil resistance meters shall not be used to perform this test. A recommended 12 volt DC power source is a heavy duty lead acid automobile battery. The anode shall be lowered into the water or drilling mud filled hole at ten foot increments and held in place while the voltage and current output of the DC current source are measured and recorded. This information shall be formally recorded, typed, signed, dated and submitted by the Contractor as required under 1.05.C.

G. Vent Pipe Installation: The vent pipe shall be installed in the hole with the first anode. The bottom of the vent pipe shall be capped. The top of the vent pipe shall be capped throughout the anode and coke breeze backfill installation procedure to prevent intrusion of foreign material. Care shall be exercised to avoid intrusion of drilling mud into the vent pipe.

H. Anode Installation: The anode well shall contain ten (10) tubular cast iron anodes spaced at 10 foot intervals on centers. The anodes shall be centered in the hole using anode centralizers. The anodes shall be installed by lowering them individually into the hole by the lead wire. The lead wires shall be pre-marked for the nominal anode depth. The final depth shall be recorded with the first anode in the hole (i.e. the bottom anode) identified as anode number one (1). The anode lead wires shall not be damaged during handling or lowering into the hole. Under no circumstances shall the anode lead wires be clamped or pinched around another object while lowering the anodes into the hole. If the insulation on any anode lead wire is cut, broken or nicked, during this operation or at any other time, that complete anode assembly shall be rejected, shall not be used, and shall be removed from the job site immediately. Contractor shall replace all damaged anodes at no additional expense to the City of Houston.

I. Anode Column Coke Backfill: The coke backfill shall be slurried above-grade and then pumped into the hole after the anodes are installed. The coke shall be pumped from the bottom of the hole up using a pipe that is the length of the anode hole. The pipe used to pump the coke into the hole shall not be the vent pipe. The pipe shall be raised as the anode column is filled with coke. The pipe shall be removed from the hole after the coke installation operation is completed. A sufficient amount of backfill shall be used such that the coke breeze column will extend a minimum of five feet above the top of the uppermost anode. Extreme care shall be exercised during installation of the coke backfill so that no voids remain around the anodes.

J. Vent Pipe: The 1-inch diameter internal vent pipe shall terminate with a gooseneck fitting. The top end of the vent pipe shall be left open to allow gases from the anode hole to exit.

K. Precautions: The Contractor shall take all necessary precautions to avoid the entrance of foreign matter into the hole, movement of any soil strata, or the collapse of the drilled hole during the progression of the work. Should movement of soil strata or collapse of the drilled hole interfere with proper completion of the anode groundbed, the Contractor shall recover the wires, anodes and any vent pipe and ream or redrill the hole at his sole expense.

L. Mud And Cuttings: Drilling mud, cuttings and other waste shall be disposed of by the Contractor in accordance with the methods and procedures of the best recognized practices and shall comply with the rules and regulations of the State, City and County.

3.02 INSTALLATION OF CATHODIC PROTECTION RECTIFIERS

A. Codes: The installation shall conform to the latest edition of the National Electrical Code (NEC) and be in compliance with all City of Houston and Houston Lighting and Power codes and standards.

B. Mounting: All cathodic protection rectifiers shall be pole mounted. The pole may be omitted and the rectifier mounted on a building wall or other available permanent structure, if approved by the Engineer. Rectifiers shall be installed at a height of 4 feet above final grade.

C. Identification: All rectifiers shall be equipped with permanent engraved nameplates which identify the units with “Cathodic Protection Rectifier, Property of City of Houston, In Case of Emergency Call (713) 748-4461”.

D. Conduit: All wiring to the rectifier shall be contained in rigid galvanized steel conduit when run above grade.

1. Insulating bushings shall be used at each end of all conduit runs.

2. Galvanized steel, rigid conduit shall extend 12 inches below grade.

E. Electrical Service: AC electrical service for each rectifier unit shall be provided by the Contractor. The Contractor shall be responsible for

furnishing and installing the necessary wiring, conduits, wires, meter sockets, splice boxes and equipment to the service connection.

F. Completion: The installation shall not be considered complete until the AC and DC wiring is complete and the rectifier is capable of operating at full rated load. AC power shall be installed such that the rectifier can be activated for test purposes, however the Contractor shall leave the power off at the site. The rectifier shall be turned on and adjusted afterwards by the Corrosion Engineer.

3.03 INSTALLATION OF WIRE AND CABLE

A. Depth: All underground wires and cables shall be installed at a minimum of 36 inches below final grade with a minimum separation of 12 inches from other underground structures.

B. Conduit: All negative cables and anode lead wires shall be placed in rigid galvanized steel conduit when above-grade.

1. Insulating bushings shall be used at each end of all conduit runs.

2. Galvanized steel, rigid conduit shall extend 12 inches below grade.

3. Road borings shall utilize rigid galvanized conduit for cable routing.

3.04 INSTALLATION OF JUNCTION TERMINAL BOXES

A. Location: Junction terminal boxes shall be installed immediately adjacent to the rectifier, shall be installed to allow ready access for testing, and shall be installed at a minimum height of 3 feet above grade.

B. Concrete Pad: Junction terminal boxes shall be set in a Portland cement concrete pad. the concrete pad shall be a minimum of 12 inches diameter and no less that 2 feet thick.

C. Conduit: All cathodic protection wiring between the junction box and the rectifier shall be contained in rigid, galvanized steel conduit. Insulating bushings shall be used at the ends of all conduit.

3.05 NEGATIVE CABLE ATTACHMENT

A. Negative cables shall be attached to the pipe by thermite welding.

B. The tank surface to which the wires are to be attached shall be clean and dry.

C. A grinding wheel shall be used to remove all coating, mill scale, oxide, grease and dirt from an area approximately 3 inches square. The surface shall be cleaned to bright metal.

D. The wires to be thermite welded to the pipe shall have approximately 1 inch of insulation removed from each end, exposing clean, oxide-free copper for welding.

E. Using the proper size thermite weld mold as recommended by the manufacturer, the wire shall be placed between the graphite mold and the prepared metal surface. All wires No. 12 AWG shall have a copper sleeve crimped over the wire.

F. The metal disk shall be placed in the bottom of the mold.

G. Place the thermite weld charge in the mold. Squeeze the bottom of the weld charge container to spread ignition powder over the charge.

H. Close the mold cover and ignite the starting powder with a flint gun.

I. After the exothermic reaction, remove the thermite weld mold and gently strike the weld with a hammer to remove the weld slag. Pull on the wire to assure a secure connection. If the weld is not secure or the wire breaks, repeat the procedure.

J. If the weld is secure, coat all bare metal and weld metal with Kop-Coat.

3.06 FLUSH-MOUNT TEST STATIONS

A. Flush mount test stations shall be installed adjacent to the tank.

B. Sufficient slack shall be coiled beneath the test station to allow for soil settlement and to prevent damage to the leads during backfilling. Additional slack shall be left to allow for the withdrawal of the terminal board a minimum of 18 inches above the top of the terminal box for test purposes.

C. Flush-mount test stations shall be installed with permanent copper/copper sulfate reference electrodes where indicated on the drawings.

1. The reference electrode shall be installed approximately 12 inches from the tank bottom.

2. Native soil shall be compacted by hand around the electrode and the balance of backfill shall be selected granular backfill material.

3. The backfilled reference electrode shall be saturated with 5 gallons of water.

D. Test stations installed outside areas of permanent paving materials shall be set in a Portland cement concrete pad. The concrete pad shall be a minimum of 24 inches square and no less than 4 inches thick.

3.07 INSTALLATION TESTING OF THE CATHODIC PROTECTION SYSTEMS

A. General: After the cathodic protection equipment has been installed, the system shall be inspected, tested and adjusted as necessary to achieve compliance with accepted corrosion control standard set forth by NACE.

B. Energization: The initial energizing of the cathodic protection system shall be performed by a Corrosion Engineer hired by the Contractor.

C. Notice: Prior to native state and polarized potential testing, the Contractor shall give a minimum of 48 hours notice to the City of Houston to facilitate observation of the tests by a City Representative.

Contact: City of Houston
Graphics and Engineering Management Section
306 McGowen
Houston, TX 77006

Mr. Wayne Dessens, P.E. or
Mrs. Tiffany Pham, P.E.

Telephone: (713)525-9928

D. Method: The Corrosion Engineer shall:

1. Observe native state and polarized (Instant OFF) tank-to-soil potentials to ensure that cathodic protection is being provided to the tank bottom in accordance with accepted NACE criteria.

2. The Corrosion Engineer shall record tank-to-soil potential measurements on the permanent reference electrode and around the perimeter of the tank.

3. The Corrosion Engineer shall determine if interference exists on nearby structures and, if so, take steps to find a satisfactory solution to the problem.

E. Verification and Responsibilities

1. Contractor shall correct, at his expense, any deficiencies in materials or installation procedures discovered during the post-installation inspection.

2. Corrosion Engineer shall provide written documentation of any deficiencies discovered during the post installation inspection.

F. Equipment: All cathodic protection testing instruments shall be in proper working order and calibrated according to factory specifications.

G. Report: A written report shall be submitted in accordance with Section 1.05, Submittals.

END OF SECTION

Section 16950

UNINTERRUPTIBLE POWER SUPPLIES

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. This section covers Uninterruptible Power Supplies to ensure reliable control system power.

1.02 REFERENCES

A. Each variable frequency drive shall be designed, constructed, and tested in accordance with applicable standards and shall be designed for installation in accordance with the NEC. The UPS shall be UL listed.

1.03 SUBMITTALS

A. Submit product data and shop drawings under provisions of Section 01330 - Submittal Procedures.

1. Submit in complete packages grouped to permit review of related items as outlined in these specifications.

2. Bind submittals in three-ring binders with complete indexing and tab dividers. Completely tag and label equipment information to correspond with Drawings.

3. Review of Submittals will be for conformance to Contract Documents and for application to specified functions.

B. Product Data: Submit descriptive product literature including manufacturer's specifications for each component specified.

C. Drawings

1. Name of manufacturer.

2. Types and model numbers.

3. Rated UPS load capacity and run-time.

4. Overall dimensions and weights.

5. Schematics, including maintenance bypass.

6. Wiring diagrams, including all internal and external devices and terminal blocks.

7. List of diagnostic indicators.

D. Quality Control Submittals

1. Field Reports: UPS units commissioned in the field by the contractor or manufacturer is to include start-up report. The report will include installation overview, any parameter changes to default settings, and confirmation of fail-over test.

E. Operations and Maintenance (O&M) Data.

1. Submit operation and maintenance data notebook in accordance with Section 01782 - Operations and Maintenance Data.

2. Information and drawings submitted must reflect the final installed condition. Revise documents requiring updates following testing and start-up.

3. In addition to the content specified in Section 01782 - Operation and Maintenance Data, provide the following information:

a. Name, address and telephone number of the UPS supplier's local service representative.

b. Complete list of supplied system hardware parts with full model numbers referred to system part designations, including spare parts and test equipment provided.

c. Copy of approved submittal information and system shop drawings as specified in Paragraph 1.3, Submittals, with corrections made to reflect actual system as tested, delivered and installed at the site. Provide half-size blackline reproductions of all shop drawings larger than 11 inches x 17 inches.

d. Configuration and monitoring software.

e. Complete up-to-date system software documentation.

f. Manufacturer's hardware, software, installation, assembly and

operations manuals for the UPS. Provide all manuals in PDF format on CD-RW or DVD-RW.

F. Project Record Documents

1. Submit record documents under provisions of Section 01785 - Project Record Documents.

1.04 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Manufacturer shall be a company specializing in manufacturing products specified in this Section, having proven compatibility with the City's existing facilities and at least 3 years of documented experience. The company shall maintain service facilities within 100 miles of the City of Houston.

1.05 DELIVERY, STORAGE AND HANDLING

A. Deliver products to site in factory-sealed containers. Store and protect products under provisions of Section 01610 - Basic Product Requirements.

B. Check for damage upon receiving products on site.

C. Store products in a clean, dry area; maintain temperature in accordance with NEMA ICS 1.

1.06 ENVIRONMENTAL REQUIREMENTS

A. Maintain area free of dirt and dust during and after installation of products.

B. Provide temporary heating and air conditioning units and equipment required to maintain environmental conditions specified for UPS units.

PART 2 P R O D U C T S

2.01 UNINTERRUPTIBLE POWER SUPPLY (UPS)

A. Manufacturer and Model: Powerware 9130 Tower Model with BD Relay Interface Card and HS-MBP Maintenance Bypass, or equal approved by end user.

B. Rating: Provide uninterrupted conditioned power to PLC and critical components for 10 minutes at a load of 1000 VA.

C. Description: Continuous-duty, online, solid state uninterruptible power system incorporating double-conversion technology. The UPS shall operate in conjunction with the existing electrical system to protect electronic equipment from power disturbances that may occur in utility power such as voltage fluctuations, brownouts, blackouts, power surges and power sags.

D. Modes of Operation: The UPS shall operate as an online, double-conversion UPS with the following modes:

1. Normal Mode: The rectifier shall derive power as needed from the commercial AC utility or generator source and supply filtered and regulated DC power to the online inverter. The inverter shall convert the DC power at its input to highly regulated and filtered AC power for the critical loads.

2. High Efficiency Mode: In the presence of favorable incoming utility conditions, the UPS shall optimize its operating state to maximize its efficiency.

3. Battery Mode: Upon complete failure of utility power, the UPS shall provide power to the critical loads through the inverter, from the UPS' internal or extended batteries. When utility power returns, the unit shall return to Normal Mode operation.

4. 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.

5. Standby Mode: When initially attached to a utility or other power source, the UPS shall start in Standby Mode until the user initiates power to the critical load. In this mode, the UPS shall recharge the batteries, but power shall not be supplied to the critical load.

E. TVSS Rating: Total energy rating more than 520J, 320V/130J MOV from L-N, L-G, and N-G.

F. Input Voltage: 90-138 VAC, 45 to 65 Hz.

G. Output Power Factor: 0.9.

H. Input Line Cord: 6-ft. attached line cord with 5-15P.

I. Output Receptacles: Six 5-15R

J. Operating Temperature: 32 to 104 degrees F.

K. Serial Communication Interfaces: RS-232 port (DB9) and USB (Universal Serial Bus) for communication to vendor-supplied Power Management Software.

L. Relay Output: Include optional Relay Output Card for status reporting to the PLC.

M. External Maintenance Bypass: Include HS-MBP.

2.02 HOT–SWAP MAINTENANCE BYPASS

A. Manufacturer and Model: Powerware HS-MBP-15 Maintenance Bypass, or equal approved by end user.

B. Rating: 1440 VA

C. Description: Power Distribution Unit (PDU) style maintenance bypass configured as follows:

1. Line cords with plugs to input line power and UPS output

2. Six receptacles for outputs to loads

3. Selector switch for normal and bypass

PART 3 E X E C U T I O N

3.01 INSTALLATION

A. Verify that location is suitable for UPS and HS-MBP installation.

B. Do not install UPS until building environment can be maintained within the service conditions required by the manufacturer.

3.02 RELATED INSTALLATION REQUIREMENTS

A. Inspect completed installation for physical damage, proper alignment, anchorage and grounding.

END OF SECTION