

Document 00910

ADDENDUM NO. 1

Date of Addendum: 3/20/15

PROJECT NAME: 11th Street Odor Control Facility Improvements

PROJECT NO: WBS No. R-000020-0010-4

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, 15th Floor
Houston, Texas 77002
Attn: Akhter Hussain, 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.

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.

CHANGES TO PROJECT MANUAL

BIDDING REQUIREMENTS

1. Section 00010 – Table of Contents: Remove pages 5, 6, and 7 and replace with revised pages 5, 6, and 7 included with this Addendum.
2. Section 00410B – Bid Form Part B: Remove Section 00410B in its entirety and replace with revised Section 00410B included with this Addendum.

SPECIFICATIONS

3. Section 01110 – Summary of Work: Remove page 2 and replace with revised page 2 included with this Addendum.
4. Remove Section 02220 – Demolition in its entirety and replace with revised Section 02220 attached.

00910-1
02-01-2004

ADDENDUM NO. 1

5. Add Section 02505 – High Density Polyethylene (HDPE) Solid and Profile Wall Pipe. This is a City of Houston Standard Specification.
6. Remove Section 11264 – Biological Tower-Type Odor Control System in its entirety and replace with revised Section 11264 attached.
7. Remove Section 11330 – Foul Air Fans in its entirety and replace with revised Section 11330 attached.
8. Remove Section 13440 – Odor Control Station Control System in its entirety and replace with revised Section 13440 attached.
9. Remove Section 13446 – Primary Instrumentation Devices in its entirety and replace with the revised Section 13446 attached.
10. Add Section 15180 – Piping Insulation in its entirety as attached.
11. Add Section 15778 – Heat Tracing for Piping in its entirety as attached.
12. Remove Section 15892 – Odor Control, Fiberglass Duct in its entirety and replace with Section 15892 attached.
13. Remove Section 13130 – Prefabricated Fiberglass Enclosures in its entirety and replace with revised Section 13130 attached.
14. Remove Section 17100 – Prestressed Concrete Camera Pole in its entirety and replace with section 13550 - Prestressed Concrete Cameral Pole attached.
15. Remove Section 17200 – Perpetual Power Unit (PPU), WIMAX Radio and Camera in its entirety and replace with section 13560 - Perpetual Power Unit (PPU), WIMAX Radio and Camera attached.
16. Delete Section 16480 Motor Control Center in its entirety.
17. Delete Section 16662 Motor Management Relay in its entirety.
18. Delete Section 16670 Lightning Protection Systems in its entirety.

CHANGES TO DRAWINGS

19. All Sheets. Remove Pipe Call Out FAD/PVC and replace with Pipe Call Out FAD/PVC or HDPE. Underground Foul Air Duct material may be PVC or HDPE. Refer to Section
20. Sheet 9 of 42, Drawing No. CF-003. Remove Note 2 and replace with the following:
 2. DESIGN SHALL MEET A MINIMUM OF 110 MPH (3 SECOND GUST) WIND LOAD AND SEIZMIC DESIGN CATEGORY A. ASSEMBLE AND ANCHOR WITH STAINLESS STEEL HARDWARE.
21. Sheet 26 of 42, Drawing No. I-002. Delete the Pulsation Dampener and the Back Pressure Valve upstream of the Flow Indicating Transmitter.
22. Sheet 27 of 42, Drawing No. I-003. Delete the Pulsation Dampener and the Back Pressure Valve upstream of the Flow Indicating Transmitter.
23. Remove Sheet 18 of 42, Drawing No. E-003 and replace it with Shee18 of 42, Drawing No. E-003 attached.
24. Remove Sheet 19 of 42, Drawing No. E-004 and replace it with Sheet 19 of 42, Drawing

No. E-004 attached.

25. Sheet 19 of 42, Drawing No. E-004. Add Note.

3: A SINGLE PANEL THAT COMBINES THE FUNCTIONS OF THE FERROUS SULFATE PUMP CONTROL PANEL, CALCIUM NITRATE PUMP CONTROL PANEL, AND THE CHEMICAL FEED POWER PANEL (CFP-1) IS ACCEPTABLE. THE WIRING FOR ANY MODIFICATIONS TO THE ARRANGEMENT SHOWN SHALL BE SUBMITTED FOR APPROVAL. ALL CONTROL FUNCTIONS SHALL BE MAINTAINED AS SHOWN FOR THE ORIGINAL DESIGN.

CLARIFICATIONS

26. Question from prospective Bidder: Is it correct that there are three chemical feed panels, one for Ferrous Sulfate, one for Calcium Nitrate and one chemical feed panel?

Response: The chemical feed panels shown on Drawing E-004 can be separate or combined, as shown on Drawing E-004 included in this Addendum No. 1.

27. Question from prospective Bidder: Chemical Tank levels and flows go to all the chemical feed panels. Is CFP-1 required if all signals go to SCADA?

Response: Local tank level and flow needs to be indicated at the local panel as well as being sent to SCADA as shown on Drawing E-004 included in this Addendum No. 1.

28. Question from prospective Bidder: Is the fiberglass enclosure large enough?

Response: To allow room in the existing building, it is acceptable to put chemical feed controls all in one panel with proper instrument indication. A larger enclosure foot print is acceptable as long as the support structure foot print is also made larger.

29. Question from prospective Bidder: Bid Item 10 indicates 3 new light poles. Sheet E-002 appears to show 4. Please clarify.

Response: Bid Form 00410B includes 3 new light poles and 1 existing light pole to be relocated. One light pole on sheet E-002 is an existing light pole that is to be relocated.

30. Question from prospective Bidder: Should there be a minimum bid price for extra unit price bid items?

Response: Minimum bid prices are included in this Addendum No. 1 for the extra unit price bid items

31. Question from prospective Bidder: How long is the 20 inch drop pipe that is to be removed in the junction box referred to in Section C Sheet 13? Are there existing pipe supports in the junction box that need to be removed?

Response: This pipe is shown italics and in accordance with pipe callouts on Sheet 2 it is existing. The drop pipe has been previously removed. There is no work inside the junction box.

32. Question from prospective Bidder: Is raising the perimeter fence part of this project?

Response: This is a precautionary measure in the event that the Owner requests it at the time of construction (no request to date). Perimeter fencing modifications will be an Allowance Item and the Bid Form was changed.

33. Question from prospective Bidder: Are the chemical storage tanks insulated or heat traced?

Response: Section 15166 was corrected by this addendum to eliminate insulation and/or heat tracing on the chemical storage tanks.

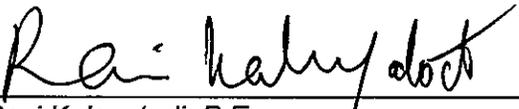
34. Question from prospective Bidder: Are temporary systems only required if the 60 day maximum out of service time is exceeded?

Response: This is a correct statement, temporary systems are only required if the 60 day maximum out of service time is exceeded.

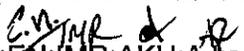
35. Question from prospective Bidder: Where is the coating specified in Section 09901S required?

Response: This coating is only required where concrete coating protection has been previously applied. Specifically, inside the chemical feed manhole and existing converted wet well. New coating is only required if existing coating is damaged during installation of new connections.

END OF ADDENDUM NO. 1


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

DATED: 3/20/15


RK:EN:IMR:AKH:AJ:sdd

END OF DOCUMENT



Doc.		Doc. Date
<u>No.</u>	<u>Document Title</u>	
01785	Project Record Documents	08-01-2003
DIVISION 2 - SITE WORK		
02136	WASTE MATERIAL HANDLING, TESTING AND DISPOSAL	01-01-2011
02220	DEMOLITION.....	09-25-2014
02221	REMOVING EXISTING PAVEMENTS AND STRUCTURES.....	07-01-2009
02233	CLEARING AND GRUBBING	01-01-2011
02260	TRENCH SAFETY SYSTEM	02-01-2011
02316	EXCAVATION AND BACKFILL FOR STRUCTURES	01-01-2011
02317	EXCAVATION AND BACKFILL FOR UTILITIES.....	01-01-2011
02318	EXTRA UNIT PRICE WORK FOR EXCAVATION AND BACKFILL	01-01-2011
02336	LIME-STABILIZED SUBGRADE.....	10-01-2002
02427	PLASTIC LINER FOR LARGE-DIAMETER CONCRETE SEWERS AND STRUCTURES	10-01-2002
02504	CENTRIFUGALLY CAST FIBERGLASS PIPE	02-01-2011
02505	HIGH DENSITY POLYETHYLENE (HDPE) SOLID AND PROFILE WALL PIPE	02-01-2011
02506	POLYVINYL CHLORIDE PIPE	01-01-2011
02512	WATER TAP AND SERVICE LINE INSTALLATION	04-27-2012
02516	CUT, PLUG, AND ABANDONMENT OF WATER LINES	01-01-2011
02526	WATER METERS	01-01-2011
02712	CEMENT STABILIZED BASE COURSE.....	10-01-2002
02713	RECYCLED CRUSHED CONCRETE BASE COURSE	07-01-2009
02751	CONCRETE PAVING	07-01-2009
02752S	CONCRETE PAVEMENT JOINTS.....	09-25-2014
*02752	CONCRETE PAVEMENT JOINTS	10-01-2002
02753	CONCRETE PAVEMENT CURING	10-01-2002
02754	CONCRETE DRIVEWAYS	09-01-2002
02821	CHAIN-LINK FENCES AND GATES.....	10-23-2014
02911	TOPSOIL	10-01-2002
02912	TREE, PLANT, AND HARDSCAPE PROTECTION.....	07-01-2009
02915	TREE PLANTING	01-01-2011
02921	HYDROMULCH SEEDING	01-01-2011
02922	SODDING	07-01-2009
02951	PAVEMENT REPAIR AND RESTORATION	07-01-2009
DIVISION 3 - CONCRETE		
03315	CONCRETE FOR UTILITY CONSTRUCTION	10-01-2002
03600	GROUT, NON-SHRINK.....	09-25-2014
DIVISION 5 - METALS		
05500	METAL FABRICATIONS.....	10-28-2014

Doc. No.	Document Title	Doc. Date
05502	ANCHOR BOLTS, EXPANSION ANCHORS & INSERTS	10-28-2014
05511	METAL STAIRS	10-25-2014
05521	PIPE AND TUBE RAILINGS	10-28-2014
05530	GRATINGS	09-25-2014
DIVISION 6 – WOOD AND PLASTICS		
06600	FIBERGLASS REINFORCED PLASTIC GRATING AND STRUCTURAL FABRICATIONS.....	09-25-2014
DIVISION 9 – FINISHES		
*09901	PROTECTIVE COATINGS	01-01-2011
09901S	PROTECTIVE COATINGS.....	01-15-2014
DIVISION 11 – EQUIPMENT		
11005	COMMON MOTOR REQUIREMENTS	09-25-2014
11009	COMMON CONTROL PANEL REQUIREMENTS	09-25-2014
11016	COMMON PUMP REQUIREMENTS	09-25-2014
11017	COMMON REQUIREMENTS FOR CHEMICAL FEED EQUIPMENT SYSTEMS	09-25-2014
11085	CHEMICAL FEED EQUIPMENT	09-25-2014
11264	BIOLOGICAL TOWER-TYPE ODOR CONTROL SYSTEM.....	09-25-2014
11330	FOUL AIR FANS	09-25-2014
DIVISION 13 - SPECIAL CONSTRUCTION		
13130	PREFABRICATED FIBERGLASS ENCLOSURES	09-25-2014
13440	ODOR CONTROL STATION CONTROL SYSTEM	08-01-2014
13446	PRIMARY INSTRUMENTATION DEVICES.....	08-01-2014
13471	CONTROL CABINET ENCLOSURES	08-01-2014
13550	PRESTRESSED CONCRETE CAMERA POLE.....	02-24-2015
13560	PERPETUAL POWER UNIT (PPU), WIMAX RADIO AND CAMERA	02-24-2015
DIVISION 15 – MECHANICAL		
15010	BASIC MECHANICAL REQUIREMENTS	09-25-2014
15015	PIPING SYSTEM, BASIC MATERIALS AND METHODS.....	09-25-2014
15030	POLYVINYL CHLORIDE (PVC) SOCKET WELDED PIPE	09-25-2014
15100	VALVES, BASIC REQUIREMENTS AND MISCELLANEOUS.....	09-25-2014
15166	POLYETHYLENE CHEMICAL STORAGE TANKS.....	09-25-2014
15180	PIPING INSULATION	03-17-2015
15778	HEAT TRACING FOR PIPING.....	03-17-2015
15892	ODOR CONTROL, FIBERGLASS DUCT.....	09-25-2014
DIVISION 16 – ELECTRICAL		
16010	BASIC ELECTRICAL REQUIREMENTS	08-01-2014

Doc. No.	Document Title	Doc. Date
16060	ELECTRICAL DEMOLITION.....	08-01-2014
16111	CONDUIT, FITTINGS AND BODIES	08-01-2014
16120	600-VOLT BUILDING WIRE AND CABLE	08-01-2014
16121	600-VOLT CONTROL CABLE	08-01-2014
16122	600-VOLT POWER CABLE	08-01-2014
16125	THERMOCOUPLE EXTENSION CABLE.....	08-01-2014
16126	INSTRUMENTATION CABLE	08-01-2014
16131	DEVICE, PULL AND JUNCTION BOXES.....	08-01-2014
16140	WIRING DEVICES.....	08-01-2014
16160	CABINETS AND ENCLOSURES	08-01-2014
16161	PANELBOARDS	08-01-2014
16165	DISCONNECT SWITCHES.....	08-01-2014
16170	GROUNDING AND BONDING.....	08-01-2014
16171	LOW VOLTAGE ELECTRIC MOTORS.....	08-01-2014
16195	ELECTRICAL IDENTIFICATION.....	08-01-2014
16290	LOW VOLTAGE SURGE PROTECTION DEVICES	08-01-2014
16402	UNDERGROUND DUCT BANKS	08-01-2014
16410	LOW VOLTAGE POWER FACTOR CORRECTION CAPACITOR	08-01-2014
16461	DRY-TYPE TRANSFORMERS	08-01-2014
16510	LIGHTING FIXTURES	08-01-2014

END OF DOCUMENT

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

B. BASE UNIT PRICE TABLE:

Item No.	Spec Ref.	Base Unit Item Description	Unit of Measure	Est. Qty	Unit Price (this column controls)	Total in Figures
1	01502	Mobilization	LS	1	\$61,500 ⁽¹⁾	\$61,500
2	02220	Demolition and salvage of items in the chemical feed area shall include but not be limited to: Remove and dispose of PVC piping, concrete equipment and shelter pads, emergency eyewash station, and water line. Salvage and store onsite two (2) ferrous sulfate and (1) one calcium nitrate storage tanks, a fourth tank not in service, existing chemical feed pumps and fiberglass shelter.	LS	1		
3	02220	Demolition and salvage of items in the bio-scrubber area shall include but not be limited to: Remove and dispose of concrete equipment support, stairs, buried duct, & duct supports. Salvage two (2) tower-type bio-scrubbers, ducts, control and irrigation systems, and two (2) foul air fans.	LS	1		
4	02821	Demolish and replace the existing chain link gate privacy slat double gate at the site access driveway with a new gate of like construction.	LS	1		
5	11264 11330 03315	Furnish and install tower-type bio-scrubber wastewater odorous air treatment system including but not be limited to two vessels, irrigation system, instrumentation & controls, and two foul air fans with concrete support pads, ductwork with dampers, and other accessories to make a complete and operational system.	LS	1		

Item No.	Spec Ref.	Base Unit Item Description	Unit of Measure	Est. Qty	Unit Price (this column controls)	Total in Figures
6	05512 03315	Furnish and install an aluminum odor control system power and control platform with access stairs and handrail, concrete pedestal and footings.	LS	1		
7	11085 15100 15030	Furnish and install chemical feed equipment including but not limited to two peristaltic pumping systems with all appurtenances for calcium nitrate and ferrous sulfate feeding. Each system mounted on a support framework for attaching to the wall inside the fiberglass shelter.	LS	1		
8	15166 15100 15030	Furnish and install, three (3) vertical, 4,000 gallon cross-linked HDPE double wall storage tanks, each with epoxy coated steel support base. All above ground PVC piping and accessories to complete the chemical systems.	LS	1		
9	13130 05500 15511 15512 05530	Furnish and install, a prefabricated fiberglass enclosure for housing chemical feed equipment, piping, panels, and controls, including an open construction FRP support base, aluminum stairs, handrail, landing and two additional standard steel pipe bollards, emergency eyewash/shower and hose station.	LS	1		
10	16510	Furnish and install yard lighting , 3 new poles with LED lights, conduit, wiring, and terminations and relocate 1 existing light pole	LS	1		
11	16111 16402	Furnish and install 200A/480V service including disconnect, meter, duct bank, conduits, and terminations from pole to odor control panel and duct bank, conduits, junction boxes, wiring and terminations, and instruments for the chemical feed system.	LS	1		
12	16170	Furnish and install grounding system for the bio-scrubber facilities.	LS	1		
13	13550 13560	Furnish and install communication system, including but not limited to 46' loan star concrete pole, WiMAX radio, PPU-1 pp, camera, wiring, LED light.	LS	1		

Item No.	Spec Ref.	Base Unit Item Description	Unit of Measure	Est. Qty	Unit Price (this column controls)	Total in Figures
14	01570	Filter fabric barrier for storm water pollution control.	LF	400		
15	01570	Hay bales placed for storm water pollution control.	LF	40		
16	02260	Trench safety system all types of soil, all depths over 5 feet.	LF	110		
17	02220	In-place bedding sand for Chemical Storage Tank and Bio-scrubber storage area.	CY	15		
18	02336	Lime Stabilize subgrade under fan pads and soil around existing odor control system slab.	SY	130		
19	02951 03315	Saw cut and remove a 35' X 10' section of reinforced concrete paving at the chemical feed area and replace with like pavement.	SY	60		
20	02506 15030	Buried sched. 80 PVC chemical and water piping from the chemical area through the area of removed pavement.	LF	380		
BASE UNIT PRICE TOTAL:						\$ _____

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C. EXTRA UNIT PRICE TABLE:

Item No.	Spec Ref.	Base Unit Item Description	Unit of Measure	Est. Qty	Unit Price (this column controls)	Total in Figures
21	02951 03315	Extra concrete pavement.	SY	10	\$ 150.00 ⁽²⁾	\$ 1,500.00 ⁽²⁾
22	03315	Extra Class "A" concrete installed in place for structures	CY	5	\$ 500.00 ⁽²⁾	\$ 2,500.00 ⁽²⁾
23	03315	Extra Grade 60 Reinforcing steel in place	LB	2000	\$ 0.95 ⁽²⁾	\$ 1,900.00 ⁽²⁾
24	15892	Extra 30 inch diameter fiberglass reinforced foul air duct	LF	10	\$ 190.00 ⁽²⁾	\$ 1,900.00 ⁽²⁾
25	15892	Extra 36 inch diameter fiberglass reinforced foul air duct	LF	10	\$ 233.00 ⁽²⁾	\$ 2,330.00 ⁽²⁾
26	15892	Extra 42 inch diameter fiberglass reinforced foul air duct	LF	10	\$ 320.00 ⁽²⁾	\$ 3,200.00 ⁽²⁾
27	15892	Extra 48 inch diameter fiberglass reinforced foul air duct	LF	10	\$ 353.00 ⁽²⁾	\$ 3,530.00 ⁽²⁾
EXTRA UNIT PRICE TOTAL:						\$ _____

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D. CASH ALLOWANCE TABLE:

Item No.	Spec Ref.	Cash Allowance Short Title	Cash Allowance in figures (1)
28	01110	Building Permit	\$ 10,000
29	01110	Perimeter Fencing/Landscaping	\$ 25,000
30	01110	Electrical Service Provider Fees	\$ 10,000
CASH ALLOWANCE TOTAL:			\$ 45,000

E. ALTERNATES TABLE: \$[N/A]

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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.

9. Prefabricated fiberglass shelter of 6' width by 4.5', and 7' wall height with insulated walls roof, door, and other appurtenances and walls suitable for mounting chemical feed equipment and panels. Open construction FRP support base 3' tall with solid platform surface for mounting the fiberglass shelter. Aluminum stair, handrail, and grated landing at shelter. Emergency eyewash/shower, hose station with manual shut-off valve in box, and two City standard concrete filled steel pipe bollards.
 10. Yard lighting, 3 new poles with LED lights, conduit, wiring, and terminations and relocate 1 existing light pole.
 11. Provide 200A/480V service including disconnect, meter, duct bank, conduits, and terminations from pole to odor control panel and duct bank, conduits, junction boxes, wiring and terminations, and instruments for the chemical feed system.
 12. Provide a grounding system for the bio-scrubber facilities.
 13. Provide a communication system, including 46' loan star concrete pole, WiMAX radio, PPU-1 pp, camera, wiring, LED light.
 14. Filter fabric barrier for storm water pollution control.
 15. Place hay bales for storm water pollution control.
 16. Trench safety system for all types of soil, all depths over 5 feet.
 17. Lime stabilize subgrade under fan pads and soil around existing odor control system slab.
 18. Saw cut and remove a section of reinforced concrete paving at the chemical feed area of the site and replace with like pavement.
 19. Install new buried ferrous sulfate and calcium nitrate feed pipes from the chemical containment area to an existing manhole and install a new buried water line through the area of removed pavement.
- C. The following shall be provided by the contractor as needed to complete the work specified. All work shall be coordinated with the OWNER'S project manager.
1. Temporary facilities and controls as specified in Division 1 Section 01504.
 2. Provide quality control, material testing, field-testing, and related services in accordance with Division 1 Section 01450. This work shall be coordinated with the OWNER'S contact person.
 3. Provide training of OWNER'S operation and maintenance personnel in accordance with Division 1 Section 01755. This work shall be coordinated with the OWNER'S Contact person,
 4. Field surveying required for support of construction operations.
- D. Extra Work Items
1. Unit Cost line items are provided in the Bid Form for common Extra Work Items associated with this project. All Extra Work shall be coordinated with the OWNER's project manager.
- E. Cash Allowances
1. Include the following specific Cash Allowances as indicated in the Bid Form:
 - a) Building Permit Allowance – This allowance to be used for reimbursement of actual Building Permit Fees.
 - b) Perimeter Fencing/Landscaping Allowance – This allowance to be used to raise the height of perimeter fencing and landscaping required by the OWNER. Work shall not be done under this allowance unless approved by the OWNER's project manager.
 - c) Electrical Service Provider Fee Allowance – This allowance to be used to pay electrical service provider fees associated with installing new power panel.

1.03 CITY-FURNISHED PRODUCTS

- A. Items Furnished by the City for Installation and final connection by Contractor: Existing water meter at the site to be relocated.

Section 02220

DEMOLITION

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. This Section includes the following:

1. Preparation of temporary storage area.
2. Salvage and store the existing biological tower-type odor control units (bio-scrubbers), existing foul air blowers and motors, associated above ground duct work and dampers, existing irrigation control panels, and other miscellaneous appurtances.
3. Salvage of the existing chemical storage tanks and fiberglass enclosure.
4. Demolition of the existing chemical feed piping and pumping systems.
5. Demolition of the existing blower foundation and existing concrete paving for chemical feed piping.
6. Either abandoning in place and/or removing below-grade construction as designated on Drawings.
7. Disconnecting, capping or sealing, and either abandoning in-place or removing site utilities as designated on Drawings.
8. Salvaging items for reuse by Owner.

- B. Related Sections include the following:

1. Division 2 Section 02136 "Waste Material Handling, Testing, and Disposal".
2. Division 2 Section 02221 "Removing Existing Pavements and Structures".
3. Division 2 Section 02233 "Clearing and Grubbing".
4. Division 15 Sections for demolishing or relocating site mechanical items.
5. Division 16 Sections for demolishing or relocating site electrical items.

1.03 DEFINITIONS

- A. Demolish: Completely remove and legally dispose of off-site.
- B. Recycle: Recovery of demolition waste for subsequent processing in preparation for reuse.
- C. Salvage: Carefully detach from existing construction, in a manner to prevent damage, and deliver to Owner. Include fasteners or brackets needed for reattachment elsewhere.

1.04 MATERIALS OWNERSHIP

- A. Unless otherwise indicated, demolition waste becomes property of Contractor.
- B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner. Carefully salvage in a manner to prevent damage and promptly return to OWNER.

1.05 SUBMITTALS

- A. Proposed Protection Measures: Submit informational report, including drawings, that indicates the measures proposed for protecting individuals and property, for environmental protection, for dust control, and for noise control. Indicate proposed locations and construction of barriers. Adjacent Facilities: Detail special measures proposed to protect adjacent facilities to remain.

DEMOLITION

- B. Schedule of Facilities Demolition and Salvage Activities: Indicate the following:
 1. Detailed sequence of work, with starting and ending dates for each activity.
 2. Temporary interruption of utility services.
 3. Shutoff and capping or re-routing of utility services.
- C. Facility Plans: Drawings indicating the locations of temporary protection and means of egress for adjacent occupied facilities, if applicable.
- D. Inventory: Submit a list of items to be removed and salvaged and deliver to Owner prior to start of demolition.
- E. Pre-demolition Photographs or Video: Show existing conditions of adjoining construction and site improvements that might be misconstrued as damage caused by facility demolition operations. Submit before the Work begins.
- F. Landfill Records: Indicate receipt and acceptance of hazardous wastes by a landfill facility licensed to accept hazardous wastes.

1.06 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- B. Standards: Comply with ANSI A10.6 and NFPA 241.

1.07 PROJECT CONDITIONS

- A. Facilities immediately adjacent to demolition area will be in use. Conduct demolition so operations of these facilities will not be disrupted.
 1. Provide not less than 72 hours' notice of activities that will affect operations of adjacent facilities.
 2. Maintain access to existing walkways, exits, and other facilities used by occupants of adjacent buildings and/or operations of adjacent facilities. Do not close or obstruct walkways, exits, or other facilities used by occupants of adjacent facilities without written permission from authorities having jurisdiction.
- B. Owner assumes no responsibility for buildings, structures, and other facilities to be demolished.
 1. OWNER will maintain conditions existing at time of inspection for bidding purpose as far as practical.
- C. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.
 1. Owner will remove hazardous materials before start of the Work.
 2. If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify ENGINEER and OWNER. OWNER will remove hazardous materials under a separate contract.
- D. On-site storage or sale of removed items or materials is not permitted.

1.08 COORDINATION

- A. Arrange demolition schedule so as not to interfere with Owner's on-site operations.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that utilities have been disconnected and capped before starting demolition operations.

- B. Review Project Record Documents of existing construction provided by Owner and ENGINEER. Owner or ENGINEER does not guarantee that existing conditions are same as those indicated in Project Record Documents.
- C. Inventory and record the condition of items to be removed and salvaged.
- D. Perform an engineering survey of condition of facilities to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during demolition operations. Locate tensioned steel tendons and include recommendations for de-tensioning, if applicable.

3.02 PREPARATION

- A. Existing Utilities: Locate, identify, disconnect, and seal or cap off indicated utilities serving facilities to be demolished.
 - 1. Arrange to shut off indicated utilities with utility companies.
 - 2. If removal, relocation, or abandonment of utility services will affect adjacent occupied buildings or operating facilities, then provide temporary utilities that bypass buildings and structures to be demolished and that maintain continuity of service to other buildings, structures, and facilities.
 - 3. Cut off pipe or conduit a minimum of 24 inches below grade. Remove cables or wires from conduit back to power source. Cap, valve, or plug and seal remaining portion of pipe or conduit after bypassing according to requirements of authorities having jurisdiction.
 - 4. At power surface remove any identification and installed plate identifying as 'Spare' or 'Not in Service.'
- B. Temporary Shoring: Provide and maintain interior and exterior shoring, bracing, or structural support to preserve stability and prevent unexpected movement or collapse of construction being demolished. Strengthen or add new supports when required during progress of demolition.
- C. Salvaged Items: Comply with the following:
 - 1. Clean salvaged items of dirt and demolition debris.
 - 2. Pack or crate items after cleaning. Identify contents of containers.
 - 3. Store items in a secure area until delivery to Owner.
 - 4. Transport items to storage area designated by Owner.
 - 5. Protect items from damage during transport and storage.

3.03 PROTECTION

- A. Existing Facilities: Protect adjacent walkways, loading docks, building entries, and other facilities during demolition operations. Maintain exits from existing facilities.
- B. Existing Utilities: Maintain utility services to remain and protect from damage during demolition operations.
 - 1. Do not interrupt existing utilities serving adjacent occupied or operating facilities unless authorized in writing by Owner and authorities having jurisdiction.
 - 2. Provide temporary services during interruptions to existing utilities, as acceptable to Owner and authorities having jurisdiction.
 - a. Provide at least 72 hours' notice to Owner if shutdown of service is required during changeover.
- C. Temporary Protection: Erect temporary protection, such as walks, fences, railings, canopies, and covered passageways, where required by authorities having jurisdiction, and as indicated.
 - 1. Protect adjacent buildings and facilities from damage due to demolition activities.
 - 2. Protect existing site improvements, appurtenances, and landscaping to remain.
 - 3. Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.

DEMOLITION

4. Provide protection to ensure safe passage of people around building demolition area and to and from occupied portions of adjacent buildings and structures.
 5. Protect walls, windows, roofs, and other adjacent exterior construction that are to remain and that are exposed to building demolition operations.
- D. Remove temporary barriers and protections where hazards no longer exist. Where open excavations or other hazardous conditions remain, leave temporary barriers and protections in place.

3.04 DEMOLITION, GENERAL

- A. General: Demolish indicated structures and equipment completely. Use methods required to complete the Work within limitations of governing regulations and as follows:
1. Do not use cutting torches until work area is cleared of flammable materials. Maintain portable fire-suppression devices during flame-cutting operations.
 2. Maintain fire watch during and for at least 4 hours after flame cutting operations.
 3. Maintain adequate ventilation when using cutting torches.
 4. Locate demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
- B. During demolition, perform surveys to detect hazards that may result from facilities demolition activities.
- C. Site Access and Temporary Controls: Conduct demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
1. Do not close or obstruct streets, walks, walkways, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.
 2. Use water mist and other suitable methods to limit spread of dust and dirt. Comply with governing environmental-protection regulations. Do not use water when it may damage adjacent construction or create hazardous or objectionable conditions, such as ice, flooding, and pollution.
- D. Explosives: Use of explosives is not permitted.

3.05 DEMOLITION BY MECHANICAL MEANS

- A. Proceed with demolition of structural framing members systematically, from higher to lower level.
- B. Below-Grade Construction: Demolish foundation walls and other below-grade construction that are within footprint of new construction and extending 5 feet outside footprint indicated for new construction. Abandon below-grade construction outside this area. Remove below-grade construction, including basements, foundation walls, and footings, to at least 12 inches below grade.
- C. Existing Utilities: Demolish and remove existing utilities and below-grade utility structures.
1. Remove existing utilities and piping that are within 5 feet outside footprint indicated for new construction.
 2. Abandon utilities outside this area by plugging pipes and removing cables within conduits back to motor control centers or source.
 3. Remove nameplate from motor starters or panelboards and replace with new nameplate identified as "Spare."
 4. Remove all underground utility structures and fill in accordance with Section 02300 "Earthwork." If within roadways, replace with like paving materials.

3.06 SALVAGED ITEMS

- A. Salvage: Items to be salvaged are indicated below:

1. Biological Trickling Filter Tower–type Odor Control System, including vessels, associated ductwork, blowers with motors, blower power and control panels, irrigation control panels, and other miscellaneous appurtenances.
 2. Fiberglass Enclosures
 3. Chemical Storage Tanks.
- B. Prepare temporary storage area by placing and leveling a 3 inch layer of clean sand on top of existing grade and under each stored chemical storage tank and bioscrubber. Sand shall be free from clay and clay lumps, shale, loam, organic matter, salt, chlorides, and other deleterious materials in accordance with ASTM C33. Sand to have not more than 15% passing a No. 200 sieve in accordance with ASTM C117.
- C. Biological Trickling Filter (Bioscrubber) System Salvage
1. CONTRACTOR shall secure the services of the bioscrubber manufacturer representative to supervise and approve the decommissioning of the units. Manufacturer representative shall ensure the systems are operating properly during the clean air flush and then again during the drying period. Manufacturer representative shall inform the CONTRACTOR when the media has reached the point of being clean and when the media is dry. The manufacturer representative shall be present during the moving of the bioscrubbers to the storage area.
 2. Disconnect ductwork upstream of the existing blowers from the odor source. The existing blowers and bioscrubbers should be left operational at this time. Operate the blowers and bioscrubbers with irrigation water operating but pulling clean air through the system. Operate the system for 6 days to completely flush the existing biomass and low pH filtrate from the scrubbers.
 3. At the end of the flushing period, turn off the irrigation water but continue to operate the blowers for 3 days to dry the scrubber media.
 4. Turn off blowers and disconnect the bioscrubber from the system.
 5. Remove the scrubber media cartridge from the FRP vessel.
 6. Move the FRP vessel to the storage location.
 7. Replace scrubber media cartridge in FRP vessel. Reinstall cover. All openings in the vessel shall be covered to prevent varmint entry.
 8. Media shall not be allowed to remain exposed to sunlight for more than 1 hour.
- D. Chemical Storage Tank Salvage
1. Drain remaining chemical from each tank into the chemical feed manhole on site. Flush the remaining chemical from the tank using water.
 2. Disconnect all external piping.
 3. Move each tank to the storage area and cover all openings to prevent varmint entry.
- E. Irrigation Water Panel Salvage
1. Open all valves and drain all water from the panel. Orient panel to ensure all water will drain prior to storage.
 2. Place panel in storage area. OWNER will relocate panel to an indoor storage facility.
- F. Electrical Power and Control Panels Salvage
1. Disconnect power supply and lock out for safety.
 2. Remove panels and secure doors shut. Place in storage area with a temporary tarp covering. OWNER shall relocate panels to an indoor storage facility.
- G. Move FRP enclosures and blowers with motors to storage area. OWNER will relocate blowers to an indoor storage facility.

3.07 SITE RESTORATION

- A. Below-Grade Areas: Completely fill below-grade areas and voids resulting from building demolition operations with satisfactory soil materials according to backfill requirements in Division 2 Section "Earthwork."

DEMOLITION

- B. Site Grading: Uniformly rough grade area of demolished construction to a smooth surface, free from irregular surface changes. Provide a smooth transition between adjacent existing grades and new grades.

3.08 REPAIRS

- A. Promptly repair damage to adjacent buildings caused by demolition operations.

3.09 DISPOSAL OF DEMOLISHED MATERIALS

- A. Remove demolition waste materials from Project site and legally dispose of them in an EPA-approved landfill acceptable to authorities having jurisdiction.
 - 1. Do not allow demolished materials to accumulate on-site.
 - 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
- B. Do not burn demolished materials.

3.10 CLEANING

- A. Clean adjacent structures and improvements of dust, dirt, and debris caused by demolition operations. Return adjacent areas to condition existing before demolition operations began.

END OF SECTION

Section 11264

BIOLOGICAL TOWER-TYPE ODOR CONTROL SYSTEM

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:

- 1. CONTRACTOR shall remove from service and salvage the existing biological tower-type odor control units (bio-scrubbers), the existing foul air blowers and motors, associated above ground duct work and dampers, existing irrigation control panels, and other miscellaneous appurtenances. Refer to Section 02220 – Demolition.
- 2. The SUPPLIER shall furnish, install, startup, balance, and test a complete Odor Control System (OCS), including foul air fans (Section 11330), biological tower-type odor control units (bio-scrubbers), appurtenances, instrumentation, and controls as specified herein and referenced sections of the specifications and the Drawings. The components of the OCS shall be furnished by a single supplier.
- 3. This section includes two (2) biological tower-type odor control units. Each biological tower-type odor control unit shall include the tower unit, irrigation system and mist eliminators, vessels or containers, inert inorganic media, valves, pumps, inlet air plenum, conduit, wiring, and control system.
- 4. The proposed system shall treat odors from the following locations in accordance with the requirements of this Section and the Drawings:
 - a. North Side Relief Tunnel Junction Chamber (as indicated on the Drawings);
 - b. 11th St Facility Wet Well Structure (as indicated on the Drawings);
- 5. To ensure system compatibility, a single SUPPLIER is responsible for the successful operation of each item of equipment and for the integrated system. The responsibility of the SUPPLIER shall include the approval of installation, system optimization, and warranties for the components and performance of the complete Odor Control System.
 - a. The responsibility of the Supplier shall also include providing hardware and ladder logic programming that conforms to City of Houston Standards.

B. Related Sections:

- 1. Division 1 Section 01330, "Submittal Procedures."
- 2. Division 1 Section 01755, "Starting Systems."
- 3. Division 9 Section 09901, "Protective Coatings."
- 4. Division 11 Section 11330, "Foul Air Fans."
- 5. Division 15 Section 15892, "Odor Control, Fiberglass Duct."

1.03 REFERENCES

- A. The following testing procedures shall be used to verify performance of the equipment, most current edition:
 - 1. ASTM E679: Determination of Odor and Taste Threshold by a Forced-Choice Ascending Concentration Series Method of Limits.
 - 2. EN 13725: Air Quality – Determination of Odor Concentration by Dynamic Olfactometry.

1.04 SUBMITTALS

- A. The following submittals are required.

1. Shop drawings specific to the project and applicable product data shall be bound neatly in a single package. The following information shall be submitted, as a minimum:
 - a. Manufacturer and model number of equipment.
 - b. Material Safety Data Sheets.
 - c. Layout drawings including all proposed system components with dimensions, clearances required and sizes indicated, anchor locations and sizes, details of ductwork or piping connections, size and location of required electrical conduits and conduit openings, and total weights of the product. Layout drawings shall be to scale in English units, provided on 11"x17" bond paper and on compact disk in AutoCAD format.
 - d. Include flow directions, process information, loading rates, empty bed residence time, water requirements, etc., descriptions and provisions for adjustments and alarms on operating components. Indicate extent of shop fabrication and field joint types and locations.
 - e. Detailed specifications and data describing the materials of construction, material thickness, linings, and coatings for all components.
 - f. Submit data that verifies the system is capable of uniformly distributing flow throughout the system without short-circuiting and will meet the specified treatment requirements.
 - g. SUPPLIER shall provide a list of similar installations with reference and contact information for operating systems. SUPPLIER shall have a minimum of five (5) successful installations of similar size for acceptance and shall have at least five (5) similar systems in continuous operation in similar applications for three (3) years. Submittals received without current names and phone numbers for reference contacts may be deemed non-responsive.
 - h. Descriptions and characteristics of media, anticipated media life at design conditions and current replacement cost (material supply only) of media.
 - i. Nutrients required for startup and operation, including concentrations and dosage rates, and range of operation.
 - j. Empty bed residence times for range of operating flows.
 - k. Headloss (inches of water column) through the bio-scrubber media, distribution plenum, and complete unit and odor control system over range of flows.
 - l. All required utility connection points and supply requirements including power and water (quality, quantity, and pressure).
 - m. Complete information on electric motors furnished including make and type of motor, brake horsepower and locked rotor current at full voltage.
 - n. Complete electrical control schematic and wiring diagrams and data on equipment, devices and controls to be furnished, including support for control panel.
 - o. Location and telephone number of nearest stocking distributor of spare parts.
 - p. Startup and test schedule with test procedures.
 - q. Equipment installation report with field test data and test records in accordance with Section 01330 (submit as record data after startup).
 - r. Warranties and service agreements.
 - s. All structural design calculations, drawings, and associated items shall be MANUFACTURER's responsibilities, and shall be including all scrubber vessels items, deflection of the vessel at the point of connection with the ductwork, thickness, anchor bolt size and location, hold-down lugs, lifting hooks, and loads imposed by appurtenances such as inlet and outlet ducting and internal media. The OWNER or OWNER'S Representative shall review the structural drawings and calculations for completeness only. All structural drawings and calculations shall be signed and stamped by a Professional Engineer (registered in the State of Texas) prior to submittal to the OWNER.
 - t. Design of system shall be in accordance with applicable local, state, and national standards and codes.

- u. A certificate from the vessel manufacturer listing the nomenclature, composition, and characteristics of the resin or other plastics shall be supplied with the submittal data, as well as vessel and support calculations as specified if fiberglass is used for the scrubber vessel.
 - v. Calculations for irrigation requirements, including recirculation rates.
 - w. Any other information necessary for the OWNER or OWNER'S representative to determine compliance with the specifications.
2. Instrumentation and Control Submittals:
- a. P&IDs and Process Flow Diagrams.
 - b. Instrument specifications in ISA Format with catalogue cut sheets.
 - c. Instrument list with tag names, ranges, alarm set points, and manufacturer contact information.
 - d. Description of control system in written form including functions monitored, controlled, and alarmed. Include sequence of operation and interface requirements.
 - e. PLC Network Submittals:
 - 1) First Submittal
 - 1. PLC Input/Output List.
 - 2. PLC Hardware and software, Ethernet Switch, and Operator Interface Terminal (OIT) specifications with catalogue cut sheets.
 - 3. Control panel Layout with overall dimensions, Panel NEMA rating, Panel exterior color, and layout of external and internal mounted components.
 - 4. Submit heat dissipation calculations for every control panel listing all heat loads, appropriate ambient temperatures, and required cooling.
 - 5. Loop Diagrams.
 - 6. Interconnection wiring diagrams.
 - 7. PLC Soft link Input/Output List (Made available in Contiguous Registers) for Control/Owner's HMI.
 - 2) Second Submittal (Furnish as one single submittal)
 - 1. Hard copy of the PLC Application program (Programming software manual) with explanation of conventions used. Descriptions of the program functions shall be included to aid in understanding by Owner personnel.
 - 2. Soft Copy of the PLC Application program with comments on CD-ROM.
 - 3. Hard copy of Color graphics, alarm lists, reports & trends. Graphics must be approved by the Owner.
 - f. This submittal shall also include screen shots of all OIT graphic screens and complete PLC database including specific data register mapping required for the CS Integrator subcontractor to establish Ethernet mapping for remote monitoring and control as shown in the Drawings and specified herein.
3. Complete Operation and Maintenance (O&M) Manuals shall be provided per Section 01782 and Division 1 requirements and shall include complete O&M information for all components of the system. O&M Manuals shall be submitted at least thirty (30) days prior to final acceptance of the system. In addition to standard information, the O&M manuals shall include:
- a. Scrubber media handling information and safety data sheet, including replacement procedures.
 - b. Certification statement from manufacturer verifying that the media is nonhazardous.
 - c. Fan sizing calculations. These shall include calculations of pressure loss through the proposed synthetic media, and losses through the system.
 - d. Complete point-to-point wiring diagrams. Complete component bill of material with manufacturers catalog cut sheets marked to show components provided.
 - e. Submit copies of final PLC and OIT program versions in native format.
 - f. Training video in a format approved by the Owner for the odor control equipment components.

- B. Partial or incomplete submittals will not be reviewed. Any exceptions from this specification shall be itemized in an exceptions table.

1.05 QUALITY ASSURANCE

- A. The MANUFACTURER shall provide an installation report prior to final acceptance. In addition to the requirements of Section 01330, the equipment installation report shall state that biological treatment system is achieving the specified removal efficiencies. Test data on the installed system shall be included in the report.
- B. All equipment of each type specified in this section shall be supplied by a single OCS Supplier and shall be the product of manufacturers regularly engaged in the design and manufacturing of biological odor scrubbing equipment. The OCS SUPPLIER, in coordination with the Foul Air Fans manufacturer(s) shall be responsible for supplying a complete functioning system.
- C. MANUFACTURER shall maintain a complete stock of spare parts commonly needed for the equipment specified at a location within 500 miles of Houston, Texas or shall be able to deliver the spare parts within 48 hours of notification.
- D. All pieces of equipment shall have a stainless steel manufacturer's nameplate securely affixed in a conspicuous place on the equipment showing the ratings, serial number, model number, manufacturer and other pertinent nameplate data.
- E. Upon completion of the installation, each piece of equipment and the system shall be tested for satisfactory operation without excessive noise, vibration, overheating, etc. All equipment must be adjusted and checked, for misalignment, clearances, supports, and adherence to safety standards. Excessive vibration or noise from equipment while operating will be cause for rejection of equipment.
- F. Performance testing shall be conducted as specified herein, and per Section 01755, "Starting Systems."
- G. Post installation Inspection: MANUFACTURER shall provide a field representative to inspect the system eleven (11) months after substantial completion of the entire project and shall submit an inspection report within seven (7) calendar days of each inspection.

1.06 DELIVERY, STORAGE AND HANDLING

- A. Delivery, storage and handling shall be in full accordance with MANUFACTURER'S instructions. Fabricated assemblies shall be shipped in the largest sections permitted by carrier regulations, properly match-marked for ease of field erection.

1.07 INITIAL SUPPLY OF CONSUMABLES

- A. MANUFACTURER shall furnish and indicate types, brands, and quantities of initial lubricants, oil, grease, nutrient solutions, biological seeding material, etc. necessary to startup equipment. MANUFACTURER shall provide and install the recommended lubricants and shall comply with all manufacturer recommended procedures.
- B. If nutrients are required for operation, MANUFACTURER shall provide a one-year supply (beginning at acceptance of the odor control unit) of nutrients in addition to supplies for startup and testing.

1.08 WARRANTY

- A. Special Equipment Warranty: Refer to Division 1 for Special Equipment Warranty requirements. Additional warranty requirements are listed below.
- B. Media: Special media warranty shall be for ten (10) years from final acceptance of the odor control equipment and shall provide for complete replacement of the media, including equipment, materials, labor, freight, and any and all costs associated with washing, replacing or regenerating

the media as needed. Media failure includes increase in pressure drop through the media such that the specified airflow rates are not achievable with the installed equipment.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with all specified requirements, available manufacturers offering products include the following:

1. BioAir Solutions, LLC
2. Enduro Composites, Inc.
3. Biorem
4. Engineered Composite Systems
5. Evoqua Water Technologies
6. Daniel Mechanical Company
7. Met-Pro Environmental Air Solutions (Bio-Pro System) or Approved Equal

2.02 PERFORMANCE AND DESIGN REQUIREMENTS

A. Source Characteristics for the 11th Street Facility: Expected odorant composition is given in Table 1.

TABLE 1: PERFORMANCE AND DESIGN REQUIREMENTS

Foul Air Parameters	Value or Range
Foul Air Flow Rate	Typical Operation: 25,000 cubic feet per minute (cfm) (total); 12,500 cfm (per unit)
Average Inlet Hydrogen Sulfide Concentration Range	25-50 parts per million (ppm)
Inlet Hydrogen Sulfide Concentration Transient Peak	200 ppm
Other Inlet Odorants	Reduced Sulfides, VOCs, Amines
Ambient Air Temperature	0-115°F
Empty Bed Residence Time (EBRT)	10 seconds, minimum at Typical Operating Condition
Maximum Pressure Drop (from inlet to outlet flanges)	6.5 inches w.c., maximum

B. Removal requirements:

1. Refer to Paragraph 3.3 of this Section for additional performance testing requirements.
2. Biological Tower-Type Odor Control System Guarantee (at the Typical Operating Condition):
 - a. H₂S Removal: Minimum ninety-nine percent (≥99%) of inlet hydrogen sulfide or the outlet concentration shall be less than 0.1 ppm, whichever is less stringent.
 - b. Odor Removal:
 - 1) ≥ 90% or ≤ 1000 D/T, whichever is less stringent (provided that the average inlet H₂S concentration is >20 ppmv and the total inlet non-H₂S reduced sulfur compound concentration is < 0.2 ppmv)
 - 2) ≥ 80% or ≤ 2000 D/T, whichever is less stringent (provided that the average inlet H₂S concentration is ≤20 ppmv or the total inlet non-H₂S reduced sulfur compound concentration is ≥ 0.2 ppmv)

2.03 BIOLOGICAL TOWER-TYPE ODOR CONTROL SYSTEM

A. The MANUFACTURER shall:

1. Supply all materials and equipment exposed to the airstream, condensate, or leachate with protection from corrosion damage. Corrosion resistant materials and equipment are required unless specifically permitted in this section.
2. Provide all hardware, anchors, embedded anchors, and miscellaneous metals that are Type 316 stainless steel.
3. Obtain approval from the OWNER or OWNER's representative for all coatings to be used in the completed installation. Coatings shall be in accordance with Section 09901, where applicable. **All outside visible fiberglass reinforced plastic exterior surfaces shall be beige in color.**
4. Provide an odor control system that operates using biological processes and does not rely on carbon either integrated within the media or as a polishing stage for meeting the specified performance for the biological tower-type odor control system.
5. Provide sampling ports (minimum 1/2-inch diameter) for the inlet, exhaust and a minimum of one (1) intermediate stages to measure airflows and airstream constituents. Ports shall be easily accessible by OWNER'S personnel and shall be routed to ground level. Provide a pressure gauge to measure the pressure in the distribution plenum at the base of the scrubber unit. Sample ports routed to ground level shall include a drip leg with ball valve. Provide a ball valve on the end of the sample line.
6. Provide sample ports with ball valves on condensate and leachate drains to measure pH. Ports shall be easily accessible by OWNER's personnel. Provide pH probes in the locations as designated on the Drawings.
7. CONTRACTOR shall heat trace, insulate, and place aluminum jacket on all exposed water lines and valves.
8. All drains from a pressure area shall include a trap with cleanout to be provided by MANUFACTURER. Trap shall contain a depth of water sufficient to prevent escape of foul air from the system.

B. Vessel Requirements

1. All materials used in the vessel shall be inherently corrosion resistant or shall have a corrosion resistant coating. Design drawings for vessel(s) shall be sealed by a licensed engineer registered in the State of Texas.
2. Acceptable materials include:
 - a. Fiberglass Reinforced Plastic (FRP) vinyl ester resin in accordance with ASME RTP-1.
 - 1) Provide a gel coat (**beige in color**) on all surfaces and UV inhibitor on all external surfaces.
 - 2) Submit certificate from the vessel manufacturer listing the nomenclature, composition, and characteristics of the resin, as well as vessel and support calculations.
 - b. Grade 316L stainless steel.
 - c. Hastelloy C.
 - d. Other materials may be utilized on a case-by-case basis subject to approval by OWNER and its ENGINEER.
3. Design of system shall be in accordance with applicable local, state, and national standards and codes. Provide an aluminum or FRP ladder with cage and landings fastened to each scrubber used to access the exhaust stack.
4. Tank shall meet the following loading criteria:
 - a. Wind load limit when anchored: 130 mph.
 - b. Concentrated top load limit: 250 lb. on a 16 square inch area.
 - c. Seismic zone: 0.

C. Irrigation system: The system shall include an irrigation system.

1. Irrigation system shall provide water for biological activity. Irrigation shall be monitored and controlled by PLC, as appropriate for the Manufacturer's process.

2. Indicate in the submittal what the water requirements are for operation, including water type (potable/non-potable) and maximum instantaneous flow rate in gpm. Provide an in-line filter or strainer on the water supply line.
- D. Particulate removal: MANUFACTURER'S design shall consider particulates such as wind-blown dust that may be present in the airstream and shall provide for their removal if equipment performance shall be hampered by their presence.
- E. Comply with the requirements of Division 9 Section 09901, "Protective Coatings."

2.04 INSTRUMENTATION, CONTROL AND ELECTRICAL COMPONENTS

- A. All instrumentation, control and electrical components provided under this section shall comply with the requirements on the Drawings and Division 11 and 16 Sections.
- B. Control Panel
 1. General: Refer to Section 11009 "Common Control Panel Requirements for Equipment" for the general requirements of the Control Panel. Provide control system for equipment system, including but not limited to, for monitoring the following instruments and controls. This list is not intended to completely depict all of the functional requirements of the control system provided under this Section. The system supplier shall provide all additional instrumentation and controls necessary to produce a safe and operable system.
 2. The panel shall include the following controls mounted on panel door;
 - a. Run and fail status for each piece of equipment
 - b. Start/stop push buttons for each piece of equipment.
 - c. HOA switches for each piece of equipment.
 - d. Fail reset button for each piece of equipment
 - e. Elapsed run time meter for each piece of equipment.
 - f. Operator Interface Panel
 3. Panel shall communicate to Control System via Ethernet.
 4. Recirculation Pump Starter
 5. Circuit for Irrigation Piping heat tracing.
 6. Panel shall be provided with air conditioning.
 7. The Duty/Standby rotation of the blowers will be controlled by the bio-scrubber Control Panel.
- C. Functional Requirements
 1. The following sequence of the operation is provided to establish a basic level of detail and complexity for the system. Individual manufacturer's recommendations for their specific machine settings will be taken into consideration during the shop drawing review process.
 2. The bio-scrubber system may be operated in the automatic mode by placing the HAND/OFF/AUTO selector switch within the OIT in the AUTO position. The AUTO MODE indicator shall be illuminated on the OIT and the PLC shall control the bio-scrubber system equipment automatically as defined by the system supplier.
 3. To operate the bio-scrubber system in the manual mode, the operator shall place the HAND/OFF/AUTO selector switch in the HAND position on the OIT. The HAND MODE indicator shall be illuminated on the OIT. The operator shall control the bio-scrubber system equipment manually via pushbuttons on the OIT.
 4. Positive status shall be wired back in the form of discrete contracts from field equipment or starters. A piece of equipment shall be considered failed if it is requested to START, STOP, OPEN, or CLOSE and the PLC does not receive proper feedback after an adjustable period of time.
 5. The PLC-based control functions at the MCP shall include control and operator interface capability plus pass-through to the control system for remote control and monitoring of position, speed, running status, and failure status for each piece of equipment.

6. The Foul Air Fans shall be directly controlled by hardwired I/O and logic from the PLC in the Odor Control System MCP.
- D. Field Instrumentation
1. Instruments shall include, but not be limited to pH probe(s), pressure gauge(s), level switch(es), water flow meter(s), and differential pressure sensor(s).
- E. Sequence of Operation
1. The following sequence of the operation is provided to establish a basic level of detail and complexity for the system. Individual manufacturer's recommendations for their specific machine settings will be taken into consideration during the shop drawing review process.
 2. The bio-scrubber system may be operated in the automatic mode by placing the HAND/OFF/AUTO selector switch within the OIT in the AUTO position. The AUTO MODE indicator shall be illuminated on the OIT and the PLC shall control the bio-scrubber system equipment automatically as defined by the system supplier.
 3. To operate the bio-scrubber system in the manual mode, the operator shall place the HAND/OFF/AUTO selector switch in the HAND position on the OIT. The HAND MODE indicator shall be illuminated on the OIT. The operator shall control bio-scrubber system equipment manually via pushbuttons on the OIT.
 4. Positive status shall be wired back in the form of discrete contracts from field equipment or starters. A piece of equipment shall be considered failed if it is requested to START, STOP, OPEN, or CLOSE and the PLC does not receive proper feedback after an adjustable period of time.
 5. The PLC-based control functions at the MCP shall include control and operator interface capability plus pass-through to the control system for remote control and monitoring of position, speed, running status, and failure status for each piece of equipment.

2.05 CONTROL DESCRIPTION

A. General

1. The Odor Control System is a stand-alone control system monitored by the Control System. The MCP provides supervisory and automatic control through the panel's OIT and physical switches and is used by the Plant Operators to make adjustments to foul air fan and bio-scrubber controls.
2. All control actions at the Odor Control MCP are performed using the Odor Control PLC. To prepare for the Odor Control System to run, the Operator shall make selections from the following equipment and control options:
 - a. Odor Control Foul Air Fan (Select one of the two supply fans for each specified location).
3. To the run the Odor Control System from the MCP, all equipment controlled by the Odor Control System must have their Local/Remote switches on their Local Control Panels in the Remote position and applicable VFD/MCC Hand/Auto switches in the Auto position.

2.06 SPARE PARTS

A. The following spare parts shall be provided:

1. One (1) set of special tools required for maintenance or adjustment.
2. Two (2) sets of fuses of each type used.
3. Two (2) spare relays of each type used.
4. One (1) spare bulb of each type used on panel fronts.
5. One (1) spare water panel strainer element.
6. Other items as recommended by the Manufacturer and Supplier.

PART 3 EXECUTION

3.01 FABRICATION AND FACTORY TESTING

- A. The procedure shall consist of the Test Plan submittal and the Testing, and shall comply with Section 01755, "Starting Systems." In the Test Plan submittal, the approach to testing is stated along with a description of the general approach to testing all functions. This plan gives the reader a good idea of how the testing will be conducted. The details of the testing are in the Testing Sections. The Test Plan submittal shall include the following:
1. Purpose
 2. References
 3. Test Environment Statement
 4. Procedure
 5. Test Section Checklist
- B. The body of the Factory Testing is split into sections around similar functional test areas. The sections contain a minimal amount of description of the testing with the great majority dedicated to recording the data. Each section includes the following:
1. Test Number.
 2. Test Purpose.
 3. Acceptance Criteria.
 4. Detailed Test Procedure.
 5. Data Collection Portion of the Form.
 6. Comments Section.
 7. Signature Block.
 8. Date Block.
 9. Approval Block.
- C. All major system controls for the Odor Control System shall be factory tested for compliance with the construction and functional requirements specified herein and a report of the results of these tests shall be submitted in writing to the Engineer for each control panel separately, prior to shipment. All PLC and OIT programming shall be performed at the factory. Certification of test results shall be submitted to the Owner and Engineer. Factory testing shall consist of an Unwitnessed Factory Test (UFT). Supplier shall notify the Engineer and Owner of the successful completion of the UFT. Examples of testing sections are as follows:
1. Panel wiring.
 2. Panel power on operational test.
 3. I/O check from panels through the software.
 4. Testing of manual operations.
 5. Testing of functional modules of programming (automatic and sequencing).
 6. Trending and Alarm verification.
 7. Security.
 8. Power loss and restoration.
 9. OIT and graphics shall be tested.
- D. Successful completion of UFT and approval of PLC programming by the Engineer are required prior to shipment of the PLC. Retainage of payment shall be withheld until successful completion of UFT and approval of PLC programming as described herein.

3.02 MANUFACTURER'S SERVICES

- A. Manufacturer's services shall comply with the requirements of Division 1 Section 01755 "Starting Systems."
- B. Submittal of O&M Manuals shall be coordinated with Manufacturer's services so that final manuals are provided before classroom or site training begins.
- C. The MANUFACTURER shall furnish a qualified startup engineer or field representative to provide guidance with installation. The field representative shall also inspect all equipment described

herein after installation, assist in troubleshooting, advise the CONTRACTOR during startup, balancing, and testing, and instruct OWNER's personnel in routine maintenance and troubleshooting procedures. Working days shall consist of eight-hour (8-hr) days, exclusive of travel time. The MANUFACTURER shall coordinate the scheduling of such training and startup assistance with OWNER'S personnel. OWNER may videotape training session.

- D. Manufacturer's Representative: Present at Project site or classroom designated by OWNER, for minimum person-days listed in Table 2, travel time excluded:

TABLE 2: MANUFACTURER'S SERVICES

Work Description	No. Person Days	No. Trips
Installation assistance and inspection	1	1
System balancing and functional and performance testing	1	Can be combined with training
Pre-startup classroom or site training	1	1
Facility startup	1/2	Can be combined with training
Follow up visit 11 months after substantial completion for inspection and training	1	1

3.03 START-UP, BALANCING, AND ACCEPTANCE TESTING

- A. Startup of the odor control system shall be done in accordance with MANUFACTURER'S recommendations and as specified in Section 01755, "Starting Systems."
- B. Each portion of the OCS shall be tested as specified herein and as indicated in Division 1. The OCS shall be sampled at the intake of each bio-scrubber and at each bio-scrubber unit discharge.
- C. In the presence of the OWNER and the OWNER's engineer, CONTRACTOR shall adjust and balance the odorous air flow in the complete foul air collection system. Requirements include measurement and establishment of the air quantities and pressures as required to meet design Specifications, and recording and reporting the results.
- D. In the presence of the OWNER and the OWNER's engineer, CONTRACTOR shall test the operation of the odor control system. Final acceptance shall not be made until after successful completion of the performance testing and receipt of the final installation report.
- E. Testing Equipment: CONTRACTOR shall supply the equipment listed below for the duration of the performance testing. Equipment shall remain on site until performance testing has been accepted by the OWNER or OWNER'S representative. Submit current calibration certificates for each piece of equipment used along with test results. CONTRACTOR shall comply with equipment manufacturer's recommendations for equipment use.
 - 1. Odalog Hydrogen Sulfide Gas Logger by Detection Instruments. One Range 0-1000 ppm Odalog; two low-range 0.001-2.0 ppm Odalogs; one Low-Range Sampling System (LRSS-2) and one Multiple Odalog Sampling System (MOSS-2) unit, each with sufficient PVC or Teflon hose for testing.
 - 2. Alnor AXD 540 Micromanometer by TSI Incorporated, Range 250-15,500 fpm, with 18-inch pitot tube and hoses, or acceptable equivalent.
 - 3. Accuro gas detector pump by Drager Safety. Include 10 tubes for Hydrogen Sulfide 0-2000 ppm.
 - 4. Odor sampling shall commence one hour after the H₂S monitoring equipment has been installed and is determined to be stable. Two (2) sample sets, each consisting of the bio-scrubber inlet and bio-scrubber discharge from each pair of treatment units shall be taken, each sample set taken one hour apart. The inlet and outlet samples for each

treatment unit shall be taken concurrently and the sampling time and inlet and outlet H₂S levels logged in the field prior to shipment. The samples shall be shipped to the laboratories for analysis to be received within 24 hours. The analyses and respective laboratories shall include:

5. ODOR UNITS TESTING:
St. Croix Sensory
1150 Stillwater Blvd. North
Stillwater, MN 55082
1-800-879-9231
 6. REDUCED SULFIDES TESTING:
ALS Environmental (formerly Columbia Analytical Services, Inc.)
2655 Park Center Drive, Suite A
Simi Valley, CA 93065
805-526-7161
- F. Adjusting, Balancing, and Testing Procedure:
1. The OCS shall be adjusted and balanced prior to testing. This process shall include:
 - a. Adjusting the air flow rates from the specified foul air sources (e.g., reduce fan speed, throttling with damper adjustments).
 - b. Balancing the system to proportion flows within the distribution system (sub mains, branches, and terminals) according to specified design quantities.
 2. Measure the airflow velocity (feet per minute(fpm)), static pressure (inches water column (in. wc)), and velocity pressure (in. wc) into each odor scrubber/adsorption unit. Airflows shall be within five percent (5%) of the specified value before testing may commence.
 3. Measure the airflows into each individual scrubber/adsorption unit. Airflows shall be within 5% of equal or specified distribution before testing may commence.
 4. Using the Draeger pump and H₂S tubes, verify the inlet H₂S concentration is less than 1,000 ppm.
 5. Connect the low range Odalog LRSS-2 tube to the exhaust of each scrubber/adsorption unit being tested. Connect the high range (0-1000 ppm as appropriate) Odalog MOSS-2 tube to the foul air collection system at the inlet of the bio-scrubber(s) being tested. Coordinate sampling locations with the OWNER or OWNER'S Representative. Odalogs shall be set to log time, temperature (°F) and H₂S concentration at two-minute intervals, maximum. Log data continuously for a minimum of two weeks for each pair of scrubber/adsorption units. Comply with the Odalog manufacturer's instructions and recommendations for use. Odalogs must be logging data during the duration of the tests. Testing shall comply with Section 01755, "Starting Systems," and Division 1.
 6. Using the low-range Odalogs, log bio-scrubber exhaust H₂S concentrations at maximum two-minute intervals.
- G. Testing Report: CONTRACTOR shall submit the following:
1. CD-ROM containing the original Odalog data files and files exported into Microsoft Excel format. Written report shall include graphs of Odalog data.
 2. Dimensioned drawing showing locations and identification of samples taken.
 3. Date, time, sample and results of each sample taken.
 4. Airflow rate, static and velocity pressures at the time of sampling.
 5. Any deviations from the test procedure with an explanation.
 6. Original log of sample information including but not limited to duration of each sampling event and overall performance test, equipment type used for each sampling event, type of constituent measured in each sampling event.
- H. Acceptance: Determination of satisfactory performance will be made by the OWNER or OWNER'S representative based on the above performance testing or additional testing as needed. Acceptable H₂S removal will be determined by averaging the continuously logged inlet

H₂S concentrations and averaging the continuously logged outlet concentrations measured by the Jerome meter or Odalogs, as appropriate. Odor sampling shall be performed in accordance with ASTM E679 and EN 13729. If the sampling results do not meet the requirements of Paragraph 2.2, Item B of this Section, the MANUFACTURER will be given four weeks to make necessary modifications to the odor control system before a retest is conducted at no expense to the OWNER. The OWNER may withhold the cost of any retest from the CONTRACTOR's final payment. If the system fails two retests, the MANUFACTURER shall remove and replace the odor control system with one that meets the requirements, at its sole cost.

- I. MANUFACTURER may conduct concurrent testing at their option at no cost to the OWNER. Concurrent testing by the MANUFACTURER will not be used as a basis for unit acceptance.
- J. All warranty and guarantee periods shall be in accordance with Division 1 and Paragraph 1.08 of this Section. Performance testing may not begin until the system is connected to all the foul air sources listed in Paragraph 1.02, Item A.3 of this Section.

END OF SECTION

Section 11330

FOUL AIR FANS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Coordinating Supplier:

1. The SUPPLIER of the Biological Tower-Type Odor Control System (Section 11264) shall be responsible for providing all equipment listed in this specification section.

B. Section Includes:

1. The SUPPLIER shall furnish, provide installation guidance, startup, and test two (2) foul air fans with variable frequency drives (VFDs), as shown in the Drawings, and as specified herein for a complete and operable system. Each foul air fan unit shall include all equipment components, materials, accessories, wiring, control system (compatible with the Plant Control System (PCS)), and incidentals as required for functional equipment, excluding ducts or dampers.
2. To ensure system compatibility, a single SUPPLIER is responsible for providing a complete odor control system, the successful operation of each item of equipment in the package, and for the integrated system which also includes Biological Tower-Type Odor Control Systems (Section 11264). The responsibility of the SUPPLIER shall include the approval of installation, system optimization, and warranties for the components and performance of the complete Odor Control System.

C. Related Sections:

1. Division 1 Section 01330, "Submittal Procedures."
2. Division 1 Section 01755, "Starting Systems."
3. Division 9 Section 09901, "Protective Coatings."
4. Division 11 Section 11009, "Common Control Panel Requirements."
5. Division 11 Section 11005, "Common Motor Requirements."
6. Division 11 Section 11264, "Biological Tower-Type Odor Control System."

1.03 REFERENCES

- A. Reference Standards: This Section contains references to the following documents. They are part of this Section as specified and modified. In case of conflict between the requirements of this Section and those of the listed documents, the requirements of this Section shall prevail. Comply with applicable provisions and recommendations of the following, except where otherwise shown or specified.

1. AFBMA, Anti-Friction Bearing Manufacturers Association.
2. AMCA 210-97/ASHRAE 51-1985, Laboratory Methods of Testing Fans for Rating.
3. AMCA 300, Reverberant Room Method for Sound Testing of Fans.
4. ASHRAE 51-1985 Laboratory Methods of Testing Fans for Rating.
5. ASTM C 582, Specification for Contact-Molded Reinforced Thermosetting Plastic Laminates for Corrosion Resistant Equipment.
6. ASTM D 2563, Practice for Classifying Visual Defects in Glass reinforced Plastic Laminate Parts.
7. ASTM D4167-97 (2002), Standard Specifications for fiber-Reinforced Plastic Fans and Blowers.
8. IEEE 112, Standard Test Procedure for Polyphase Induction Motors and Generators.

FOUL AIR FANS

9. NEC, National Electric Code.
 10. NEMA, MG1 - Motors and Generators.
 11. NFPA, National Fire Protection Association.
 12. SSPC, Steel Structures Painting Council.
 13. Underwriter's Laboratories, Inc.
 14. AMCA 211-94, Certified Ratings Program – Air Performance
 15. ANSI/AMCA 204-96, Balance Quality and Vibration Levels for Fans
- B. Inspection and Testing Requirements: The visual inspection of the equipment shall comply with ASTM D 2563, Visual Acceptance Level II.
- C. Listing, labeling or marking, as conforming to the standards of AMCA, Underwriter's Laboratories, Inc., American National Standards Institute, Inc., or other nationally recognized testing organization approved by Code, on various pieces of equipment furnished shall be prima facie evidence of conformity with the approved standards for safety to life and property.
- 1.04 SUBMITTALS
- A. Shop Drawings: Submit for approval the following:
1. MANUFACTURER shall submit for review to OWNER or OWNER'S representative, sufficient literature, detailed specifications, and drawings to show dimensions, fabricator or manufacturer, speed, model, size, type, horsepower, service factors, efficiency, materials used, design features, internal construction, weights, and any other information required by OWNER or OWNER'S representative for review of odor control fans and all appurtenances. No odor control fan equipment shall be accepted, and installation shall not be allowed until such review has been completed.
 2. Additional requirements for information to be included with Shop Drawings are specified below:
 - a. Submittal for the odor control fans shall include as a minimum the following:
 - 1) Manufacturer's certified rating data.
 - 2) Certified Shop Drawings providing all important materials and details of construction, dimension, and anchor bolt locations. (w/ FINAL PRINTS AFTER APPROVAL).
 - 3) Descriptive literature, bulletins, and catalogs of the equipment.
 - 4) The total weight of the equipment.
 - 5) A complete bill of materials.
 - 6) A list of the manufacturer's recommended spare parts. Include gaskets, packing, etc., on list.
 - 7) Complete data on motors, motor starters, nameplate data and controls.
 - 8) Data on noise in accordance with AMCA #300.
 - 9) Description of surface preparation and shop primer and shop finish coating as specified in this Section.
 - 10) Inlet and outlet connection bolt hole patterns.
 - 11) Results of factory dynamic balance of fan and field check of dynamic balance of fan.
 - 12) Complete electrical wiring diagrams and data on controls to be furnished, as pertinent.
 - 13) Specific design parameters for this project including flow rates and pressure losses for normal conditions. Include AMCA certified blower curves showing efficiency, cfm, outlet velocity, static pressure, brake motor horsepower, and decibel level ratings.
- B. Shop Test Results:
1. Submit results of routine factory motor tests.
 2. Submit results of material tests.
- C. Field Test Results: Submit a written report providing the results of the required field tests per Paragraph 1.5, Item K of this Section.

- D. Manufacturer's Reports: Submit a written report of the results of each visit by a manufacturer's service person, including purpose and time of visit, tasks performed and results obtained.
- E. Operation and Maintenance Manuals: Submit complete installation, operation and maintenance manuals, test reports, maintenance data and schedules, description of operation, and spare parts information.
- F. Lubricant Specification: Furnish a lubricant specification for the type and grade necessary to meet the requirements of the equipment.
- G. Partial or incomplete submittals shall not be reviewed. Any exceptions from this specification shall be itemized in an exceptions table.

1.05 QUALITY ASSURANCE

- A. The MANUFACTURER shall provide an installation report prior to final acceptance. In addition to the requirements of Section 01302, the equipment installation report shall state that the treatment system is achieving the specified removal efficiencies. Test data on the installed system shall be included in the report.
- B. Odor Control Fan Manufacturer's Qualifications: Equipment Supplier shall supply a fan from a manufacturer that has a minimum of five (5) years of experience of producing similar equipment and shall be able to show evidence of at least five installations, of the same size and type, in satisfactory operation for at least five years.
- C. Materials Testing: Materials employed in items fabricated of fiberglass reinforced plastic shall be capable of withstanding maximum calculated stresses that may occur during fabrication, installation and continuous operation, with allowance for an adequate safety factor. To confirm materials properties, tests shall be conducted by an independent, qualified testing laboratory on representative material samples in accordance with the latest revision of Standards referenced in Paragraph 1.3.B, above.
- D. Products supplied under this Section shall be produced by manufacturers regularly engaged in the production of such items and have a successful history of product acceptability, as interpreted by OWNER or OWNER'S representative.
- E. When two or more units of equipment for the same purpose are required they shall be the product of one MANUFACTURER.
- F. MANUFACTURER'S installation report is required prior to final acceptance.
- G. Excessive vibration of equipment while operating shall be cause for rejection. This is based upon "IN" readings on the fan bearings at installation fan rpm per the requirements of Fan Application Category BV-3 of AMCA ANSI Standard 204-96. If Final Trim Balancing is required it is the responsibility of the SUPPLIER to have this done by a MANUFACTURER approved Vibration Specialist.
- H. MANUFACTURER shall maintain a complete stock of spare parts commonly needed for the equipment specified at a location within 500 miles of Lubbock, Texas, or shall furnish spare parts within 48 hours of request.
- I. Each major equipment item shall have an engraved stainless steel MANUFACTURER'S nameplate securely affixed in a conspicuous place on the equipment showing the ratings, serial number, model number, MANUFACTURER and other pertinent nameplate data.
- J. If the equipment being offered differs from these specifications, all revisions in the design and construction of the structure, piping, appurtenant equipment, electrical work, etc. required to accommodate such a substitution shall be made at no additional cost to the OWNER.
- K. Factory Test Reports with curves, vibration, sound, pressure, and bearing analyses shall be provided by the MANUFACTURER (AMCA 210 and 300).

FOUL AIR FANS

- 1.06 PRODUCT DELIVERY, STORAGE, AND HANDLING
- A. Product Delivery, Storage and Handling:
1. SUPPLIER shall be responsible for safe transportation, storage, and handling of the equipment.
 2. MANUFACTURER shall protect all flange faces and the more fragile appurtenances of the sub-assemblies, with padding between pieces in order to prevent one piece from impacting with another, and by crating or other means for shipment.
 3. Large sub-assemblies shall be supported during unloading to prevent excessive deflection and overstressing.
 4. Suction and discharge ports shall be protected against entry of foreign objects.
- 1.07 EQUIPMENT INSPECTIONS
- A. A thorough inspection of each piece of equipment shall be conducted by the CONTRACTOR upon arrival at construction site to inspect for damage incurred in transit. Any damage shall be immediately repaired by respective equipment fabricator's personnel, not a sales representative, or the equipment shall be returned to the SUPPLIER.
- 1.08 EQUIPMENT FABRICATION
- A. FRP equipment and accessories shall be fabricated in a heated and well ventilated structure protected from weather and temperature extremes. Entire fabrication, curing and assembly process of any piece of FRP equipment shall be indoors. SUPPLIER shall submit an affidavit certifying that all FRP equipment shall be fabricated, cured and assembled as described in this Section and in accordance with the manufacturer's recommendations.
- 1.09 EQUIPMENT DEFECTS
- A. Equipment that has mechanical defects and does not meet manufacturer's vibration requirements shall be rejected and shall be replaced at MANUFACTURER'S full expense for furnishing, installing, removal, and replacement.
- B. Mechanical defects shall include excessive vibration, improper balancing of rotative parts, improper tolerances, binding, excessive bearing heating, defective materials, improper fitting of parts, and any other defect which shall in time damage the equipment or impair its operation.
- C. Requirements must be met concerning minimum and maximum dimensions and the specifications for materials. If it is found upon delivery that materials do not agree with the requirements of these Specifications as to materials, size, type, quality, or metallurgy, they shall be rejected as unfit for use.
- 1.10 WARRANTY
- A. Special Equipment Warranty: Refer to Specification 01100 "Special Conditions", Item 14.A, for Special Equipment Warranty requirements.
- PART 2 PRODUCTS
- 2.01 ODOR CONTROL FANS
- A. General: Refer to schedule at end of this specification for specific fan requirements. Provide each odor control fan complete with motor, drive, guard, and baseplate. The fan shall be constructed such that all surfaces in contact with the corrosive gas stream are to be made of solid, corrosion resistant fiberglass reinforced plastic (FRP) for the fan housing and FRP for the fan wheel. All nuts, bolts and fasteners in contact with the gas stream shall be type 316 SST and encapsulated in FRP. AMCA Arrangement 4, which places the motor shaft in the corrosive gas stream, is unacceptable.

- B. Type: Single width, single inlet, backward curved type impeller, minimum Class II centrifugal fan with fixed discharge. Each fan shall be tested and rated in accordance with ASHRAE 51-75, AMCA Standard 210 and shall be licensed to bear the AMCA 211-94 Certified Ratings Seal for air performance, and be guaranteed by MANUFACTURER to deliver rated performance.
- C. Performance: 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 MANUFACTURER'S expense, in an AMCA Registered Laboratory. Fans shall have a sharply rising pressure characteristic extending throughout the operating range to assure quiet and stable operation. Fan brake horsepower shall be equal to or less than the BHP specified in the schedule at the listed static pressure and CFM.
- D. Sound: MANUFACTURER shall provide a sound power level rating for fans tested and rated in accordance with AMCA Standards 300 and 301. Sound power ratings shall be in decibels (reference 10-12 watts) in eight octave bands. The maximum sound level shall be at or below 80 decibels at 5 feet.
- E. Construction: Fan shall be constructed in accordance with the ASTM D-4167 standard specification for fiber-reinforced plastic fans and blowers to ensure structural integrity. All parts exposed to the gas stream shall be constructed of, or encapsulated in, an FRP laminate capable of resisting continuous airstream temperatures of 250°F. Fan housing must be fabricated of polyester resins; and "C" grade or better surface veil; To prevent premature deterioration of airstream components a Hartkoate abrasive/erosive resistant coating of 50-60 mils thickness shall be applied or an equivalent coating.
1. Housing: Fan housing shall be designed so that air leakage through joints and seals is negated. All bolted pieces shall be EPDM gasketed for air tightness. Fan housing shall be made of FRP construction and electrically grounded.
 2. Fan Wheel: Fiberglass construction, backward curved wheel, non-loading, high efficient, one-piece, resin transfer mold. A hand lay-up or assembly of component type wheel is not acceptable. Utilize Dow Derakane 510-A vinyl ester resin.
 3. Fan Shaft: Shaft shall be of Type 316 stainless steel or fiberglass designed to operate 25% below first critical speed. Shaft and impeller shall be electromechanically, statically and dynamically balanced to the requirements of Fan Application Category BV-3, AMCA 204 and shall receive an operational test prior to shipment. Provide Teflon or equivalent double lip seal with Type 316 stainless steel mounting plate between shaft and housing. Seal shall positively prevent liquid and gas leakage.
 4. Fan Bearing Base: Provide Type 316 stainless steel fan bearing base.
 5. Fan Bearings:
 - a. Each fan shaft shall be supported by approved, grease lubricated, self-aligning ball or roller bearings made of vacuum degassed 52100 steel. Ball or roller bearings shall be made by MANUFACTURERS who are members of the Anti-Friction Bearing MANUFACTURERS Association (AFBMA) and shall be selected for a minimum rating life (L-10) of 100,000 hours at the fans maximum rated speed and based on Basic Dynamic Load Ratings calculated from AFBMA formulas (AFBMA Standards, Section No. 9, and Section No. 11, Latest Revisions). Material factors used in formula calculations shall be based on values assuming a conventional good quality, hardened bearing steel without benefit of vacuum degassing. Specifically, for pound and inch units, factor "f" shall be as given in the tables of AFBMA Standards cited above.
 - b. The operating internal temperature of ball bearings with ambient temperature of 80°F shall not exceed 200°F. Temperature measurements shall be made with a thermal imaging thermometer. (Thermometers shall have an accuracy at 130°F of ±2°F). Where thermometer wells are not provided or required, the surface temperature of the bearing housing shall be measured by a thermometer pressed firmly against the surface and sealed with a suitable plastic putty. Temperature readings during inspection and start-up after 3 hours of run time that exceed 140°F as measured by the thermometer-surface method, shall be deemed presumptive evidence that the operating internal temperature of the bearings exceed 200°F, unless SUPPLIER can conclusively prove otherwise with a

FOUL AIR FANS

- bearing temperature analysis to the satisfaction of the OWNER or OWNER'S representative. In the absence of such proof, it shall be incumbent to reduce the temperature at or below 140°F with no additional cost to the OWNER.
- c. Bearing temperature shall not exceed 225°F at the fan's maximum rated speed.
 - d. Computations on bearing selection shall be submitted for approval and shall show complete details of loading. A dynamic factor of 2.0 shall be applied to loading. Ball and roller bearings shall be enclosed in oil-tight housings equipped with approved shaft seal rings and shall be suitably arranged for high pressure grease lubrication.
 - e. The bearing supports for the shaft shall be of rigid design and shall be securely fastened to the base to ensure the proper alignment of the main shaft bearings. Bearings located in the corrosive gas stream are not acceptable.
 - f. Bearings shall be factory lubricated with a premium quality NLGI 2 or 3-grade multi-purpose ball bearing grease having corrosion inhibitors, anti-oxidant additives and mechanical stability for high speed operation. Bearing grease shall be multi-purpose lithium soap grease. The grease shall also have a minimum base oil viscosity of 500 SUS at 100°F and shall be suitable to operate continuously at 225°F. Heavy, long fibered greases will not be acceptable for use in bearings.
 - g. Product and Manufacturer: Provide bearings as manufactured by one of the following:
 - 1) Link Belt, Series 6800 roller bearings
6. Fan impeller and driving pulley shall be secured to shaft with keys and set screws.
 7. Fan housing shall have flanged discharge and inlet drilled connection and companion flanges (ANSI dimensions). Fan shall be separated from ductwork at inlet and outlet by flanged flexible connections. CONTRACTOR shall coordinate flange drilling with duct.
 8. Stainless steel nameplates giving the name of the MANUFACTURER, serial number, model number, rated capacity in cfm, head in inches of water (gage), fan in rpm, and any other pertinent data shall be permanently affixed to each fan with stainless steel hardware.
 9. Fan Motors:
 - a. Motors shall conform to the requirements of Section 16010.
 - b. Solid shaft, ball bearing, energy efficient type.
 - c. Motors shall be in accordance with all current applicable standards of NEMA, IEEE, AFBMA, NEC, ANSI and NFPA 820.
 - d. Motors shall be normal starting torque, normal slip, squirrel cage induction type.
 - e. Motors shall be supplied with Class H insulation and rated for continuous duty at 50°C ambient temperature and 80°C (Class B) temperature rise at a 1.15 service factor.
 - f. Motors shall be inverter rated for use with Variable Speed Drives specified in Section 16269.
 - g. Motors shall be of sufficient size so that there shall be no overload on the motors above rated nameplate horsepower under any condition of operation from shut-off to zero head, unless otherwise specifically permitted in this Section.
 - h. Motor thrust bearings shall be adequate to carry continuous thrust loads under all conditions of fan operation.
 - i. Lubrication may be grease or oil type.
 - j. Motor efficiencies shall be determined in accordance with NEMA Standard MG1-12.53a and IEEE Standard 112, Test Method B. Nominal and guaranteed efficiencies shall be included on motor nameplates in compliance with NEMA Standard MG1-12.53.b.
 - k. Stainless steel nameplates giving the name of the MANUFACTURER, serial number and all data shall be permanently attached to each motor.
- F. Access Doors: Raised type, stud mounted access doors with gaskets. Studs shall be embedded and encapsulated in FRP housing.
- G. Odor control fan mounting shall be AMCA standard Arrangement 10 up to 15 horsepower, 20 horsepower and above shall be Arrangement 1 with fabricated Type 316 Stainless Steel Channel Sub-base and slide rail type motor mounting. Fan base shall be bolted directly to equipment slab and shop painted with an epoxy coating for outside/corrosive application.

- H. Drains: The blower shall be properly sealed to prevent condensate leaks and shall be provided with a condensate drain. Provide drains at low point of scroll, 1-inch pipe coupling welded to housing with threaded corrosion resistant plug. CONTRACTOR shall install a trap in the drain of necessary length to prevent foul air from blowing into the drain system.
- I. Drive: Matched V-belts and adjustable sheave pulleys shall be cast steel or cast iron, sized for 1.5 service factor.
- J. Belt and Shaft Guard: Stainless steel construction epoxy painted with tachometer hole, OSHA approved. Provide shaft and bearing guard.
- K. The field installed and operating fan inboard and outboard bearing motions shall not exceed the in-situ operation levels for Fan Application Category BV-3 of ANSI/AMCA 204-96. The instrument system used must have a flat response down to 120 rpm. MANUFACTURER shall measure the vibrations after start-up in the presence of the OWNER'S representative.
- L. Fan vibrations that exceed the ANSI/AMCA 204-96 in-situ operation levels, as described above, during operation in the warranty period shall be reduced by MANUFACTURER. MANUFACTURER can choose to dynamically balance the fan in place using a recognized specialist, replace bearings or make structural modifications to reduce the vibrations, as approved by the OWNER.
- M. MANUFACTURER shall furnish and install a sticker identifying the fan maximum operating speed. Speed changes that exceed this value are not permitted.
- N. Coatings:
 - 1. Baked epoxy phenolic or "cold set" epoxy-phenolic amine cured, brush or spray coats in accordance with manufacturer's specifications. **Exterior surfaces shall be beige in color.**
- O. Acceptable Odor Control Fan Manufacturers:
 - 1. Hartzell.
 - 2. New York Blower.
 - 3. Or Approved Equal
- P. Operation and Controls: The operation and controls shall be provided as required to furnish the complete OCS specified in Section 11264.
- Q. Provide a parallel blade outlet damper
- R. All fasteners (nuts, bolts and washers) used for Odor Control Fans shall be Type 316 stainless steel.
- S. Odor Control Fans shall be located in outdoor and corrosive areas. All mechanical and electrical equipment and material shall conform to NEMA 4X, non-metallic requirements.

2.02 SURFACE PREPARATION AND PAINTING

- A. All gears, bearing surfaces, machined surfaces and other surfaces which are to remain unpainted shall receive a heavy application of grease or other rust/corrosion resistant coating. The coating shall be maintained during storage and until the equipment is placed into operation.
- B. MANUFACTURER shall certify, in writing, that the shop primer and shop finish coating system is compatible with intended outside / corrosive application as shown on the Contract Drawings. A corrosive atmosphere of hydrogen sulfide and dilute sulfuric acid are expected to be present. **Exterior surfaces shall be beige in color.**

2.03 TOOLS AND SPARE PARTS

- A. General: MANUFACTURER shall furnish all special tools that are required to assemble, disassemble, repair, and maintain any item of mechanical equipment, with respective equipment. Special tools shall include any type of tool that has been specifically made for use on an item of equipment for assembly, disassembly, repair, and maintenance. When special tools are provided

FOUL AIR FANS

- they shall be marked or tagged, and a list of such tools shall be included with maintenance and operation instructions describing use of each marked tool. Additional requirements shall be included with individual items of equipment.
- B. Furnish and deliver the following spare parts for each blower size.
 - 1. Two (2) sets of spare belts.
 - 2. Two (2) sets of bearings.
 - 3. Two (2) replacement Teflon seals.
 - C. Furnish list of solvents for cleaning dirt, grease and oil from surface of non-metallic parts.
 - D. Spare parts shall be packed in sturdy containers with clear indelible identification markings, referencing the equipment that they are intended for, and shall be stored in a dry, warm location until transferred to the OWNER at the conclusion of the project. Provide complete ordering information including manufacturer, part number, part name and equipment for each part to be used.

PART 3 EXECUTION

3.01 INSTALLATION

- A. SUPPLIER shall install and test all odor control fan equipment. MANUFACTURER's installation report shall be required prior to final acceptance.
- B. Odor control fan equipment shall be installed as specified herein and as shown on Drawings, and in accordance with the manufacturer's recommendations and instructions. Equipment shall be installed in such manner that connecting piping shall not impose any strain whatever on any equipment. Equipment shall be set upon grouted foundations, level or perpendicular, as the case may be, so that connecting flanges, screwed connections, or flexible connections shall meet without strain or distortion. Base leveling nuts shall be blocked out during grouting of foundations, the grout allowed to set for not less than three days, leveling nuts loosened and followed by grouting of block-outs, with non-shrink grout.
- C. All equipment shall be installed with Type 316 stainless fasteners.
- D. SUPPLIER shall assure that all equipment furnished under this Section is suitable for installation as specified. The SUPPLIER is responsible for determining the necessary clearances and headroom required to move all equipment to its final location.
- E. In every case where a drive motor is connected to a driven piece of equipment by a flexible coupling, the coupling halves shall be disconnected and alignment between motor and equipment checked and corrected. Machinery shall first be perfectly aligned and leveled by means of Type 316 stainless steel wedges and shims near anchor bolts. Anchor bolts shall be tightened against shims on wedges and equipment shall again be checked for level and alignment before placing grout.
- F. Equipment bases shall not be grouted nor foundation bolts finally tightened until all piping connections are complete and in satisfactory alignment with no strain transmitted to the equipment.
- G. Examine pads or supports to receive odor control fans for:
 - 1. Proper anchor bolt locations.
 - 2. Unevenness, irregularities and incorrect dimensions.
- H. Supervise installation in accordance with odor control fan manufacturer's instructions and recommendations.
- I. Provide flanged flexible connections at air inlet and discharge of odor control fans.
- J. All equipment shall be installed on concrete bases and secured with anchor bolts in accordance with the manufacturer's recommendations. CONTRACTOR shall accurately shim base to grade

- and spaces between shims filled with an approved non-shrink grout. After grout has reached its initial set, exposed edges shall be cut back 1/2-inch and edges neatly finished with 1:2 cement mortar.
- K. Supplier shall include furnishing and applying an initial supply of grease and oil, recommended by the respective MANUFACTURER.
- L. Connect all piping, valves, and accessories as necessary to complete the installation.
- M. Install all conduit and wiring and complete all connections.
- 3.02 INSPECTION OF ODOR CONTROL FANS
- A. OWNER or OWNER'S representative reserves right to reject any and all items of equipment found to have following: blisters, chips, crazing, exposed glass, dry cracks, burned areas, dry spots, foreign matter, or entrapped air at the laminate surfaces which does not satisfy the tolerances specified in ASTM D 2563 Table 1, Acceptance Level II for inside and outside surfaces or meet the specified requirements.
- 3.03 INSPECTION AND START-UP ADJUSTMENTS
- A. The SUPPLIER shall perform the following inspection of equipment with the equipment manufacturer's representative.
1. Verify proper equipment mounting and setting.
 2. Verify that control, interlock and power wiring is complete.
 3. Verify alignment of each motor and drive.
 4. Verify proper piping connections and accessories.
 5. Verify that lubrication is completed.
 6. Verify direction of rotation.
 7. Verify setting of safety controls.
 8. Monitor heat buildup in bearings.
 9. Check motor loads against nameplate data.
 10. Verify proper starter overload heater sizes.
 11. Verify function of safety and operating controls.
 12. Verify proper operation of equipment.
 13. Remove all loose materials and obstructions from interior of ducts and fans.
 14. Remove debris and waste materials resulting from installation.
- B. The SUPPLIER shall conduct the following Start-up Adjustments:
1. Adjust fan for proper alignment and flow.
 2. Set volume control devices for approximate positions in preparation for final testing and balancing.
 3. Balance system in accordance with the CFM provided in this section and in Section 11264 Biological Tower-type Odor Control System.
- 3.04 FIELD TESTS
- A. After OCS SUPPLIER, FOUL AIR FAN SUPPLIER and OWNER or OWNER'S representative have mutually agreed that the equipment installation is complete and ready for continuous operation, MANUFACTURER shall conduct an operating test of the equipment and controls in the presence of OWNER or OWNER'S representative to demonstrate that the equipment and its controls function correctly.
- B. MANUFACTURER shall perform standard AMCA tests 210 and 300, as a minimum.
- 3.05 MANUFACTURER'S SERVICES
- A. MANUFACTURER shall furnish the services of a qualified factory-trained manufacturer's service person for areas where the odor control fans are installed to assist in the installation of the

FOUL AIR FANS

equipment, check the installation before it is placed into operation, assist in the performance of field vibration tests, supervise initial operations, and instruct the plant operators in the care, operation and maintenance of the equipment.

- B. Manufacturer's Representative: Present at Project site or classroom designated by OWNER, for minimum person-days listed in the following table, travel time excluded:

Work Description	No. Person Days	No. Trips
Installation assistance	1/2	1
Inspection, functional and performance testing	1/2	Can be combined with installation assistance trip
Startup, field vibration testing, and site training.	1/2	1
Follow up visit 11 months after substantial completion for inspection and training	1/2	1

- C. Service person shall verify that lubrication systems are complete, clean and filled with the proper grade of lubricants.
- D. Reports: SUPPLIER shall submit a report by service person of each visit to the site. Reports shall provide complete information on time, schedule, tasks performed, persons contacted, problems corrected, test results, training, instruction and all other pertinent information.
- E. Training: In addition to above requirements, furnish services to instruct and train plant operators in the proper care, operation and maintenance of equipment.
- F. Additional Inspections – Eleven (11) months after acceptance of the odor control fans, the manufacturer's factory trained service person shall perform an inspection of the system and submit an inspection report to OWNER.

3.06 FAN SCHEDULE

Number Provided	2
Fan Designation	FAN-101, FAN-102
Elevation, MSL	50 ft
Service	Wastewater Collection System Foul Air
Ambient Temperature Range	0°F - 110°F
Capacity	
Design Flow Rate	25,000 cfm
Static Pressure*	12 inches w.c.
Maximum Speed	1,500 rpm
Maximum Outlet Velocity	2,700 fpm
Motor	
Horsepower	75 HP
Voltage/Phase/Hz	460/3/60
Type	TEFC, Severe Duty
Wheel Diameter	49 inches
Arrangement	Note 1
Rotation	Clockwise

Discharge	Top Horizontal
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*Static pressure includes 4.0 inches w.c. for the for the bio-scrubber and 8.0 inches w.c. for all other system loses, including ductwork. Head losses within the bio-scrubber shall be confirmed by the SUPPLIER and the total static pressure of the fans adjusted as necessary to overcome 8.0 inches w.c. of system losses. The minimum acceptable static pressure rating of the fans shall be 10.0 inches w.c.

Note 1 - Per Drawings, as determined by system supplier. FAN-101 and FAN-102 are of "Opposite" Arrangements.

END OF SECTION

Section 13130

PRE-FABRICATED FIBERGLASS ENCLOSURES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section Includes:
 - 1. Pre-fabricated fiberglass enclosures.
 - 2. Enclosure electrical items, lights, outlets, power panels, alarm systems, and related devices.
 - 3. Heating, ventilation, and air conditioning.

1.03 DESIGN REQUIREMENTS AND CRITERIA

- A. Fabrication Requirement: Provide factory-built pre-fabricated molded fiberglass enclosure(s) completely assembled in accordance with Drawings and Specifications, delivered to the Project site for installation by the CONTRACTOR. Manufacturer shall provide all lifting cables and hardware required for the off-loading and installation of the building.
- B. Design Criteria:
 - 1. Structural:
 - a. Provide a corrosion-resistant, molded fiberglass bonded structure with no external seams or joints comprised of walls, roof, and door designed for the site conditions and adequate to support equipment and associated loads to be imposed. The walls and roof shall be integral with a three-inch wide flange around the entire lower perimeter for anchoring to concrete slab.
 - b. Walls, roof, and floor shall be sandwich construction consisting of 1/8th inch thick fiberglass skin and 1 inch thick rigid polyisocyanurate foam core. The door shall be of similar construction and 1-3/4 inch thick.
 - 2. Enclosure:
 - a. Type and Size:
 - 1) Pre-fabricated fiberglass enclosure.
 - 2) Width: 6 feet
 - 3) Length: 4.5 feet
 - 4) Height, at Wall: 7 feet.
 - 5) Roof, Walls, and Floor:
 - a) Roof Thickness, Minimum: 1-1/8 inches.
 - b) Wall Thickness, Minimum: 1-1/8 inches.
 - c) Floor Thickness, Minimum: 1-1/8 inches with minimum foam density of 6 lb/cf.
 - d) Anchor Flange Thickness, Minimum: 1/2 inch reinforced for required wind and flood loads.
 - b. Specifications:
 - 1) Flood Load: 250 PSF
 - 2) Snow Load: 30 PSF
 - 3) Wind Load: 110 mph at 3 second gust
 - 4) Seismic Zone: Seismic Design Category A
 - c. Comply with NEMA 3R requirements.

PRE-FABRICATED FIBERGLASS ENCLOSURES

1.04 SUBMITTALS

- A. Product Data: Provide construction details, material descriptions, dimensions of individual components and profiles, rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings: Provide plans, elevations, sections, details, and attachments to other work.
 - 1. Detail building components; indicating dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 2. Specific design parameters for this project as specified herein.
 - 3. Layout, sizes, types and materials for anchor bolts to be furnished.
 - 4. Wiring Diagrams: For power, signal, and control wiring diagrams, including terminals and numbers.
 - 5. Building weights and lifting points.
- C. Operation and Maintenance Data: Provide in accordance with Division 1.
- D. Information Submittals:
 - 1. Manufacturer's Certification of Compliance.
 - 2. Special shipping, storage and protection, and handling instructions.
 - 3. Manufacturer's instructions for installation.
 - 4. Qualification Data: For manufacturer and manufacturer's representative, if applicable.
 - 5. Factory tests.
 - 6. Warranties and service agreements.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications:
 - 1. Pre-fabricated fiberglass enclosure shall be the product of a manufacturer having at least ten (10) U.S. installations of the enclosure type being proposed, each with a minimum of 5 years of satisfactory service.
 - 2. A list of similar installations shall be furnished with the shop drawing submittal, including names and telephone numbers of contacts.
- B. Source Limitations: Pre-fabricated fiberglass enclosure of each type specified in this section shall be supplied by a single manufacturer. This does not require that all equipment be manufactured by a single manufacturer, but does require that the manufacturer of the system shall be responsible for the complete system.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, handle and store equipment components in accordance with shop drawings, manufacturer's written instructions, and the requirements of Division 1 Section 01610 "Basic Product Requirements."
- B. Additional Requirements:
 - 1. Store building on dunnage placed at proper locations to prevent cracking, distortion, or any other physical damage.
 - 2. Building provided with lifting fixtures for lifting and setting without incurring damage to walls or roof.

1.07 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components that fail(s) in materials or workmanship within specified warranty period.
 - 1. Warranty Period:
 - a. Pre-fabricated Fiberglass Enclosure: Five (5) years from date of Substantial Completion.

- b. All Other Components: Two (2) years from date of Substantial Completion.
2. Cost for the removal, shipment, repair and installation by CONTRACTOR shall be included in warranty, as well as correction of defective work.

PART 2 PRODUCTS**2.01 MANUFACTURERS**

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Jacobs Manufacturing Corporation
 2. Associated Fiberglass Enterprises
 3. Bebco Industries
 4. Plasti-Fab®
 5. Shelter Works™

2.02 ENCLOSURE STRUCTURE

- A. Material Properties:
1. Fiberglass laminate shall consist of polyester resin reinforced with a minimum of 25% by weight E-Glass and shall meet the minimum physical properties listed in Table 1.

Table 1 Laminate Properties		
Property	ASTM Standard	Value
Tensile Strength, psi	D-698	14,000 psi
Flexural Strength, psi	D-790	25,000 psi
Flexural Modulus, psi	D-790	1,000,000 psi
Thermal Barrier Temperature Rise	E-119	Avg. Temp. Rise of 250 ^o F after 15 Minute Exposure

2. Rigid foam core shall be closed cell, dimensionally stable over the specified range of operating temperatures, contain no CFC's, and meet the physical properties listed in Table 2.

Table 2 Foam Properties	
Property	Value
Density, lbs/ft ³	2.0
Closed Cell Content	90%
Thermal Conductivity, BTU in/hr ft ² 0F	0.14
Temperature Range, ^o F	-100 to +225
Flame Spread	< 25
Smoke-Developed Index per ASTM E84	< 400

- B. Wall Panels:
1. Seamless, one-piece wall composed of 1-inch minimum insulating foam core encapsulated between two 1/8-inch fiberglass reinforced polyester skins.
 2. Insulation Value: R-6.7.
 3. Exterior and interior surfaces shall a 10 to 20 mil gelcoat finish backed by a resin rich layer of resin and chopped glass, containing a UV inhibitor. Gelcoat shall be white in color.
 4. When equipment is to be secured to the walls, provide a layer of 1/2-inch wood sheathing bonded to the foam and encapsulated into the wall.

PRE-FABRICATED FIBERGLASS ENCLOSURES

5. Wall penetrations are to be reinforced, integrally molded as applicable, designed for the loads involved.
 6. Provide an integrally molded three inch minimum flange for mounting the enclosure to a concrete foundation.
- C. Roof:
1. Vaulted hip or gabled design, seamless, one-piece roof composed of 1-inch minimum insulating foam core encapsulated between two 1/8-inch fiberglass reinforced polyester skins.
 2. Insulation Value: R-6.7.
 3. Provide roof trusses, molded and integrated into roof panels, as required for support and to suspend loads from roof.
 4. Exterior and interior surfaces shall have a 10 to 20 mil gelcoat finish backed by a resin rich layer of resin and chopped glass, containing a UV inhibitor. Gelcoat shall be white in color.
 5. Stainless Steel removal lifting eye.
- D. Floor: Not Included.
- E. Doors:
1. Construction: Insulated FRP door of similar construction to walls, mounted in a recess, having a minimum clear opening of 36" by 72", and a raised all weather sill.
 2. Seal or Gasket: Provide a resilient, closed cell form neoprene seal per ASTM D1056 on all four edges.
 3. Hardware:
 - a. Provide stainless steel hardware consisting of a 3-point door catch holding door closed at top, middle and bottom.
 - b. Provide padlocking door handle, heavy duty hinges, and a spring loaded door holder.
 - c. Hinges shall be of a tamper proof design.
 - d. Provide drop type door handle having large offset handle and escutcheon for a padlock and an inside door handle.
 - e. On double doors, one door receives hardware described above and the other is held closed with a slide bolt.
 4. Provide a rain visor or small awning over the door.
 5. Door Styles:
 - a. Nominal Width: Single Door 3'-4"
 - b. Nominal Height: 6'-8"
- F. Finishes:
1. Exterior: Finished with a smooth gelcoat surface of minimum 10 mil thickness with color as indicated below.
 - a. Walls: White
 - b. Roof: White
 - c. Door: White
 2. Interior: Finished with a smooth white gelcoat surface of minimum 10 mil thickness
- 2.03 ELECTRICAL AND HVAC
- A. For the enclosure (6'-0" wide, 4'-6" long, 7'-0" wall height) provide 100A power service, two convenience outlets, two fluorescent light fixtures, and heater and exhaust fan as specified under paragraphs I and J.
- B. Electrical Requirements: Provide the following main power distribution, lighting, convenience outlets, and related electrical devices.
1. Power Service: 100A; 120/240 V, single phase, 60 Hertz.
 2. Disconnect Switch: 100A exterior disconnect switch.
 3. Main Distribution Panel: 100A single phase, 30 spaces.
 4. Surge Suppression: 40K peak amp surge suppressor.
 5. Convenience Outlets: 2 125V/20A Duplex outlets.

6. Exterior GFI Outlets: (1) 125V/20A Outlet.
7. Timer Switch: (1) Six hour.
- C. Lighting: Unless otherwise shown on the Drawings provide the following interior and exterior lighting.
 1. Interior: 2 each 4-foot, dual tube fluorescent light fixtures with light guards.
 2. Exterior: (1) Exterior light with photocell and motion detector above each door.
 3. Emergency: (2) Emergency fixture with dual flood lights located adjacent to each door.
 4. Switch (2) 20 amp light switch located adjacent to each door.
- D. Alarms: Provide a 25-pair alarm terminal box with intrusion, smoke, power failure, HVAC failure, and high/low temperature.
- E. Grounding: (1) 2-inch x 15-inches x 3/4-inch ground bar.
- F. Conduits, Boxes, and Related Items: PVC construction.
- G. Addition Items:
 1. Smoke Detector: (1) Smoke detector.
 2. Fire Extinguisher: (1) 5-lb CO2 fire extinguisher, wall mounted by each door.
 3. Log Book: (1) Literature Holder, wall mounted.
- H. Paragraph "F" will be used when enclosure is used for MCC and paragraphs "I" and "J" will be used for chlorine equipment or where air conditioning is not required.
- I. Heating:
 1. Provide a forced air electric space heater for freeze protection. Heater shall be thermostatically controlled, and shall be capable of maintaining 60°F with an outdoor ambient temperature of 0°F.
 2. Heat load calculations shall be included in enclosure submittal.
 3. Thermostat shall be adjustable from 60 to 80°F.
- J. Ventilation:
 1. Exhaust Fan:
 - a. Capacity: Unless otherwise specified, provide 12 air changes per hour exhaust fan with an exterior gravity louver.
 - b. Location: On the side wall, near the door.
 - c. Control: Manual and automatic operating modes using an exterior wall mounted, NEMA 4, 3-position selector switch located at the entrance door.
 - 1) Identification: "Exhaust Fan".
 - 2) Positions labeled AUTO/OFF/ON.
 1. "AUTO" position; fan shall be energized when the enclosure door is opened.
 2. "ON" position, the fan shall run continuously.
 3. "OFF" position will de-energize the fan.
 - 3) Exhaust fan shall not share a breaker circuit with wall receptacles.
 2. Vents: Provide adjustable, louver vents, complete with screen and covered with FRP shroud at locations shown on the Drawings.

2.04 SOURCE QUALITY CONTROL

- A. Fiberglass Enclosure: Factory inspected prefabricated fiberglass enclosure as follows:
 1. Visual inspection for defects shall be made without the aid of magnification.
 2. Defects shall be classified as to type and level as shown in ASTM D2563.
 3. Allowable surface tolerances shall not exceed tolerances listed in Table 3.

PRE-FABRICATED FIBERGLASS ENCLOSURES

Table 3 Fiberglass Enclosure Allowable tolerances	
Defects	Allowable Tolerances
Cracks, crazing, chips, pits, blisters, dry spots, fish eyes, burned areas, or entrapped air	None
Scratches	None more than 0.002 inches in depth
Exposed glass, exposure of cut edges	None
Wrinkles and solid blisters	Maximum deviation: 10% of thickness, but not to exceed 1/8 inch
Surface porosity (pinholes or pores in the laminate surface)	None
Foreign matter	None

- B. Electrical Testing:
 - 1. Inspect and test electrical systems prior to shipment. Inspection and testing results shall be documented, signed by the inspector, and a copy of the inspection checklist provided.
 - 2. Electrical components and parts will be inspected for quality workmanship and installation. Inspection includes conduit, conduit couplings, conduit brackets, electrical panels, A/C units, exterior and interior lights, outlets, smoke detectors, and alarms. In addition, the following tests will be performed as a minimum:
 - a. Polarity test.
 - b. Continuity test.
 - c. Dielectric test.
 - d. Operational test.
- C. Product Inspection: Provide Manufacturer's Certification of Compliance indicating the product has been manufactured in compliance with the Drawings and Specifications. If repairs are required, they will be performed and reinspected before the product is approved for shipment.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Install and adjust equipment in accordance with the Drawings, approved shop drawings, and the manufacturer's instructions. Do not operate the equipment until the installation is approved by the manufacturer's representative.
- B. Enclosure should be handled in such a manner at the jobsite such that they are not damaged from equipment and excessive stresses. Lift gear, rigging, etc. shall be as specified by the manufacturer.
- C. Examine and inspect enclosure upon arrival for compliance with Drawings and Specifications. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Lift enclosure per manufacturer's instruction and place on concrete slab. Install enclosure on the concrete foundation in accordance with manufacturer's instruction.
- B. Prefabricated fiberglass enclosure shall bear fully on a concrete foundation that is larger than the enclosure footprint. Concrete foundation should be level to 1/8-inch in all directions. Provide positive drainage from the foundation.

END OF SECTION

SECTION 13440

ODOR AND BIO-TRICKLING FILTER CONTROL SYSTEM

PART 1 GENERAL

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).

ODOR AND BIO-TRICKLING FILTER CONTROL SYSTEM WBS No. R-000020-0010-4

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

ODOR AND BIO-TRICKLING FILTER CONTROL SYSTEM WBS No. R-000020-0010-4

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

ODOR AND BIO-TRICKLING FILTER CONTROL SYSTEM WBS No. R-000020-0010-4

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. PLC CPU

- 1. Manufacturer and Model: Siemens Industry, S7-1214C
- 2. Port: Ethernet, RJ45
- 3. Built-in Discrete I/O: 14 Discrete Inputs (24 VDC), 10 Relay Outputs
- 4. Built-in Analog I/O: 2 Analog Inputs
- 5. Power: 24 VDC
- 6. Expandability: 8 Signal Modules, 1 Signal Board, 3 Communication Modules

B. Discrete Input Expansion Module

- 1. Manufacturer and Model: Siemens Industry, S7-1221
- 2. Discrete Inputs: 16

ODOR AND BIO-TRICKLING FILTER CONTROL SYSTEM WBS No. R-000020-0010-4

3. Input Type: 24VDC, Current Sourcing/Sinking

C. Relay Output Expansion Module

1. Manufacturer and Model: Siemens Industry, S7-1222
2. Relay Outputs: 16
3. Output Type: 5-30 VDC, 30W / 5-250 VAC, 200W

D. Discrete Input / Output Expansion Module

1. Manufacturer and Model: Siemens Industry, S7-1223
2. Discrete Inputs: 8
3. Input Type: 24VDC, Current Sourcing/Sinking
4. Relay Outputs: 8
5. Output Type: 5-30 VDC, 30W / 5-250 VAC, 200W

E. Analog Input Expansion Module

1. Manufacturer and Model: Siemens Industry, S7-1231
2. Analog Inputs: 4
3. Input Types: 0-20 ma

F. Analog Output Expansion Module

1. Manufacturer and Model: Siemens Industry, S7-1232
2. Analog Outputs: 4
3. Output Types: 0-20 ma

G. Memory Card

1. Manufacturer and Model: Siemens Industry, S7-954
2. Capacity: 4 MB or larger.

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 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. Ethernet Switch - Remote WiMAX

- a. Manufacturer and Model: Siemens Industry, X310
- b. Design: Industrial, Managed, DIN Rail Mount
- c. Copper Ports: Ten (10) RJ45, 10/100 Mbps
- d. Fiber Optic Ports: None
- e. Configuration Back-up: Include configured C-Plug
 - 1) Mounting: Standard DIN rail, PLC Rail
 - 2) Diagnostic LEDs: Power, Link Status, Communications
 - 3) Housing: Metal
 - 4) Include C-Plug Configuration Plug

2. Industrial Ethernet Cable, Copper, for Runs Outside Control

ODOR AND BIO-TRICKLING FILTER CONTROL SYSTEM WBS No. R-000020-0010-4

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

ODOR AND BIO-TRICKLING FILTER CONTROL SYSTEM WBS No. R-000020-0010-4

- 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 ZBook 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 i7-4700MQ Processor (2.4 GHz, 4MB L3 cache)
 - c. Memory: 8GB 1600 MHz DDR3L SDRAM.
 - d. Hard drive: 750 GB 7200 rpm SATA, 32GB MSATA SSD

- 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: NVIDIA 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 Encryption 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

ODOR AND BIO-TRICKLING FILTER CONTROL SYSTEM WBS No. R-000020-0010-4

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 Switch.
 - 8. 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 BTF, and odor control system. Where displays required modification.
The contractor to display required information needed for the operations. The CONTRACTOR 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 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 on this project. The CONTRACTOR 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 Odor 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

ODOR AND BIO-TRICKLING FILTER CONTROL SYSTEM WBS No. R-000020-0010-4

the contractor for panels show to be installed on the drawings:

- a. Odor PLC: Display all screens (see below a sample of display as minimum)
 - 1) PLC Screen List
 - 2) Odor system equipment diagram
 - 3) Odor points indication (equipment on "RED" off "GREEN")
 - 4) Odor Status/Alarms and indication
 - 5) PLC I/O Health Status
 - 6) 7-day level/flow trends/alarm summary

- b. Bio Tricking 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 screens above showing levels, flows, equipment status and high and low 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.

ODOR AND BIO-TRICKLING FILTER CONTROL SYSTEM WBS No. R-000020-0010-4

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 EXECUTION

3.01 SYSTEM DESCRIPTION

A. Bio Trickling Filter

1. General: The Bio Trickling Filter is a vendor provided package with its own controller (Siemen S7-1214C). It consists of two reactors, two blowers, 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 Odor control panel via Cat5e/Cat 6.

B. Odor Control

1. General: **There are two blowers drawing foul air from the facility's two wet wells (junction boxes) to the bio-trickling filters for treatment.**

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. 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 and send a Start/Stop command to the blower from the **local or SCADA HMI**. There will be no automatic sensor to control the blowers automatically.

C. Chemical Feed System:

1. There are two new Ferrous Sulfate tanks each with level sensor and pump with pressure indicator and discharge flow meter.
2. There is one new Calcium Nitrate tank with level sensor and pump with pressure indicator and discharge flow meter.
3. There will be a single manufacturer control panel controlling and monitoring the chemical feed system. Tank levels, pump on/off status, pump failures, flows, and tank leak detections are monitored by SCADA system.

- D. 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. 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, alarm and additional information indicated in the Drawings, 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 City of Houston Wastewater Operations SCADA staff or any specific contract resources selected by Wastewater staff**. Contractor shall provide iFIX graphic display data points required to develop displays to monitor and control all existing equipment and systems associated with bio-tricking filter, odor control blower, and chemical feed system. Contractor 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. All new and existing I/O points to be verified by contractor for any bit change and message displays for status, analog, and rate databases.

3.02 INSTALLATION

ODOR AND BIO-TRICKLING FILTER CONTROL SYSTEM WBS No. R-000020-0010-4

- 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. flow, level, etc.).
 - 5. Complete demonstration of each alarm by simulation of actual field device action.
 - 6. Complete demonstration and verification (level, flow, and 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): Two people.
 - 2. HMI (Siemens TP900) basic/advanced programming (three days): Two people.

END OF SECTION

SECTION 13446

PRIMARY INSTRUMENTATION DEVICES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Ultrasonic level transmitter, flow meter, Hydrogen sulfide gas detector, Differential pressure transmitters, Diaphragm seals, power transformers, phase/voltage monitor relay, terminal blocks, surge protections, 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

PRIMARY INSTRUMENTATION DEVICES

- 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 Ultrasonic Level Transmitter (Chemical tanks)

- A. Manufacturer:
 - 1. Siemens: Model SITRANS Probe LU.
 - 2. Or approved equal.
- B. Description: 2-wire loop powered ultrasonic transmitter for level. The transducer is available as ETFE (ethylene-tetrafluoroethylene) or PVDF (polyvinylidene fluoride) to suit the chemical conditions of each tank.
- C. Range: 0.3 m (1 ft) to 15 m (50 ft).
- D. Power: 12-30 V DC 20W
- E. Temperature: -20 to +50 °C (-5 to +122 °F)
- F. Accuracy: 0.15 % of span.
- G. Beam angle: 10 degree at -3 db boundary.
- H. Memory: non-volatile EEPROM, no battery required.
- I. Communication: 4-20mA HART.
- J. Output: 0-20 mA, 4-20 m 550 ohm maximum.
- K. Spare Unit: Provide a spare unit in addition to the unit installed.
- L. Warranty: 18 months minimum from the time acceptance by City.
- M. Accessories: The level probe shall be installed with a flange adaptor.

PRIMARY INSTRUMENTATION DEVICES

2.02 TRANSIT TIME/DOPPLER FLOW METER (CHEMICAL FEED SYSTEM)

1. Flow Element

a. Type:

- 1) Transit time type.
- 2) Strap on sensor design.

b. Function/Performance:

- 1) Accuracy: Plus or minus 1.6 percent of reading flow from 0.03 FPS to full scale.
- 2) Operating Temperature: Minus 22 degrees Fahrenheit to plus 266 degrees Fahrenheit

c. Physical:

- 1) Sensors shall be mounted diagonally across from each other and shall be mounted through special windows. Sensors housing shall be stainless steel.

d. Options/Accessories Required:

- 1) Each flow meter assembly (sensor and transmitter) shall be factory calibrated. The calibration report shall be included in the final O & M manual.

e. Manufacturer(s):

- 1) Flexim Model 7407
- 2) No substitution

2. Transmitter/Converter

a. Type:

- 1) Electronic, microprocessor based, match to flow element.

b. Function/Performance:

- 1) Accuracy: See flow element.
- 2) Operating Temperature Range: Plus 14 degrees F to 140 degrees F.
- 3) Output: 0/4-20 ma.
- 4) Power Requirements: 120 V, 60 Hz.
- 5) Diagnostics: Sound Velocity, Signal amplitude, SNR, SCNR, standard deviation of amplitudes and transit times
- 6) Circuitry: Solid state microprocessor based. Battery memory backup in case of power failure.

c. Physical:

- 1) Enclosure: NEMA 4X.

d. Options/Accessories Required:

- 1) Provide a local indicator with scale engraved in engineering units of flow.
- 2) The totalizer can only be reset to zero manually.
- 3) Provide all manufacture interconnecting cable, connectors and fittings between the transmitter/converter and the flow sensors.

e. Manufacturer(s):

- 1) Supplied with flow element.

2.03 HYDROGEN SULFIDE GAS DETECTOR

A. Subject to compliance with the Contract Documents, the following Manufacturers are acceptable:

1. **MSA International Ultima X3**
2. Honeywell
3. Scott

PRIMARY INSTRUMENTATION DEVICES

4. Approved Equal
- 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.
- C. General
1. Provide sufficient lengths of Manufacturer's specialty cables for installation of power and signal conductors as provided with each instrument.
- D. **Type**
1. **316 Stainless Steel**
 2. **LED's and relays**
 3. **Electronic, microprocessor based**
 4. **Continuous, dual channel**
 5. **Hydrogen Sulfide Level indicator**
- E. Function/Performance
1. Sense the presence of hydrogen sulfide gas prior to reaching toxic levels.
 2. Provide early warning indication to personnel.
 3. Response Time: Less than 10 seconds to 90% of final reading from a step change in gas concentration.
 4. Range: 0-50 PPM.
 5. Alarm Settings: Field adjustable.
 6. Temperature Limits: 0 to 50 degrees C (32 to 122 degrees F).
 7. Sensor Life: Three (3) years.
 8. Minimum of two contacts to alert personnel of gas concentration levels.
 9. Front mounted power-on and high alarm indicating lights.
 10. Indicating meter graduated in Parts per Million (PPM) Hydrogen Sulfide.
 11. Minimum two output contacts for remote indications as shown on the Drawings.
 12. ModbusRTU Communication Interface to Controller.
- F. **Physical**
1. **Housing: Class 1, Div. 1, Groups A, B, C and D.**
 2. **Wall mounting with sensor remote from indicating transmitter.**

3. Shielded two-wire or three-wire sensor-to-controller wiring.
4. Adjustable alarm setting.
5. Local Indication.

G. Power Requirements

1. 24vdc

H. Options/Accessories

1. Provide an integral indicator scaled in engineering units.
2. Provide hand held programmer(s) where full setup is not available for the instrument

2.04 DIFFERENTIAL PRESSURE TRANSMITTERS

A. Subject to compliance with the Contract Documents, the following Manufacturers are acceptable:

1. Rosemount
2. Endress + Hauser
4. Approved Equal

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.

C. General

1. Provide signal surge protection at all transmitters.

D. Type

1. Microprocessor based intelligent type.
2. Diaphragm actuated.

E. Function/Performance:

1. Output: 4-20 mA DC. Output shall be linear for pressure applications.
2. Accuracy: 0.1 percent of span (linear output).
3. Stability: Combined temperature effects shall be less than 0.2 percent of maximum span per 50 degrees F temperature change. Effect on accuracy due to static pressure changes shall be negligible.
4. RFI Protection: 0.1 percent error between 27 and 500 MHZ at 30 v/m field intensity.
5. Drift: 0.10 percent per six months for 4-20 mA output.

PRIMARY INSTRUMENTATION DEVICES

6. Sensor Technology: Digital.
7. Over Range Protection: Provide positive over range protection.

F. Physical

1. Electrical Classification: Intrinsically safe for Class I and Class II, Division 1 locations.
2. Enclosure: NEMA 4X.
3. Sensor Diaphragm Material: 316 Stainless Steel 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.

G. Power Requirements:

1. Loop powered, two wire type.

H. Required Options/Accessories

1. Provide span and zero adjustment at each transmitter.
2. Provide local indication at each transmitter using LCD readout. Scale shall be in engineering units. With a minimum of 4 digits of precision
3. For each transmitter provide a manifold as specified herein, with the following Modes:
 - a. Normal Mode
 - b. Zeroing Mode
 - c. Isolation Mode
 - d. Calibration Mode
 - e. Blowdown Mode
4. Provide hand held programmer(s) where full setup is not available for the instrument directly from the display.

2.05 DIAPHRAGM SEALS- THREADED

A. Subject to compliance with the Contract Documents, the following Manufacturers are acceptable:

1. Red Valve Company, Inc.
2. Ashcroft.
3. Approved equal

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.

C. General

1. Rating to match pipe rating.

D. Type

1. Thread attached.
2. Welded Metal Diaphragm.
3. Exposed Surfaces - 316 stainless steel.

E. Function/Performance

1. Purpose: To protect instruments or gauges from the process medium.
2. A flexible diaphragm shall separate the process medium from the instrument element. Space on the instrument side of the diaphragm shall be completely filled with a suitable silicone or instrument oil. The process pressure is transmitted by the liquid filled system to the instrument element.
3. Filling Screw: Include on all units.
4. Pressure Limits: 1,000 psi.
5. Flushing Connection: Include on all units.
6. Capillary tubing as required.

F. Physical

1. Top Housing: Carbon Steel, Cadmium plated.
2. Diaphragm: 316 ELC Stainless Steel.
3. Exposed Surfaces: 316 stainless steel.
4. Bolts, Nuts and Plugs: 18-8 stainless steel or 316 stainless steel.
5. Capillary: 1/4-in stainless steel armor shielded.

G. Power Requirements

1. None

H. Required Options/Accessories

2.06 CONTROL POWER TRANSFORMERS

- A. Transformer: NEMA ST 1 machine tool transformer with isolated secondary winding.

PRIMARY INSTRUMENTATION DEVICES

- 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.

2.07 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.

2.08 TERMINAL BLOCKS

- A. Manufacturers
 1. Bussmann.
 2. Phoenix Contact.
 3. General Electric Company.
 4. Weidmuller.
 5. Allen Bradley.
 6. Schneider Electric
- 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.

2.09 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 EXECUTION

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 Bio Trickling Filter, and Odor

PRIMARY INSTRUMENTATION DEVICES

system PLC panel.

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 13550

PRESTRESSED CONCRETE CAMERA POLE

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. This specification is to establish design and quality standards for static cast concrete poles for WiMAX antenna support and CCTV camera.

1.02 SUBMITTALS

- A. Conform to Section 01330 – Submittal Procedures.
- B. Product Data: Provide manufacturer’s product literature and specifications.
- C. Mounting dimensions and instructions.
- D. Equipment weights
- E. Equipment height

1.03 QUALITY ASSURANCE

- A. The concrete poles furnished under these specifications shall be designed and manufactured in accordance with requirements and/or recommendations of the American Concrete Institute Standard “Building Code Requirements for Structural Concrete” (ACI 318 - Latest Edition), unless otherwise specified.
- B. Poles shall be designed in accordance with the Prestressed Concrete Institute “Guide for Design of Prestressed Concrete Poles.”
- C. All pole design and structural calculations shall be prepared by a licensed professional engineer experienced in prestressed concrete design. Calculations shall be signed and sealed by a licensed professional engineer, licensed in the State of Texas.
 - 1. Manufacturer must have a minimum of 10 years experience manufacturing static cast, square tapered prestressed concrete poles. Documentation of such experience shall be provided in the submittal.
 - 2. Manufacturer shall be certified by the City of Houston as an Approved Fabricator of Precast Concrete. A copy of the current certification documentation shall be provided in the submittal.

3. No alternate pole designs to the pre-engineered, static-cast, prestressed concrete pole will be allowed unless pre-approved by the owner TEN (10) days prior to the bid date.

PART 2 PRODUCTS

2.01 PRESTRESSED CONCRETE CAMERA POLE

A. Acceptable Manufacturer

1. Lonestar Prestress Mfg., Inc. Cat. No. 462602-CP-L
2. Approved Equal

B. PHYSICAL CHARACTERISTICS

1. All poles shall be prestressed concrete and suitable for direct embedment into the ground without special foundations.
2. Shape and Length: Poles shall be square in cross-section, with chamfered corners, and shall have a standard taper of 0.162 inch per foot. Cross-sectional dimensions shall not deviate by more than 3/8 inch. The allowable tolerance for overall length shall be +3 inches and -2 inches. The width of the bottom face of the pole (as it is cast) may be less than the top face.
3. Finish: The pole shall have a smooth gray finish with no cracks. The top surface of each pole shall be troweled until all projections, depressions, and irregularities have been removed and the entire surface has a smooth texture and neat lines. Square corners and sharp edges shall be tooled to form smooth, chamfered corners. All small cavities shall be cleaned, saturated with water and then filled with mortar. A small cavity is defined as one larger than 1/4 inch but smaller than 3/4 inch in diameter, and less than 3/8 inch deep. Larger non-structural cavities and spalls shall be repaired by opening the side of the damaged area on a 1 to 1 slope using a mechanical grinder, cleaning thoroughly and filling with a high-strength non-shrink concrete repair material. Poles with other defects may be repaired only upon authorization of, and using the method prescribed by the Design Engineer.
4. Sealing Steel Strands: The end of each reinforcing strand (in the tip and butt) shall be burned back to a minimum depth of 1/2 inch. The holes left by the removal of the strand shall be thoroughly cleaned of any loose residue. The holes shall then be completely filled with non-shrink grout and smoothed evenly with tip or butt surface.

- | | | |
|----|---------------------------|------------------|
| 3. | Aggregates | ASTM C33 or C330 |
| 4. | Reinforcing Bars | ASTM A615 |
| 5. | Cold Drawn Spiral Wire | ASTM A82 |
| 6. | Prestressing Strand, 270K | ASTM A416 |

2.03 STRENGTH REQUIREMENTS

- A. Pole shall be designed for wind pressures determined in accordance with ASCE 7-02 for a 3-second gust wind speed of 120 mph. The wind pressures shall be applied to the pole and all attached lighting, cameras and miscellaneous hardware.
- B. Poles of each standard type, unless otherwise specified, shall be designed for the ultimate groundline moments from the above noted wind pressures with the modifications to accommodate allowances for handling, transportation and erection.
- C. Poles shall be capable of withstanding single point pickup from the horizontal position when lifting from a point 30% of the overall length down from the tip.

2.04 GROUNDING

- A. Poles shall include a concrete encased electrode conforming to NEC 250.52 (A) (3).
- B. Poles for both WiMAX antenna and CCTV cameras shall have separate handholes for camera and signal cabling and WiMAX antenna.

PART 3 EXECUTION

3.01 QUALITY CONTROL

- A. Tests shall be made and records shall be maintained in accordance with the requirements of Prestressed Concrete Institute MNL-116, "Manual for Quality Control for Plants and Production of Precast Prestressed Concrete Products."

3.02 DRAWING AND DESIGN INFORMATION

- A. Manufacturer shall furnish detailed design drawings for the poles bid or supplied, including but not limited to the following:
 - 1. Total weight.
 - 2. Overall height.

3. Dunnage and pickup points, including both one-point and two-point pickup locations.

3.03 INSTALLATION

- A. Poles shall be supported and protected during site storage, lifting and setting to prevent damage to the pole. Spalls or other damage incurred during these operations shall be repaired to restore the pole to “as new” condition.

END OF SECTION

Section 13560

PERPETUAL POWER UNIT (PPU), WiMAX RADIO AND CAMERA

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. This specification is to establish design and quality standards for Perpetual Power Unit (PPU), WiMAX radio and Camera.

1.02 SUBMITTALS

- A. Conform to Section 01330 – Submittal Procedures.
- B. Product Data: Provide manufacturer's product literature and specifications.
- C. Electrical schematics and wiring diagram for control devices.
- D. Mounting dimensions and instructions.
- E. Equipment weights.
- F. Equipment height.

1.03 REFERENCE STANDARDS

- A. National Fire Protection Association (NFPA)
- B. American National Standards Institute, (ANSI)
- C. Factory Mutual, (FM).
- D. Institute of Electrical and Electronic Engineers, (IEEE).
- E. National Electrical Code, (NEC).
- F. National Electrical Manufacturers Association, (NEMA).
- G. Underwriters' Laboratories, Inc., (UL).
- H. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.04 REGULATORY REQUIREMENTS

- A. Conform to the requirements of NFPA 70.

- B. Furnish products listed and classified by UL as suitable for the purpose specified herein and as shown on the Drawings.

PART 2 PRODUCTS

2.01 PERPETUAL POWER UNIT (PPU)

A. Acceptable Manufacturer

1. Clear Site Communications, Inc., Model No. PPU-1.
2. Or Approved Equal.

B. PHYSICAL CHARACTERISTICS

1. The Perpetual Power Unit (PPU) provides a clean uninterrupted flow of power to outdoor devices that require 24/7 operation as used for video monitoring, communications and remote sensing, even if the power source is undependable or intermittent. When power is available, the PPU will supply power to the loads (application devices) as well as charge and maintain its own deep cycle battery bank. When the power input is cut, no down time results since the application devices continue to receive power from the battery bank.
2. The PPU provides functions that a UPS provides, but on a much larger scale. Depending on the load and configuration, the PPU can power application devices for days without any power input, then very rapidly recharge its own battery bank when power is provided.
3. The PPU makes available real time information about its power input, load, and charging system via its Ethernet interface. Warning can be automatically sent by mail or text if input power is unexpectedly absent. This allows power problem to be detected and responded to with no system down time. Also, in IP communications networks, the PPU can monitor the application devices and automatically reset them if a problem is detected.

C. SPECIFICATIONS

1. Input Voltage Range: 100-277VAC 50/60Hz
2. Max Power Consumption: 225Watts
3. Output Voltage Range: 11-16VDC
4. Max Load: 100 Watts
5. Batter Type: VRLA Sealed AGM Deep Cycle 12V
6. Battery Capacity: 104Ah

7. Max Charging Power: 180 Watts (15 Amps)
8. Temperature Compensated
9. Low Voltage Load Disconnect
10. Electronic Protections: Overload, Short Circuit, High Voltage
11. System Controller (PPC): Web Based, Remote Control Remote Alerts, connector RJ45
12. Breakers: Battery, DC In, PPC, Load.
13. Enclosure: Vented Aluminum Nema 3R, Dimensions 16"x16"x10"
14. Operating temperature: -26 to 45 degree Celsius
15. Operating Humidity: 10% to 95% Non-Condensing

2.02 WIMAX RADIO

A. Acceptable Manufacturer

1. Telrad Model No. CPE7000 Outdoor
2. Or Approved Equal.

B. SPECIFICATIONS

1. IP67 environmental rating – suitable for the harshest outdoor deployment scenarios
2. High gain 15dBi embedded antenna
3. TD-LTE – 3GPP Release 9, UE Category 4
4. Dual Mode WiMAX/LTE solution enabling transition from WiMAX to TD-LTE
5. TD-LTE – 3GPP Release 9, UE Category 4
6. One Data port, one VoIP port
7. High gain 15dBi embedded Antenna
8. Device Management – Web and TR69
9. IP67 environmental rating – fully ruggedized - suitable for the harshest outdoor deployment scenarios.

2.03 CAMERA

- A. Subject to compliance with the Contract Documents, the following Manufacturers are acceptable:
1. Pelco Spectra Series
 2. Axis Q60 Series
 3. Approved Equal
- 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.
- C. General:
1. Provide Pan-Tilt-Zoom Cameras as shown. The environmental camera system shall consist of an outdoor camera and housing designed specifically for use in moderate to severe climate conditions and shall include thermostatically controlled heater, window defroster/defogger, sun shroud, viewing window wiper and insulation blanket along with any accessories which may be required for a complete environmental camera system.
 2. The camera system shall be able to transmit/receive video and data over a single Ethernet cable.
 3. All mounting hardware shall be furnished with the system. Cameras and mounting hardware type shall be as shown.
- D. Pan-Tilt Camera Features:
1. Type: High Resolution, Color, Integrated Receiver, Low Light Sensitivity.
 2. Provide pan and tilt drive where indicated:
 - a. Pan:
 1. Adjustable speed.
 2. Preset Speed: 100 degrees per second.
 3. Movement: 360 degrees continuous pan rotation.
 - b. Tilt:
 1. Adjustable speed.
 2. Preset Speed: 30 degrees per second.
 3. Movement: Unobstructed +40 degrees to -90 degrees from horizontal.
 3. Zoom: Lens: f/1.4 (f = 4.1-73.8 optical, 18 optical zoom, 4X electronic zoom).

4. Signal Format: H.264 Compression.
5. Effective Pixels: 720 (H) x 480 (V).
6. Focus: Automatic with manual override.
7. Sensitivity: 0.5 lux minimum.
8. Electrical:
 - a. Input Voltage: Power over Ethernet.
 - b. Maximum Power Consumption: 15 watts.
 - c. Camera and Lens Voltage: 48 VAC.
9. Mounting Brackets:
 - a. All mounting brackets shall be of corrosion-resistant construction and shall be load rated to support camera, housing and pan and tilt drive components and accessories specified herein. Mounting heads shall be adjustable.
 - b. Mounting shall be suitable for pole, wall, or parapet mounting as shown.
 1. For wall mounting, provide the Esprit Series EWM Wall Mount, by Pelco, or equal.
 2. For parapet mounting, provide the Series PP100 Parapet Mount and Esprit Series EWM Wall Mount, by Pelco, or equal.
10. Environmental Enclosure:
 - a. NEMA 4X rated.
 - b. Maximum Wind Condition: Operational in 90 mph winds.
 - c. Material: Die-cast, extruded and sheet aluminum; stainless steel.
 - d. Viewing Window: 0.2-inch thick, optically-clear, impact resistant.
 - e. Operating Temperature: -40° to 122°F.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install all security cameras and WiMAX equipment in the locations as shown in the plans and in accordance with the manufacturer's recommendations.
- B. Test the radio and camera systems to City requirements and to demonstrate correct installation and operation of equipment. O & M manual shall be furnished prior to testing for reference during testing and correction for final O & M.
- C. Camera locations as specified per City WWO Instructions.
- D. If site does not required camera, turn over camera to the City WWO personnel as spare.
- E. Before 7-days test, demonstrate the system to the City WWO inspectors and Project Manager.
- F. The CCTV System shall be installed and wired completely as shown by CONTRACTOR who shall utilize the services of a manufacturer-trained and authorized Security System Supplier.
- G. The camera and PPU units shall be performed by Clearsite Communications.
- H. The WiMAX Systems shall be installed and wired completely as shown by Crystal Communication that currently contract with COH, who shall utilize the services of a manufacturer-trained and authorized Security System Supplier.

3.02 MANUFACTURER'S FIELD SERVICES

- A. Prepare and start systems under provisions of Section 01755 – Starting Systems.

3.03 SYSTEM TESTING

- A. Provide systems demonstration under provisions of sections 01770 – Closeout procedures.
- B. Perform system testing as required by individual component Sections. Configure and adjust components for proper operation. Submit 6 copies of Manufacturer's Installation Inspection, and Field Testing Reports. Replace components found to be defective.

END OF SECTION

SECTION 15180

PIPING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions with Appendices thereto, Supplementary General Conditions, Special Conditions, other Instructions and Provisions, and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Insulation Materials:
 - a. Cellular glass.
 - b. Flexible elastomeric.
 - c. Mineral fiber.
 - 2. Adhesives, mastics, sealants, and tapes.
 - 3. Factory-applied and field-applied jackets.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings:
 - 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
 - 2. Detail attachment and covering of heat tracing inside insulation.
 - 3. Detail insulation application at pipe expansion joints for each type of insulation.
 - 4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
 - 5. Detail removable insulation at piping specialties, equipment connections, and access panels.
 - 6. Detail application of field-applied jackets.
 - 7. Detail application at linkages of control devices.
 - 8. Detail field application for each equipment type.

1.4 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.
 - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed

index of 50 or less.

2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver insulation, coverings, cements, adhesive, 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.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

- A. General Requirements:
 1. Products shall not contain asbestos, lead, mercury, or mercury compounds.
 2. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
 3. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
 4. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- B. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells.
 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Cell-U-Foam Corporation; Ultra-CUF.
 - b. Pittsburgh Corning Corporation; Foamglas Super K.
 2. Block Insulation: ASTM C 552, Type I.
 3. Special-Shaped Insulation: ASTM C 552, Type III.
 4. Board Insulation: ASTM C 552, Type IV.
 5. Preformed Pipe Insulation with Factory-Applied ASJ-SSL: Comply with ASTM C 552, Type II, Class 2.
 6. Factory fabricated shapes according to ASTM C 450 and ASTM C 585.
- C. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.
 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Aeroflex USA Inc.; Aerocel.
 - b. Armacell LLC; AP Armaflex.
 - c. RBX Corporation; Insul-Sheet 1800 and Insul-Tube 180.
- D. Mineral-Fiber, Preformed Pipe Insulation:
 1. Products: Subject to compliance with requirements, available products that may be

incorporated into the Work include, but are not limited to, the following:

- a. Fibrex Insulations Inc.; Coreplus 1200.
 - b. Johns Manville; Micro-Lok.
 - c. Knauf Insulation; 1000 Pipe Insulation.
 - d. Manson Insulation Inc.; Alley-K.
 - e. Owens Corning; Fiberglas Pipe Insulation.
2. Type I, 850 deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ-SSL.

2.2 INSULATING CEMENTS

- A. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.

2.3 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated. Adhesive shall be as recommended by the supplier of the insulation and jacket materials.

2.4 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II, and as recommended by insulation supplier.
- B. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.
 1. Water-Vapor Permeance: ASTM E 96, Procedure B, 0.013 perm at 43-mil dry film thickness.
 2. Service Temperature Range: Minus 20 to plus 180 deg F.
 3. Solids Content: ASTM D 1644, 59 percent by volume and 71 percent by weight.
 4. Color: White.

2.5 SEALANTS

- A. Joint Sealants:
 1. Joint sealants shall be as recommended by pipe insulation supplier and the Materials shall be compatible with insulation materials, jackets, and substrates.
 2. Permanently flexible, elastomeric sealant.
 3. Service Temperature Range: Minus 100 to plus 300 deg F.
 4. Color: White or gray.
- B. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:
 1. Materials shall be compatible with insulation materials, jackets, and substrates.
 2. Fire- and water-resistant, flexible, elastomeric sealant.
 3. Service Temperature Range: Minus 40 to plus 250 deg F.
 4. Color: White.

2.6 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
 - 1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
 - 2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.

2.7 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
 - 1. Adhesive: As recommended by jacket material manufacturer.
 - 2. Color: White.
 - 3. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
 - a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.
 - 4. Factory-fabricated tank heads and tank side panels.
- C. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105 or 5005, Temper H-14.
 - 1. Minimum Thickness:
 - a. Outdoors: 0.024 inches.
 - b. Indoors: 0.016
 - 2. Finish: Stucco-embossed.
 - 3. Moisture Barrier for Indoor Applications: 1-mil- thick, heat-bonded polyethylene and Kraft paper.
 - 4. Moisture Barrier for Outdoor Applications: 3-mil- thick, heat-bonded polyethylene and Kraft paper or 2.5-mil- thick Polysurlyn.
 - 5. Factory-Fabricated Fitting Covers:
 - a. Same material, finish, and thickness as jacket.
 - b. Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
 - c. Tee covers.
 - d. Flange and union covers.
 - e. End caps.
 - f. Beveled collars.
 - g. Valve covers.
 - h. Field fabricate fitting covers only if factory-fabricated fitting covers are not available.
- D. Underground Direct-Buried Jacket: 125-mil- thick vapor barrier and waterproofing membrane consisting of a rubberized bituminous resin reinforced with a woven-glass fiber or polyester scrim and laminated aluminum foil.

2.8 ACCESSORIES

- A. Tapes supplied with products per manufacturers recommendations.
- B. Securements: Aluminum bands, insulations pins and hangers, staples, wire, corner angles and related components supplied with products per manufacturers recommendations.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that applies to insulation.
- C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.2 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment and piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment and pipe system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during application and finishing.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at

- hangers, supports, anchors, and other projections with vapor-barrier mastic.
1. Install insulation continuously through hangers and around anchor attachments.
 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:
1. Draw jacket tight and smooth.
 2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.
 - a. For below ambient services, apply vapor-barrier mastic over staples.
 4. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- P. For above ambient services, do not install insulation to the following:
1. Vibration-control devices.
 2. Testing agency labels and stamps.
 3. Nameplates and data plates.
 4. Manholes.
 5. Handholes.
 6. Cleanouts.

3.3 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
 - 1. Seal penetrations with flashing sealant.
 - 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 - 3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
 - 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
- C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
 - 1. Seal penetrations with flashing sealant.
 - 2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 - 3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
 - 4. Seal jacket to wall flashing with flashing sealant.
- D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
 - 1. Comply with requirements in Division 7 Section "Through-Penetration Firestop Systems" for firestopping and fire-resistive joint sealers.
- F. Insulation Installation at Floor Penetrations:
 - 1. Pipe: Install insulation continuously through floor penetrations.
 - 2. Seal penetrations through fire-rated assemblies.

3.4 GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
 - 1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
 - 2. Do not insulate flexible pipe couplings and expansion joints.

3. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
 4. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
 5. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
 6. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below ambient services, provide a design that maintains vapor barrier.
 7. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
 8. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below ambient services and a breather mastic for above ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
 9. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
 10. Stencil or label the outside insulation jacket of each union with the word "UNION." Match size and color of pipe labels.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
- D. Install removable insulation covers at locations indicated. Installation shall conform to the following:
1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.

2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges except divide the two-part section on the vertical center line of valve body.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.5 CELLULAR-GLASS INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above ambient services, secure laps with outward clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below ambient services, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of cellular-glass block insulation of same thickness as pipe insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When preformed sections of insulation are not available, install mitered sections of cellular-glass insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

15180-9
03-17-2015

ADDENDUM NO. 1

1. Install preformed sections of cellular-glass insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

3.6 FLEXIBLE ELASTOMERIC INSULATION INSTALLATION

- A. Seal longitudinal seams and end joints with manufacturers recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- B. Insulation Installation on Pipe Flanges:
 1. Install pipe insulation to outer diameter of pipe flange.
 2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
 3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
 4. Secure insulation to flanges and seal seams with manufacturers recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- C. Insulation Installation on Pipe Fittings and Elbows:
 1. Install mitered sections of pipe insulation.
 2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- D. Insulation Installation on Valves and Pipe Specialties:
 1. Install preformed valve covers manufactured of same material as pipe insulation when available.
 2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
 3. Install insulation to flanges as specified for flange insulation application.
 4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.7 MINERAL-FIBER INSULATION INSTALLATION

- A. Insulation Installation on Straight Pipes and Tubes:
 1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
 2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
 3. For insulation with factory-applied jackets on above ambient surfaces, secure laps with outward clinched staples at 6 inches (150 mm) o.c.
 4. For insulation with factory-applied jackets on below ambient surfaces, do not staple

longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch (25 mm), and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.8 FIELD-APPLIED JACKET INSTALLATION

A. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturers recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.
2. Install PVC fitting covers on insulated interior piping, on all mineral fiber insulated piping, and on all heat traced piping.

B. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

1. Install aluminum jackets on exterior above grade piping and fittings and on interior piping insulated using cellular-glass.

3.9 FINISHES

- A. Equipment and Pipe Insulation with ASJ or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Division 9 painting Sections.
 - 1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
 - a. Finish Coat Material: Interior, flat, latex-emulsion size.
- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- D. Do not field paint aluminum or stainless-steel jackets.

3.10 PIPING INSULATION SCHEDULE

- A. General Requirements:
 - 1. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.
 - 2. All exposed outdoor piping and piping installed in unheated vaults, 6-inches in diameter and smaller (Unless otherwise indicted on the Drawings) shall be insulated.
 - 3.

PIPE INSULATION SCHEDULE

Flowstream	Pipe Diameter (Inches)	Insulation Thickness (Inches)		Insulation Type ⁽³⁾
		Indoor	Outdoor ⁽²⁾	
Instrument Sensing Lines ⁽¹⁾	----	NA		
Domestic Hot Water		3/4	3/4	Flexible Elastomeric
Domestic Cold Water			1	Flexible Elastomeric
Water and Waste Water	Less than 2	NA	1-1/2	Cellular-glass Mineral Fiber
Water and Waste Water	2 to 6	NA	2	Cellular-glass Mineral Fiber
Water and Waste Water	8 to 12	NA	2	Cellular-glass Mineral Fiber
Vent, Air Release	1 to 2	NA	1	Flexible Elastomeric Mineral Fiber
Blower Air Piping ⁽⁴⁾				Mineral Fiber
Sample	1/2 to 1	NA	3/4	Flexible Elastomeric

1. Instrument sense lines include tubing used for differential pressure measurements in venture flow meters, pressure indicating devices, and other instruments.

2. Outdoor includes piping exposed to atmosphere; areas inside unheated vaults, utility corridors, chases, etc.
3. When more than one insulation type named Contractor may select.
4. Apply insulation to hot blower discharge piping in accessible areas for personnel protection.

B. Heat Trace:

1. Provide heat tracing in accordance with Division 15 Section "Heat Tracing."
2. Size insulation to accommodate heat tracing cable

3.11 INDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket. If more than one material is listed, selection from materials listed is Contractor's option.

1. Piping, Concealed:
 - a. None.
2. Piping, Exposed:
 - a. PVC: 30 mils thick.
 - b. Aluminum, Stucco Embossed: 0.016 inch thick.

3.12 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket. If more than one material is listed, selection from materials listed is Contractor's option.

B. Piping:

1. PVC: 30 mils thick.
2. Aluminum, Stucco Embossed with Z-Shaped Locking Seam: 0.024 inch thick.

END OF SECTION

SECTION 15778

HEAT TRACING FOR PIPING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

Drawings and general provisions of the Contract, including General Conditions with Appendices thereto, Supplementary General Conditions, Special Conditions, other Instructions and Provisions, and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

This Section includes piping heat tracing for freeze prevention with the following electric heating cables: Self-regulating, parallel resistance.

1.03 RELATED WORK

See Division 15 Section 15180 "Piping Insulation" for insulation of piping.

1.04 SUBMITTALS

- A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for each type of product indicated.
- B. Schedule heating capacity, length of cable, spacing, and electrical power requirement for each electric heating cable required.
- C. Shop Drawings: For electric heating cable. Include plans, sections, details, and attachments to other work.
- D. Wiring Diagrams: Power, signal, and control wiring.
- E. Field quality-control test reports.
- F. Operation and maintenance data.
- G. Warranty: Special warranty specified in this Section.

1.05 QUALITY ASSURANCE

Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.06 WARRANTY

Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace electric heating cable that fails in materials or workmanship within specified warranty period.
Warranty Period: 10 years from date of Substantial Completion.

PART 2 PRODUCTS

2.01 SELF-REGULATING, PARALLEL-RESISTANCE HEATING CABLES

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

HEAT TRACING FOR PIPING

BH Thermal Corporation.
Chromalox, Inc.; Wiegard Industrial Division; Emerson Electric Company.
Delta-Therm Corporation.
Easy Heat Inc.
Nelson Heat Trace.
Pyrotenax; a division of Tyco Thermal Controls.
Raychem; a division of Tyco Thermal Controls.
Thermon Manufacturing Co.
Trasor Corp.

- B. Heating Element: Pair of parallel No. 18 AWG, tinned, stranded copper bus wires embedded in crosslinked conductive polymer core, which varies heat output in response to temperature along its length. Terminate with waterproof, factory-assembled non-heating leads with connectors at one end, and seal the opposite end watertight. Cable shall be capable of crossing over itself once without overheating.
- C. Electrical Insulating Jacket: Flame-retardant polyolefin.
- D. Cable Cover: Stainless-steel braid, and polyolefin outer jacket with UV inhibitor.
- E. Maximum Operating Temperature (Power On): 150 deg F.
- F. Maximum Exposure Temperature (Power Off): 185 deg F.
- G. Maximum Operating Temperature: 300 deg F.
- H. Capacities and Characteristics:

Normal Pipe Size (Inches)	Minimum Heat Tape Application Rate (Watts/Linear Foot)
1/2	1.0
3/4 - 1	1.2
1 1/2	1.5
2	1.8
2 1/2 - 3	1.9
4	2.7
6	8
8 - 10	5 (2 strips)
12-14	8 (2 strips)

- I. Electrical:
Volts: 120 Volts
Phase: Single
Hertz: 60

2.02 CONTROLS

- A. Pipe-Mounting Thermostats for Freeze Protection:
 1. Remote bulb unit with adjustable temperature range from 30 to 50 deg F.
 2. Snap action; open-on-rise, single-pole switch with minimum current rating adequate for connected cable.
 3. Remote bulb on capillary, resistance temperature device, or thermistor for directly sensing pipe-wall temperature.
 4. Corrosion-resistant, waterproof control enclosure.

2.03 ACCESSORIES

Cable Installation Accessories: Fiberglass tape, heat-conductive putty, cable ties, silicone end seals and splice kits, and installation clips all furnished by manufacturer, or as recommended in writing by manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine surfaces and substrates to receive electric heating cables for compliance with requirements for installation tolerances and other conditions affecting performance.
 - 1. Ensure surfaces and pipes in contact with electric heating cables are free of burrs and sharp protrusions.
 - 2. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Install electric heating cable across expansion, construction, and control joints according to manufacturer's written recommendations using cable protection conduit and slack cable to allow movement without damage to cable.
- B. Electric Heating Cable Installation for Freeze Protection for Piping:
 - 1. Install electric heating cables after piping has been tested and before insulation is installed.
 - 2. Install electric heating cables according to IEEE 515.1.
 - 3. Install insulation over piping with electric cables according to Division 15 Section "Plumbing Insulation."
 - 4. Install warning tape on piping insulation where piping is equipped with electric heating cables.
- C. Set field-adjustable switches and circuit-breaker trip ranges.
- D. Protect installed heating cables, including nonheating leads, from damage.

3.03 CONNECTIONS

- E. Ground equipment according to Division 16 Section "Grounding and Bonding."
- F. Connect wiring according to Division 16 Section "Conductors and Cables."

3.04 FIELD QUALITY CONTROL

- A. Testing: Perform tests after cable installation but before application of coverings such as insulation, wall or ceiling construction, or concrete.
 - 1. Test cables for electrical continuity and insulation integrity before energizing.
 - 2. Test cables to verify rating and power input. Energize and measure voltage and current simultaneously.
- B. Repeat tests for continuity, insulation resistance, and input power after applying thermal insulation on pipe-mounting cables.
- C. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION

Section 15892

ODOR CONTROL, FIBERGLASS DUCT

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section Includes:
 - 1. FRP ducts, fittings, dampers, expansion joints, hangers and supports.

1.03 REFERENCES

- A. American Water Works Association (AWWA):
 - 1. M-45 American Water Works Manual of Water Supply Practices "Fiberglass Pipe Design"
- B. ASTM International, Inc. (ASTM):
 - 1. C582 Specification for Contact-Molded Reinforced Thermosetting Plastic (RTP) Laminates for Corrosion-Resistant Equipment
 - 2. D2310 Classification for Machine-Made "Fiberglass" Pipe
 - 3. D2992 Practice for Obtaining Hydrostatic Design Basis for Fiberglass Pipe and Fittings
 - 4. D3299 Filament-Wound Glass-Fiber-Reinforced Thermoset Resin Chemical-Resistant Tanks
 - 5. D3567 Practice for Determining Dimensions of "Fiberglass" (Glass-Fiber Reinforced-Thermosetting-Resin) Pipe and Fittings
 - 6. D3982 Specification for Contact Molded "Fiberglass" Duct and Hoods
 - 7. D4021 Glass Fiber-Reinforced Polyester Underground Petroleum Storage Tanks
 - 8. D4097 Contact-Molded Glass-Fiber-Reinforced Thermoset Resing Chemical-Resistant Tanks
- C. Voluntary Product Standard, U.S. Department of Commerce (VPS):
 - 1. PS 15-69 "Custom Contact-Molded Reinforced Polyester Chemical-Resistant Process Equipment" (Replaced with ASTM D2996, D3299, D4021 and D4097)

1.04 SUBMITTALS

- A. Shop Drawings: For Duct System. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail duct assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 2. Provide a detailed layout of the duct support system showing locations and type of hangers and supports to be provided.
 - 3. Provide field butt and wrap joint connection details on shop drawings.
 - 4. Provide copy of manufacturer's certified ASTM D2992 HBD testing results.
- B. Qualification Data: For qualified manufacturer.
- C. Material Certificates: For each type of material or product, from manufacturer.

ODOR CONTROL, FIBERGLASS DUCT

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Manufacturer shall demonstrate a minimum of five years of experience in similar applications for size of odor control duct system furnished. References shall be provided upon request.
- B. Single Manufacturer: Duct systems shall be the product of a single manufacturer.
- C. Preinstallation Conference: Conduct conference at Project site.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Belco Manufacturing
 - 2. Bondstrand
 - 3. Spunstrand
 - 4. Ershigs
 - 5. Fibercast

2.02 DUCT AND FITTINGS

- A. Design Conditions:
 - 1. Duct system shall be designed for a working pressure range of 12-inches WC positive and minus 2-inches WC negative pressure.
 - 2. Buried duct shall be designed per AWWA M-45 and shall be rated for H-20 loading.
 - 3. Minimum wall thickness for FRP duct shall conform to the following:
 - a. Wall thickness for internal positive pressure determined by ASTM D2310 using duct manufacturers certified ASTM D2992 Hydrostatic Design Basis (HDB) test results. Provide copy of HDB testing with the wall thickness calculations.
 - b. Comply with the minimum thickness listed in the table below.

Duct Inside Diameter (inches)	Wall Thickness (inches)
3 - 16	0.1875
18 - 24	0.250
30 - 36	0.250

- c. FRP ductwork shall be designed and fabricated for odor control service to carry warm, moisture-laden air with hydrogen sulfide, mercaptans and other organic and inorganic compounds typically associated with wastewater treatment.
 - d. Resin:
 - 4. Resin Type: Premium corrosion resistant and fire retardant brominated bisphenol-A vinyl ester. Resin shall not contain pigments, dyes, colorants or fillers.
 - 5. Flame Spread Rating: Class 1 flame spread rating (25 or less).
 - 6. Thixotropic agents may be added to control resin viscosity per resin manufacturer's instructions.
 - 7. Acceptable resins with 3 percent antimony trioxide are:
 - a. AOC Vipel KO22.
 - b. Ashland Chemical Hetron FR922.
 - c. Interplastics CoRezyn 8442.
- B. Reinforcement:
 - 1. Surfacing Veil: Class C with a silane finish and a styrene soluble binder.

2. Chopped Strand Mat: Type E glass, minimum 1-1/2 ounces per square foot with a silane finish and a styrene soluble binder.
 3. Continuous Roving, Chopper Gun Spray-up: Type E glass.
 4. Woven Roving: Type E glass, minimum 24 ounces per square yard with a five by four weave.
 5. Continuous Roving, Filament Wound: Type E glass with a silane finish.
- C. Construction:
1. Ductwork, 10-Inch and Smaller: Hand lay-up or filament wound construction.
 2. Ductwork, 12-Inch and Larger: Filament wound.
 3. Not Acceptable: Cast duct with no reinforced internal corrosion barrier or press molded fittings.
 4. Allowable Deflection: 1/2-inch maximum between supports.
 5. Safety Factor: 10 to 1 for pressure and 5 to 1 for vacuum.
 6. Out-of-Roundness: Limited to 1.0% of diameter.
 7. Length, Flanged Duct Sections: Maximum variance \pm 1/2-inch at 70oF.
 8. Un-flanged Ductwork: Square on ends in relation to center axis within \pm 1/8-inch, 24-inch diameter and smaller; \pm 3/16-inch, diameters greater than 24-inch.
- D. Laminates:
1. Layers: Resin-rich inner surface, an interior corrosion barrier, an interior structural layer, and an exterior corrosion layer and UV resistant coating.
 2. Inner Surface: Nominal 10-mils thick consisting of a single ply Class C glass surfacing veil embedded in a resin-rich surface. Resin content shall be 90%.
 3. Interior Layer: Nominal 90-mils thick consisting of at least two layers of chopped strand mat. Resin content shall be 75%.
 4. Structural Layer: Type E glass meeting minimum wall thickness specified in the previous table. Total wall thickness includes the inner surface layer.
 - a. Contact molded structural layer shall include alternate layers of chopped strand mat and woven roving.
 - b. A layer of chopped strand mat or spray chop shall precede filament wound structural layer. The structural layer shall consist of a minimum of two complete cross hatched layers of continuous filaments applied in a helix angle of 55 to 65 degrees for above-ground ductwork and 75 degrees for buried ductwork.
 5. Exterior Corrosion Layer: Single Class A or C glass veil shall be applied to all ductwork.
 6. Exterior UV Resistant Coating: Factory applied paraffinated gel coat with UV inhibitors.
Exterior color shall be beige.
- E. Fittings:
1. General Construction:
 - a. Construction: Hand-lay up construction fabricated from the same resin and shall have the same strength as the ductwork.
 - b. Internal Diameter: Equal to adjacent duct.
 - c. Angle Tolerance: \pm 1 degree, 24-inch and smaller, and \pm 1/2 degree, larger than 24-inch.
 2. Elbows:
 - a. Centerline radius shall be 1-1/2 times diameter.
 - b. Elbows, 24-Inch and Smaller: Smooth radius.
 - c. Elbows, 30-Inch and Larger: Mitered, provide a minimum two mitered joints (3-piece) for elbows greater than 45 degrees.
 3. Flanges:
 - d. Provide flanged connections to flexible connectors, expansion joints, vessels, demisters, fans, silencers, and at other locations shown on the Drawings.
 - e. Hand lay-up construction, with dimensions in accordance with VPS PS 15-69 and as shown on the Drawings.
 - f. Drilled in accordance with VPS PS 15-69, Table 2, having backs flat face permitting washer seating fully on bolt face and flange back.

ODOR CONTROL, FIBERGLASS DUCT

- g. Flange Face Tolerance:
 - 1) Perpendicular to duct axis with 1/2 degree.
 - 2) Flat within $\pm 1/32$ -inch, 18-inch diameter and smaller.
 - 3) Flat within $\pm 1/16$ -inch, 20-inch and larger.
- h. Gaskets: EDPM, full face, 1/8-inch minimum thickness.
- i. Bolts, Nuts and Washer: Type 316 stainless steel.
- 3. Joints:
 - a. Type: Butt and wrap in accordance with VPS PS 15-69.
 - b. Field Weld Kits: Furnished by manufacturer, consisting of fiberglass and reinforcing material, pre-cut and individually packaged for each joint. Bulk glass rolls will not be acceptable.
 - c. Resin, Catalyst and Putty: Furnished in bulk, plus 10% extra for waste.

2.03 EXPANSION JOINTS

- A. General:
 - 1. Provide where shown on Drawings.
 - 2. Unless otherwise specified or indicated on Drawings, flanged where connecting ductwork to equipment, otherwise slip-type will be acceptable.
- B. Construction:
 - 1. Type: W-design configuration with integral flanges suitable for service with FRP ductwork under conditions specified.
 - 2. Backing Rings: 3/8-inch thick, 2-inches wide, Type 316 stainless steel where flanged joints or flexible joints noted.
 - 3. Extension: 3-inches.
 - 4. Compression: 2-1/2 inches.
 - 5. Lateral Offset: 2-1/2 inches.
 - 6. Thickness: 1/4-inch minimum.
 - 7. Bolts, Nuts and Washers: Type 316 stainless steel.

2.04 BUTTERFLY DAMPERS

- A. Round Fiberglass Reinforced Plastic Dampers:
 - 1. Type: Butterfly.
 - 2. Corrosion Resistant: Comply with requirements for ductwork.
 - 3. Leakage:
 - a. Balancing: 3 cfm/sq. ft. at 10-inches WC maximum.
 - b. Isolation: 5.25 cfm/sq. ft. at 30-inches WC maximum.
 - c. Unless otherwise shown on Drawings, all dampers shall be isolation.
 - 4. Fabrication:
 - a. Frame and Blade: Premium vinyl ester, with blade fully encapsulating shaft.
 - b. Shaft: Premium vinyl ester for manually actuated dampers.
 - c. Bearings and Bushings: Teflon.
 - d. Pins and Hardware: Type 316 stainless steel.
 - e. Blade Stop: Provide consisting of FRP angles with full circumference EDPM seals.
 - f. Flanged ends with Type 316 hardware.
 - g. Damper Operator:
 - 1) Size, 24-Inch and Smaller: Hand quadrant actuator fabricated of Type 316 stainless steel with a 5-stage locking device.
 - 2) Size, Larger than 24-Inches: Unless otherwise specified, provide gear operator with an epoxy coating.
 - 3) Balancing Dampers: Fully adjustable slot with extra hole drilled in handle to permit "drill and pin-in place" once system is balanced.
 - 4) Isolation Damper: Bear the AMCA seal.
 - 5) Valve Box with Operating Stem extending to the ground surface and position indicator that identifies direction and number of turns to open or

close the damper: Provide on buried balancing dampers.

4. Protect the flanged joints, gaskets and hardware of buried dampers with protective wrapping before burying. Encasement for wrapping buried control dampers shall be installed according to AWWA C105 and shall be as follows:
 - a. Form: Sheet or tube.
 - b. Material: LLDPE film of 0.008-inch minimum thickness or high-density, cross-laminated PE film of 0.004-inch minimum thickness.
 - c. Color: Black.

2.05 DUCT HANGERS AND SUPPORTS

- A. Hangers and supports shall comply with the requirements of Division 15 Section "Hangers and Supports for Piping Systems" with the spacing complying with the requirements listed in the table below.

Duct Inside Diameter (inches)	Maximum Span (feet)
3 - 18	10
20 - 24	15
30 - 36	20

- B. Duct Support Locations:
 1. General: Not all locations are shown on the Drawings and CONTRACTOR shall be responsible for the design of additional supports and for overall stability of the ductwork system.
 2. Exterior Supports:
 - a. Designed to include weight of duct and to withstand applicable combinations of wind and seismic loadings in accordance with the applicable building codes.
 - b. Support shall be of the "saddle type" as shown on the Drawings.
 - c. Locations shown on the Drawings are approximate and CONTRACTOR shall confirm support requirements and locations.

PART 3 EXECUTION

3.01 INSTALLATION

- A. General:
 1. Examination: Prior to installation, each duct length and fittings shall be inspected, flushed clean of any debris or dust, and straightened if not true.
 2. Install ductwork in a neat and workmanlike manner, properly aligned, and cut from measurements taken at the site to avoid interferences with structural members, architectural features, openings and equipment.
 3. Exposed ducts shall afford maximum headroom and access to equipment, and where necessary, installed with sufficient slopes for venting and drainage of liquids and condensate to low points.
 4. Protect the flanged joints, gaskets and hardware of buried dampers with manufacturer recommended wrapping before burying.
 5. CONTRACTOR shall obtain training by manufacturer's field representative in the correct installation and support of the ductwork.
- B. Supports and Anchors:
 1. Ductwork shall be firmly supported with fabricated or commercial hangers and supports in accordance with the requirements of Division 15 Section "Hangers and Supports for Piping Systems" and as described in Part 2 – Products.
 2. Provide supports at equipment and structural members to avoid stress on ductwork and the connecting items.

ODOR CONTROL, FIBERGLASS DUCT

3.02 DUCTWORK JOINTS

A. Butt and Wrap Joints:

1. Prior to joining, ends shall be ground smooth. Remove all debris and dust.
2. Ends shall be resin-coated.
3. Ductwork, 24-Inch and Larger: Apply and interior corrosion wrap.
4. Butt and wrap sequence shall be as specified by ductwork manufacturer to the thickness indicated on the shop drawings.

3.03 INSPECTION AND FIELD TESTING

A. Inspection: Inspect finished installation for proper joints and sufficient supports, anchoring, interference, and damage to ductwork, fittings and coating. Repair damaged to the satisfaction of the ENGINEER.

B. Field Testing:

1. CONTRACTOR shall provide all test equipment, labor, materials and devices at no extra cost to OWNER.
2. Ductwork system shall be tested to 1-1/2 times the maximum working pressure.
3. Leakage may be determined by loss of pressure, soap solution, chemical indicator, or other positive and accurate method.
4. All fixtures, devices, or other accessories connected to the ductwork system, which could be damaged if subjected to the test pressure, shall be disconnected and ends of the branch lines plugged or capped.
5. Repair leaks and retest ductwork system.

END OF SECTION

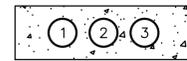


TABLE FOR SECTION 1

CONDUIT NO.	CONDUIT TAG	CONDUIT SIZE	DESCRIPTION
1	OCCP-M	3"C	3#4/0, 3#4/0G, 1#6G
2	-	3"C	SPARE
3	OCCP-C	2"C	COMMUNICATIONS

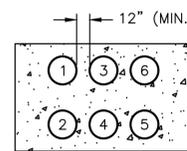
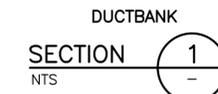


TABLE FOR SECTION 2

CONDUIT NO.	CONDUIT TAG	CONDUIT SIZE	DESCRIPTION
1	LP1-14,16	2"C	3#4, #8G (CHEMICAL FEED POWER PANEL CFP-1)
2	OFCP-3C	2"C	35#14, (4)SPARE TO CJP
3	SPARE	2"C	TO CJC
4	OFCP-5I	2"C	(5)TSW, (2)SPARE FOR ANALOG SIGNALS TO CJC
5	SPARE	1"C	TO CJC
6	LP1-10	1"C	SITE LIGHTS

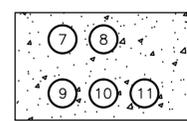
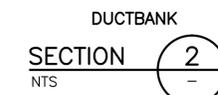
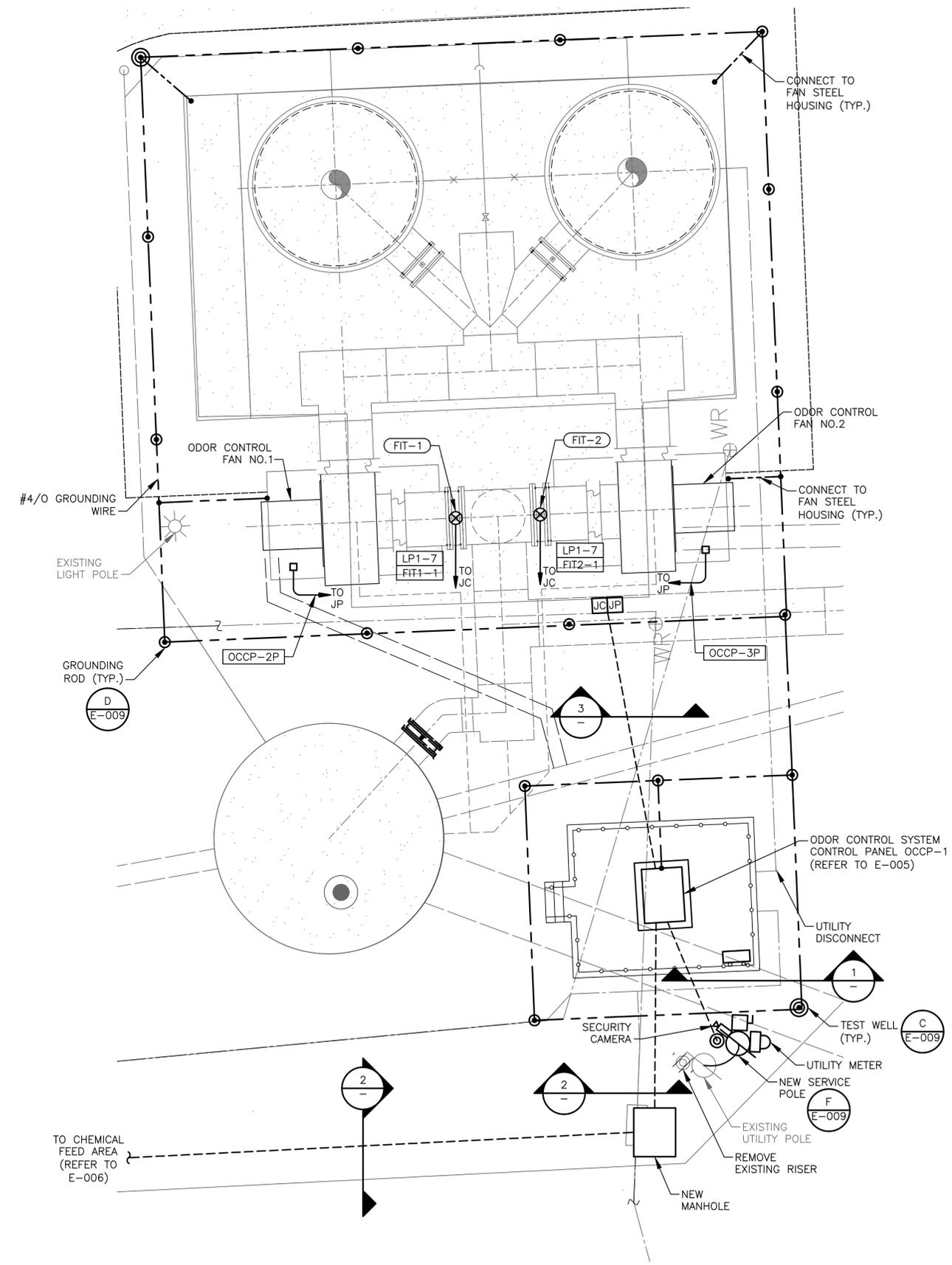
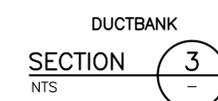


TABLE FOR SECTION 3

CONDUIT NO.	CONDUIT TAG	CONDUIT SIZE	DESCRIPTION
7	FIT1-1	1"C	TO CONTROL J-BOX
8	OCCP-2P	2"C	TO POWER J-BOX
9	FIT2-1	1"C	TO CONTROL J-BOX
10	OCCP-3P	2"C	TO POWER J-BOX
11	SPARE	1"C	TO POWER J-BOX



ENLARGED SITE PLAN
1/5" = 1'-0"

TO ARRANGE FOR LINES TO BE TURNED OFF OR MOVED, CALL CENTERPOINT ENERGY AT 713-207-2222.

NOTICE:
FOR YOUR SAFETY, YOU ARE REQUIRED BY TEXAS LAW TO CALL 811 AT LEAST 48 HOURS BEFORE YOU DIG SO THAT UNDERGROUND LINES CAN BE MARKED. THIS VERIFICATION DOES NOT FULFILL YOUR OBLIGATION TO CALL 811.

VERIFICATION OF PRIVATE UTILITY LINES

Date:

CenterPoint Energy/Natural Gas Facilities Verification ONLY. (This signature verifies that you have shown CNP Natural Gas lines correctly - not to be used for conflict verification) (Gas service lines are not shown) Signature valid for six months.

Date:

CenterPoint Energy/UNDERGROUND Electrical Facilities Verification ONLY (This signature verifies existing underground facilities - not to be used for conflict verification.) Signature valid for six months.

NO.	DATE	REVISION	BY
1	03/18/15	ADDENDUM NO.1	HF

APAI NO.: 1102-004-02 DRAWN BY: JH
ISSUE DATE: 10/03/2014 CHECKED BY: HF

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TEXAS REGISTERED ENGINEERING FIRM F-13

CITY OF HOUSTON
DEPARTMENT OF PUBLIC WORKS AND ENGINEERING
11TH STREET ODOR CONTROL FACILITY
ENLARGED ODOR CONTROL SITE PLAN
ELECTRICAL

WBS NUMBER	FOR CITY OF HOUSTON USE ONLY
R-000020-0010-4	
DRAWING SCALE	
1/5" = 1'-0"	
CITY OF HOUSTON PM	
AKHTER HUSSAIN, P.E.	
DWG NO.: E-003	
SHEET NO. 18 OF 42	

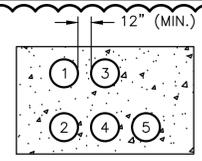


TABLE FOR SECTION 2

CONDUIT NO.	CONDUIT TAG	CONDUIT SIZE	DESCRIPTION
1	LP1-14,16	1" C	3#6, #8G CHEMICAL FEED POWER PANEL CFP-1
2	OFCP-3C	2" C	35#14, (4) SPARE
3	SPARE	2" C	TO CJC
4	OFCP-5I	2" C	(5) TSW, (2) SPARE FOR ANALOG SIGNALS
5	SPARE	2" C	-

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1	03/18/15	ADDENDUM NO.1	HF
2			

APAI NO.: 1102-004-02
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GAI

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CITY OF HOUSTON
 DEPARTMENT OF PUBLIC WORKS AND ENGINEERING

11TH STREET ODOR CONTROL FACILITY ENLARGED CHEMICAL FEED SITE PLAN
 ELECTRICAL

WBS NUMBER	FOR CITY OF HOUSTON USE ONLY
R-000020-0010-4	
DRAWING SCALE	
3/8" = 1'-0"	
CITY OF HOUSTON PM	
AKHTER HUSSAIN, P.E.	
DWG NO.: E-004	
SHEET NO. 19 OF 42	

