SECTION 13252 - MIST TYPE CHEMICAL ODOR CONTROL SYSTEMS

City of San Diego, CWP Guidelines

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NTS: Portions of this Section, pertaining to the FRP tanks (design, fabrication, installation, testing, etc.) must be reviewed by the FRP engineer retained by the Design Consultant. See Section 06610 for selection and qualifications of the FRP engineer.

Further, Design Consultant shall combine this Section with other appropriate odor control Specifications (e.g., Section 13251 - Activated Carbon Odor Control Systems) to create a system specification with unit responsibility for the entire odor control system. The system specification shall cover all related instrumentation and controls, pumps and piping, ductwork, and other accessories.

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PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

A. The WORK of this Section includes providing odor control systems consisting of all piping, tankage, ductwork, valves, [water softeners,] control panels, pumps, compressors, fans, instrumentation, conduit, wiring, and other appurtenances necessary for complete and operable systems.

B. The WORK also includes coordination of design, testing and installation.

C. The WORK also requires that one manufacturer be made responsible for furnishing the WORK of this Section, but without altering or modifying the CONTRACTOR'S responsibilities under the CONTRACT DOCUMENTS.

D. To facilitate the interchangeability of spare parts, all similar components for the systems, such as the foul air fans, air compressors, and chemical feed pumps, shall be the products of single manufacturers.

1.2 RELATED SECTIONS

A. The WORK of the following Sections applies to the WORK of this Section. Other Sections of the Specifications, not referenced below, shall also apply to the extent required for proper performance of this WORK.

1. Section 06610 Glass Fiber and Resin Fabrications
2. Section 11000 Equipment General Provisions
3. Section 11175 Pumps, General
4. Section 11261 Metering Pumps

5. Section 13209 Fiberglass Reinforced Plastic Tanks
6. Section 15855 Air Handling and Moving Equipment
7. Section 15860 FRP Ductwork

1.3 SPECIFICATIONS AND STANDARDS

A. Except as otherwise indicated, the current editions of the following apply to the WORK of this Section:

1.	ANSI/AWS D1.1	Structural Welding Code-Steel
2.	NBS PS 15	Custom-Contact-Molded Reinforced Polyester Chemical-Resistant Process Equipment
3.	AISC-1978	Specification for the Design, Fabrication, and Erection of Structural Steel for Buildings
4.	ASTM A 325	Specification for High-Strength Bolts for Structural Steel Joints
5.	ASTM A 490	Specification for Heat-Treated Steel Structural Bolts 150 ksi (1035 MPA) Tensile Strength
6.	ASTM C 581	Practice for Determining Chemical Resistance of Thermosetting Resins Used in Glass Fiber Reinforced Structures Intended for Liquid Service
7.	ASTM D 638	Test Method for Tensile Properties of Plastics
8.	ASTM D 695	Test Method for Compressive Properties of Rigid Plastics
9.	ASTM D 790	Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
10.	ASTM D 883	Definitions of Terms Relating to Plastics
11.	ASTM D 2563	Recommended Practice for Classifying Visual Defects in Glass-Reinforced Plastic Laminate Parts
12.	ASTM D 2583	Test Method for Indentation Hardness of Rigid Plastics by Means of a Barcol Impressor
13.	ASTM D 2584	Test Method for Ignition Loss of Cured Reinforced Resins
14.	ASTM D 3299	Specification for Filament-Wound Glass Fiber Reinforced Thermoset Resin Chemical-Resistant Tanks
15.	NFPA 255	Method of Test for Surface Burning Characteristics of Building Material

1.4 SHOP DRAWINGS AND SAMPLES

B. The following shall be submitted in compliance with Section 01300:

1. Shop Drawings:

a. Shop drawings showing dimensions of the complete system, instrumentation, electrical service, duct and water and drain connections, routing of chemical solution piping to the spray nozzles.
b. Materials and equipment list.
c. Structural calculations and drawings for the scrubber vessels, loads, and deflection of the vessel at the point of connection to the ductwork, wall thickness, anchor bolt size and location; ladder and platform design, and location of lifting hooks. Also, calculations showing that the vessels and other equipment shall withstand an earthquake in Seismic Zone 4 and sustained wind load of [50] pounds per square foot. All structural drawings and calculations shall be stamped and signed by a registered structural engineer experienced in the design of plastic and fiberglass structures. The CONSTRUCTION MANAGER will review the structural drawings and calculations for completeness only.

2. References: Information on at least one successfully performing odor control system of comparable size and complexity the manufacturer has supplied in the recent past, with contact names, addresses, and telephone numbers.
3. Samples: A representative sample of the vessel laminate for approval of surface finish and visual defects. The fabricated WORK shall be identical in surface finish and visual quality.

1.4 OWNER'S MANUAL

A. The following shall be included in the OWNER'S MANUAL in compliance with Section 01300:

1. **Certificates:** Certificates from the FRP ductwork supplier that:

a. The type of resin used has been tested in accordance with ASTM C 581 and is compatible with an environment consisting of air, caustic, hydrogen sulfide gas, methane, aromatic hydrocarbon vapors, droplets of salt water, and droplets of water containing sodium hypochlorite, hydrogen peroxide, sodium hydroxide, and sulfuric acid.
b. The type of fiberglass used has a flame spread rating of 25 or less and a smoke developed rating of 50 or less as measured in accordance with NFPA Standard No. 255.
c. The ductwork meets the deflection requirements under the vacuum pressure and hoop loading indicated herein.

2. A certificate from the vessel manufacturer listing the name, composition, and characteristics of the resin.

1.5 FACTORY TESTING

A. **Inspection and Testing Requirements:** The CONSTRUCTION MANAGER reserves the right to reject delivery of any pieces of equipment found, upon inspection, to have any blisters, chips, crazing, exposed glass, cracks, burned areas, dry spots, foreign matter, surface porosity, sharp discontinuity or entrapped air at the surface of the laminate. Any item which does not satisfy the tolerances indicated below shall be rejected.

FRP PRODUCT TOLERANCES

Defect	Inside Surface	Outside Surface
Blister	None	Max dimension: 1/4-in dia x 1/8 in high Max density: 1 per sq ft Min separation: 2 in apart
Chips	None	Max dimension of break: 1/4-in and thickness no greater than 10 percent of wall thickness Max density: 1 per sq ft
Crazing	None	Max length: 1/2 in Max density: 5 per sq ft Min separation: 2 in
Cracks	None	None
Exposed Glass	None	None
Scratches	None	Max length: 1 in Max depth: 0.010 in
Burned Areas	None	None
Surface Porosity	None	None
Foreign Matter	None	None
Sharp Discontinuity	None	None
Pits	Max 1/8 in, dia by 1/32 in deep Max: 10 per sq ft	Max 1/8 in dia by 1/16 in deep Max: 10 per sq ft
Dry Spot	None	2 sq in per sq ft
Entrapped Air	None at the surface 1/16 in and 10 per sq in max within	1/8 in and 4 per sq in or 1/16 in and 10 per sq in

laminate

B. Notification of the fabrication schedule must be given to the CONSTRUCTION MANAGER at least two weeks in advance of any exterior gel coating (or equivalent) of the vessel . The CONSTRUCTION MANAGER reserves the right to be present at the fabricators facility for visual inspection of equipment to be supplied.

C. Prior to shipment, all vessels must be smoke-tested at a pressure of one psi and held for a minimum of one hour, with no visible signs of leaks or excessive wall deflection. The CONSTRUCTION MANAGER reserves the right to be present at the fabricator's facility during testing and shall therefore be notified of test schedule at least 2 weeks in advance.

1.6 SERVICES OF MANUFACTURER

A. **Startup Assistance**: The startup of each odor control facility shall be accomplished under the supervision of an experienced startup engineer from the manufacturer furnished by the CONTRACTOR. The startup engineer shall be at the jobsite for a minimum of [5] working days to inspect the installation of each system, and direct the startup of each system. The startup engineer shall furnish a written certification that each system is correctly installed, with all indicated and required components, and that each is capable of meeting the specified performance requirements. This written certification shall be submitted to the CONSTRUCTION MANAGER prior to the startup of any system.

B. **Performance Test:** The CONTRACTOR shall furnish an experienced manufacturer representative to perform the [3] day performance test on the project site.

C. **Instruction of OWNER'S PERSONNEL**: The CONTRACTOR shall furnish the services of a trained, qualified representative of the equipment manufacturer for each piece of equipment for at least [2] days after units are put in proper working order, for the purpose of inspecting the installation and instructing the OWNER'S operating personnel.

1.7 QUALIFICATIONS

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NTS: In the paragraph below, define the terms "comparable size and complexity" for the equipment or system specified. Requiring experience of more than one successful project requires sound justification and prior written approval from the City Project Manager.

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A. **Manufacturer**: Company specializing in odor control systems of the type and size indicated with at least one successfully performing system of comparable size and complexity manufactured in the recent past. Systems of comparable size and complexity shall have the following characteristics: [ ].

PART 2 -- PRODUCTS

2.1 GENERAL

A. **Process Description:** The CONTRACTOR shall provide equipment which utilizes chemical [absorption] and [adsorption] processes for removal of odors. Foul air from the plant process facilities shall be delivered to a scrubber vessel. [Sodium hypochlorite] [Sodium hydroxide] [hydrogen peroxide] shall be introduced into the scrubber vessel at the same location as the foul air in the form of an atomized mist. The equipment provided shall be designed to provide a minimum of [99] percent removal of H_2S in the foul air stream, and [ ] percent of odor units.

B. Equipment and facilities indicated on the drawings are based on equipment typically provided by one manufacturer [ ]. Any design changes necessitated by the selection of another approved manufacturer shall be the CONTRACTOR's responsibility, and all design and construction costs associated with any such changes shall be borne by the CONTRACTOR. All design changes shall be subject to review and approval by the CONSTRUCTION MANAGER.

C. If the CONTRACTOR desires to use the system of a manufacturer other than those listed, it shall submit to the CONSTRUCTION MANAGER operational or pilot test data indicating the successful operation of the alternative odor control equipment in wastewater treatment facilities. Such data shall be submitted to the CONSTRUCTION MANAGER for review prior to the submittal of equipment shop drawings. The alternative manufacturer's system design shall be similar to that which is successfully demonstrated in other wastewater treatment facilities by pilot testing or full-scale operational data; however, in no case shall scrubber vessel detention times and construction materials be less than those specified, nor shall the capacities of the chemical feed systems or the capacities of the exhaust fans be less than specified. No alternative odor control equipment shall be provided which cannot demonstrate successful operation to the satisfaction of the CONSTRUCTION MANAGER.

D. **Performance:** Each chemical odor control system shall be designed for the following operating conditions and criteria:

Equipment No's	-	[ ]
Location	-	[ ]
Number of Systems	-	[ ]
Air Flow (cfm)	-	[ ]
Vessel Dimensions (ft)	-	[ ]
H_2S concentration at point of removal (ppm)	-	[ ]
Maximum Air Pressure Loss Across Absorber Inlet to Outlet at Design Flow, inches w.c.	-	[ ]
Minimum Retention Time	-	[10 sec]

2.2 SCRUBBER CONTACT CHAMBER

A. **General:** Scrubber vessels shall comply with Section 06610. Each scrubber vessel shall be a fabricated FRP, concurrent flow tower, to conform to the following set of design criteria.

Location	Equipment No.	Minimum Detention Time (sec)	No. Vessels Req'd.	Vessel Dimensions (ft dia x ft ht*)
[ ]				
[ ]				
[ ]				
[ ]				

*Side wall height.

B. **Materials of Construction:** The vessels/scrubber towers shall be constructed of fiberglass. The resin shall be reinforced with an interior Type C fiberglass veil and an exterior continuous, even-tensioned fiberglass filament wound reinforcement. The scrubber towers shall be one piece construction with no cell joints. A final gel coat is required such that no glass fiber is exposed. Final gel coat shall be pigmented. The fiberglass shall contain an ultraviolet absorber to protect the resin from ultraviolet degradation. The resin shall be suitable for continuous exposure to saturated hydrogen sulfide gas, [sodium hypochlorite mist], [hydrogen peroxide mist], [sodium hydroxide mist] and [sulfuric acid].

C. The minimum wall thickness of the tower shall be 1/4-inch and the skirt thickness not less than 1/2-inch. Surfaces shall be smooth with no exposed fiber, sharp projections, foreign inclusions, air bubbles, pinholes, or delaminations. The structural section of the tower shall not include the internal veil and shall have an ultimate tensile strength of not less than 30,000 pounds per square inch. The scrubber towers shall be designed with no stiffeners.

D. **Color:** The color of fiberglass scrubbers will be selected by the CONSTRUCTION MANAGER prior to the start of fabrication. The CONTRACTOR shall submit for approval standard color selections prior to fabrication.

E. **Structural Design:** The CONTRACTOR shall assign to the odor control system equipment supplier full responsibility for the complete structural design of each scrubber vessel tower. Each tower with inlet piping and exhaust stack, shall be freestanding and shall be designed for Seismic Zone 4 and to withstand a sustained wind load of not less than [50] pounds per square foot.

F. **Construction Details:** The scrubber vessels shall be provided complete with all air inlets, manways, flanged outlets, duct connections and stainless steel anchor bolts as indicated herein. Hold-down brackets, lifting lugs, painted lifting instructions, and anchor plates shall be provided as recommended by the manufacturer, and approved by the CONSTRUCTION MANAGER. All scrubber vessels shall have dome-shaped covers.

G. All pipe outlets shall be flanged. Screwed outlets shall not be acceptable. Each scrubber shall have a 2-inch drain connection with a tee for mounting the pH probe, and a fluid trap which maintains the pH probe in a continuous submerged condition. The pipe outlet size for the atomizer spray nozzles shall be as recommended by the manufacturer. A 24-inch diameter access hatch shall be provided adjacent to each spray nozzle to facilitate its removal for cleaning.

H. Duct inlets and outlets shall be flanged. Connections shall be provided on the system inlets and the exhaust stacks for mounting of hydrogen sulfide probes. Where duct inlets are near the bottom of the towers, the inlets shall be connected to a 90-degree elbow located inside the tower, facing downward.

I. Each scrubber vessel shall have a 36-inch diameter flanged manway located for easy access to the interior of the scrubber from the ground. The manway bolts shall be Type [316] stainless steel. All other nuts and bolts for attachment of equipment to the scrubber vessel, and anchor bolts shall be Type 316 stainless steel.

J. A fiberglass access ladder with safety cage and platform, fiberglass grating, and picket type hand railing, shall be provided for access to atomizer spray nozzles located at the top of the tower, and hydrogen sulfide probes located on the exhaust stack. The access ladder shall comply with Section 06610. The stack shall terminate with a Type 316 stainless steel bird screen.

K. The bottom of the scrubber vessel shall be slightly sloped to the drain line.

L. Each scrubber shall have an exhaust stack the same diameter as the influent foul air stack. The exhaust stack shall have a height of 3 feet above the top of the scrubber vessel.

2.3 CHEMICAL FEED AND DILUTION SYSTEM

A. **General:** The chemical feed and dilution system shall take sodium hypochlorite and sodium hydroxide, dilute these chemicals, and deliver them to the spray nozzle where the chemical solutions are atomized into a fine mist. Contact between the odorous gases and the chemical shall mist result in oxidation of odor-causing compounds. The chemical feed and dilution system shall contain all piping and equipment necessary to deliver chemicals from storage tanks to the scrubber vessel, at the feed rates specified herein.

B. **Chemical Dilution Panels**: Each scrubber system shall be provided with a chemical dilution panel as indicated herein. The panel shall be fabricated of 3/4-inch thick fiberglass complying with Section 06610 or 10 gauge stainless steel with stainless steel stiffeners. The height and width shall both be 6 feet. The panel shall be free-standing, mounted on legs fabricated of Type 304 stainless steel. Anchor bolts shall also be Type 304 stainless steel. The Chemical Dilution Panel shall support the chemical feed pumps and piping, compressed air piping, water meter and water piping.

2.4 CHEMICAL METERING PUMPS

A. **General:** Positive displacement, diaphragm type chemical metering pumps shall be provided to deliver [50 percent sodium hydroxide] and [12.5 percent sodium hypochlorite] to the scrubber vessels. All chemical metering pumps shall be suitable for 24 hours per day operation under the following Operating Conditions:

		[Sodium Hydroxide:]		[Sodium Hypochlorite:]	
Pump I.D. No.	Location	Min. Flow (gph)	No. of Pumps Required	Min. Flow (gph)	No. of Pumps Required
[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

B. **Pump Construction:** The chemical metering pumps shall be in accordance with Section 11261, with the following, additional provisions: chemical metering pumps shall have an output adjustable over a range of 200:1, from zero flow to maximum capacity while pumps are in operation. Adjustment shall be by means of two dial knobs, one to adjust stroke length over a 10:1 range, and the other to adjust stroke frequency over a range of 20:1. Pumps shall have HAND-OFF-AUTOMATIC switches. All pumps shall have a discharge pressure of [35 psig,]. Internal pressure relief shall be incorporated into the pump drive to stop pumping action at [50 psig.] Polyethylene discharge and suction tubing shall be provided complete with compression fittings. A foot valve with an integral strainer shall be provided for the suction line and an injection check valve with [1/2-inch] NPT male connection for the injection line. The injection check valve shall incorporate a dilating discharge orifice which prohibits scaling and accumulation of crystalline deposits.

C. **Pump Drive:** The pump shall operate on a 115-volt, 60-Hz, single-phase power supply. Controls shall be housed in an enclosure, NEMA rated in accordance with the area designations of Section 16050. The solid state electronic pulser shall be fully encapsulated. Electronics shall be housed in a chemical resistant enclosure at the control panel end of the pump, NEMA rated based on area classifications as specified in Section 16050, for maximum protection against chemical spillage.

D. **Control:** Control of the sodium hypochlorite pumps' flow rate shall be manual. The pumps shall be automatically shut off if a low level is sensed in the appropriate sodium hypochlorite tanks. The sodium hydroxide pumps shall have a 3 position selector switch, HAND-OFF-AUTO, so that the pumps may be controlled ON/OFF manually [or by a 4 to 20 mA signal from the sensor monitoring scrubber drainage pH].

E. **Pipe Connections:** Polyethylene tubing with Type 316 stainless steel or other suitable compression fittings shall be provided between the chemical tanks or drums and the suction side of the pumps.

2.5 CHEMICAL DILUTION PANEL PIPING

A. **General:** The CONTRACTOR shall be responsible for the piping of the chemical dilution panel, and the piping from the chemical dilution panel to the spray nozzles. Each chemical dilution panel shall have piping for compressed air, water and chemicals. The CONTRACTOR shall provide all fittings, valves, meters, and gauges required as indicated.

B. **Air Piping:** Each air line at the chemical dilution panel shall have 2 pipe unions (one at the top and one at the bottom of the panel), ball valve, check valve, and pressure indicator. Air lines shall be provided in accordance with the following schedule.

Location	No. of Lines Required	Line Size (in. dia.)
[ ]	[ ]	[ ]
[ ]	[ ]	[ ]
[ ]	[ ]	[ ]
[ ]	[ ]	[ ]

C. Air piping up to the panel shall be galvanized steel pipe. Piping on the panel, and between the panel and the spray nozzle connection outside the towers shall be stainless steel pipe. Air piping inside the scrubber vessel shall be Type 316, Schedule 10 stainless steel pipe.

D. **Water Piping:** A 1/2-inch galvanized steel pipe potable water line shall be connected to each chemical dilution panel. The panel shall contain a pipe union, ball valve, backflow preventer, solenoid valve, pressure reducing valve, check valve, rotameter, and pressure gauge before it connects to the 1/2-inch Type 316 stainless steel tube chemical pump discharge header. The potable water line on the panel shall be Type 316 stainless steel tube. The maximum water flow rate shall be one gpm per nozzle. PVC-coated electrical conduit and wire for the solenoid valve shall be provided and installed between the stainless steel solenoid valve and the LCP.

E. [Ion exchange self-regenerating type water softeners shall be provided for each chemical dilution panel. The water softeners shall have a minimum salt storage capacity of [200] lb and a minimum exchange capacity of [20,000] grains. The manufacturer shall be responsible for all piping connections to and from the water softeners. Power for the water softeners shall come from the odor control local control panel. The CONTRACTOR shall be responsible for installing all conduit and wire required for the water softener electrical connections in accordance with the requirements of Divisions 13 and 16. Water softeners shall have a minimum water output of [2 gpm] and shall be suitable for outdoor installation.]

F. All other pretreatment systems recommended by the manufacturer shall be furnished and installed.

G. **Chemical Piping:** All chemical metering pumps shall discharge into a common 1/2-inch Type 316 stainless steel header through a check valve and a 1/2-inch Type 316 stainless steel tube. The header shall contain a strainer, a blowdown connection (a tee with a ball valve for draining the line) and 1/2-inch type 316 stainless steel tubes with ball valves to each scrubber vessel spray nozzle. Two-stage systems will have 2 chemical lines, and single stage systems only one line.

H. Connection to spray nozzle shall be in accordance with the manufacturer's published recommendations, as approved by the CONSTRUCTION MANAGER.

I. The 1/2-inch piping shall be routed in 1-inch galvanized steel pipe conduit, provided by the CONTRACTOR, running between the scrubber vessel and nozzle and the chemical dilution panel.

2.6 AUTOMATIC pH CONTROL SYSTEM

A. The chemical feed system shall be designed for the automatic injection of sodium hydroxide if the pH residual of the scrubber drain liquid falls below a desired set point. This set point shall be as recommended by the manufacturer.

B. The pH of the scrubber vessel drain liquid shall be continuously monitored and displayed at respective odor control local control panels. Output signals from the probe shall be transmitted to the analyzer over standard signal wire. The probe unit shall be automatically temperature compensated and shall have a minimum sensitivity of 0.10 pH. The unit shall have a PVC housing with a threaded submersion shield with glass electrode suitable for operating temperature ranges between -30 degrees F and 140 degrees F.

C. The analyzer shall be compatible with the probe supplied. Signal output shall be 4-20 mA-dc. Unit shall be operated on 120-V ac power. The indication shall have a range of 0 to 14 pH units. The unit shall be provided with 2 form C relays which may be independently adjusted over the entire range. The relay contacts shall be rated for 120 volts ac, 10 amps.

D. The automatic pH control system shall be furnished with all necessary cable, and the CONTRACTOR shall install the cables from the pH sensors to the local control panels as indicated.

2.7 CHEMICAL TANKS

A. **General:** The following fiberglass chemical tanks shall be furnished for containment of a [15] percent [sodium hypochlorite] [sodium hydroxide] [ ] solution in accordance with the requirements of Section 13209:

Tank No.	Location	Tank Volume (gals)	Tank Diameter (inches)	Straight Tank Height (inches)
[ ]	[ ]	[ ]	[ ]	[ ]
[ ]	[ ]	[ ]	[ ]	[ ]
[ ]	[ ]	[ ]	[ ]	[ ]
[ ]	[ ]	[ ]	[ ]	[ ]

B. **Appurtenances:** The sodium hypochlorite tanks shall all have 2-inch PVC drains with 2-inch PVC ball valves. The piping connections shall be flanged. The tanks shall have a domed top with a 3-inch vent, a 3-inch overflow, and a 24-inch diameter flanged manway. Each of the tanks shall have a 1-inch opening in the dome for the installation of a bubbler tube to be provided and installed by the CONTRACTOR. All other connections and appurtenances shall be as indicated.

C. **Chemical Spray Nozzles:** The chemical spray nozzles shall be made of Type 316 stainless steel, or titanium for sodium hypochlorite, and shall be designed to atomize sodium hypochlorite and sodium

hydroxide chemical solutions into a fine mist of droplets 5 to 20 microns in size. One chemical spray nozzle shall be provided for each scrubber vessel. Chemical spray nozzles shall be installed in such a way that they may be easily removed for cleaning, repair, or replacement.

2.8 COMPRESSED AIR SYSTEMS

A. **General:** Each chemical spray nozzle requires the addition of compressed air for atomization of the chemical solution. Compressed air systems shall be provided as indicated herein.

B. **Blowers:** Compressed air systems shall consist of positive displacement blowers of the rotary, involute design with electric motor and V-belt drive, as specified in Section 11371.

C. **Blower Design Data:** The following blowers shall be furnished and installed as part of the chemical odor control systems:

Equip. I.D. No.	Location	Disp. Cap. (scfm)	Dis. Press. (psig)	Motor Size (hp)	Min. Blower Speed (rpm)	Max. Blower Speed (rpm)	Flange Size	Suct. Dis. Flange Size (in.)
[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]		[ ]
[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]		[ ]
[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]		[ ]
[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]		[ ]

2.9 EXHAUST FANS

A. **General:** The CONTRACTOR shall provide FRP foul air exhaust fans as indicated. Each fan shall be a Duct Axial Fan, with a V-belt drive, designed for continuous, 24-hour per day service. Each fan housing, impeller, inlet flange, and outlet flange shall be constructed of fiberglass reinforced polyester in accordance with Section 06610 and National Bureau of Standards "Voluntary Product Standard PS 15" where applicable. The surface of all fiberglass reinforced polyester in contact with the odorous air shall be corrosion resistant and suitable for contact with any scrubbing solution carryover. The exterior surface of the fiberglass reinforced polyester in contact with the atmosphere shall be finished with a final gel coat which shall protect the fiberglass from ultraviolet radiation. The finished exterior shall be smooth with no exposed fiber, sharp projections, foreign inclusions, air bubbles, pin holes, or delaminations. The fan shall be statically and dynamically balanced at operating speed prior to shipment.

B. **Fan Operating Conditions:**

Service		-	Foul air - hydrogen sulfide
Elevation above sea level (ft)		-	[ ]
Inlet Temperature (degrees F.)	(max)	-	[ ]
	(min)	-	[ ]
Relative Humidity (percent)		-	[ ]

C. **Fan Design Data:**

Equip. I.D. No.	Discharge Capacity (cfm)	Static Pressure (in WC)	Min. Motor Size (hp)	Max. Fan Speed (rpm)	Max. Motor Speed (rpm)
[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

D. **Materials and Construction:**

Impellers	-	Single piece, solid fiberglass construction. Minimum 6 blades.
Drive shaft	-	Stainless steel, plastic coated, keyed at both ends. Suitable for V-belt drive.
Drive	-	V-belt drive with epoxy coated steel, vented safety cover over both the motor and the V-belts.
Bearings	-	Heavy-duty, self-aligning, deep row, radial-ball type shielded and mechanically sealed in cast iron housing. All bearings shall be rated for a minimum L-10 life of 100,000 hours.
Lubrication	-	Grease lubricated. Stainless steel lube tubes extend from bearings to the exterior of the fan housing.
Internal bolts	-	Resin-coated stainless steel.
Drive mounting	-	Motor is mounted on the exterior of the fan housing.
Connections	-	Flanged connections on both ends. Flanges shall be fiberglass.
Base	-	Epoxy-coated steel mounting shoes both to inlet and discharge flanges.

E. **Drive:** V-belt drive with heavy duty, explosion-proof, electric motor, suitable for outdoor installation, and 480-volt, 3-phase, 60-Hz power supply, as specified in Section 16040.

F. Each fan additionally shall be provided as a complete unit with the following accessories:

1. 2 neoprene, flanged, flexible connectors
2. 1 set of spring-type, heavy duty restrained vibration isolators
3. 1 pressure gauge with valve
4. All necessary fittings, supports and controls

2.10 CONTROLS

A. **General:** The operation of each odor control system shall be controlled from the odor control local control panel (OC-LCP). The panel equipment, operational sequences, and indication/alarm functions are described in this subsection. Each OC-LCP shall provide for both coordinated and independent operation of the water supply, compressed air supply, chemical metering system, and exhaust fan.

B. **Control Panel Equipment:** The panel shall contain HAND-OFF-AUTOMATIC (HOA) switches or ON/OFF switches and run indicating lights for:

- Dilution Water Solenoid Valve (OPEN-CLOSE-AUTO)
- Exhaust Fan (HOA)
- Each Air Compressor (HOA)
- Sodium Hypochlorite Pumps (ON/OFF)
- Sodium Hydroxide Pump (ON/OFF)

C. The panel shall contain System Start, System Stop, and Rinse Start pushbuttons, and run indicating light for the rinse cycle.

D. The control panel shall indicate system drainage pH which will control the sodium hydroxide pump[, and shall indicate the inlet and exhaust foul air H_2S concentrations].

E. Each panel shall contain all necessary relays, contacts, timers, microswitches, terminals, latches, and programmable controllers to operate the odor control system and send and receive remote signals, as indicated.

F. Motor starters for the fans and compressors shall be contained in nearby motor control centers as indicated. The OC-LCPs shall contain all other transformers, disconnects, circuit breakers, and motor starters necessary for the specified operation of the system.

G. Each control panel shall be NEMA rated in accordance with the area designations of Section 16050. It shall be free standing, mounted on a stainless steel frame as shown. Each OC-LCP shall be furnished completely pre-wired with factory mounted instruments, controls, and indicators as required.

H. **Systems Operations:** In the manual operating mode, each piece of equipment shall be operated independently when the control switch is turned to the HAND (or open) position.

I. When the control switch for each piece of equipment is in the AUTOMATIC position, the system functions in the automatic mode. In this mode, the system Start button shall be depressed to start the system in the following sequence:

1. Water supply solenoid valve opens, pH controller is activated, compressor starts, chemical feed pump(s) starts, and exhaust fan starts.

J. When the system stop button is depressed, all compressors, exhaust fans, and chemical feed pumps stop simultaneously, with the water supply solenoid valve closing.

K. When the system is running in the automatic mode, the rinse button shall activate the following when depressed:

1. The chemical pumps, stop.

2. An adjustable 2 to 5 minute timer shall be activated which shall close the water supply solenoid valve and stop the exhaust fan and air compressors upon timing out. After the timer times out, the system can be restarted by depressing the system start pushbutton.

L. In the automatic mode, loss of pressure in the compressed air line, water supply line or sodium hypochlorite feed line, failure of the exhaust fan, or low level in the sodium hypochlorite use tanks or storage tank shall cause a common alarm to signal at the appropriate OC-LCP, and the main control board for all systems. A common alarm indicating odor control system failure at the specific location shall be signalled. In a similar fashion, a low or high pH signal shall cause a separate alarm to sound as indicated above.

M. All monitoring (level, pH, [H_2S,] operating, and failure) signals from the [ ] odor control facilities shall be sent to the [ ] local control board for indication. The CONTRACTOR shall provide necessary transmitters, relays, contacts, etc., to allow for signals to be sent to these locations. All control signals shall be 4-20 mA.

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NTS: The hydrogen sulfide monitoring system, specified below, is an optional item. Where the cost for such a system is not justified, it can be deleted.

_____ #$

[2.11 HYDROGEN SULFIDE MONITORING SYSTEM

A. **General:** The CONTRACTOR shall supply and install a hydrogen sulfide (H_2S) monitoring system consisting of H_2S monitors, ambient air H_2S monitors and associated piping, conduit, wiring and appurtenances.

B. **System Responsibility:** The CONTRACTOR shall assign to one manufacturer full responsibility for the entire H_2S monitoring system to provide all equipment indicated in this Section and factory representative services as indicated below.

C. **H_2S Sensors:** [ ] H_2S sensors shall be provided. One sensor shall be provided on each scrubber vessel exhaust stack, and one sensor shall be provided on each foul air duct leading into the scrubber system. In addition, ambient air H_2S sensors shall be mounted in the following locations: [.] The ambient H_2S sensors shall be mounted between 7 and 9 feet above the floor. The sensors shall

be solid-state, semi-conductor diffusion/adsorption type units. The CONTRACTOR shall furnish and install conduit and wire to the ambient H_2S sensors.

D. The sensors shall sense from 0 to 10 ppm in less than 10 seconds with 50 ppm H_2S applied. The sensors shall be 100 percent clear in less than 3 minutes. The sensors shall detect from 0 to 100 ppm of H_2S and shall exhibit no loss of sensitivity of response time due to lack of exposure or prolonged exposure to H_2S. The operating temperature range of the sensors shall be -30 degrees F to +150 degrees F.

E. The sensors shall be guaranteed to operate as specified for a period of one year after successful startup of the H_2S monitoring system.

F. **H_2S Monitors:** H_2S monitors shall be provided and installed in each odor control system local control panel. Each monitor shall have 2 channels for continuous readout of system influent and exhaust H_2S concentration in ppm. H_2S signals from each odor control facility [and the ambient H_2S monitors] shall be sent to the main control board for indication.

G. Each monitor shall indicate H_2S concentration in a range of 0 to 100 ppm. Monitors shall be equipped with channel selector switch with channel scan mode, for monitors with two or more channels, high and low level alarms and reset buttons for each channel, and malfunction alarms and reset buttons for each channel. The H_2S monitors shall have automatic calibration with no zero or pot adjustments.

H. The H_2S equipment supplier shall furnish all cable required between the H_2S sensors and H_2S monitors and the H_2S monitors and the odor control LCPs. The cable shall be installed by the CONTRACTOR.

I. **H_2S Calibrator:** The CONTRACTOR shall supply one portable H_2S calibrator for calibration of the H_2S monitors. The calibrator shall have an output range of [20 to 100] ppm and shall be equipped with a 12-volt DC rechargeable battery. An electrically driven diaphragm pump shall convey the H_2S to the instrument to be calibrated.

2.12 NAMEPLATES, TOOLS AND SPARE PARTS

A. **Spare Parts**: Each blower, fan, pump, and any other piece of equipment with moving parts shall be furnished with one year's supply of lubricants and one set of the following spare parts for each piece of equipment:

1. Bearings
2. Seals
3. Driver bulb
4. Filter elements

B. The spare parts shall be labeled and packaged as indicated in Section 11000.

2.13 MANUFACTURERS

A. Chemical odor control systems shall be as manufactured by the following (or equal):

1. Calvert Environmental Equipment Co.
2. Quad Environmental Technologies Corp.

B. Fiberglass resin shall be as manufactured by the following (or equal):

1. Dow Chemical Co. [Derakane 411.5]
2. ICI American [Altac 580]
3. Ashland Chemicals [Hetron 922]

C. [Water softeners] shall be as manufactured by the following (or equal):

1. Kane International, Inc.
2. Bruner Corporation
3. Culligan

D. Exhaust fans shall be as manufactured by the following (or equal):

1. Ceilcote
2. Hartzell Propeller Fan Co.

E. Fiberglass duct work shall be as manufactured by the following (or equal):

1. Justin Enterprises
2. Fiber-Dyne, Inc.
3. Ceilcote Co.

F. H_2S monitoring system shall be as manufactured by the following (or equal):

1. Texas Analytical Control, Inc.
2. Rexnord Gas Detection Products

PART 3 -- EXECUTION

3.1 GENERAL

A. All parts for the odor control system shall be installed in strict accordance with the manufacturer's instructions and under the guidance of the manufacturer's field representative.

B. The equipment shall be fabricated, erected, assembled, and placed in proper operating condition in full conformity with the Drawings and Specifications, and engineering data, instructions, and recommendations of the equipment manufacturer. Each item of equipment shall be provided complete with all supports, electric drive units, shafts, sprockets, mechanical equipment, electrical work, and appurtenances ready for operation. All vessels and parts shall be amply proportioned for the stresses which may occur during operation, fabrication, and erection. Individual parts which are alike in all units shall be alike in workmanship, design, and materials, and shall be interchangeable.

Guards shall be provided for all exposed moving shafts, drives, or parts as required by the applicable safety codes.

C. Unless otherwise shown, the power supply to the equipment will be 480-volt, 60-Hz, 3-phase.

D. **Supports:** The CONTRACTOR shall support all runs of ductwork at least every 5 feet and more frequently if required to meet the sag requirements indicated herein. Supports shall be fabricated out of galvanized steel and designed to meet the installation requirements. Attachment of the supports to fiberglass ducting with screws is unacceptable. All fiberglass vessels, fans, and major sections of ductwork, shall be provided with lifting lugs or eyes to facilitate handling and installation.

3.2 FIELD JOINTS

A. Field joints in fiberglass ducts shall be made by wrapping with strips of reinforcement saturated with resin, the reinforcement being at least the thickness of the heaviest plastic section being joined. Extension to a sufficient distance on each side of the joint is required to make the joint at least as strong as the pieces joined. Mating edges shall be filled with resin paste to cover cut edges and fill voids. The inside surface of the joint shall be sealed with one layer of reinforcement where accessible.

3.3 STARTUP AND TESTING

A. **General:** The CONTRACTOR shall be responsible for the successful startup and testing of each odor control facility. The CONTRACTOR shall furnish all necessary facilities, manpower, chemicals, tools, instrumentation, and laboratory testing services required during this phase of the WORK.

B. Upon completion of the installation, each piece of equipment and each 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.

C. All startup and testing shall be done under the direction and supervision of the manufacturer. The CONSTRUCTION MANAGER shall be advised of the testing and startup schedule at least [2] weeks in advance.

D. The performance of the system shall be verified by a [3]-consecutive-day, 24-hour-per-day, performance test conducted by the CONTRACTOR. All temporary power and water supply facilities, and H_2S sample collection and testing equipment shall be furnished by the CONTRACTOR during these [3] days, plus [5] days additional testing for mechanical equipment. Influent and effluent H_2S samples shall be collected and analyzed every [3] hours for [3] days. For the purpose of performance testing, the CONTRACTOR shall supply bottled H_2S to simulate design influent H_2S concentrations.

E. The CONTRACTOR shall be required to test the odor control systems at an influent H_2S concentration of [50] ppm on each of the [3] consecutive test days, with a concentration of 15 ppm the remainder of the time. Removals shall be [99] percent of the influent hydrogen sulfide, as measured in ppm, and [ ] percent of odor units.

F. Hydrogen sulfide (H_2S) concentrations shall be measured using a wet chemical method where a known volume of air is bubbled through a controlled volume of calcium hydroxide and starch solution which absorbs H_2S. H_2S content shall then be analyzed by a titration and colorimetric determination. The CONTRACTOR shall utilize a portable H_2S analyzer to provide rapid feedback during testing. However, the final H_2S determination for evaluating system performance shall be by the above described wet chemical method. All H_2S testing shall be conducted by a laboratory mutually selected and agreed upon by the CONTRACTOR and the CONSTRUCTION MANAGER. The costs of all H_2S determinations shall be borne by the CONTRACTOR.

G. At the conclusion of the test, the CONTRACTOR shall submit [5] copies of the complete test report to the CONSTRUCTION MANAGER, which shall include summaries of the influent and exhaust H_2S concentrations, test methods, any unusual occurrences, and any other useful information. The test report will be reviewed and approved by the CONSTRUCTION MANAGER prior to the final acceptance of any of the odor control systems.

3.4 SUPPLY OF CHEMICALS

A. After conducting the performance tests, the CONTRACTOR shall refill all the tanks with the necessary chemicals.

3.5 CLEANUP

A. After completion and testing the CONTRACTOR shall remove all debris and spilled chemicals from the site and clean the entire system to render it ready for startup.

** END OF SECTION **