Division 6 - Specifications for Odor Control Systems and Bioxide Tank/Feed System.

ZABOCS 6000 ODOR CONTROL SYSTEM
BIOXIDE TANK AND FEED SYSTEM

All odor control systems and components shall meet the Collier County noise ordinance during normal operation at all adjacent property lines/easement lines for daytime and nighttime criteria. Contractor to provide quieter motors, sound enclosures, sound barriers, or other measures as necessary to meet this requirement. Motor insulating jackets may be accepted based on County approval.

PART 1 - EXISTING SIEMENS / US FILTER ZABOCS 6000 ODOR CONTROL UNIT TO BE RELOCATED

The contractor shall relocate the existing ZABOCS 6000 odor control unit onsite per the new location depicted in the Civil plans. The contractor shall refer to and comply with the manufacturer's specifications and general layout drawings (included elsewhere in these specifications) for the unit installation and performance testing and start up. This includes making all the necessary connections to the electrical systems, structural attachment to the slab, isolation pad, water service, drain line, air piping connections, etc. The contractor shall provide the materials, equipment, and labor necessary to provide a properly functioning unit once relocation is complete and the replacement wear items have been installed.

The contractor shall retain the services of a qualified company (to be approved by the County) to obtain and install the proposed replacement parts listed in the Civil plans for the ZABOCS 6000. After installation, the contractor shall then perform the required functional testing and startup to ensure the unit is operating in accordance with the manufacturer specifications prior to the required air balancing procedure.

See the air balancing criteria specified in the Bioscrubber Odor Control System (Biotrickling Filter) specification for the requirements pertaining to balancing the flows between the ZABOCS unit and the proposed Biotrickling Filter which shall be connected in series to allow the operation of both units together or each unit individually.
PART 2 - SIEMENS BIOXIDE TANK AND FEED SYSTEM

Siemens shall provide the bioxide tank and feed system per its contract with Collier County. The contractor shall provide the materials, equipment, and labor necessary to install, connect, and facilitate the operation of the proposed Bioxide tank and feed system. The contractor shall coordinate with Siemens to receive the unit, unload, store, protect and install the tank, feed system, and all associated appurtenances.

The contractor shall provide the required concrete slab as noted in the Civil and Structural plans including the necessary piping, fittings, wiring, conduit, etc. necessary to provide a functioning unit in accordance with the manufacturer specifications. The contractor shall provide the slab penetrations for the conduit and drain piping in accordance with the manufacturer layout drawings.
PART 1 – GENERAL

NOTE: This specification is included to document the manufacturer requirements for installing a ZB-6000 odor control unit, providing the materials for installation, and for the required performance criteria to provide a properly functioning unit once relocation/installation is complete. The existing ZB-6000 unit is to be relocated and reinstalled onsite per the location shown in the plans. A new ZB-6000 unit is not proposed, therefore, some of the criteria below will not apply to this contract.

1.1 SCOPE

A. The work specified herein shall include designing, furnishing and installing all equipment and materials necessary to provide the Owner with a completely operational Biological Odor Control System. The system shall be a completely packaged two-stage, biological absorption/adsorption system of UNITARY CONSTRUCTION. The Manufacturer shall be responsible for providing a complete Odor Control System that shall include, but not be limited to FRP vessel, nozzles, two independent stages of inorganic treatment media, moisture controls, nutrient supply system, air supply fan, interconnecting ducting, and all necessary accessories.

1.2 DESCRIPTION

A. Multi-Stage Package System: The Manufacturer shall furnish and install a complete "once-through two-stage", pre-piped, wired, and packaged UNITARY CONSTRUCTION odor control system including two integral treatment stages, exhaust fan, valves, fittings, ductwork, and all other equipment and accessories as specified to provide a complete and functioning system. The biological treatment stage shall utilize an inorganic expanded clay media to facilitate absorption and adsorption of odor compounds. The polishing stage shall utilize a virgin activated carbon polishing media that shall be specifically designed to adsorb odorous compounds with the ability to support biological degradation of the compounds. The first stage shall operate with an independently controlled irrigation system to maintain optimum wetted conditions to support unique microbial growth for biological destruction of the odorous compounds and removal of toxic metabolites. Systems using any type of organic media and systems using a single inorganic media shall not be acceptable.

B. Design Basis The mechanical, structural, process and electrical design has been based on a ZABOC§ odor control system manufactured by Siemens Industry, Inc., San Diego, California.
C. Specified Manufacturer: Siemens Industry, Inc., or pre-approved equal.

1.3  REFERENCE STANDARDS


B. ASTM D-883: "Definition of Terms Relating to Plastics"

C. ASTM D-2583: "Test for Indentation Hardness of Rigid Plastics by Means of Barcol Impressor."


1.4  QUALITY ASSURANCE

A. Manufacturer: The products furnished under this section shall be by a manufacturer who has been regularly engaged in the design and manufacture of the equipment and who has a minimum of 5 years experience in design, fabrication and testing of biological odor control systems. The odor control Manufacturer shall show evidence of at least ten identical 2-stage design installations in satisfactory operation in wastewater treatment plant facilities for at least 5 years. The odor control Manufacturer shall have used proposed biofiltration media for a minimum of 5 years. Any proposed non-specified manufacturers shall demonstrate to the satisfaction of the ENGINEER that the quality of their equipment is equal to that made by those manufacturers specifically named herein. Any manufacturer whose main business is FRP manufacturing shall not be accepted as a supplier of the complete system.

B. Inspection and Testing Requirements: The ENGINEER reserves the right to reject delivery of any or all pieces of equipment found, upon inspection, to have any or all of the following: 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 that does not satisfy the tolerances as below shall be rejected:

<table>
<thead>
<tr>
<th>Defect</th>
<th>Inside Surface</th>
<th>Outside Surface</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blister</td>
<td>None</td>
<td>Max. dimensions: 1/40 diameter by 1/80 high; Max density: 1 per sq. ft.; Min. separation: 20 apart</td>
</tr>
<tr>
<td>Feature</td>
<td>Condition</td>
<td>Max. Dimension/Depth/Distance</td>
</tr>
<tr>
<td>-------------------------</td>
<td>-----------</td>
<td>------------------------------</td>
</tr>
<tr>
<td>Chips</td>
<td>None</td>
<td>Max. dimension of break: 1/4&quot; and thickness no greater than 10% of wall thickness; Max. density: 1 per sq. ft.</td>
</tr>
<tr>
<td>Crazing</td>
<td>None</td>
<td>Max. length: 1/2&quot;; Max. density: 5 per sq. ft.; Min. separation: 20</td>
</tr>
<tr>
<td>Cracks</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Exposed Glass</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Scratches</td>
<td>None</td>
<td>Max. length: 1(\bar{\circ}) Max. depth: 0.010(\bar{\circ})</td>
</tr>
<tr>
<td>Burned Areas</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Surface Porosity</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Foreign Matter</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Sharp Discontinuity</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Pits</td>
<td>Max. 1/8 inches, dia. by 1/32 inches deep; Max: 10 per ft(^2)</td>
<td>Max. 1/8(\bar{\circ}) dia. by 1/16(\bar{\circ}) deep; Max: 10 per sq. ft.</td>
</tr>
<tr>
<td>Dry Spot</td>
<td>None</td>
<td>2 sq. in. per sq. ft.</td>
</tr>
<tr>
<td>Entrapped Air</td>
<td>None at the surface 1/16 inches and 10 per square in. max</td>
<td>1/8(\bar{\circ}) and 4 per sq. in. or 1/16(\bar{\circ}) and 10 per sq. in. within laminate</td>
</tr>
</tbody>
</table>

C. The Engineer reserves the right to be present at the fabricators facility for visual inspection of equipment to be supplied.

D. Upon completion of the installation, each piece of equipment and each system shall be tested for satisfactory operation without excessive noise, vibration, overheating, etc. Compliance shall be based on the equipment manufacturer’s specifications and all applicable costs and standards. All equipment must be adjusted and checked for misalignment, clearances, supports, and adherence to safety standards.

E. The Manufacturer shall be responsible for the successful startup and testing of each odor control facility. The Manufacturer shall provide all necessary facilities, manpower, tools, instrumentation, and laboratory testing services required during this phase of the work.

1.5 SUBMITTALS

A. The Manufacturer shall submit complete Shop Drawings for the System, together with all piping, ductwork, valves, and control for review by the ENGINEER.

B. Shop Drawings: The Manufacturer shall submit the following information for approval before equipment is fabricated:
1. Drawings of system showing assemblies, arrangements, piping, electrical, mounting
details, equipment outline dimensions, fitting size and location, motor data, operating
weights of all equipment and sufficient information to allow the ENGINEER to check
clearances, connections, and conformance with the specifications.
2. Materials of construction of all equipment.
3. Manufacturer’s catalog data, operating literature. Specifications, performance data,
and calibration curves for exhaust fan and auxiliary components.
4. Complete instrumentation, control, logic and power wiring diagrams in sufficient detail
to allow installation of the instrumentation, controls, and electrical components.
5. Manuals: Furnish manufacturer’s installation, operation and maintenance manuals,
bulletins, and spare parts lists.
6. Reference list demonstrating minimum qualifications as require in paragraph 1.4.A
above.

C. Pre-Approval Submittals: Each supplier submitting an alternate to the equipment defined
herein shall provide the following submittals 20 days prior to the established bid date.
Failure to provide a complete and thorough submittal package shall render their pre-
approval request non-responsive and will not be considered. Approval of manufacturers
will be at the sole interpretation of the Engineer. A blanket statement that equipment
proposed will meet all requirements will not be sufficient to establish equivalence to the
specified manufacturer(s). If requested by the Engineer, the supplier must be prepared to
demonstrate a unit similar to the one proposed. The following information is required:
1. A complete set of drawings as described in Section 1.5.B. Provide a minimum of one
drawing per system clearly showing how the proposed system will fit on the site.
2. A reference list of no less than then ten (10) 2-stage installations of the type and size
of system proposed. The installations must have been in service for a minimum of 5
years. The list shall include the following information: Owner name and accurate
contact information, placed in service date, and design conditions including air flow
rate and H2S loading. Provide graphical performance data from a minimum of 10
systems showing the inlet and outlet levels of hydrogen sulfide. Failure to submit
references for non-standard units may deem the proposal “non-responsive” and will be
rejected without further review.
3. A complete summary of operating cost shall be provided. At a minimum the following
information shall be provided:
   Â Annual electrical operating cost. Show calculations and use $0.06/kW-hr.
   Â Media replacement cost.
   Â Nutrient cost per year.
4. A copy of the performance guarantee and the warranty.
5. It shall be the supplier’s responsibility to carefully examine each item of the
specifications. Failure to offer a complete proposal or failure to respond to each
section of the technical specifications will cause the proposal to be rejected without
further review as “non-responsive.” All exceptions and/or deviations shall be fully
described in the appropriate section. Deceit in responding to the specifications will be
cause for automatic rejection. The supplier must include a separate sheet listing any
and all deviations to the specifications. The Engineer understands that manufacturers
design systems with different features. This listing is therefore integral to the
Engineer’s determination of an equivalent product. Each deviation must reference the
listed specification, by number if necessary, and explain in full detail how the proposed
system is different.

6. Provide information on service center and personnel as required by section 3.5 below.

1.6 MANUFACTURER’S SERVICES

A. The system manufacturer's representative shall be present at the job site for the following
time period; travel time excluded:
1. Sixteen hours for inspection of the installation and training of Owner's staff in operation
of the system.
2. Provide one trip for two days for these tasks.

PART 2 - PRODUCTS

2.1 GENERAL

A. The Manufacturer shall provide an odor control system specified which shall treat in a
single pass the odorous air from the contaminated areas. The system shall be designed
for continuous, automatic operation and also be capable of manual operation. Access
manways shall be provided to allow access to the internals of the system. The system
shall be designed to withstand a temperature up to 120°F. The multi-stage packaged FRP
system shall be of UNITARY CONSTRUCTION, as specified in Section 2.3. The module
and all accessories shall be factory mounted, piped, and wired to the maximum extent
possible. If required for NFPA 820 compliance, the control panel will be mounted
remotely, at least 3 feet from the airstream by the contractor. The contractor shall
interconnect the wiring between the remote-mounted control panel and the junction box on
the ZABOCS. The system shall be provided by Siemens Industry, Inc., San Diego,
California, or pre-approved equal.

2.2 DESIGN AND PERFORMANCE CRITERIA

A. Design and Performance Criteria:
1. Criteria: The system shall be capable of removing foul air at a rate no lower than the
rate shown on the following table.

2. Foul air removed from the facility will have an average and peak concentration of
hydrogen sulfide (H₂S) and design air flow rate as listed in the following table:

<table>
<thead>
<tr>
<th>System I.D.</th>
<th>Air Flow Rate, cfm</th>
<th>Ave. Inlet H₂S Conc.</th>
<th>Peak H₂S Conc.</th>
</tr>
</thead>
</table>

Division 6 - Specifications for Odor Control Systems and Bioxide Tank/Feed System.
3. **System Performance:** The odor control system shall demonstrate following performance when operating under design flow conditions listed above.

<table>
<thead>
<tr>
<th>INLET</th>
<th>OUTLET</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-10 ppm H₂S</td>
<td>0.1 ppm H₂S</td>
</tr>
<tr>
<td>Greater than 10 ppm H₂S</td>
<td>1.0% of inlet</td>
</tr>
</tbody>
</table>

4. **Maximum Pressure Drop:** The pressure drop across the odor control system shall not exceed 5.0 in.w.c. at the maximum air flow rate specified above.

### 2.3 MULTI-STAGE FRP PACKAGED BIOLOGICAL ABSORPTION/ADSORPTION SYSTEM:

A. **General:** The gas treatment system shall be a TWO-STAGE, ONCE THROUGH BIOLOGICALLY ACTIVE ODOR REMOVAL SYSTEM OF UNITARY CONSTRUCTION, designed to remove minimum of 99% of H₂S vapor in a single pass. The system shall consist of one biological gas conditioning/treatment stage and one vertical gas polishing stage in series. The first stage shall facilitate biological destruction of odor compounds absorbed by the liquid in the system and adsorbed on the inorganic media. The biological section shall include a spray header to distribute liquid evenly over the media. The complete treatment vessel shall be fabricated of premium grade FRP.

1. The first treatment stage shall contain inorganic expanded clay media, Siemensô BIOLITE, specifically designed to support biological growth for degradation of odor compounds. This stage shall provide absorption of odors from the air stream. The second polishing stage shall contain coal based virgin media specifically designed to adsorb odor compounds and to support biological degradation of those compounds. This stage shall provide final removal of odors to the specified level. Overall media depth shall be a minimum of 48 inches.

2. The first stage of media shall be wetted with fresh potable or re-use make-up water.

3. The overall system size, including the fan, controls, and appurtenances shall not exceed the dimensions shown on the contract drawings. Access manways shall be provided to allow access to the system internals. As a minimum, access manways shall be provided between the treatment stages. A portion of the system top shall be removable for access to the top of the second stage.

4. The system shall be included with all piping, valves, and internals. The material of construction of internals shall be as follows:
   - Packing Media Support: HDPE and FRP
   - Liquid Distributor: PVC
   - Spray Nozzles: PVC

5. The system shall have all components pre-mounted and piped on the unitary constructed system. The system shall be shipped as a single piece.

B. **Material of Construction:**
1. The vessel and accessories shall be contact molded manufactured in accordance with NBS PS 15-69, ASTM D 4097 for contact molding. Any material of construction other than FRP with premium grade resin will not be allowed.

2. Resin used in the system liner shall be a premium vinyl ester type such as Hetron 922 by Ashland Chemicals, Derakane 411 by Dow Chemical, Vipel F010 by AOC, or approved equal. The resin shall be reinforced with an inner veil of a suitable synthetic organic fiber such as Nexus 111-00010.

3. Reinforcement: Glass fiber reinforcement used shall be commercial grade corrosion resistance borosilicate glass.
   - All glass fiber reinforcement shall be Type C, chemical grade, Type E electrical grade.
   - Surfacing veil shall be 10 mil Nexus 111-00010 or equal.
   - Mat shall be Type "E" (electrical grade) glass, 1 1/2 oz. per sq. ft with a nominal fiber length of 1.25 ± 0.25 inches, with a silane finish and styrene soluble binder.
   - Continuous glass roving, used in chopper gun spray-up applications shall be type "E" grade with chrome or silane coupling agent.
   - Alternate layers of mat and woven roving used for reinforcement.

4. Miscellaneous:
   - Stainless Steel: Unless otherwise specified, all fasteners, and metal attachments, such as anchors, brackets etc shall be ANSI 316SS.
   - Gaskets: Unless otherwise specified, all gaskets shall be EPDM.

C. Fabrication:
   1. General: Fabrication shall be in accordance with NBS PS 15-69, ASTM D 3299 and ASTM D-4097. All non molded surfaces shall be coated with resin incorporating paraffin to facilitate a full cure of the surface. All cut edges, bolt holes, secondary bonds shall be sealed with a resin coat prior to the final paraffinated resin coat. All voids to be filled with a resin paste.

   2. Corrosion Liner: The inner surface of all laminates shall be resin rich and reinforced with one NEXUS 111-00010 with a minimum thickness of 10 mils. The interior corrosion layer shall consist of two layers of 1 1/2 oz. per sq. ft. chopped strand mat. If the application is by chopper gun spray up the glass fiber shall be 1/2 to 2 in length. The total corrosion liner thickness shall be a minimum of 100 mils and have a resin to glass ratio of 80/20. All edges of reinforcement to be lapped a minimum of one inch.

   3. Structural Laminate: Structural laminates shall consist of alternating layers of 1-1/2 oz per sq. ft mat or chopped glass and 24 oz per sq. yard woven roving applied to reach a designed thickness. Actual laminate sequences shall be per the laminate tables shown on fabrication drawings. The exterior surface shall be relatively smooth and shall have no glass fibers exposed. The exterior shall be surface coated with gel coat containing ultra violet light inhibitors.

D. Accessories: Air inlet, air outlet, spray headers, baffles, media support, drain and all connections shown on the drawings shall be provided by the manufacturer. Tie down lugs shall be integrally molded into the walls of the vessel. All external bolts shall be 316SS
and designed for the specified loads. Interior fasteners shall be of corrosion resistant materials such as PVC or FRP.

E. Neoprene Pad: A 1/4” thick, 60 durometer neoprene rubber sheet shall be provided and placed underneath the vessel during installation.
F. NFPA 820 [OPTION]:
1. The system shall be designed and fabricated in compliance with National Fire and Protection Agency Code 820. As a minimum, all equipment installed on the system shall be rated for Class I, Division 2, Group D.
2. All motors and equipment within three feet of the air stream shall be rated for Class I, Division 2, Group D.
3. The local control panel will be mounted remotely from the scrubber system and shipped separately. The installation and wiring of the remote-mounted control panel to the fan, nutrient pump, and solenoid valves will be the responsibility of the Contractor.

2.4 EXHAUST FAN

A. General. Fan shall be centrifugal design manufactured of FRP with a radial blade wheel. The wheel shall be statically and dynamically balanced. The fan inlet shall be slip type and the fan outlet shall have a flanged nozzle. The fan will be provided with a double lip type shaft seal.

B. Fan shall be supplied with a TEFC motor with 1.15 service factor suitable for three-phase, 60Hz, 480 volt service. The fan shall be direct driven. The motor shall be inverter-duty.

C. Performance. The fan shall be tested and rated in accordance with AMCA and shall bear the AMCA seal. The fan shall be designed for the following specifications:

<table>
<thead>
<tr>
<th>Exhaust Fan Design Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air Flow Rate, cfm</td>
</tr>
<tr>
<td>S.P. up to System Inlet, in WC</td>
</tr>
<tr>
<td>Total Pressure Drop, in WC</td>
</tr>
<tr>
<td>Motor, HP</td>
</tr>
</tbody>
</table>

D. Fan shall be manufactured by New York Blower, Hartzell, or equal.

2.5 INSTRUMENTATION AND SYSTEM CONTROLS

A. The electrical control panel shall provide electrical control for the exhaust fan and water addition system. A 480 VAC, 3-phase power supply shall be supplied to the panel to power the system.

B. The control panel enclosure shall be of fiberglass construction and rated NEMA 3R with ventilation fan. The panel shall be mounted to the system assembly and factory tested to full operation with all other components prior to shipment. If required for NFPA 820 compliance, the control panel will be mounted remotely, at least 3 feet from the airstream.
by the contractor. The contractor shall interconnect the wiring between the remote-mounted control panel and the junction box on the ZABOCS.

C. The panel shall have the following components or capabilities:
   1. Fan switch (ON-OFF).
   2. Fan VFD.
   3. Push-to-test button for water valve.
   4. Timer relay for on/off control of water valve.
   5. Nutrient Pump (HAND-OFF-AUTO)

D. The water control cabinet shall be constructed from a NEMA 12 rated FRP cabinet with all internal piping SCH 80 PVC. The cabinet shall be mounted to the system assembly. The cabinet shall contain the following components:
   1. Pressure reducing valve.
   2. Nutrient Pump (Explosion Proof if NFPA 820 requirements are applicable).
   3. Irrigation solenoid valve (Explosion Proof if NFPA requirements are applicable).
   4. Irrigation system pressure gauge.

E. Water pressure regulator, solenoid valve, and rotameter shall be provided for control of water application rates. These components shall be mounted in the water control cabinet.

2.6 ACCESSORIES

A. **Water Flow Control**: The direct reading rotameter shall be a variable area type with a Teflon float, EPR "O" rings, and PVC fittings. The rotameter shall have a direct reading scale.

B. **Water Distribution System**. The first media stage shall be equipped with an independent water distribution system. The system shall be designed to irrigate the top of the first media bed with complete and even coverage via spray nozzles.

C. **Nutrient Addition**. A nutrient containment and metering system shall be provided with the system. Nutrients supplied as a coating to the support media shall not be allowed.

2.7 PIPING

A. All make-up water and drain piping shall be SCH 80 PVC. The Contractor shall insulate and heat trace all external piping as required by climatic conditions.

2.8 NUTRIENT RESERVOIR

A. The Nutrient Reservoir shall be integrated into the system sump. Loose external tanks shall not be allowed.
PART 3 - EXECUTION

3.1 SITE AND UTILITIES

A. The system shall be located on a foundation as shown on the drawing. The following utilities shall be provided at the site and located as shown on the drawing. Site preparation, utility service, and installation are not provided by the Manufacturer under these specifications.

1. Electrical – 480 VAC, 3-phase service is required.
2. Water Supply – a 3/4 inch water supply with backflow preventer are required. Water supply must provide for a minimum of 30 psi continuous pressure at 6 GPM and a hardness not to exceed 200 mg/L as calcium carbonate.
3. Drain – a minimum 2 inch P.V.C. gravity drain to sewer with a barometric trap is required.

3.2 START-UP AND TRAINING

A. The services of a factory representative shall be provided as specified in Section 1.6 to insure proper installation and start-up of the system. The Manufacturer shall make any changes to the system that may be necessary to meet the specified performance under inlet conditions as specified.

3.3 OPERATION AND MAINTENANCE MANUALS

A. Six manuals shall be submitted prior to final acceptance of the equipment.

3.4 WARRANTY

A. Manufacturer shall warrantee the whole system, both in material and workmanship for a period of one year from the day of beneficial occupancy. This period shall not extend beyond 18 months after delivery of equipment to job site.

3.5 SERVICE CENTER

A. To be an approved odor control system supplier, the system supplier shall have complete ongoing service capability with factory trained personnel. The service center shall be able to provide the following services: operational analyses consisting of field H2S measurements, airflow measurements, sampling and analysis, and operational trouble shooting. A manufacturer’s sales representative office shall not be acceptable.

B. Each service center shall be staffed with full time employees of the odor control system supplier.
SLOPED CONCRETE PAD

PLAN

ELEVATION

LEFT VIEW

Note: This drawing is included for reference only. The field notes, dimensions, details, and requirements, etc. reported herein are to be used at the Master Pump Station 312 Site.

Existing Zabdos 6000 units that are to be removed from the property are not removed.

Reference: Usifor Product.
PART 1 - GENERAL

1.1 SCOPE

This section covers the work necessary to design, furnish, and install a Biotrickling Filter odor control system as specified herein. The odor control system consists of Biotrickling Filter tower, internal structural members, media with support grating, mist eliminator, internal piping, liquid distributors, modular support skid that includes nutrient feed system, electrical controls, irrigation valves, recirculation pumps, nutrient storage tank, fan, and all necessary accessories.

1.2 DESCRIPTION

A. System Description: It is the intent of this specification that a complete Biotrickling Filter system be provided by a single manufacturer having complete system responsibility. The system shall include, but not be limited to:
   - Biotrickling Filter Tower
   - Air Exhaust Fan
   - Scrubber Recirculation Pumps
   - Nutrient Feed & Dilution System
   - Electrical Control Cabinet
   - Water Control Cabinet
   - Nutrient Storage Tank

The components listed above shall be installed to form a complete and operational biological odor control system in accordance with the requirements specified in this section. The drawings show minimum features and equipment required for the system.

Additional requirements:
- Per FDEP requirements, a “non-sparking” graphite-impregnated FRP fan and wheel are required for safety.
- A sound enclosure available from Siemens shall be provided for the fan motor to reduce noise levels.
- See Section 3.3 Performance Testing below regarding air flow balancing of new Biotrickling Filter unit and existing Zabocs 6000 odor control unit.

B. The mechanical, structural, and electrical design has been based on a Biotrickling Filter odor control system as manufactured by Siemens Water Technologies. The cost of any changes and modifications to mechanical, structural, electrical, and emergency electrical facilities necessary to adapt alternate equipment to the layout and design shown shall be borne by the Contractor. Clearances shown on the Drawings shall be maintained. Any such proposed changes or modifications are subject to review and acceptance of the OWNER. Any costs associated with the engineering review shall be borne by the Contractor.

C. Coordination: To ensure that all the equipment is properly coordinated and will function in accordance with the requirements of the Contract Documents, the Contractor shall obtain all equipment specified herein from an odor reduction scrubber manufacturer in who shall be vested unit responsibility for the proper function of the complete system. However, The Contractor shall retain ultimate responsibility under this Contract for equipment coordination, installation, operation and guarantee, and the Contractor shall furnish and install all labor, equipment, materials, appurtenances, specialty items and services not provided by the supplier but required for a complete and operable system. The equipment covered by this specification is intended to be standard equipment of proven ability as manufactured by reputable concerns having extensive experience in the production of such equipment. The equipment furnished shall be
manufactured and installed in accordance with the best practice and methods, and shall operate satisfactorily when installed as shown and as specified in the Contract Documents.

D. Specified Manufacturer: Siemens Water Technologies, San Diego, California, U.S.A.

1.3 QUALITY ASSURANCE

A. Manufacturer: The products furnished under this section shall be of a manufacturer who has been regularly engaged in the design and manufacture of biological odor control equipment for a minimum of five years. Any costs associated with engineering review of an alternate supplier shall be borne by the contractor.

B. Reference Standards: The 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 ASTM standards:

2. ASTM C582, Contact-Molded Reinforced Thermosetting Plastic Laminates for Corrosion Resistant Equipment.
3. ASTM D638, Test for Tensile Properties of Plastics.
4. ASTM D695, Test for Compressive Properties of Rigid Plastics.
5. ASTM D746, Test Method for Brittleness Temperature of Plastics and Elastomers by Impact
7. ASTM D883, Standard Nomenclature Relating to Plastics.
10. ASTM D2310, Machine Made Reinforced Thermosetting Resin Pipe.
12. ASTM D2583, Test for Indentation Hardness of Plastics by Means of a Barcol Impresser.
14. ASTM D3299, Filament-Wound Glass Fiber Reinforced Polyester Chemical Resistant Tanks
15. ASTM D4097, Contact Molded Fiber Reinforced Thermoset Chemical Resistant Tanks.

1.4 SUBMITTALS

A. Submittals shall be made in accordance with Division ___ GENERAL REQUIREMENTS. In addition, the following specific information shall be provided:

1. The manufacturer shall submit detailed description of the laminate and the type of reinforcing to be used and a letter from the resin manufacturer stating:
   a. That the laminate and reinforcing material used will provide chemical resistance at least equal to the published chemical resistance for the resin for the intended application.
   b. That the resin will meet the performance requirements stated and is suitable for the service conditions specified herein and the fabrication technique proposed.

2. All material properties used in the calculations shall be derived from actual destructive testing of similar laminates.

3. Detailed shop drawings showing weights and dimensions of equipment, all nozzles and manways, wall thicknesses, laminate make-up, fabrication techniques, and construction materials.

4. A description of the proposed quality control program that will be used during the manufacturing of the scrubber. Include the resume of the quality control manager.

5. A schedule for the scrubber's fabrication along with the location of the fabrication site.
6. Written instructions as to the recommended methods for unloading, storing, and installing the fiberglass scrubbers and recommended lifting and handling procedures.
7. Submit listing of previous installations and references to the Engineer. The proposed vessel fabricator must demonstrate an experience record of at least 5 years with the manufacturer of filament-wound fiberglass vessels for industrial service.
8. Submit written installation procedures.
9. Submit factory test certifications.
10. Submit manufacturer recommended support ledge requirements for liquid distributor, packing support, and mist eliminator. Submit recommended influent feed pipe design for liquid distributor.
11. Submit certification indicating the quality control, testing, and inspection has been completed and standards specified herein have been met prior to shipment to the jobsite.
12. Submit color chart describing the available colors for the vessel exterior pigment color to be selected by the Engineer.
13. Schematic of the system, showing all components and controls.
14. Electrical data for all equipment.
15. Information and data for all instrumentation and controls and for the control panel, including wiring and interconnection diagram.
16. Control panel layout drawing and fabrication details.
17. Complete listing of physical and chemical process parameters required for proper operation of the system.
18. In addition, the following data for motors shall be provided:
   Motors:
   Name and manufacturer
   Type and model
   Bearing type and lubrication
   Horsepower rating and service factor
   Temperature rating
   Full load rotative speed
   Net weight
   Efficiency at rated load
   Full load current
   Overall dimensions

1.5 MANUFACTURER’S SERVICES

The system manufacturer's representative shall be present at the job site for the following time period; travel time excluded:
1. One day for inspection and certification of the installation.
2. One day to train Owner's staff in operation of the system.
3. Two days for initial startup and monitoring of system.
4. One follow-up trip for three days, 3 to 4 weeks after startup to assess the acclimation process, adjust to steady state operation, and performance testing.
5. A minimum of two trips are required.

1.6 SERVICE CONDITIONS

Ambient Air Temperature Range: 40 - 110°F (5 to 50°C)
Entering Air Temperature Range: 40 - 100°F (5 to 40°C)

1.7 DELIVERY AND INSTALLATION

Components and accessories shall be shipped in safe packaged containers to prevent damage. Installation of components at the job site shall be in strict compliance of manufacturer's recommendations and under adequate supervision provided by the system supplier.

1.8 DESIGN SPECIFICATIONS AND PERFORMANCE REQUIREMENTS
Design Air Flow Rate, cfm | 840
---|---
Average Inlet H2S Concentration, ppm(v) | 800
Peak Inlet H2S Concentration, ppm(v) | 1200
Recirculation Rate, gpm | 67
Irrigation Water, gph | 400

The odor control system shall be capable of meeting the following performance when operating under design conditions:

<table>
<thead>
<tr>
<th>Inlet</th>
<th>Outlet</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 ≤ 50 ppm H2S</td>
<td>&lt; 0.5 ppm H2S</td>
</tr>
<tr>
<td>&gt; 50 ppm H2S</td>
<td>1.0% of Inlet*</td>
</tr>
</tbody>
</table>

* The allowable outlet H2S concentration shall be 0.5 ppm or 1.0% of inlet concentration, whichever is greater.

1.9 OPERATION AND MAINTENANCE MANUALS

Six (6) copies of a 3-ring bound O & M manual shall be provided.

PART 2 - PRODUCTS

2.1 BIOTRICKLING FILTER

A. General: Each Biotrickling Filter shall be vertical, counter-current flow, and shall consist of FRP vessel, biological media, spray nozzles, mist eliminator, sump, and all internals. Process support equipment, which includes the nutrient reservoir, auxiliary sump, recirculation pumps, irrigation control cabinet, and electrical cabinet shall be included pre-piped and pre-wired and factory tested on a single Process Support and Control skid.

B. Fiberglass Vessel:

<table>
<thead>
<tr>
<th>Air Flow Rate, cfm</th>
<th>840</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum Bed Depth, ft.</td>
<td>7.0</td>
</tr>
<tr>
<td>Maximum Vessel Diameter, ft.</td>
<td>10.0</td>
</tr>
<tr>
<td>Maximum Vessel Straight Wall Height, ft.</td>
<td>14.0</td>
</tr>
<tr>
<td>Inlet Dimension, ft. (WxH)</td>
<td>2.0 x 0.8</td>
</tr>
</tbody>
</table>

C. Materials & Construction:
1. The Biotrickling Filter shall be cylindrically shaped with upflow air passage and countercurrent liquid flow. Vessel size and configuration shall be as shown on the drawings. Unit shall be complete with flanges, nozzles, manways, lifting lugs, anchor lugs, and other appurtenances.
2. The vessel shall be either helically filament wound or contact molded according to NBS PS 15-69, ASTM D-3299, and ASTM D-4097. The vessel shall be designed for negative pressure service conditions as specified for Type II Grade I tanks in ASTM D 3299. Any fabrication by hand lay-up shall not be acceptable. Any system made of PVC, polypropylene, or any other material shall not be acceptable. A 10:1 safety factor shall be used for internal pressure loadings and a 5:1 safety factor shall be used for external and vacuum loadings. Contact molded components and accessories, including scrubber baffles, shall be fabricated in accordance with ASTM D 4097 and PS 15-69. The resin used shall be Division 6 - Specifications for Odor Control Systems and Bioxide Tank/Feed System.
Hetron 922, Dow Derakane 411-45, or equal. The resin will be exposed continuously to chemical scrubbing liquid and gas as listed in the service conditions above.

3. The laminate shall consist of a single resin rich layer, with Nexus 111-00010 reinforcement followed by two 1-1/2-ounce layers of random chopped strand glass, fully wetted out with resin. This interior surface shall yield a minimum 100-mil thick corrosion barrier. Filament wind over this to the required thickness. Exterior surface coat shall be paraffinated, complete with ultraviolet screener such as UV-9. No thixotropic or other additives shall be used. The pigment tone will be selected by the Engineer during the submittal.

4. The minimum properties of filament wound laminate shall be as specified in ASTM D 3299.

5. The minimum properties of contact molded laminate shall be as follows:
   - Minimum glass content: 35 percent
   - Tensile strength: 17,000 psi
   - Tensile modulus: 1,400,000 psi
   - Flexural strength: 27,000 psi
   - Flexural modulus: 1,000,000 psi

6. Anchorage: Each tank shall be furnished with concrete anchors and hold down lugs, complete with 316 stainless steel plates, bolts, nuts, and washers for proper anchoring of the tank as required by the design calculations.

7. Visual defects shall be better than Level II on the inside of the vessel and better than Level III on the outside in accordance with ASTM D 2563.

8. Tower components shall be preassembled at the point of fabrication. Preassembly will not require all joints to be factory assembled, but all joints shall be prepared for field fabrication and square within plus or minus 3/16 inch. Each matched piece shall then be numbered correspondingly. All FRP work shall be protected from atmospheric or otherwise induced conditions of adverse temperatures, moisture, wind, or blowing dust and sand and other contaminants that would adversely affect the laminate or joint construction. The protective means shall be provided during the construction and curing period.

9. Other than those associated nozzles, couplings, manways, and top and bottom heads, the towers shall be filament wound in one piece with no more than one joint.

10. All metal hardware shall be 316 stainless steel.

11. Sizes of manways shall be as shown on the Drawings and shall be in accordance with ASTM D 3299. As a minimum, four manways (sump, top, and bottom of packing, and top of mist eliminator) shall be provided for each tower.

12. Flanged nozzles, double flanged gusseted nozzles, bottom drain nozzle, and threaded full couplings shall be provided as required. Flanged nozzles with 1/8-inch thick EPDM full-face gaskets of 60 durometer shall be provided by the supplier. Press-molded flanges are not acceptable. Threaded full couplings shall be PVC.

13. The bottom or reservoir section shall include air inlet connection, makeup water connection, recirculation pump suction connection, drain, overflow, and sump low level indicator fabricated of SCH 80 clear PVC pipe.

14. Each bioscrubber sump shall be equipped with a titanium or hastelloy grounding rod. The grounding rod will provide an earth ground for the bioscrubber solution. The Contractor shall install a grounding rod adjacent to the bioscrubber for connection to the lugs.

D. **Media Support:** Media support plates shall be VINYL ESTER FRP GRID type. Free area shall be a minimum of 95 percent of the cross-sectional area of the tower. Packing support plates and mid span supports shall be suitable to support weight of the packing specified plus entrained recirculation solution. Opening size shall not allow passage of packing media in any random orientation. Construction shall be fiberglass constructed of vinyl ester resins. Furnish supplier instructions for placement and removal of the packing support in and out of the tower.

E. **Biological Media:** The media material shall be synthetic reticulated polyurethane foam, resistant to the corrosive attack of acids. The media configuration shall promote thorough mixing and good contact between the gas and irrigation solution. Organic material, clay, or mineral media shall not be allowed.

F. **Liquid Distributor:** A liquid distribution header shall be provided to uniformly distribute the scrubbing liquid onto the packing material. Internal spray piping shall have flanged connection...
for easy removal. The liquid spray distributor system shall be PVC or FRP. Full cone, 150° non-clog spray nozzles shall be attached to the header. The spray nozzles shall have a minimum free passage diameter of 0.25 inch and shall be specifically designed to be clog resistant. Pressure loss across the nozzle at design capacity shall be no more than 10 psi. The spray nozzles shall be Teflon, polypropylene or PVC.

G. **Exhaust Stack:** Each tower scrubber shall be furnished with a flanged connection vertical stack fabricated from fiberglass reinforced plastic with flanged connection to the scrubber outlet. Each stack shall be provided with one inch diameter fitting for outlet air sampling.

H. **Identification Tag:** Vessel shall be provided with a permanently attached, 16-gauge stainless steel equipment identification plate or label laminated into the final fiberglass coat. The label shall state the following in 1/4-inch die-stamped lettering for the plate or 1-inch lettering for the laminated label:
   1. Equipment identification (tag) number shown on Drawings and vessel name “BIOLOGICAL SCRUBBER”.
   2. Resin type, inner surface reinforcement, and resin manufacturer’s name
   3. Date of manufacture
   4. Manufacturer’s name and address
   5. Allowable temperature range
   6. Design pressure (vacuum)
   7. Vessel dimensions
   8. Operating Weight

I. **Neoprene Pad:** A 1/4" thick, 60 durometer neoprene rubber sheet must be placed underneath the scrubber vessel.

### 2.2 EXHAUST FAN

A. **Exhaust Fan:** Fan shall have fiberglass reinforced plastic centrifugal backward inclined impeller. The wheel shall be dynamically balanced. Resin shall be suitable for exposure to the specific service conditions. The shaft shall be carbon steel and shall have a stainless steel sleeve. The shaft seal shall be Teflon or Viton.

B. **Bearings** shall be heavy duty, self aligning grease lubricated ball type with minimum of 100,000 hour B-10 life. OSHA approved belt guard and shaft guard shall be provided. Motor shall be high-efficiency, TEFC, 1800 RPM with a 1.15 service factor and suitable for 3/60/230-460V. Fan shall be belt driven. Fan shall have a constant V-belt drive.

C. **Fan Housing** shall be constructed of fiberglass and reinforced with rigid bracing to increase structural integrity. Bearing support brackets shall be positioned to directly oppose belt tension forces. Fan housing shall be a curved scroll design with a 1-inch drain connection at the bottom of the fan scroll. The fan inlet shall be slip type and the fan outlet shall have a flanged nozzle.

D. **The fan shall be designed for the following specifications:**

<table>
<thead>
<tr>
<th>Specifications</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design Air Flow Rate, cfm</td>
<td>850</td>
</tr>
<tr>
<td>S.P. up to Scrubber Inlet, in. WC</td>
<td>2.0</td>
</tr>
<tr>
<td>Total Pressure Drop, in. WC</td>
<td>4.2</td>
</tr>
<tr>
<td>Motor HP</td>
<td>2.0</td>
</tr>
</tbody>
</table>

E. **Flexible Connector:**
   1. Provide flanged expansion joint for outlet of fan to FRP vessel inlet transition piece. The flange drilling shall be coordinated with fan and transition.
   2. Type: W-design configuration with molded corners suitable for service with FRP duct.
   3. The properties of the flexible connectors shall be as follows: Material shall be EPDM. Material shall be resistant to ultraviolet light degradation and shall be suitable for contact...
with odorous air as specified herein. The backing rings shall be 1/4-inch thick, 26wide, type 304 stainless steel. The length from flange-to-flange shall be 60 unless shown otherwise. The extension shall be 1 inch, compression shall be 2 inches, lateral offset shall be 2.5 inches, and the thickness shall be 1/4-inch minimum.

4. Manufacturer shall be Senior Flexonics or approved equal.

F. The fan shall be shipped loose from the scrubber system and be anchored to a concrete pad without vibration isolators.

G. The motor shall be manufactured by WEG, TECO, Tatung or approved equal.

H. Fan shall be New York Blower, Hartzell, or equal. The fan shall have an AMCA seal.

2.3 PROCESS SUPPORT AND CONTROL SKID

All appurtenant equipment to the fan, tower assembly, and internals must be incorporated on a single skid that is pre-piped, pre-wired, and tested by the manufacturer. The components shall include:

A. Recirculation Pump: One recirculation pump shall be supplied. The recirculation pump shall be seal-less, magnetic, centrifugal type. The pump shall be totally enclosed, manufactured of polypropylene, and shall include Kynar rear housing. The pump motor shall be TEFC, 3500 rpm, 230/460 VAC/3-Ph/60 Hz and shall include a 1.15 service factor.

B. Nutrient Feed System: The Nutrient feed system stores and delivers biological nutrients to the spray nozzle where the solution is circulated through the packing media. The nutrient reservoir shall be integrated into the support skid. The nutrient feed system shall include a nutrient pump, reservoir and all piping and equipment necessary to deliver nutrients from the reservoir to the irrigation water. The nutrient supply system shall be integrated into the Process Support Skid.

C. Nutrient Storage Tank: A nutrient reservoir shall be constructed of FRP and integrated into the support skid and furnished for the containment of biological nutrients.
   1. The tank shall be made of fiberglass reinforced plastic and be suitable for storage in direct sunlight.
   2. The reservoir shall be provided with bulkhead pipe connections for tank drain, outlet, inlet, pressurized water connection, low level indicator, and vent. Flanged connections shall be of the same materials as the tank wall. Threaded connections shall be of standard NPT. The tank details showing the locations of all openings, nozzles, and appurtenances shall be included in shop drawings and submitted for approval before fabrication of the chemical storage tank.
   3. The reservoir shall have a low level indicator and a connection to a pressurized water source that is controlled by a ball valve.

D. Irrigation Piping: The piping on the Process support and Control Skid shall be Sch. 80 PVC.

E. Instrumentation and Controls:
   1. The electrical control panel shall provide electrical control for the exhaust fan, pumps, and water and nutrient addition systems. Provide control panel labeled to UL508 standards. Provide control panel rated for 10,000A SCCR.
   2. A 480 VAC, 3-phase feed shall be supplied to the panel for use to power the system. Provide panel with circuit breaker main disconnect and 480v-3ph surge suppression module. The control panel shall include motor starters for fan and pumps. Provide fuse protection for all motor circuits. Provide three spare fuses of each size and type.
   3. The control panel enclosure shall be of 304 stainless steel construction and rated NEMA 4X-Ventilated. Provide forced ventilation as required to dissipate the heat load generated within. The enclosure shall be fitted with a sun shield and painted white. The panel shall be
mounted to the Process and Control Skid assembly and factory tested to full operation with all other components prior to shipment.

4. The panel shall have the following components or capabilities:
   - Fan switch (ON-OFF)
   - Recirculation pump (ON-OFF)
   - Nutrient pump switch (H-O-A)
   - Blower VFD

5. Provide dry contact closures for remote monitoring and control for:
   - OCU Run (contact output)
   - OCU Fault (contact output)
   - OCU blower fan permissive to Run (contact input).

6. The water control cabinet shall be constructed from a NEMA 12 rated FRP cabinet with all internal piping SCH 80 PVC. The panel shall be mounted to the Process and Control Skid assembly. The cabinet shall contain the following components:
   - Nutrient pump
   - Recirculation system pressure gauge.
   - Make-up water pressure gauge.

7. Water rotameter shall be provided for control of water application rates.

8. Additional requirements: Provide control panel in conformance to specification 26 29 13 Control Panels.

G. Recycle Piping: All recycle piping, irrigation water and drain piping, and blowdown piping shall be SCH 80 PVC.

2.4 FRP FABRICATION SPECIFICATIONS FOR SCRUBBER:

A. General: Each bioscrubber vessel shall be a Fiberglass Reinforced Plastic (FRP) vessel. All materials and fabrications furnished in accordance with these specifications shall comply with all federal, state, and local ordinances of the place of installation and with the following code and standards:
   2. ASTM D-883: “Definition of Terms Relating to Plastics”

B. Design Criteria: Scrubber absorber vessel shall conform to the following structural design criteria:
   - Working Pressure:
     - Scrubber Portion: 6” WC vacuum
     - Sump Section: Hydrostatic load of sp. gravity = 1.1
   - Wind Load: 100 mph

C. Material of Construction:
   1. The scrubber absorber vessels, and accessories shall be contact molded manufactured in accordance with NBS PS 15-69 and ASTM D 4097 for contact molding, and ASTM D 3299 for filament winding. Any visual defects shall not exceed ASTM D-2563 Table 1.
   2. Resin used in fabrication shall be a premium vinyl ester type such as Hetron 922 by Ashland Chemicals, Derakane 411 by Dow Chemical or approved equal. The resin shall be reinforced with an inner veil of a suitable synthetic organic fiber such as Nexus 111-00010.
   3. Reinforcement: Glass fiber reinforcement used shall be commercial grade corrosion resistance borosilicate glass.
      a. All glass fiber reinforcement shall be Type C, chemical grade, Type E electrical grade.
      b. Surfacing veil shall be 10 mil Nexus 111-00010 or equal.
c. Mat shall be Type "E" (electrical grade) glass, 1 1/2 oz. per sq. ft with a nominal fiber length of 1.25 ± 0.25 inches, with a silane finish and styrene soluble binder.

d. Continuous glass roving, used in chopper gun spray-up applications shall be type "E" grade with chrome or silane coupling agent.

e. Woven roving used for reinforcement shall be 24 oz. per sq. yard type "E" glass and have a 5 x 4 plain weave.

4. Miscellaneous:
   a. Stainless Steel: Unless otherwise specified, all fasteners, and metal attachments, such as anchors, brackets etc shall be ANSI 316SS.
   b. Gaskets: Unless otherwise specified, all gaskets shall be EPDM.

D. Fabrication:
   1. General: Fabrication shall be in accordance with NBS PS 15-69, ASTM D 3299, and ASTM D-4097. All non molded surfaces shall be coated with resin incorporating paraffin to facilitate a full cure of the surface. All cut edges, bolt holes, secondary bonds shall be sealed with a resin coat prior to the final paraffinated resin coat. All voids to be filled with a resin paste.
   2. Corrosion Liner: The inner surface of all laminates shall be resin rich and reinforced with one NEXUS 111-00010 with a minimum thickness of 10 mils. The interior corrosion layer shall consist of two layers of 1 1/2 oz. per sq. ft. chopped strand mat. If the application is by chopper gun spray up the glass fiber shall be 1/2 to 2 in length. The total corrosion liner thickness shall be a minimum of 100 mils and have a resin to glass ratio of 80/20. All edges of reinforcement to be lapped a minimum of one inch.
   3. Structural Laminate: Structural laminates shall consist of alternating layers of 1-1/2 oz per sq. ft mat or chopped glass and 24 oz per sq. yard woven roving applied to reach a designed thickness. Actual laminate sequences shall be per the laminate tables shown on fabrication drawings. The exterior surface shall be relatively smooth and shall have no glass fibers exposed. The exterior shall be surface coated with white gel coat containing ultra violet light inhibitors.

E. Acceptance: The engineer, owner, or their designated representative shall be allowed access to the equipment during and after fabrication for the purpose of verifying compliance to the contract specifications. The engineer’s inspection is not intended to replace the fabricator’s own quality assurance procedure.

PART 3 - EXECUTION

3.1 INSTALLATION

The complete biological odor control system shall be installed in strict accordance with the manufacturer's recommendations. The system shall be compatible with the basic provisions shown.

3.2 FIELD ENGINEERING/START-UP

The biological odor control system manufacturer shall provide field engineering start-up assistance to start-up, test, and arrive at proper operating conditions. Minimum service time required shall be as listed in Section 1.5 - Manufacturer's Services. If additional time is required for reasons attributable to the odor control equipment supplier, the costs will be borne by the supplier. Should the extra time be required because of reasons attributable to the Contractor, these charges will be borne by the Contractor at prevailing rates.

3.3 PERFORMANCE TESTING

A. General: The Contractor shall be responsible for all costs associated with odor control system testing.
B. **Functional Testing:** Using nonodorous ambient air, the entire odor control system shall be operated for not less than 24 continuous hours in order to demonstrate the mechanical and electrical integrity of the system. Any mechanical or electrical breakdowns, unusual vibrations, or control sequencing problems shall be considered sufficient cause to reject the test. Inability to successfully complete the functional testing in five tries shall be considered cause for the construction manager to reject the odor control system. Contractor shall balance all air flows prior to system performance testing.

C. **Performance Testing:** The performance tests shall be conducted after sufficient acclimation time and at such time as all anticipated odorous air streams are present in the scrubber inlet. The time of the tests and detailed test procedure shall be submitted for approval prior to the testing period.

1. During testing, scrubber overflow, recirculation and scrubber air flow rates shall be held constant. Changes in scrubber system operating conditions shall not be permitted. All fine-tuning of operating conditions shall be performed prior to testing.
2. Design operating conditions shall be maintained for a minimum of 4 hours. During this time, all pertinent operating parameters shall be monitored and recorded, sufficient sampling and analysis shall be conducted to demonstrate that flow rates are at design conditions.
3. Hydrogen sulfide concentration shall be measured in each scrubber inlet and outlet. Inlet and outlet levels shall be measured once every 30 minutes using a portable H₂S analyzer such as Interscan, Jerome or equal.

4. **Results:** A description of the performance tests shall be submitted. The hydrogen sulfide compound removal efficiency shall be as specified in the design and performance requirements. Should scrubber system performance not meet any of the above requirements, that system have failed the performance tests. The Contractor shall make any additions or modifications to that scrubber system as may be necessary, at no additional cost to the Owner, and the performance tests for that system shall be repeated in its entirety.

5. **Additional requirements:**
   - The contractor shall retain the services of Siemens to perform the required air flow balancing of the new Biotrickling Filter and the existing ZABOCS 6000 odor control unit. The Biotrickling Filter shall function per the criteria listed elsewhere in this specification. The ZABOCS unit shall function to provide six air changes per hour in each of the three wetwell chambers during normal operation.

   The airflow balancing shall occur for the three operating scenarios listed below. The scenarios can be test run and balanced at start up and the dampers shall be marked with the required setting for each condition.

   **Required operating scenarios:**
   1. Flow during "normal" operation of the Biotrickling Filter working in series with the ZABOCS unit.
   2. Flow during operation of the Biotrickling Filter only.
   3. Flow during operation of the ZABOCS unit only.

   The O&M manuals shall include a detailed text and tabular description of the operating strategy, damper settings, flow rates, and other detailed settings and adjustments for the three operating scenarios.

### 3.4 OPERATION AND MAINTENANCE TRAINING

The Contractor shall provide the services of a factory-trained manufacturer's representative to provide training of the Owner's personnel in the proper operation and maintenance of the equipment. Prior to final acceptance, the Contractor shall furnish the Construction Manager with
two copies of the manufacturer's certifications. Training shall be performed in accordance with Section ________.

3.5 MANUFACTURER'S REPRESENTATIVE

The Contractor shall include in his bid all costs associated with providing the services of the manufacturer's field representative for checking, aligning, testing, placing in operation, and Owner training.

3.6 MANUFACTURER'S WARRANTY

The Contractor shall procure and provide copies of all certified manufacturer's warranty. The complete system, including accessories and components, shall be warranted for one year by the manufacturer having unit responsibility.

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