PART 1 GENERAL

1.1 SECTION INCLUDES

A. Biofiltration odor control system and appurtenances as shown on the Drawings and specified in this Section.

1.2 SYSTEM DESCRIPTION

A. Furnish and install a pre-engineered biofiltration odor control system including all appurtenances necessary for a complete installation.

1. The following components of the biofiltration odor control system shall be furnished by the specified manufacturer of the biofiltration odor control system and installed by the CONTRACTOR:

   a. Biofiltration odor control units
   b. Moisture integrator bubblers
   c. Moisture separators
   d. Odor control system blower
   e. Odor control system electrical control panel
   f. Carbon Vesse (if specified in the drawings).

2. The following components of the biofiltration odor control system shall be furnished and installed by the CONTRACTOR: Connecting odor control air pipe, fittings, valves, and accessories

   a. Odor control system water supply pipe, fittings, valves, and accessories
   b. Odor control system drain pipe, fittings, valves, and accessories
   c. Piping support

3. Other Work required to complete the biofiltration odor control system shall be performed by the CONTRACTOR. Other Work required to complete the biofiltration odor control system includes, but is not necessarily limited to, the following:

   a. Conduit, wiring, and other field electrical work required for a complete odor control system.
   b. Excavation, backfill, grading, and site restoration required for a complete odor control system.
c. Concrete foundations, supports, and related Work required for a complete odor control system.
d. Masonry work required for a complete odor control system.

B. The biofiltration odor control system shall be designed in accordance with generally accepted criteria and shall meet all requirements of the State of Florida Department of Environmental Protection. The following minimum design parameters shall be incorporated into the design of the biofiltration system.

1. Duty: Continuous
2. Ambient Environment: Outdoor
3. Ambient Temperature Range: 20°F to 120°F
4. Ambient Relative Humidity: 10% to 100%
5. Project Site Elevation: [_____] feet above MSL
7. Design Air Flow and head: [_____] scfm at a vacuum of [_____] inches WG
8. Average Influent H2S Concentration: [_____] ppm
9. Maximum Influent H2S Concentration: [_____] ppm
10. Required Effluent H2S Concentration: Greater than 99% removal, or less than 1 ppm H₂S, whichever is less

1.3 SUBMITTALS

A. General: As specified in:

1. General Conditions;
2. Supplementary General Conditions;
3. Section 01340 Shop Drawings and Working Drawings;
4. This Section.

B. Submit the following prior to equipment manufacture:

1. Shop drawings and product data specified in Section 01340, including the following:

a. Description and schematic diagrams of control systems to include overall biofiltration odor control unit wiring diagram and wire sizes. Complete control schematics, including coordination with electrical control devices, wiring diagrams, and suitable outline drawings shall be furnished for approval before proceeding with manufacture.

b. Data on the characteristics and performance of the blower. Data shall include guaranteed performance curves, based on actual shop tests of similar units, which show that they meet the specified requirements for
pressure, capacity, efficiency, and horsepower. Curves shall be submitted on 8-1/2" x 11" sheets, at as large a scale as practical.

c. Complete motor data.

2. Manufacturer's outline of services specified in this Section.

C. Submit the following prior to equipment installation:

1. Manufacturer’s installation instructions.
2. Manufacturer’s Operation and Maintenance Data.
3. Special tools and spare parts list specified in Section 01600 Material and Equipment

D. Submit the following prior to Substantial Completion:

1. System performance test data specified in this Section.
2. Written Warranties specified in this Section.

E. In the event that it is impossible to conform with certain details of the Specifications, describe and justify completely all non-conforming aspects.

F. The submittal format shall be in the form of a booklet, suitably tabbed and divided to cover all areas noted above and for each major equipment item. The submittal booklet shall include adequate detail and sufficient information for the ENGINEER to determine that all of the equipment proposed meets the detailed requirements of the specifications. Incomplete or partial submittals will not be reviewed.

1.4 OPERATING INSTRUCTIONS

A. Provide five (5) copies of an Operation Installation and Maintenance Manual. The Manual shall be prepared specifically for this installation and shall include all required cuts, drawings, equipment lists, descriptions, etc., that are required to instruct operation and maintenance personnel unfamiliar with such equipment.

B. A representative of the biofiltration odor control system manufacturer who has complete knowledge of proper operation and maintenance shall be provided to instruct representatives of the OWNER on proper operation and maintenance. This work may be conducted in conjunction with the inspection and the installation and test run as specified in this Section. If there are difficulties in operation of the equipment due to the biofiltration odor control system manufacturer's design or fabrication, additional service shall be provided at no cost to the OWNER.
1.5 QUALITY ASSURANCE

A. The manufacturer of the biofiltration odor control system shall be responsible for the performance, and fabrication of the biofiltration odor control system units including the following:

1. Biofiltration Odor Control Units
2. Moisture Integrator Bubblers
3. Moisture Separators
4. Odor Control System Blower
5. Odor Control System Electrical Control Panel
6. Carbon Vessel (if specified in the drawings)

B. Selection and arrangement of all components of the biofiltration odor control system shall be coordinated by the biofiltration odor control system manufacturer with the ENGINEER.

C. Install the biofiltration odor control system with installation services by the biofiltration odor control system manufacturer as specified in this Section.

D. Biofiltration odor control system manufacturer shall be responsible for the structural and process integrity of the design; which must also be documented by a Professional Engineer registered in the State of Florida.

E. Biofiltration odor control system manufacturer shall provide initial gas sampling and laboratory testing.

1. Initial gas sampling and laboratory testing shall identify odorous compounds and their respective levels. Sampling and testing for odorous compounds shall include, but shall not necessarily be limited to, the following compounds and detection limits (DL):

   a. Hydrogen sulfide (DL<20)
   b. Dimethyl sulfide (DL<10)
   c. Dimethyl disulfide (DL<10)
   d. Ethyl mercaptan (DL<20)
   e. Methyl mercaptan (DL<20)
   f. Carbonyl sulfide (DL<20)
   g. Carbon disulfide (DL<10)

2. Sampling shall be done between the hours of 7:00 A.M. and 10:00 A.M.

3. Do not exceed sample holding time limits.

4. Gas chromatography (GC) using the appropriate detector for the required detection limits shall be the basis of the laboratory testing.
5. Initial gas sampling and laboratory testing shall be done at no additional cost to the OWNER and shall be done to verify that the odor control system herein specified will provide the OWNER's level of accepted gas treatment.

6. A Letter of Guarantee, along with test results verifying this sampling and testing has been done, shall be submitted to the ENGINEER.

1.6 WARRANTY

A. Equipment Warranty and Media Warranty

1. Biofiltration odor control system shall be warranted to be free from defects in workmanship, design, and materials. If any part of the biofiltration odor control system should fail during the warranty period, it shall be replaced at no additional cost to the OWNER.

2. Warranties shall cover all components of the biofiltration odor control system for at least one year with the following exceptions:

   a. Biofilter media shall be warranted by the biofiltration odor control system manufacturer to meet the required H$_2$S effluent concentration limitation specified in this Section without media change-out for a term of at least three years from the date of installation. The biofiltration odor control system manufacturer shall replace the media at the regular price of the media less the pro-rated amount based on the life of the original media; i.e. regular price less 33% if media last only two years. Replacement media shall be delivered and installed at no additional cost to the OWNER.

   b. Structural integrity of the enclosures for biofiltration odor control units, the humidification units, and the dehumidification units shall be warranted for a period of at least five (5) years. If any cracks, leaks, or structural failure of these enclosures result in failure of the biofiltration odor control system to meet the required H$_2$S effluent concentration limitation specified in this Section, the biofiltration odor control system manufacturer shall repair or replace the enclosures at no additional cost to the OWNER.

B. Performance Guarantee

1. Biofiltration odor control system manufacturer shall guarantee the performance of the entire biofiltration odor control system for a period of 365 days from the date of final acceptance of the biofiltration odor control system.

2. If the biofiltration odor control system fails to meet the H$_2$S effluent concentration specified in this Section, the biofiltration odor control system manufacturer shall make the necessary adjustments, modifications, equipment
repair, equipment replacement, and H₂S testing at no additional cost to the OWNER.

PART 2 PRODUCTS

2.1 MANUFACTURER AND MODEL

A. Biofiltration odor control system shall be BioCube™ Aerobic Biofilter with Pentpak biofiltration odor control units manufactured by AMETEK Rotron Biofiltration, Saugerties, NY.

B. No substitution is permitted.

2.2 BIOFILTRATION ODOR CONTROL SYSTEM, GENERAL

A. Biofiltration odor control system equipment shall be standard equipment of proven ability as manufactured by reputable manufacturers having long experience in the production of such equipment. Equipment furnished shall be designed and constructed in accordance with the best practice and methods, and shall operate satisfactorily when installed.

B. Equipment furnished shall be new and unused.

C. The biofiltration odor control system shall be totally enclosed, climate controlled per the operating temperature range specified in this Section and operate under vacuum with the blower downstream of the overall biofiltration odor control units and moisture separator. Non-enclosed systems, non-climate controlled systems, or systems operated under blower pressure in lieu of vacuum will not be considered.

D. Enclosures for the biofiltration odor control units, moisture integrator bubblers, and moisture separators shall be constructed of high density polyethylene (HDPE) with ESCR (100% IgEpal F₅₀) of greater than 1,000 hours. All material used shall be corrosion resistant and suitable for operation in a moist atmosphere containing hydrogen sulfide, sulfuric acid, and other corrosive compounds. Concrete vessels and enclosures will not be considered. Metal vessels and enclosures will not be considered. Coated vessels and enclosures that are not corrosion resistant will not be considered.

2.3 BIOFILTRATION ODOR CONTROL UNITS

A. Biofiltration odor control units shall utilize odor metabolizing aerobic microorganisms to reduce the concentration of hydrogen sulfide in air flowing through the unit. Systems designed for the treatment of odors using any form of the addition of chemical agents will not be considered. Systems designed for the treatment of lift station odor control using chemical masking will not be considered.
B. The biofiltration odor control units shall be stacked, interlocking trays. Each unit shall consist of five active trays and one cover tray. The five active trays shall be filled with biologically active media. The cover tray shall provide a sealed top cover for the odor control unit.

1. Media tray and cover tray shall be identical construction.
2. Each tray shall be capable of holding 20 cubic feet of medium.
3. Each trays shall be approximately 6 feet in diameter and 14 inches high.
4. Each tray shall weigh approximately 120 pounds empty.
5. Trays shall be designed for flow rates of between 10 and 200 SCFM.
6. Trays shall be molded from High Density Polyethylene (HDPE) with ESCR greater than 1,000 hours.
7. Each tray shall have an integral plenum, inlet port and outlet port (3" FNPT).
   a. Inlet port of the top tray shall be used for introduction of the MIB-conditioned process stream.
   b. Outlet port of the bottom tray shall be used as an exhaust to the Moisture Separator.

8. The top tray shall contain a spray nozzle assembly that may be used to directly add water to the filter medium (3/4" MNPT connection).

C. Each stack of biofiltration unit trays shall be held together with stainless steel tie rods and wing nuts.

D. Each stack of biofiltration unit trays shall be factory mounted on a skid.

E. Overall dimensions of each stack of biofiltration odor control units mounted on a skid shall be 72 inches wide by 72 inches long by approximately 82 inches high.

2.4 MOISTURE INTEGRATOR BUBBLERS (MIB)

A. MIB shall provide process stream humidification and temperature control prior to introduction to the biofiltration odor control units. Water shall be added to the process stream as required to maintain the moisture concentration in the biofiltration odor control unit media at an optimum level for the odor reducing microorganisms. The process stream shall be heated as required to maintain the temperature in the biofiltration odor control unit media at or above the minimum temperature required for the odor reducing microorganisms to remain alive and active.
B. MIB shall be stacked, interlocking trays. MIB trays shall be identical to the biofiltration odor control unit trays.

C. Each MIB shall consist of three trays: two stacked and one inverted on top.
   1. The bottom tray shall serve as the reservoir for the Moisture Integration Chamber formed by the two trays above.
   2. The reservoir tray shall house a thermostatically controlled heating element for control of moisture integration water temperature.

D. Each MIB shall be connected to the facility water supply.
   1. Water usage shall be approximately 1 gallon per 50 SCFM per hour of air processed through the biofiltration odor control system.
   2. An automatic float valve system shall be provided for automated replenishing of the water reservoir.
   3. Strainers, filters, or strainers and filters shall be provided as required to condition the water supply to the MIB.

2.5 MOISTURE SEPARATORS

A. Moisture separators shall separate condensate and excess moisture from the process stream after treatment in the biofiltration odor control units. Moisture separators shall protect the odor control system blower from damage by water ingestion.

B. Moisture separators shall be stacked, interlocking trays. Moisture separator trays shall be identical to the biofiltration odor control unit trays.

C. Each moisture separator shall consist of two trays: with the top tray inverted over the bottom tray.

D. Water collected in moisture separators shall be disposed of under normal O&M procedures.

E. Each moisture separator shall be mounted underneath the MIB that serves the same stack, or stacks, of biofiltration odor control units.

2.6 MOISTURE INTEGRATOR BUBBLER/MOISTURE SEPARATOR ASSEMBLY

A. Each stack of Moisture Integrator Bubbler trays and Moisture Separator trays shall provide humidity control, temperature control, and moisture separation for one to four stacks of biofiltration odor control units.
B. Each stack of Moisture Integrator Bubbler trays and Moisture Separator trays shall be held together with stainless steel tie rods and wing nuts.

C. Each stack of Moisture Integrator Bubbler trays and Moisture Separator trays shall be factory mounted on a skid.

D. Overall dimensions of each stack of Moisture Integrator Bubbler trays and Moisture Separator trays mounted on a skid shall be 69 inches wide by 72 inches long by approximately 68 inches high.

2.7 ODOR CONTROL SYSTEM BLOWER

A. The odor control system blower shall provide the motive force to move air through the entire biofiltration odor control system.

B. Odor control system blower shall be Cincinnati Fan, Model HP-4C20.

C. Odor control system blower shall have a design capacity of 300 SCFM when drawing a vacuum of 27 inches of water.

D. Blower shall be driven by an electric motor with the following characteristics:

1. Motor Horsepower: [______] HP
2. Motor Enclosure: TEFC
3. Electrical Characteristics: 230/460 volts, 60 Hertz, 3 phase

E. Blower and motor shall be designed for continuous operation.

F. Blower and motor shall be suitable for operation outdoors.

1. Provide all covers and other devices required to protect the blower and motor from direct contact with rainfall.
2. Provide all covers and other devices required to shield the blower and motor from sunlight.

2.8 ODOR CONTROL SYSTEM ELECTRICAL CONTROL PANEL

A. A stainless steel, NEMA 4X all-weather electrical control panel will be provided for wall mounting in a non-hazardous location.

B. The panel will provide branch circuit protection and controls for the regenerative blower and MIB heater.

C. Alarms shall be provided for high and low water fault conditions.

D. A main disconnect and security lock out shall be provided.
2.9 CARBON VESSEL

A. A carbon vessel shall be furnish by the biofiltration system supplier. This carbon vessel will be located on the discharge of the blower to remove any remaining traces of odor contaminants. The vessel containing the carbon shall be constructed of linear polyethylene with a 6-inch flanged inlet and outlet as shown in the drawings. Include 200 pounds of granular activated carbon TIGG Type HSS or equal with the following specifications:

<table>
<thead>
<tr>
<th>Substrate Virgin Activated Carbon</th>
</tr>
</thead>
<tbody>
<tr>
<td>Iodine Number, mg/g, minimum</td>
</tr>
<tr>
<td>Carbon Tetrachloride, wt%, minimum</td>
</tr>
<tr>
<td>U.S. Sieve, 90 wt%, minimum</td>
</tr>
</tbody>
</table>

| Sodium Hydroxide                        |
| Weight % Virgin Carbon Basis, Minimum   |

| Typical Physical Properties             |
| Bulk Density, lb/ft                     |
| Moisture (as packed), wt%               |

2.10 ODOR CONTROL SYSTEM PIPING

A. Process stream air piping shall be PVC, rated for temperatures to 160°F.

1. Pipe shall be Schedule 40.
2. Fittings shall be Schedule 40.

B. Piping shall be sized by biofiltration system manufacturer for minimal and negligible frictional losses and shall be provided by the CONTRACTOR.

C. Provision of pipe supports shall be the responsibility of the CONTRACTOR.

D. Exposed PVC pipe and fittings shall be field painted with UV-resistant white paint and black flow direction arrows as specified in the drawings.

2.11 SYSTEM WIRING

A. Biofiltration odor control system wiring shall be the joint responsibility of the CONTRACTOR and the biofiltration odor control system manufacturer.

B. Wiring shall be as specified in Division 16.

2.12 CLEANING AND PACKING

A. Thoroughly clean equipment, components, and subassemblies of water, sand, dirt, grit, grease, oil, and other foreign materials before preparation for shipment. Protect
machined surfaces against physical damage and exposure to elements during shipping, handling, storage, and installation.

B. Equipment items shall be properly protected so that no damage or deterioration will occur from the time of shipment until installation is completed and the units and equipment are ready for operation.

C. Finished surfaces of all exposed blower and equipment openings shall be protected.

D. Finished iron or steel surfaces not painted shall be properly protected to prevent rust and corrosion.

E. Proper care shall be taken to protect mechanical parts from the entrance of water during shipment, storage and handling.

F. Each box or package shall be properly marked to show its contents.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install odor control system in accordance with the biofiltration odor control system manufacturer’s written instructions, in accordance with the Drawings, and as specified in this Section.

B. Align and adjust rotating equipment in accordance with the biofiltration odor control system manufacturer’s written instructions. Lubricate bearings in accordance with the biofiltration odor control system manufacturer’s written instructions.

C. Adjust valves and controls in accordance with the biofiltration odor control system manufacturer’s written instructions.

D. Paint exposed PVC pipe and fittings with a coating containing UV inhibitors. Finish paint color shall be as specified on the drawings. Paint flow direction arrows in black on process air piping.

3.2 INSTALLATION INSPECTION

A. A representative from the biofiltration odor control system manufacturer shall be present during system installation and shall certify the system installation.

B. After the biofiltration odor control system has been installed and connected, an inspection of the system shall be performed in the presence of the ENGINEER. The system shall be accepted for equipment testing by the ENGINEER prior to starting the system equipment.
3.3 TESTING AND EQUIPMENT START-UP

A. A representative from biofiltration odor control system manufacturer shall perform equipment start-up.

B. Test odor control system blower and blower controls after the ENGINEER has accepted the biofiltration odor control system for equipment testing.

C. Test odor control blower in accordance with blower manufacturer’s written instructions. As a minimum do the following:
   1. Start-up, check, and operate blower.
   2. Verify blower is rotating in the proper direction.
   3. Measure air flow rate through blower as follows:
      4. Inlet valve 100% open
         a. Adjust inlet valve as required to reduce air flow rate through blower to design conditions and record valve setting.
         b. Adjust inlet valve as required to reduce air flow rate through blower to 75% of design air flow rate and record valve setting.
         c. Adjust inlet valve as required to reduce air flow rate through blower to 50% of design air flow rate and record valve setting.
      5. Record concurrent readings for the following at the four points specified above:
         a. Motor voltage
         b. Motor amperage
         c. Blower discharge pressure
         d. Air flow rate through blower.

D. Check water supply system.
   1. Demonstrate that float valve is functioning properly.
   2. Measure and record water flow rate into Moisture Integrator Bubblers using the plant service water flow meter.

E. Check drain system.
   1. Demonstrate that there is free flow of water through the drain system.
2. Demonstrate that drain system valves function properly.

F. Perform functional test of biofiltration odor control system controls.
   1. Demonstrate that humidification control system is functioning properly.
   2. Demonstrate that temperature control system is functioning properly.
   3. Demonstrate that blower starter and controls are functioning properly.
   4. Verify that alarms are functioning.

G. After blower, system water supply, system drains, and system controls have been accepted by the ENGINEER, place odor control system in operation.

3.4 PERFORMANCE TESTING

A. After biofiltration odor control system has been placed in operation, a bio-acclimation period of 2-4 weeks will be allowed prior to performance testing.

B. A representative from biofiltration odor control system manufacturer shall conduct performance testing.

C. Conduct a performance test of the biofiltration odor control system after the acclimation period. The performance test shall meet the following requirements:
   1. The combined effluent H$_2$S concentration shall be continuously monitored over a period of four days. This effluent sampling location shall be at the discharge of the blower prior to the carbon vessel. One of the test days shall be a Monday. The H$_2$S concentration shall be monitored with a continuously reading H$_2$S data logger, with sampling intervals no less than five minutes.

   2. In addition to the continuous H$_2$S monitoring above, four grab samples of influent air and two grab samples of effluent air from each stack of biofiltration unit trays shall be measured for H$_2$S concentration under peak sulfide loading conditions, which typically occur between the hours of 7:00 A.M. and 10:00 A.M. Influent H$_2$S sampling location is in the air piping between the wet well and the moisture integrator. Measurement of H$_2$S concentration by Draeger tube method is acceptable for these grab samples.

   3. One matching set of Tedlar bag grab samples of the influent air, effluent air from the blower and effluent air from the carbon vessel shall be taken on one day between the hours of 7:00 A.M. and 10:00 A.M. to determine removal efficiency of the organic sulfide compounds in addition to H$_2$S. Laboratory analyses of these samples shall be performed for organic sulfide compounds, inorganic
sulfide compounds, and other odor producing compounds including, but not limited to, the following:

a. Hydrogen sulfide (DL<20)
b. Dimethyl sulfide (DL<10)
c. Dimethyl disulfide (DL<10)
d. Ethyl mercaptan (DL<20)
e. Methyl mercaptan (DL<20)
f. Carbonyl sulfide (DL<20)
g. Carbon disulfide (DL<10)

All sample holding times should be met.

D. If the effluent H₂S concentration does not meet the performance criteria specified in this Section, the CONTRACTOR shall make necessary adjustments and repeat the performance test for another four days. A total of four sets of four-day performance tests will be allowed. Should the biofiltration odor control system fail to perform as specified after four sets of four-day performance tests, the system shall be modified as required to meet the specified performance criteria. System modifications required to meet specified performance criteria shall be completed at no additional cost to the OWNER.

E. The ENGINEER will review the results of performance testing. Obtain ENGINEER acceptance of the biofiltration odor control system performance test prior to final acceptance of the biofiltration odor control system.

3.5 CLEANING

A. Clean grease, oil, and other debris and deposits from exterior surfaces of equipment and exposed piping.

B. Remove wire scrap, insulation scrap, and other debris from interior of control enclosures. Clean interior and exterior of control enclosures.

END OF SECTION