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Definitions

A. AFD: adjustable frequency drive
B. Approval Required (AP): The Buyer’s Technical Representative (BTR) must approve the Contractor’s submittal; however, work associated with the submittal may proceed prior to BTR approval
C. Approval Required Prior to Work (APW): The BTR must approve the Contractor’s submittal prior to the Contractor being authorized to proceed with any activity/work associated with the submittal
D. BTR: Buyer’s Technical Representative
E. Buyer: Contract Officer
F. Construction Contractor: Separate contractor responsible for the construction of the facility housing the package system, installation of the package system, and installation of all supporting systems
G. Contractor: The Offerer to whom a contract is written for a Task(s)
H. Contractor’s Project Manager: Contractor’s Project Manager responsible for a specific task(s)
I. FAT: Factory Acceptance Test
J. FIO: for information only
K. FRP: fiberglass reinforced plastic
L. HTU: height of transfer unit
M. Manufacturer: The original equipment manufacturer regardless as to CHPRC’S Contract with a Contractor. The Manufacturer may be the Contractor, or a Subcontractor
N. NRTL: Nationally Recognized Testing Laboratory
O. OIT: Operator Interface Terminal
P. P&ID: Process and Instrumentation Diagram
Q. PLC: programmable logic controller
R. psig: pounds per square inch gauge
S. PTAS: Packed Tower Air Stripper
T. PVC: polyvinyl chloride
U. RTR: reinforced thermosetting resin
V. SCADA: Supervisory Control and Data Acquisition System
W. scfm: standard cubic feet per minute (68 F at 1 atm)
X. UV: ultraviolet
Y. VOC: volatile organic compounds
Z. VPGAC: vapor phase granular activated carbon
AA. WC: water column
1 GENERAL

1.1 Scope

1.1.1 This Section covers the Work necessary to design, detail, manufacture, deliver to the jobsite, and to startup and test, complete and ready for operation, one complete (stand-alone) packed tower air stripper (PTAS) system for the treatment of volatile organic compounds (VOCs) in water which shall produce the required effluent quality. The stripper may operate in two potential scenarios, treating the raw groundwater stream (before biological treatment) or treating the groundwater after the biological treatment. Performance under both scenarios, which have slightly different water qualities, is required. The off-gas from the PTAS will be treated by a fixed-bed vapor phase granular activated carbon system (provided by others) to remove VOCs before discharge to atmosphere. Each PTAS system shall include, but not be limited to, the packed tower air stripper, inlet water distributor header, dual-level inlet water v-notch-type weir-trough water distributor, packing (two sections), packing bed limiters (two sections), packing support structures (two levels), water redistributor (lower packed section), demister, inlet air “splash plate,” water discharge vapor seal, manways (three) and connections, lifting lugs, anchor bolts, acoustical baffles, silencers and insulation, off-gas dehumidifying heater, exhaust fan, and all associated indicated instrumentation as specified herein and on the applicable drawings. The dehumidifying heater shall also be provided. All system appurtenances required for a complete and functional system shall be supplied. Refer to the Process and Instrumentation Diagrams (P&IDs) in Attachment D.

1.1.2 The specified equipment is for the first phase of the system. The Buyer may purchase, simultaneously, or in a later procurement, additional equipment for a future phase of installation. The performance requirements for any future PTAS Systems will be for the same conditions, specified herein.

1.1.3 The intent of these Specifications is to indicate the level of performance and quality required for this equipment. System manufacturer can offer their standard design but shall indicate in writing where their equipment differs from this Specification, and where technical exceptions are taken.

1.2 References

1.2.1 The following Specification sections are referenced in this specification:

1.2.1.1 Section 01 43 33.LLE, Manufacturers’ Field Services
1.2.1.2 SGW-54021 01 61 00, Common Product Requirements
1.2.1.3 Section 01 78 23.LLE, Operation and Maintenance Data
1.2.1.4 Section 01 88 15, Seismic Anchorage and Bracing
1.2.1.5 SGW-54023 05 50 00, Metal Fabrications
1.2.1.6 SGW-54024 09 90 00, Painting and Coating
1.2.1.7 SGW-54051 40 99 90, Package Control Systems
1.2.1.8 Section 26 20 00.LLE, Low-Voltage AC Induction Motors
1.2.1.9 SGW-54036 26 29 23, Low-Voltage Adjustable Frequency Drive Systems
1.2.1.10 Section 43 40 02, Fiberglass Reinforced Plastic Tanks

1.2.2 The design, manufacture, and installation of this equipment shall meet or exceed the applicable provisions and recommendations of the following codes and standards authorities.

1.2.2.1 Acoustical Society of America (ASA): S1.6, Preferred Frequencies, Frequency Levels, and Band Numbers for Acoustical Measurements
1.2.2.2 American National Standards Institute (ANSI)
1.2.2.3 Air Movement and Control Association (AMCA): 99-2402, Dimensions for Industrial Centrifugal Fans & Metric Equivalents
1.2.2.4 Air Movement and Control Association (AMCA): 210, Laboratory Methods of Testing Fans for Aerodynamic Performance Rating
1.2.2.5 Air Movement and Control Association (AMCA): 300, Reverberant Room Method for Sound Testing of Fans
1.2.2.6 ASTM International (ASTM):
  1.2.2.6.1 A320, Standard Specification for Alloy-Steel and Stainless Steel Bolting for Low Temperature Service
  1.2.2.6.2 C582, Standard Specification for Contact Molded Reinforced Thermosetting Plastic (RTP) Laminates for Corrosion-Resistant Equipment
  1.2.2.6.3 D2563, Standard Practice for Classifying Visual Defects in Glass-Reinforced Plastic Laminate Parts
  1.2.2.6.4 D2583, Standard Test Method for Indentation Hardness of Rigid Plastics by Means of a Barcol Impessor
  1.2.2.6.5 D2584, Standard Test Method for Ignition Loss of Cured Reinforced Resins
  1.2.2.6.6 D2996, Standard Specification for Filament Wound Fiberglass (Glass-Fiber Reinforced Thermosetting Resin) Pipe
  1.2.2.6.7 D2997, Standard Specification for Centrifugally Cast Fiberglass (Glass-Fiber Reinforced Thermosetting Resin) Pipe
  1.2.2.6.8 D3299, Standard Specification for Filament-Wound, Fiberglass Reinforced Thermoset Resin Chemical Resistant Tanks
  1.2.2.6.9 D4097, Standard Specification for Contact Molded, Glass Fiber Reinforced Thermoset Resin Chemical Resistant Tanks
  1.2.2.6.10 D4167, Standard Specification for Fiber-Reinforced Plastic Fans and Blowers
1.2.2.7 American Society of Mechanical Engineers (ASME):
   1.2.2.7.1 Boiler and Pressure Vessel Code, Section 8, for stainless steel tanks
   1.2.2.7.2 RTP-1, Reinforced Thermoset Plastic Corrosion Resistant Equipment

1.2.2.8 National Electrical Code (NEC)
1.2.2.9 National Electrical Manufacturers Association (NEMA)
1.2.2.10 National Fire Protection Association (NFPA)
1.2.2.11 Nationally Recognized Testing Laboratories (NRTL)
1.2.2.12 Occupational Safety and Health Administration (OSHA)
1.2.2.13 Sheet Metal & Air Conditioning Contractors National Association (SMACNA)
1.2.2.14 Underwriters Laboratories (UL)
1.2.2.15 Washington Industrial Safety and Health Act (WISHA)
1.2.2.16 Washington State Energy Code

1.3 Factory Acceptance Tests

1.3.1 Factory Acceptance Tests (FATs) shall be conducted to ensure the structures, systems, and components and software meet certain requirements prior to shipment. FATs are conducted by the Manufacturer and may be witnessed as desired by the BTR. The Manufacturer shall provide a minimum two weeks’ notice to the BTR prior to the FATs. BTR may elect to visit manufacturing facility, at a mutually agreed-to time, prior to the FAT, to inspect the system.

1.4 Submittals

1.4.1 All submittal information shall be provided in English.

1.4.2 Provide specific submittals for the FRP stripper tower as required in Section 43 40 02, Fiberglass Reinforced Plastic Tanks.

1.4.3 Approval Required Prior to Work (APW) Submittals:

1.4.3.1 Provide the following items after Notice of Award for review and approval by BTR

1.4.3.2 Shop Drawings:
   1.4.3.2.1 Make, model, weight, and horsepower of each equipment assembly
   1.4.3.2.2 Manufacturer’s catalog information, descriptive literature, specifications, and identification of materials of construction
   1.4.3.2.3 Detailed Structural, Mechanical, and Electrical Drawings showing the equipment fabrications and interface with other items. Include dimensions, size, and locations of connections to other work, and weights of associated equipment
1.4.3.2.4 External utility requirements such as air, water, power, drain, etc., for each component

1.4.3.2.5 Shop and Field Painting Systems Proposed: Include Manufacturer’s descriptive technical catalog literature and specifications

1.4.3.2.5.1 Where system proposed is different from that specified or where, in the manufacturer’s opinion, the coating system(s) exceed(s) requirements specified, submit complete technical literature of the proposed system(s) to BTR for review

1.4.3.3 Electrical:

1.4.3.3.1 Total connected electrical load in kW, kVA, and amperes for system, including ancillary equipment furnished by Manufacturer

1.4.3.3.2 List three-phase electrical components, the horsepower rating or load, in amperes and voltage, if applicable

1.4.3.3.3 List components that will run off power supply other than 480V, three-phase

1.4.3.3.4 Completed motor data sheets located at end of section

1.4.3.3.5 Wiring diagrams for equipment and interconnection wiring diagrams, if applicable

1.4.3.3.6 Information on adjustable frequency drives

1.4.3.4 Instrumentation and Control:

1.4.3.4.1 P&IDs, in electronic form, using AutoCAD Version 2017 format

1.4.3.4.2 Process and instrumentation diagrams and description of functions monitored, controlled, and alarmed

1.4.3.4.3 Electronic copy of PLC software, ladder logic for PLC(s), number and location of PLC(s), and input/output (I/O) panels

1.4.3.4.4 Describe instrumentation and control components and features including software, hardware, control features, remote system capabilities, monitoring, data storage, and alarms. Provide examples of OIT screens that have been provided on previous projects. Provide a block diagram of proposed control system including OIT(s), PLC(s), and data highway

1.4.3.4.5 Software Description: Provide narrative description of control system, logic diagrams, summary of control functions, summary of monitoring functions, description of alarms, and other information to describe control system
1.4.3.5 Detailed calculations used to select the exhaust fan, include determination of
duct losses and blower and fan curves

1.4.3.6 Seismic anchorage and bracing drawings and cut sheets, as required by
Section 01 88 15, Seismic Anchorage and Bracing

1.4.3.7 Testing Requirements: Quality Assurance Inspection Plan listing all
recommended inspection and testing activities for factory, functional, and
performance testing. Minimum testing procedures shall be as specified herein

1.4.3.8 Samples:
1.4.3.8.1 All nozzle cutouts, labeled in accordance with the Submittal
drawings. Submit at the completion of vessel manufacture
1.4.3.8.2 Representative laminate sample for tower and duct

1.4.4 Information Submittals:

1.4.4.1 Provide the following items after Notice of Award as information to Buyer and
BTR.
1.4.4.1.1 Special shipping, storage and protection, and handling instructions,
in accordance with SGW-54021 01 61 00, Common Product
Requirements.
1.4.4.1.2 Manufacturer’s written/printed installation instructions.
1.4.4.1.2.1 Draft installation instructions shall be provided within
60 days after Notice of Award
1.4.4.1.2.2 Final installation instructions shall be provided a
minimum of 60 days prior to shipment of equipment
1.4.4.1.3 Manufacturer’s Certificate of Compliance for the PTAS System, in
accordance with Section 01 43 33.LLE, Manufacturers’ Field
Services
1.4.4.1.4 Certified noise level test report for Stripper Exhaust Fan as
specified herein
1.4.4.1.5 Certification that factory-applied coating system(s) is identical to
requirements specified
1.4.4.1.6 Routine maintenance requirements prior to equipment startup
1.4.4.1.7 Manufacturer’s Certificate of Proper Installation, in accordance
with Section 01 43 33.LLE, Manufacturers’ Field Services
1.4.4.1.8 Operation and Maintenance Data: As specified in
Section 01 78 23.LLE, Operation and Maintenance Data
1.4.4.1.9 Service records for maintenance performed during construction
1.4.4.1.10 Factory, functional, and performance test results as specified
herein
1.5 Quality Assurance

1.5.1 A single manufacturer who shall have sole responsibility for the system shall provide all components including media for the PTAS system. The equipment Manufacturer shall have at least five successful years of experience in the design, construction and operation of equipment of the type specified at a minimum of ten installations in the United States.

1.6 Delivery, Storage and Handling

1.6.1 Refer to SGW-54021 01 61 00, Common Product Requirements.

1.6.2 Delivery shall be made in as few packages as possible shipped at the same time. Spare parts shall be included with the system. The towers shipped horizontally shall be supported by cradles supporting at least 120 degrees (bottom one-third) of the vessel circumference.

1.6.3 Equipment shall be shipped to be adequate for final erection and construction.

1.6.4 Ship tower in accordance with Section 43 40 02, Fiberglass Reinforced Plastic Tanks.

1.7 Extra Materials

1.7.1 Furnish, tag, and box for shipment and storage the following spare parts and special tools. Special tools are any tools required to operate and maintain the equipment other than standard tools that can be easily purchased at a hardware store.

<table>
<thead>
<tr>
<th>Item</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fan bearings, gaskets, V-belts, and seals</td>
<td>One complete set/unit per air stripper</td>
</tr>
<tr>
<td>Special tools required to operate and maintain the system</td>
<td>One complete set/unit per air stripper</td>
</tr>
</tbody>
</table>
2 PRODUCTS

2.1 General

2.1.1 All equipment supplied shall be skid mounted, preassembled, pre-piped, prewired, and tested to the maximum extent possible. The Manufacturer shall size and supply anchor bolts for the PTAS skid to meet the conditions specified herein. Exhaust fan and dehumidification heater may be either mounted on a common skid with the air stripper tower, or on a separate equipment skid.

2.1.2 All components of the PTAS shall be compatible with the conditions and chemicals to which they will be subjected during normal operation of the system. Uncoated carbon steel must not be used for any wetted part in order to avoid technetium-99 accumulation. Refer to the Painting and Coating Specification, SGW-54024 09 90 00, for painting and coating requirements of carbon steel.

2.1.3 PTAS packaged system will be located outdoors.

2.1.4 Equipment Identification Plates: Provide 16 gauge Type 316 stainless steel identification plate securely mounted on each separate equipment component in a readily visible location. Plate shall bear 1/4 inch high engraved block type black enamel filled equipment identification number and letters.

2.2 Exposure Conditions

2.2.1 Liquid Design Temperature:

2.2.1.1 Minimum Sustained Temperature: 50 degrees F.

2.2.1.2 Nominal Annual Temperature: 67 degrees F.

2.2.1.3 Peak, Transient Temperature: 90 degrees F.

2.2.2 Ambient Conditions:

2.2.2.1 Outside Building Temperature: Minus 23 degrees F to plus 115 degrees F.

2.2.2.2 Air: Arid.

2.2.2.3 Elevation Above Sea Level: 727 feet.

2.2.3 Water Analysis: Furnish a PTAS system to meet the minimal criteria based on the following influent water analysis:
<table>
<thead>
<tr>
<th>Parameter</th>
<th>Average Value (Before Bioprocess)**</th>
<th>Average Value (After Bioprocess)**</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbon Tetrachloride</td>
<td>370</td>
<td>25</td>
<td>µg/L</td>
</tr>
<tr>
<td>Nitrate as Nitrogen (average)</td>
<td>30</td>
<td>5</td>
<td>mg/L</td>
</tr>
<tr>
<td>Hexavalent Chromium</td>
<td>26</td>
<td>3.8</td>
<td>µg/L</td>
</tr>
<tr>
<td>Trichloroethylene</td>
<td>2.8</td>
<td>0.4</td>
<td>µg/L</td>
</tr>
<tr>
<td>Iodine-129</td>
<td>0.4</td>
<td>0.4</td>
<td>pCi/L</td>
</tr>
<tr>
<td>Technetium-99</td>
<td>117</td>
<td>106</td>
<td>pCi/L</td>
</tr>
<tr>
<td>Tritium</td>
<td>3,000</td>
<td>3,000</td>
<td>pCi/L</td>
</tr>
<tr>
<td>Uranium</td>
<td>1.0</td>
<td>0.9</td>
<td>µg/L</td>
</tr>
<tr>
<td>Chromium (total)</td>
<td>26</td>
<td>3.8</td>
<td>µg/L</td>
</tr>
<tr>
<td>Alkalinity (as CaCO₃)</td>
<td>105</td>
<td>148</td>
<td>mg/L</td>
</tr>
<tr>
<td>Calcium as Ca</td>
<td>61</td>
<td>58</td>
<td>mg/L</td>
</tr>
<tr>
<td>Chloride</td>
<td>24</td>
<td>52</td>
<td>mg/L</td>
</tr>
<tr>
<td>Chloroform</td>
<td>4.6</td>
<td>4.0</td>
<td>µg/L</td>
</tr>
<tr>
<td>Fluoride</td>
<td>0.35</td>
<td>0.35</td>
<td>mg/L</td>
</tr>
<tr>
<td>Iron (dissolved)***</td>
<td>0.25</td>
<td>nil</td>
<td>mg/L</td>
</tr>
<tr>
<td>Magnesium</td>
<td>21</td>
<td>21</td>
<td>mg/L</td>
</tr>
<tr>
<td>Manganese (dissolved)***</td>
<td>0.084</td>
<td>10</td>
<td>mg/L</td>
</tr>
<tr>
<td>Potassium</td>
<td>5</td>
<td>5</td>
<td>mg/L</td>
</tr>
<tr>
<td>Sodium</td>
<td>21</td>
<td>21</td>
<td>mg/L</td>
</tr>
<tr>
<td>Sulfate</td>
<td>60</td>
<td>70</td>
<td>mg/L</td>
</tr>
<tr>
<td>Total Organic Carbon</td>
<td>1.6</td>
<td>1.6</td>
<td>mg/L</td>
</tr>
<tr>
<td>Total Suspended Solids***</td>
<td>1.9</td>
<td>nil</td>
<td>mg/L</td>
</tr>
<tr>
<td>Total Dissolved Solids</td>
<td>484</td>
<td>484</td>
<td>mg/L</td>
</tr>
</tbody>
</table>
The analyses indicated are estimated analyses for two potential operating scenarios that affect specified process influent conditions, treatment before biological treatment and treatment after the biological treatment.

Indicated contaminants may deviate up to twice the indicated value. Manufacturer to indicate the maximum concentration stripper can tolerate, when using vendor recommended antiscalent at vendor recommended dosage for the each indicated contaminant.

2.2.4 Airflow Rate into PTAS (each system):

2.2.4.1 Minimum Operating Condition: 2,000 scfm.
2.2.4.2 Nominal Operating Condition: 3,400 scfm.
2.2.4.3 Peak Flow: 7,000 scfm.

2.2.5 Water Flow Rate into PTAS (each system):

2.2.5.1 Minimum Operating Condition: 600 gpm.
2.2.5.2 Nominal Operating Condition: 1,250 gpm.
2.2.5.3 Peak Flow: 1,250 gpm.

2.3 Performance Requirements

2.3.1 The system shall be sized and designed to allow for continuous, 24 hours per day, 365 days per year operation, unattended for up to 5 days.

2.3.2 The system shall strip carbon tetrachloride and trichloroethylene and meet effluent requirements noted in Performance Requirements below under all specified process influent conditions, including both potential operating scenarios (i.e., treatment before biological treatment or treatment after the biological treatment) and the maximum sustained design flow rate, including simultaneous maximum sustained influent nitrate and minimum sustained inlet fluid temperature.

2.3.3 Performance Requirements:

2.3.3.1 Carbon Tetrachloride Removal: 99.7 percent.
2.3.3.2 Effluent Carbon Tetrachloride: 2 µg/L.
2.3.3.3 Trichloroethylene Removal: 86 percent.
2.3.3.4 Effluent Trichloroethylene: 0.6 µg/L.
2.3.3.5 Chloroform Removal: 99 percent.
2.3.3.6 Effluent Chloroform: 5.4 µg/L.

### 2.4 Equipment Requirements

#### 2.4.1 General:

- **2.4.1.1** Miscellaneous hardware, including bolts, nuts, washers, and fastener clips, shall be ASTM A320, of Type 316 stainless steel.
- **2.4.1.2** No dissimilar metals shall be in direct contact unless properly electrically insulated with a 2-mm thick continuous neoprene gasket and dielectric sleeves and washers for bolted connections.
- **2.4.1.3** Equipment shall fully comply with OSHA standards.
- **2.4.1.4** Electrical material and equipment shall have UL listing wherever standards have been established by that agency. Complete electrical assembly shall meet requirements of National Electrical Code (NEC), National Electrical Manufacturers Association (NEMA), Nationally Recognized Testing Laboratories (NRTL) and National Fire Protection Association (NFPA).
- **2.4.1.5** All circuit breakers shall be provided with a permanently attached lock-out provision.

#### 2.4.2 Packed Tower Air Stripper:

- **2.4.2.1** PTAS shall be of the induced draft type with internal packing.
- **2.4.2.2** PTAS housing shall be fabricated of fiberglass reinforced plastic (FRP). Tower shall have a flat bottom and dished top (head).
- **2.4.2.3** Tower shall have non-skid surface and UV protected FRP handrails with safety gate.
- **2.4.2.4** The tower shall be designed for seismic and wind loading as specified in SGW-54021 01 61 00, Common Product Requirements and in Section 01 88 15, Seismic Anchorage and Bracing. The tower shall be self-supporting with no external guy wires or structural framework. Wall thickness shall be designed to withstand the following:
  - **2.4.2.4.1** The vessels and anchors shall be designed to withstand wind loadings as specified in SGW-54021 01 61 00, Common Product Requirements, for all potential operating conditions (including with water holdup) and when empty.
  - **2.4.2.4.2** The seismic design shall consider loadings imposed by filling the height of the tower to 6-inches above the overflow with liquids of specific gravity equal to 1.1.
2.4.2.5 Each tower shall be complete with a minimum of three 24-inch diameter manways, above top of packing, between packed sections, and at grade. Manways shall allow for gravity loading and unloading of the packing and for maintenance of the v-notched water distribution channels and packing support systems. Manways shall be watertight and hinged for easy access. Manway covers shall be provided with handles.

2.4.2.6 The water and forced air will circulate counter-currently; the air being introduced below the packing. A six-inch minimum distance shall be provided between the packing support and the top of the air inlet duct to facilitate distribution of air across the packing. The air inlet ducting entrance point shall be shielded with a splash guard to avoid water collection in air ducting.

2.4.2.7 PTAS dimensions and packing requirements shall meet Performance Requirements and the following criteria:

- **Packing Depth**: Two sections of 20-feet minimum depth each as needed to accomplish the Performance Requirements (40 feet minimum total depth).
- **Tower Diameter**: 10-feet minimum.
- **Packed Bed Depth Safety Factor**: 25 percent.
- **Design Water Flux**: 25 gpm/square foot maximum.
- **Air-to-Water Ratio**: Adjustable between 15:1 to 41.9:1 (volume/volume) as needed to accomplish performance requirements.

2.4.2.8 The PTAS shall have an integral basin directly below the tower packing to collect the partially treated groundwater. The basin shall be capable of retaining a minimum of 5,000 gallons above the low water level.

2.4.2.9 FRP drip lip rings shall be provided every 5-feet.

2.4.2.10 All connections 3-inches and larger shall be flanged and shall have ANSI standard dimensions and bolting patterns. All connections and nozzles shall be FRP. Provide flanged nozzles, sized as needed, for the following connections to the tower (minimum):

- **Overflow** (include trap on overflow pipe sized to contain an internal tank pressure of plus or minus 8-inches WC).
- **Drain** (valved to drain, with valved branch and male quick connect for connection to waste truck).
- **Pressure differential sensors** (4 connections, all valved as shown).
- **Process flow inlet and outlet**.
- **Inlet bypass**.
- **Air inlet and outlet**.
- **Level switches and analog level element** (3 connections).

2.4.2.11 All bolts, fasteners, supports, hinges, lifting lugs, etc., shall be Type 316 stainless steel.
2.4.2.12 Provide service platform with non-slip surface that shall extend to edge of stripping tower with a hinged plate extending another 12-inches beyond edge of tower to allow for differential vertical and horizontal movements. Platform and hinged plate shall be sized for a minimum of 100 PSF load.

2.4.2.13 Air Pressure Drop:

2.4.2.13.1 Through Tower: Less than 4-inch WC. The tower shall include losses noted below and all other losses from ancillary parts not specifically identified:

2.4.2.13.1.1 Through Packing Support: Less than 0.1-inch WC (each).

2.4.2.13.1.2 Through Inlet Distributor: Less than 0.1-inch WC.

2.4.2.13.1.3 Through Redistributor: Less than 0.1-inch WC.

2.4.2.13.1.4 Through Mist Eliminator: Less than 2.5-inch WC.

2.4.2.13.1.5 Clean Media Head Loss: Less than 1-inch WC through 40-feet.

2.4.2.14 Maximum Pressure on Tower: Plus or minus 10-inches WC.

2.4.2.15 The top heads shall be convex unless otherwise specified. Bottom may be flat or a convex head that is built integral or may be molded with skirts and subsequently joined to the shells.

2.4.2.16 FRP tower shall be manufactured in accordance with Section 43 40 02, Fiberglass Reinforced Plastic Tanks.

2.4.3 Stripper Internals and Accessories:

2.4.3.1 Materials:

2.4.3.1.1 All tower internals shall be constructed of FRP or stainless steel.

2.4.3.1.2 All tower internals shall be constructed in segments so they can be disassembled and pass through a 24-inch diameter manway.

2.4.3.2 Inlet Water Distributor:

2.4.3.2.1 Design to distribute the flow uniformly over the tower cross-sectional area so there is no evidence of low flow areas.

2.4.3.2.2 The inlet water distributor shall consist of one or more parting boxes resting upon or supported immediately above a series of distribution boxes. Each parting box shall use slotted weirs to distribute the inlet water to the distribution boxes which are installed perpendicular to parting box or boxes. Each distribution box shall provide triangular or V-notch weirs that are spaced and sized to feed water uniformly across the surface of the packing over the range of water flow rates for which the packed tower is designed. The distributor shall provide a minimum of six distribution points per square foot of packing surface.
2.4.3.2.3 Inlet water distribution piping shall extend across the interior of the column with slots matched to feed openings in the parting box or boxes. Distribution piping shall be installed at minimum distance above the parting box(es) to minimize splashing of water.

2.4.3.2.4 Design the feed pipes for connection to the exterior influent piping to utilize a minimum amount of head loss.

2.4.3.2.5 A minimum of 1-foot shall be provided between all components to provide access for maintenance.

2.4.3.3 Mist Eliminator:

2.4.3.3.1 Tower shall include a mesh type mist eliminator. Unit shall be 6-inch thick minimum demister mesh. It shall be designed to minimize water droplets and mist carryover to the discharge duct. The mesh pad shall be secured to a rigid frame with securing straps, one per square feet, evenly distributed.

2.4.3.3.2 Mist eliminator shall remove 90 percent of all entrained water droplets greater than 10 microns in diameter and 99 percent of all droplets greater than 40 microns in diameter.

2.4.3.3.3 The mist eliminator shall be a diameter less than the stripper diameter to achieve necessary air velocity, but not less than 4 feet minimum, and shall be mounted as an attachment below the stripper tower air outlet.

2.4.3.3.4 Mist eliminator housing shall be designed to allow for inspection and removal of pads. Provide hinged access doors. Personnel access will be from the top of the stripper tower.

2.4.3.4 Packing Supports:

2.4.3.4.1 Slotted beam, gas injection type, or structural fiberglass grating.

2.4.3.4.2 Free Area: Minimum of 90 percent of the cross-sectional area of the tower.

2.4.3.4.3 Quantity: Sufficient to hold the amount of packing specified plus entrained groundwater.

2.4.3.4.4 Opening size shall not allow passage of packing media.

2.4.3.5 Redistributor: Provide orifice-riser type redistributor above the lower section of packing. The redistributor shall be designed to redistribute the water flowing from the upper section of packing. Water shall be distributed evenly across the surface of the packing, providing a minimum of 6 distribution points per square foot of packing surface. Orifices shall be sized to require a minimum of 2 inches of water level above the orifice at minimum water flow rate. Risers shall be provided to allow for separate passage of the air from the lower section to the upper section of packing. Riser height shall be sufficient to prevent overflow of water at the maximum design flow rate for the air stripping column. Deflectors shall be provided above each of the risers to prevent water flowing from the upper packing section to flow through the risers.
2.4.3.6 Bed Limiters: Each packed bed section shall be provided with a bed limiter to prevent migration of packing into the liquid distributor or redistributor and to maintain a level surface to each of the packed beds to promote even liquid distribution and uniform mass transfer. The bed limiters shall accomplish this function without causing undue pressure drop and shall provide open area greater than 90 percent of the packed tower cross section.

2.4.3.7 Inlet Air Distributor: Distribute air evenly over cross-section. Air face velocity shall not vary more than 5 percent from mean face velocity over the entire cross-section at any point.

2.4.3.8 Effluent Water Vortex Break: Provide vortex break at effluent nozzle.

2.4.3.9 Duct Connections:

2.4.3.9.1 Inlet duct connection shall be located on the side of the PTAS. The connection shall be a flanged connection and shall be sized for 7,000 CFM at approximately 800 feet per minute velocity. It is anticipated that the duct size will be approximately 60 inches by 24 inches. Final sizing shall be by the PTAS manufacturer. Coordinate the exact location with other trades. Contractor shall provide intake ductwork that shall extend from the intake opening to a termination point at 36-inch above grade. Ductwork shall be constructed of Type 316 stainless steel. Ductwork shall be designed to withstand 20-inch WC per SMACNA. Provide 2-inch inlet air filters equivalent to Farr 30-30. Size bank to provide an air velocity approximately 300 feet/minute. Intake assembly shall be similar to that shown in Attachment A to this Specification.

2.4.3.9.2 Outlet duct shall be located on the side of a duct outlet box set on the top of the tower. Duct outlet box shall be rectangular in shape and shall be provided with a 36-inch round flanged duct connection. The outlet box shall be furnished with a single hinged access door a minimum of 30 inches by 30 inches. Door shall have quarter-turn access handles and shall be furnished with viewport windows and all Type 316 stainless steel construction with 1 inch of insulation. Door shall be oriented to permit access to mist eliminator pad(s). Extend 28-inch round duct down side of stripping tower, terminating duct at 37 feet above grade with a Van Stone flange. Support the duct to the side of the tower as required. See Attachments B and C for general arrangement.

2.4.4 Packing Media:

2.4.4.1 Packing material shall be 2-inch polypropylene Jaeger Tri-Packs\textsuperscript{1} random media or Engineer approved equal. Packing supports shall be FRP. Headloss

\textsuperscript{1} Jaeger Tri-Packs
with clean packing material shall be a maximum of 0.02-inch WC per foot of packing bed depth at the maximum specified air and water flow rates.

2.4.4.2 Media shall be able to support its own weight and that of the liquid listed in the service conditions. This shall be achieved without deforming the media such that no reduction in mass transfer efficiency or increase in head loss through the media results.

2.4.4.3 The minimum quantity of packing to be supplied shall be the quantity necessary for a total of 40 feet of packing depth (two sections of 20 feet each). Provide intermediate packing supports if required to meet manufacturer’s maximum media depth limitations.

2.4.5 Centrifugal Exhaust Fans:

2.4.5.1 Provide an industrial quality skid-mounted utility fan on an industrial frame with vibration isolation. All parts of the fan in contact with the air stream shall be Type 316 stainless steel.

2.4.5.2 Fan arrangement and capacity as indicated in Exhaust Fan Data Sheet.

2.4.5.3 Construction: Fan ratings shall be based on test made in accordance with AMCA Standard 210 in an accredited AMCA laboratory. Fan wheel inlet diameters and outlet areas shall be in accordance with AMCA 99-2402 for industrial centrifugal fans. Fan shall have a rising pressure characteristic extending throughout the operating range of the fan. All parts of the fan in contact with the air stream shall be minimum Type 316 stainless steel corrosion resistant construction. Inlets and outlets shall be provided with a drilled flange.

2.4.5.4 Housing: Type 316 stainless steel, continuously welded or bolted throughout, braced and supported on a heavy duty structural frame. Provide housing drain with stainless steel ball valve. Provide manufacturer's standard access door. Provide heavy duty opposed bladed discharge damper that is lockable at any position and any RPM of the fan.

2.4.5.5 Wheel: Flat blade design with all welded and reinforced construction, wheel shall be factory balanced statically and dynamically.

2.4.5.6 Shaft: Designed to operate at no more than 80 percent of the first critical speed at the top of the speed range of the fans class. Drive shaft shall be turned ground and polished with countersinks for tachometer readings. All rotating equipment shall be enclosed in an OSHA approved guard. The guard shall have openings that will allow the use of a tachometer on both the motor and fan drive shaft.

2.4.5.7 Bearings: Heavy duty ball or roller type sized to produce a L10 life of not less than 250,000 hours based on the maximum cataloged operating speed.

2.4.5.8 Motors and Fan Wheel Pulleys: Adjustable pitch for use with motors through 15 hp, fixed pitch for use with motors larger than 15 hp. Select pulleys so that pitch adjustment is at the middle of the adjustment range at fan design conditions. Sheaves shall be fixed speed with a minimum of 50 percent
additional belts over that required for the installed motor. Sheaves and belts shall be factory installed with final alignment belt adjustment made after installation. Belts shall be oil resistant, non-sparking and non-static.

2.4.5.9 Entire fan and motor assembly shall be mounted on a heavy duty welded structural steel base. Base shall be size to securely mount the fan and motor. Frame shall be fitted with spring isolators with seismic snubbers. The frame shall be galvanized structural channel/wide flange with additional iron stiffeners as required to insure a non-flexing stable base. Provide lifting points as required to lift fan assembly by the use of a crane.

2.4.5.10 Motor shall be premium efficient TEFC compatible with the Washington State Energy Code and shall be suitable for operation with a variable speed drive. Motor and fan shall be capable of operating down to 20 percent of full RPM without the use of additional cooling devices.

2.4.5.11 Furnish each fan with a removable sound absorbing blanket that is suitable for outdoor installation. Blanket shall overlap or butt up to existing insulation with a friction closing seam. Open gaps are not acceptable. Blankets will have a low point stainless steel drain grommet or the design will incorporate a mating seam at the low point. Provide stainless steel pins to prevent shifting of the insulation. Blanket shall be 2-inches thick with a nominal 2.5 pounds per square foot density.

2.4.6 Dehumidification Heater:

2.4.6.1 Provide a duct heater mounted in a rectangular 316 stainless steel ductwork enclosure constructed to a 20-inch pressure class per SMACNA. Enclosure shall be sized as required by the duct heater manufacture and as required by the instruments required for the contractor furnishing the stripping tower. Provide the heater enclosure with transition fittings to match 28-inch round ends with Van Stone duct flanges as provided with the ductwork. See Attachments B and C for general arrangement.

2.4.7 Media Cleaning System:

2.4.7.1 Media cleaning system shall consist of a recirculation pump and eductor. Recirculation pump shall draw water from the tower sump and pump it through an eductor, which will be connected to a chemical tote by the Buyer. Chemical used for cleaning will be 3D Trasar 3DT120 from the NALCO Company. Recirculation pump and eductor shall be of non-metallic construction suitable for exposure to this chemical.

2.4.7.2 Hydraulic design and sizing of the recirculation pump and eductor shall the responsibility of the Manufacturer. Pumping rate shall be sufficient to provide full wetting of all packing.

2.4.7.3 Provide non-metallic male quick coupling connection (with cap) hard-piped to the eductor for connection to the chemical tote using a portable hose.
2.4.7.4 Provide male quick connect coupling, as required herein, for connection of hose to tanker truck for removal of chemical solution from sump following cleaning.

2.4.7.5 A single media cleaning system shall serve multiple air strippers.

2.4.8 Manufacturer Supplied System Piping and Valves:

2.4.8.1 The package system shall be provided with piping to the limits of package system responsibility as shown on the P&ID drawings, including all valves and piping as shown.

2.4.8.2 Liquid phase piping shall be of Schedule 80 PVC, sized to limit the maximum velocity to 6 feet per second. Flanged fittings shall be used at all valves, instruments, and other appurtenances. Socket type fittings may be used elsewhere. Isolation valves larger than 3 inches shall be stainless steel butterfly type. Flow control valves shall be stainless steel butterfly valve with electrical actuator. Smaller isolation valves shall be non-metallic ball type. Pump check valves shall be stainless steel swing type. Piping and valves shall be as specified in SGW-54021 01 61 00, Common Product Requirements.

2.4.8.3 Uncoated carbon steel shall not be used for any wetted part in order to avoid technetium-99 accumulation. All carbon steel shall be coated as specified in SGW-54024 09 90 00, Painting and Coating.

2.4.8.4 Exterior piping, including that installed with the PTAS System, may be heat traced and insulated in the field by the Construction Contractor. Heat tracing and insulation is not required to be provided as part of the PTAS package.

2.5 Electrical Components and Accessories

2.5.1 General: Provide field panels, electrical components, and wiring for a complete, functional system. Provide all items whether specified or not, required for proper system operation.

2.5.2 Three-phase, 480V ac will be available for the blower and fan, and for the dehumidifier. Provide main electrical panelboard, adjustable frequency drive, transformer, low-voltage panelboard, and other equipment necessary to provide power distribution and control for equipment provided. Prepiped and skid-mounted components shall be prewired to terminal junction box located on skid.

2.5.3 Motors: Provide squirrel cage induction motors in accordance with Section 26 20 00.LLE, Low-Voltage AC Induction Motors.

2.5.4 Power supplies greater than 50 volts shall be separated from control circuits and panels.

2.5.5 Conductors:

2.5.5.1 Conductors shall be copper.

2.5.5.2 Use minimum conductor size of No. 12 AWG for power circuits.
2.5.5.3 Install conductors in conduit suitable for location installed.
2.5.5.4 Size conductor and conduit per NEC.

2.6 Instrumentation and Controls

2.6.1 General:

2.6.1.1 Provide control devices, instruments and panels in accordance with general control requirements specified in SGW-54051 40 99 90, Package Control Systems.

2.6.1.2 The minimum functional requirements of the control system are specified herein. Provide additional instrumentation and controls as to provide a safe and operable system.

2.6.2 Panels: The supplier shall provide control of the packaged system via a locally mounted control Panel. As a minimum provide the following control panel(s):

<table>
<thead>
<tr>
<th>Panel No.</th>
<th>Name</th>
<th>Location</th>
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<th>Material</th>
<th>Mounting</th>
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<tr>
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<td>Pump and Treatment Process Area</td>
<td>NEMA 4X</td>
<td>316 SS</td>
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</table>

2.6.3 Instrumentation: All instrumentation provided shall meet the requirements of SGW-54051 40 99 90, Package Control Systems, with regard to preferred manufacturers (where noted) and quality and performance standards. Provide all instrumentation necessary to provide a complete and functional system. Instruments shall be wired as part of the package or skid-mounted components.

2.6.3.1 As a minimum, each PTAS System shall include the following instrumentation as shown:
2.6.3.1.1 One magnetic flow meter and indicating transmitter (tower influent)
2.6.3.1.2 Two air flow meters and indicating transmitters (tower inlet air and dehumidification discharge air). Flow meters shall be located in accessible location
2.6.3.1.3 One pH probe and indicating transmitter (tower influent)
2.6.3.1.4 One pressure indicator (tower inlet air)
2.6.3.1.5 One pressure indicator (Air Stripper Recirculation Pump discharge)
2.6.3.1.6 Four pressure differential indicating transmitters (Inlet Blower inlet filter, tower packing section 1, packing section 2, and demister)
2.6.3.1.7 Two pressure indicating transmitters (Stripper Exhaust Fan inlet and discharge)
2.6.3.1.8 One level indicating transmitter (tower sump)
2.6.3.1.9 One high level switch (tower sump)
2.6.3.1.10 One low level switch (tower sump)
2.6.3.1.11 Two temperature probes and indicating transmitters (upstream and downstream of Dehumidification Heater)
2.6.3.1.12 One high temperature cutoff switch (provided with Dehumidification Heater)
2.6.3.1.13 All pressure indicators and pressure switches shall be isolated from the process liquid and air flow by diaphragm seals, with the exception of the tower inlet air

2.6.4 Local Operator Controls and Indicators:

2.6.4.1 The package system shall provide for local operation of all process equipment, pumps, valves, etc. The control system shall include a dedicated Programmable Logic Controller (PLC) for each train, mounted in a panel on the system skid, including an Operator Interface Terminal (OIT) mounted in the same panel. The control shall be through the PLC or secondary controls to place the equipment in Local or Automatic control mode and provide for operation of the specific device.
2.6.4.2 Where hardwired controls are used they shall be located next to the equipment being controlled mounted in an appropriate NEMA enclosure.
2.6.4.3 As a minimum provide the following local control, status and indication and alarm functions for each train:
2.6.4.3.1 Control:
2.6.4.3.1.1 Tower influent flow control valve position to maintain TOWER INFLUENT PROCESS FLOW based on operator input.
2.6.4.3.1.2 Exhaust Fan speed to maintain TOWER INLET AIR FLOW based on influent flow rate and operator selected air-water ratio.

2.6.4.3.1.3 Off-Gas Booster Fan speed to maintain FAN INLET PRESSURE based on operator input.

2.6.4.3.1.4 Dehumidification Heater heat output to maintain heater TEMPERATURE RISE per operator input.

2.6.4.3.1.5 Functional descriptions for these control functions are provided herein.

2.6.4.3.2 Status and Indication:

2.6.4.3.2.1 Exhaust Fan ON

2.6.4.3.2.2 Exhaust Fan inlet pressure, inches WC

2.6.4.3.2.3 Exhaust Fan outlet pressure, inches WC

2.6.4.3.2.4 Air Stripper Chemical Recirculation Pump ON

2.6.4.3.2.5 Process influent flow rate, gpm

2.6.4.3.2.6 Process influent flow control valve position, percent open

2.6.4.3.2.7 Process influent pH

2.6.4.3.2.8 Inlet air flow rate, scfm

2.6.4.3.2.9 Dehumidification Heater discharge air flow rate, scfm

2.6.4.3.2.10 Dehumidification Heater inlet air temperature, degrees F

2.6.4.3.2.11 Dehumidification Heater discharge air temperature, degrees F

2.6.4.3.2.12 Tower sump level, feet

2.6.4.3.2.13 Air Stripper Inlet filter pressure differential, inches WC

2.6.4.3.2.14 Bottom media bed pressure differential, inches WC

2.6.4.3.2.15 Top media bed pressure differential, inches WC

2.6.4.3.2.16 Demister pressure differential, inches WC

2.6.4.3.3 Alarms:

2.6.4.3.3.1 Exhaust Fan FAIL

2.6.4.3.3.2 Tower sump HIGH level

2.6.4.3.3.3 Tower sump LOW LOW level

2.6.4.3.3.4 Dehumidification Heater HIGH temperature

2.6.4.3.3.5 Process influent flow meter FAIL

2.6.4.3.3.6 Inlet air flow meter FAIL

2.6.4.3.3.7 Dehumidification Heater discharge air flow meter FAIL

2.6.4.3.3.8 Dehumidification Heater discharge air flow LOW

2.6.5 PLC and Network Interface:

2.6.5.1 Provided PLCs shall meet the requirements of SGW-54051 40 99 90, Package Control Systems, Programmable Logic Controller (PLC).
2.6.5.2 Control logic and SCADA system interface shall be provided with programmable logic controller(s) (PLC).

2.6.5.3 The PLC shall be installed in the associated PTAS operator control panel. The PLC shall be sized to accommodate the required functionality of the system plus 50 percent spare capacity.

2.6.5.4 Provide PLC control, monitoring and alarm functions as specified in the Functional Requirements and as required to provide a complete and functional PTAS system.

2.6.5.5 The PLC shall be provided with instructions, memory, input/output capacity and hardware for all specified functions. A communications port shall be provided for connection to a laptop personal computer.

2.6.5.6 Provide original programming and any necessary onsite programming. Provide all programming software necessary to program all control functions, do all searching, monitoring, forcing, and altering operations either online or offline.

2.6.6 OIT Functions:

2.6.6.1 OIT control and monitoring functions do not require separate hardwired controls. The OIT shall provide the interface as described in the Functional Requirements. The OIT shall be housed in the panel described above along with the PLC.

2.6.6.2 Operator Interface Graphics: Provide menu-driven operator interface displays. Displays shall include:

2.6.6.2.1 An overview with on/off and alarm status of each item of equipment.

2.6.6.2.2 An alarm graphic showing the twenty most recent alarms, including time and date of occurrence. As a minimum, the alarms described above shall be provided. The alarms shall identify the affected equipment by location.

2.6.6.2.3 Displays for control and monitoring of all functions specified herein.

2.6.6.2.4 The date and time shall be changeable directly from the operator interface.

2.6.6.2.5 Provide graphics operator interface that can be expanded (developing additional graphics) by at least 50 percent without installing additional memory.

2.6.6.3 The PLC shall be provided with instructions, memory, input/output capacity and hardware for all specified functions. A communications port shall be provided for connection to a laptop personal computer.

2.6.6.4 Provide original programming and any necessary onsite programming. Provide all programming software necessary to program all control functions, do all searching, monitoring, forcing, and altering operations either online or offline.
2.6.6.5 Coordination with PICS Subcontractor:

2.6.6.5.1 The PICS subcontractor will assign IP address to the PLC and tag numbers for alarms, status, etc.

2.6.6.5.2 Coordinate and finalize data exchange requirements with PICS supplied PMCS.

2.6.6.5.3 Provide PICS with the data exchange table with tag numbers to assist in developing the system graphics.

2.6.7 External Interfaces: As a minimum the following signals shall be made available to interface with the Plant SCADA System. Interface shall be through the PLC network:

2.6.7.1 Equipment Status (Opened/Closed; On/Off; Local/Remote, Auto/Man; etc.)

2.6.7.2 Equipment runtimes

2.6.7.3 All equipment and process alarms

2.6.7.4 Process variable values

2.6.7.5 Control set points

2.6.7.6 Control commands (Open/Close; Start/Stop; etc.)

2.6.8 Functional Requirements: The following describes the minimum functional requirements of the intended system.

2.6.8.1 Process Influent Flow Control: Modulate the process influent flow control valve (FCV) to maintain an operator input flow in gpm.

2.6.8.2 Exhaust Fan Speed Control: Adjust the blower speed to maintain an operator adjustable air flow rate in SCFM.

2.6.8.3 Dehumidification Heater Control: Adjust the output from the heater based on an operator input air temperature differential in degrees F. Shut down the heater on a HIGH temperature or LOW air flow.

2.7 Miscellaneous Appurtenances

2.7.1 Metal Hardware: Type 316 stainless steel; no metal shall be used inside tower.

2.7.2 Pipe Supports: Provide for all overflow pipes, loading pipes, and recirculation pipes. Spacing of supports shall be as recommended by the fabricator, but shall not be greater than 4-feet on center. Pipe supports shall allow removal of the pipe. Supports shall be FRP complete with necessary Type 316 stainless steel bolts, nuts, and washers.
2.7.3 Lifting Lugs: Provide suitably attached for all equipment assemblies and components weighing over 75 pounds.

2.7.4 Bolting shall be hexhead machine bolts with washers, nuts and gaskets. Bolts, nuts, and washers shall the Type 316 stainless steel.

2.7.5 Support Brackets: Provide for liquid piping and ductwork. Incorporate into the filament winding system.

2.7.6 Provide handrail around top of tank with hinged safety gate.

2.8 Source Quality Control

2.8.1 Inspection:

2.8.1.1 Inspect all products prior to shipment unless specifically waived in writing by the BTR, as described in Section 43 40 02, Fiberglass Reinforced Plastic Tanks.

2.8.1.2 Notify BTR two weeks prior to the estimated date of inspection.

2.8.1.3 Repairs authorized by the BTR shall be reinspected before final acceptance unless specifically waived.

2.8.2 Factory Test:

2.8.2.1 Perform a hydrostatic leak test on each PTAS tower by filling tower to the overflow nozzle with water and allowing tower to stand for 2 hours. Tower shall show no evidence of any leakage or any notable deformation of the tank wall or bottom during the course of the test.

2.8.2.2 Furnish advance written notice of test to BTR.

2.8.3 Exhaust Fan: Submit certified report of the noise level test for each unit to the BTR. Test reports of essentially duplicate equipment may be submitted for approval in lieu of test on the actual equipment being furnished, if approved by the BTR. Include:

2.8.3.1 Adequate information to show conformance with AMCA 300 standard test procedures.

2.8.3.2 Average sound pressure levels from the equipment surfaces at the octave band center frequencies as defined in ASA S1.6 acoustical terminology.
3 EXECUTION

3.1 Site and Utilities

3.1.1 The PTAS towers, Exhaust Fan and Dehumidification heater will be located outside. Piping and ductwork to and from the PTAS system will be provided by the Construction Contractor. Site preparation, utility service, and installation are not the responsibility of the Contractor and will be the responsibility of the Construction Contractor.

3.1.2 Electric: 460-volt, three-phase electrical service will be supplied and installed by the Construction Contractor.

3.2 Installation

3.2.1 The PTAS Systems will be installed by the Construction Contractor in conformance with the Manufacturer's written instructions, as accepted by the BTR. A factory representative shall inspect the installation after completion of installation and shall make all necessary adjustments to the equipment for satisfactory operation.

3.2.2 The Manufacturer shall submit to the Buyer complete installation instructions including initial startup instructions at least 60 days prior to shipping.

3.2.3 Finished surfaces of all exposed equipment openings shall be protected. Finished iron or steel surfaces not painted or coated shall be properly protected to prevent rust and corrosion.

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

3.2.5 All piping, appurtenances, and instruments that are specified herein as part of the skid-mounted system shall be installed by the Contractor. System shall be provided with specific piping connection points at the limits of the skid for connection of facility piping by the Contractor as specified herein.

3.3 Field Finishing

3.3.1 All possible painting and coating shall be performed at the shop. See SGW-54024 09 90 00, Painting and Coating, for any field finishing.

3.3.2 FRP Tower: May be shipped in one or more pieces and field erected to final height.
3.4 Field Test, Inspection and Start-Up

3.4.1 Functional Tests: Performed in accordance with Manufacturer’s approved Quality Assurance Inspection Plan by Construction Contractor with oversight provided by Contractor.

3.4.1.1 Fan Vibration Test:

3.4.1.1.1 Take measurements at every bearing housing using IRD or General Radio calibrated electronic analyzer.

3.4.1.1.2 Prepare record log, including location identification and peak-to-peak displacement in a direction parallel to the shaft in a horizontal position and in a direction perpendicular to the shaft in both horizontal and vertical planes.

3.4.1.1.3 Air balance the equipment and retest if peak-to-peak amplitude exceeds the following limits. Methods of air balancing shall be in accordance with ASTM D4167, or as approved by the BTR.

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<thead>
<tr>
<th>Rotation Speed (rpm)</th>
<th>Vibration Amplitude (mils)</th>
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<tbody>
<tr>
<td>300 to 600</td>
<td>2.5</td>
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<tr>
<td>600 to 900</td>
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<tr>
<td>Above 3,000</td>
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</tbody>
</table>

3.5 Manufacturer’s Services

3.5.1 In accordance with Section 01 43 33.LLE, Manufacturers’ Field Services.

3.5.2 Manufacturer’s Representative: Present at site or classroom designated by Buyer for minimum person-days listed below. All training shall not commence until an accepted lesson plan for each session has been reviewed by the Buyer.

3.5.2.1 8 person-days for installation assistance and inspection.
3.5.2.2 5 person-days for facility startup.
3.5.2.3 5 person-days for functional and performance testing.
3.5.2.4 1 person-day for pre-start classroom and field training.
3.5.2.5 1 person-day for post-startup training of Buyer’s personnel.
3.6 Supplements

3.6.1 The supplements listed below, following “End of Section,” are a part of this Specification.

3.6.1.1 Exhaust Fan Data Sheet
3.6.1.2 Attachment A – Intake Filter Assembly Detail
3.6.1.3 Attachment B – Air Stripper Isometric View
3.6.1.4 Attachment C – Air Stripper Tank Section
3.6.1.5 Attachment D – H-2-833544, shts. 25A-D, 26A
EXHAUST FAN DATA SHEET

Fan Design

<table>
<thead>
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</tbody>
</table>

Operating Conditions

<table>
<thead>
<tr>
<th>Volume Flow Rate:</th>
<th>7,000 CFM</th>
<th>Fan RPM:</th>
<th>2470 rpm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fan Static Pressure:</td>
<td>20.0 in WG</td>
<td>Fan Input Power:</td>
<td>38.1 BHP</td>
</tr>
<tr>
<td>Outlet Velocity:</td>
<td>5785 ft/min</td>
<td>Fan Motor Size</td>
<td>50 HP</td>
</tr>
<tr>
<td>Altitude (above mean sea level):</td>
<td>1,000 ft</td>
<td>Operating Temperature:</td>
<td>60 Deg F</td>
</tr>
<tr>
<td>Static Efficiency:</td>
<td>57.72%</td>
<td>Mechanical Efficiency:</td>
<td>63.65%</td>
</tr>
<tr>
<td>Maximum Operating Temperature:</td>
<td>125 Deg F</td>
<td>Maximum Safe RPM:</td>
<td>2825 rpm</td>
</tr>
</tbody>
</table>

Notes:
1. All materials in contact with the air stream shall be 316 Stainless Steel.
2. Motor shall be 480V/3 inverter duty in a TEFC enclosure at 1750 RPM.
3. Entire fan/motor assembly shall be suitable for outdoor ground mounting.
4. Acoustical blanket for blower shall be suitable for approximately minimum 18 DB reduction across all octave bands.

Fan Basis of Design

Manufacturer: New York Blower
Model: Series 30 general Industrial
Size: 264
Wheel Type: LS
Attachments

- Attachment A – Intake Filter Assembly Detail
- Attachment B – Air Stripper Tank Isometric View
- Attachment C – Air Stripper Tank Section
- Attachment D – H-2-833544, shts. 25A-D, 26A