

SECTION 13 1505 – WATER FEATURE OZONE GENERATION AND INJECTION

PART 1 - GENERAL**1.1 SUMMARY**

- A. This section includes the following:
 - 1. Ozone Generation Systems including Safety Interlocks and Controls
 - 2. Air Preparation and Oxygen Concentration Systems
 - 3. Ozone Injection and Contacting Systems
 - 4. Ozone Degassing and Destruct Systems
 - 5. Ambient Ozone Monitoring and Alarms
- B. Related Sections:
 - 1. SECTION 13 1401 – WATER FEATURE PIPE AND FITTINGS
 - 2. SECTION 13 1403 – WATER FEATURE PIPE HANGERS, SUPPORTS, AND ANCHORS
 - 3. SECTION 13 1501 – WATER FEATURE MECHANICAL IDENTIFICATION
 - 4. SECTION 13 1502 – WATER FEATURE PUMPS AND MOTORS
 - 5. SECTION 13 1503 – WATER FEATURE FILTERS
 - 6. SECTION 13 1504 – WATER FEATURE CHEMICAL FEED SYSTEMS
 - 7. SECTION 13 1506 – WATER FEATURE UV STERILIZERS
 - 8. SECTION 13 1507 – WATER FEATURE HEATERS
 - 9. SECTION 13 1508 – WATER FEATURE HYDRONIC SYSTEMS
 - 10. SECTION 13 1509 – WATER FEATURE CHILLERS
 - 11. SECTION 13 1510 – WATER FEATURE HEAT EXCHANGERS
 - 12. SECTION 13 1511 – WATER FEATURE VALVES, GAUGES, AND METERS
 - 13. SECTION 13 1602 – WATER FEATURE CONTROLS
 - 14. SECTION 13 1607 – WATER FEATURE PROGRAMMABLE LOGIC CONTROLLERS

1.2 SUBMITTALS FOR REVIEW

- A. SECTION 01 3300 – SUBMITTAL PROCEDURES
- B. Product Data: Submit manufacturer's literature including printed recommendations, dimensions and sizes for Ozone Generator, Air Preparation System, Injection and Contacting Components, Degas Valves, Destruct Units, Ambient Monitor, and accessories.
 - 1. Indicate on each submittal which materials, models, data, and options are being selected.
- C. Manufacturer's Certification: Submit documentation from the Manufacturer certifying that the Ozone System, including all components, conform with the National Sanitation Foundation (NSF) Standard 50 guidelines.
- D. Operation and Maintenance Data: Provide the Manufacturer's installation instructions, specifications, start-up procedures, assembly drawings, troubleshooting checklists, schedule maintenance recommendations, and replacement part lists and repair data.
- E. Warranty: Submit manufacturer's warranty and ensure forms have been completed in the owner's name and registered with the manufacturer.

1.3 DELIVERY, STORAGE, AND HANDLING

- A. Coordinate delivery with installation time to assure minimum holding time.
- B. Accept Ozone Generator, Air Preparation System, Injection and Contacting System, Degas and Destruct Units, and Monitors and accessories on site in original factory packaging. Immediately upon receipt of shipment, inspect and check for damage.

- C. Protect Ozone Generator, Air Preparation System, Injection and Contacting System, Degas and Destruct Units, and Monitors and accessories from physical damage including effects of weather, water, and construction debris.

PART 2 - PRODUCTS

2.1 Overall Ozone System

- A. Manufacturers
 - 1. Ozone Water Systems
 - 2. CMP DEL Ozone
 - 3. Atavis (Cal Coast Tek)Pinnacle Ozone Solutions, LLC
- B. An Ozone System shall consist of a modular package incorporating the following components:
 - 1. Ozone Generator
 - 2. Air Preparation Components
 - a. Oxygen Concentrator
 - b. Air Compressor
 - 3. Injector and Bypass Assembly
 - 4. Mixing/Reaction/Degassing Tank
 - 5. Degas Valve
 - 6. Off-gas Destruct Unit
 - 7. Ambient Ozone Monitor
 - 8. Ambient Ozone Alarm Strobe Light
- C. Materials:
 - 1. Valves and Fittings for the purpose of ozone gas conveyance shall be Type 316L Stainless Steel.
 - 2. Tubing and pipe for ozone gas conveyance shall be Type 316L Stainless Steel or Teflon™.
 - 3. Seals, gaskets, O Rings, etc. for ozone gas conveyance to be Teflon™ or Aflas™.
 - 4. All exposed hardware and fasteners to be 316L Stainless Steel.
- D. The System shall provide for complete ozone isolation during shutdown.
- E. The Ozone Generator and components shall be NSF Standard 50 listed for safety and performance standards.

2.2 OZONE GENERATOR

- A. The Ozone Generator shall be of the corona discharge type, producing ozone at high concentrations (greater than 5.0-percent by weight) to provide efficiency of operation and enhance mass transfer to the process water. No Ultraviolet (UV) ozone generation systems will be allowed.
- B. Ozone shall be generated and maintained under vacuum until the point of injection into the process water and is to always be kept under vacuum.
 - 1. Pressurized ozone systems will not be allowed.
 - 2. Partial loss of vacuum shall be compensated for by automatic feed gas flow reduction.
 - 3. Critical vacuum loss shall cause a system fault and initiate system shutdown.
- C. Generator module shall be all 316L Stainless Steel, glass, and ceramic construction. No Generators utilizing combustible materials or ozone affected materials shall be allowed.
- D. Each Ozone Generator module shall be water cooled, utilizing a vertical tube in shell cooling design.
- E. Electrodes shall be gas filled glass tubes providing individualized fusing for power supply protection.
- F. Ozone Generator shall permit variable production within a range of 0- to 100-percent of rated output.

- G. Power requirements of the ozone generation (not including oxygen system) shall not exceed 20.0 Watts per gram of ozone produced per hour.
- H. Ozone Generator shall be controlled by an internal Programmable Logic Controller (PLC), to automatically control start-up and shutdown sequencing, fault protections, ORP control, oxygen concentrator feed gas operation, and remote start/stop.
- I. The generator shall be capable of continuous operation for one (1) year with no major cleaning or disassembly.

2.3 CONTROLS AND SAFETY INTERLOCKS

- A. All control circuitries shall be powered by a Class B low voltage power supply or GFCI protected and powered through an isolating step-down transformer.
- B. Each Ozone Generator shall be furnished as a package which shall include the following safety controls fully interlocked through the PLC:
 - 1. Door safety switch(s)
 - 2. External emergency shutoff button
 - 3. Loss of Vacuum
 - 4. Low Feed Gas Pressure
 - 5. Low Oxygen Concentration
 - 6. Water Backflow Detection
 - 7. Thermal protection on high voltage transformer and generator module
 - 8. Standby Mode control function
 - 9. Phase Loss Detection/Protection
- C. Each Ozone Generator shall be further furnished with the following external/remote control and monitoring circuitry interfaced through the PLC:
 - 1. Ambient Ozone Monitor interlocked to the Ozone Generator shutdown and an Alarm
 - 2. System ON/OFF
 - 3. Emergency Stop
 - 4. System Fault Alarm Conditions
 - 5. Normal System Operation indications
- D. The PLC shall use low voltage DC circuitry for all sensor inputs.
- E. The PLC shall store run time, settings, and historic information on system events in non-volatile memory for retrieval by service personnel for diagnostic and troubleshooting purposes.
- F. The PLC shall display text messages or diagnostic indicators controlled by the PLC indicating the cause of any fault event such as: Water Backflow, Door Open, Overheating, Low Feed Gas Pressure, Loss of Vacuum, etc.
- G. Each Ozone Generator shall be provided with circuitry to permit deactivation from either the local control panel or from a remote location.
- H. Each Ozone Generator shall provide input circuitry for connection of a remote monitoring/alarm equipment and output circuitry to indicate normal operation and abnormal system fault conditions to an external monitoring system.
- I. Water backflow protection shall be provided within the Ozone Generator enclosure. The device shall be interlocked with the Ozone Generator's PLC initiating system fault shutdown and isolating the Generator to prevent damage by water ingress to the generator module.

2.4 AIR PREPARATION COMPONENTS

- A. Oxygen Concentrator

1. Oxygen Concentrator(s) shall be incorporated to automatically supply low pressure, 0-15 psig (0-103 kPa), oxygen rich feed gas to the Ozone Generator(s) at the required flow rate.
 2. Oxygen Concentrators shall be capable of supplying oxygen, at the rated flow rate (or higher), to the Ozone Generator(s) at a minimum of 85-percent purity and less than -60 °C dew point.
 3. Approved Manufacturer for external Oxygen Concentrators: AirSep Corporation.
- B. Air Compressor
1. Low output systems shall incorporate small oil-less compressor(s) housed within the Ozone Generator enclosure to supply each modular Oxygen Concentrator(s) housed within the same enclosure.
 2. The Air Compressor packages for larger systems requiring external Air Preparation components shall include the following:
 - a. Air Compressor, rotary screw type, sized for 130-percent or more of the required feed of the Oxygen Concentrator.
 - b. Post Chiller.
 - c. Refrigerated Air Dryer.
 - d. Air Receiver Tank with over-pressure protection and an automatic condensate drain valve.
 - e. Filtration to remove oil, oil vapor, and any particulates larger than 0.1 micron.
 - f. Condensate management system for separation and disposal of compressor oil carryover.
 3. Approved Manufacturer for external Air Compressors: Kaesar Compressors or approved equal.
- 2.5 INJECTION SYSTEM AND BYPASS
- A. Introduction of ozone to the process water shall be via side-stream method incorporating venturi driven suction.
 - B. Approved Manufacturer: Mazzei Injector Corporation.
 - C. Venturi Injector shall be manufactured of Kynar™ for resistance to oxidation by ozone.
 - D. Venturi Injector(s) shall be sized to provide a total suction rate 1.3 to 1.5 times the total rate of ozone gas flow from the Ozone Generator(s) to develop the necessary negative pressure within the Generator and ozone conveyance lines.
 - E. Venturi Injector(s) shall further be sized with a liquid to gas ratio (V_L/V_G) of 0.05 or less and an outlet pressure of at least 15 psi (103 kPa) to assure efficient mass transfer.
 - F. Each Venturi Injector shall be furnished with stainless steel fittings to adapt to ozone conveyance tubing and will include a stainless-steel ball valve and check valve with appropriate seal materials as described in 2.1.C.
- 2.6 MIXING/CONTACT/DEGASSING TANK
- A. The Contact Vessel shall be constructed of fiberglass reinforced plastic (FRP) with ozone resistant epoxy-based vinyl ester resin interior coat.
 - B. The Vessel must be NSF 50 listed.
 - C. The Vessel must be rated for 50 psi (344 kPa) minimum working pressure.
 - D. The Vessel shall be vertically mounted.
 - E. Internal baffles shall be incorporated to eliminate short circuit flow through the Vessel.
 - F. Plumbing Connections: Inlet and Outlet fittings shall be sized as shown on the Contract Documents or to limit flow velocity to less than 6-feet per second (1.83 m/s).
 - G. A Degas fitting shall be incorporated in the top of the Vessel for connection to the Degas Valve.

H. Vessel drain fitting shall be 1-1/2- to 2-inches (40 to 50mm) minimum and be fitted with a ball valve accessible for maintenance.

I. All fastening hardware on flanges, man ways, and viewing port shall be 316L Stainless Steel.

2.7 OZONE DEGAS VALVE

A. A Degas Valve shall be incorporated and fitted to the top of the Contact Tank for the purpose of automatically venting of undissolved, ozone-containing gases from the tank and directing them to the Ozone Destruct Unit.

B. The Degas Valve body shall be constructed of PVC and ozone resistant materials used for valve seat, float, and mechanism.

C. All fastening hardware shall be 316L Stainless Steel.

2.8 CATALYTIC OZONE DESTRUCT UNIT

A. The Ozone Destruct Unit shall incorporate a preheated dry bed catalyst to remove greater than 99.5-percent of the ozone content from the off-gas.

B. Low power heater shall be incorporated to preheat saturated off-gas to above the dewpoint to prevent condensation, protecting the metal oxide catalyst bed from moisture contamination.

C. The Destruct Unit shall be constructed of 304 or 316 stainless steel with inlet fitting appropriate for connection to the Degas Valve.

D. The Destruct Unit shall be sized to handle the full ozone production capacity of the system.

E. The Destruct Unit shall incorporate minor demisting capability and automatic drain valve for condensate build-up.

F. All fastening hardware shall be 316L Stainless Steel.

2.9 AMBIENT OZONE MONITOR

A. Shall measure the level of ozone present in the room housing the ozone equipment and shall shutdown the Ozone Generator when the ozone level exceeds a warning level of 0.1 ppm and a high alarm of 0.3 ppm.

B. The Monitor shall have a range of 0-10 ppm by volume with an accuracy within 3-percent of actual.

C. The Monitor shall employ an electrochemical gas diffusion sensor requiring no expendable reagents.

2.10 AMBIENT OZONE ALARM INDICATOR STROBE LIGHT

A. Manufacturer: Edwards, N. 49R-N5 or approved equal

B. Strobe Color: Red

C. Nominal VA Rating: 25 Watts

D. Voltage: 120 VAC, 0.22 Amps

E. Mounting: Standard 4-inch (100mm) octagon (indoor only) electrical box.

F. Alarm strobe shall illuminate on activation of Ambient Ozone Alarm and shall remain on until reset at the Ambient Ozone Monitor.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine surfaces, substrates, and conditions for compliance with requirements of other sections that relate to the Work specified. Determine if surfaces, substrates, and conditions affecting the performance of the Work of this section are satisfactory. Do not proceed with the Work of this section

until unsatisfactory conditions have been corrected in a manner acceptable to the Installer. Starting installation constitutes acceptance of surfaces, substrates, and conditions.

- B. Each system shall be capable of fitting into the space shown on the Contract Documents.
- C. The Manufacturer shall supply a standard installation kit, which includes any necessary accessories and fittings for installation.
- D. Provide complete installation instructions, and operations and maintenance manual with troubleshooting guide for each system.

3.2 INSTALLATION

- A. The entire system shall be designed and installed to meet all applicable State and local codes.
- B. Nationally recognized standards, as applicable, shall be adhered to.
- C. Equipment enclosure shall be firmly attached to the flooring by lagging it into the concrete slab or housekeeping pad through holes provided according to instructions provided by the Manufacturer.
- D. Install the Ozone Generator according to instructions provided by the Manufacturer.
- E. All equipment, piping, meters, and appurtenances shall be to the Manufacturer's specification.
- F. Leave sufficient space between equipment and pipes to allow for maintenance, replacement, and inspection.
- G. Valves, pipe labels, meters, and displays must be visible and have sufficient space to access, if applicable.
- H. Install ORP probe and controller as specified by the Manufacturer.
- I. The Ozone Destruct Unit shall be installed at an elevation that is higher than the Degas Valve to prevent the possible flow of water into the Ozone Destruct Unit.
- J. All Installer supplied fasteners and hardware shall be 316L Stainless Steel.

3.3 FIELD OPERATION AND START-UP

- A. In the event of remote or local start, the Ozone Generator shall first be purged with dry oxygen from the feed gas system, then ramp up voltage to determined levels.
- B. In the event of remote or local stop including reaching high ORP the Generator will initiate shutdown and purge with dry oxygen from the feed gas system before complete shutdown and isolation.
- C. Upon any system fault the Generator shall automatically and immediately cease ozone production and purge with dry oxygen from the feed gas system before complete shutdown and isolation. Manual acknowledgement and re-start shall be required.
- D. A factory trained representative shall be on site for start-up of the system and training of operation personnel.

END OF SECTION