SECTION 23 53 16 – DEAERATRORS

SPRAY DEAERATOR & SURGE TANK COMBONATION (Piggy Back)

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Feedwater Spray Deaerator
   2. Spray Deaerator trim
   3. Surge Tank
   4. Surge Tank Trim
   5. Controls

1.2 REFERENCES

A. American Society of Mechanical Engineers (ASME):
   1. BPVC Section VIII-Rules for Construction of Pressure Vessels Division 1
   2. B31.1 - Power Piping

B. National Electrical Manufacturers Association (NEMA)
   1. NEMA 250 - Enclosures for Electrical Equipment

C. Occupational Safety and Health Administration (OSHA)
   1. Fixed Ladders – 1917.118
   2. Guardrails – 1910.23

1.3 SUBMITTALS

A. Submittals shall include:

1. Product Data: Full product description including all accessories and control settings.
2. Drawings: Submit general arrangement drawing; including dimensions, weights and ratings, wiring diagrams, and all other shop related drawings.
3. Include materials of construction of major pressure vessel parts and fittings.
4. Controls Cutsheet: Submit complete set of cutsheets for trims and controls.
5. Rigging instruction: Submit detailed instructions on manufacturers recommended lifting and unloading procedures.
6. Warranty: Submit standard form equipment warranty.

B. Closeout Submittals:

1. Operation and Maintenance Data: Submit manufacturer's descriptive literature, operating instructions, cleaning procedures, recommended spare parts list, and maintenance and repair information.
2. Manufacturer's Installation Instructions: Submit assembly, support details, connection requirements, and include start-up instructions.
3. Test Reports: Indicate deaerator meets or exceed specified performance and efficiency.
4. ASME Data Reports: Submit code paperwork required for field acceptance.

1.4 QUALITY ASSURANCE

A. The packaged surge tank and spray deaerator (SSD) must receive factory tests to check the construction, controls, and operation of the unit.
B. Allow witnessing of factory inspections and tests at manufacturer’s test facility

1.5 DELIVERY, STORAGE, AND HANDLING

A. Cover all openings, leave drain valves in open position, wrap electronics in plastic.
B. Off load the SSD in accordance with rigging instructions.

1.6 WARRANTY

A. All equipment is to be guaranteed against defects in workmanship and materials for a period of 12 months from date the equipment is first placed in use, or 18 months from date of completion; whichever shall be less.
B. 5-year extended warranty for major pressure vessel components.

PART 2 – PRODUCTS

2.1 FEEDWATER SPRAY DEAERATOR

A. Manufacturers:
    1. Superior Boiler Works

B. Type: The deaerator shall be of the atomizing spray type using a constant high velocity steam jet for complete deaeration. The atomizing valve shall be of the variable orifice type which is self-compensating to changes in load or variations in operating conditions. A reboiler or fixed orifice type atomizer is not acceptable. Single compartment spray type with feedwater pumps and controls. The deaerator shall be mounted above the surge tank using a steel frame structure secured to the

floor. The pumps shall be located directly under the deaerator and beneath the surge tank.

C. Performance: The deaerator shall heat, deaerate and deliver up to _____ pounds per hour and provide _____ (minutes) (pounds) of storage capacity below the overflow level. The deaerator shall operate satisfactorily and quietly at all loads up to its rated capacity and shall be guaranteed to heat water to saturation temperature of the steam in the heater shell and to deliver the water with an oxygen content not exceeding (0.005) (0.03) cc/liter.

D. Capacities and Characteristics:
   1. Capacity: Capable of raising temperature of condensate and makeup water to within 3 degrees F of saturated steam temperature.
   2. Minimum Working Pressure: 50 psig.

E. Construction:
   1. Codes: Comply with ASME BPVC Section VIII, and all other applicable sections of the current edition of the ASME code.
   2. Shell and Head Thickness: SA516-70, minimum 3/8" thick with 0.125" corrosion allowance minimum. Deaerator shall be stamped 50 psig per ASME section VIII at 400 degrees Fahrenheit.
   3. Material for Wetted Components: Components in contact with water that has not been deaerated shall be stainless steel.
   4. Factory-Applied Insulation and Jacket: Minimum thickness of 2 inches for mineral-fiber pipe and tank insulation. Cover insulation with preformed and removable sections of painted steel jacket to uniformly follow the contour of the tank. Jacket nominal thickness is not less than 0.030 inch.
   5. Manway: Deaerator shall have a 12" by 16" elliptical manway in storage tank, located below the normal water level, but near the tank centerline, and away from the deaeration section or internal piping. Manway location must allow

unrestricted access to tank interior with no interference from internal equipment and piping and with easy access from outside the tank. Manway shall be on same side as the surge tank manway.

6. Support: Steel saddles or legs welded to storage tank with minimum height to provide for the net positive suction head required of the pumps selected. Coordinate location with structural design of building. Support structure for deaerator shall be an integrate part of the support structure for the surge tank.
7. Nameplates: Attach to bracket projecting beyond field-applied insulation. Provide all ASME pressure vessel nameplate information as required by the Code along with information identifying the designer and manufacturer of the storage tank and the deaeration section.
8. Shell Piping and Connections:
   a. Threaded for sizes under 2 inches.
   b. Flanged, 150 psig ASME, for sizes 2 inches and above.
9. Rigging and Jacking: The deaerator is to be equipped with two lifting eyes, located on the top center line. Provisions for jacking. Jacking locations shall be clearly marked.

F. Factory Inspection and Certification: Inspect the completed deaerator assembly in accordance with the requirements of the ASME BPVC Section VIII. The deaerator inspection shall be certified.

G. Finish: The entire deaerator is to be painted with a high temperature, 400 degrees Fahrenheit minimum, silicone-based enamel.

2.2 DEAERATOR TRIM (ACCESSORIES)

A. The deaerator is to be fully trimmed by the manufacturer including the following:

1. Safety Valve(s): ASME labeled and sized to relieve full capacity of pressure-reducing valve.
2. Companion flanges.
3. Lifting eyes.
4. Pump suction piping with vortex breaker, isolation valve, strainer, and flexible connector.
5. Pump discharge piping with check valve, isolation valve, and liquid-filled pressure gauge graduated in pounds force per square inch.
6. Pump-discharge bypass relief valve with orifice plate sized to provide continuous pump operation with boiler feedwater valve closed.
7. Tank Overflow Drain: Sized to relieve full capacity at operating pressure.
8. Tank Overflow Drainer: Float-type trap, sized to relieve full capacity at operating pressure, with steel housing and stainless-steel float ball.
9. Drum level transmitter with PID loop control mounted to the vessel and wired to work seamlessly with the pneumatic makeup water valve.
10. Makeup Water: Pneumatic, modulating valve for field mounting with water-level controller factory mounted on tank. Provide three-valve bypass and inlet strainer with blowdown valve for field mounting, include a ½" NPT connection upstream and downstream and provide gauges to measure pressure before and after. Equip strainer with a drain to remove pressure for servicing.
11. Alarms: High-water-level alarm switch, low-water-level alarm switch, low water cut-off and one alarm bell with silence switch.
12. Vents: Manual and automatic vent valves.
    a. Automatic air vents shall be thermostatically controlled to provide a fast means of venting when a sudden buildup of gas occurs.
    b. Manual air vents shall have an orifice to provide continuous venting at a rate of up to 0.1 percent of rated deaerator capacity at operating pressure indicated.
13. Pressure Reducing Valve: A self-contained pilot operated valve shall be supplied to reduce the available steam pressure to the operating pressure of the deaerator. The valve to be shipped loose for field installation.

14. Meters and Gauges: Full-height, Gems Mini Suresite® or similar stainless-steel float column with plastic flags. Liquid-filled thermometer and pressure gauge graduated in pounds' force per square inch accurate to 1% or better.
    a. Gauges shall be panel mounted easily readable by operator standing at grade adjacent to unit.
15. Alarms: High-water-level alarm switch, low-water-level alarm switch, low water cut-off and one alarm bell with silence switch.
16. Vacuum Breaker: Sized by deaerator manufacturer to protect unit. Bronze body construction with bronze internal trim, chemical resistant silicone seat disc and an atmospheric vent, rated for 150 psig.
17. Provision for chemical injection quill.
18. Sample valve for sample cooler piping connection.

B. Pump(s): Two or more stages, centrifugal diffuser type, direct-coupled, vertical shaft, in-line, base-mounted, motor-driven.
    1. A total of ___ boiler feed pumps shall be furnished. Pump to be electric motor driven and to have a capacity of _____ gpm with a discharge pressure of psig.
    2. Motors shall be non-overloading type of sufficient horsepower, drip proof, suitable for operation on 3 phase, 60 cycle, _____ volts, AC. Sealing and/or cooling water shall be provided in accordance with pump manufacturer's recommendations.
    3. Pump size shall be based on pump schedule and be able to pump into the boiler at least 3% above the boiler relief valve setting to satisfy the ASME code.

C. Platform and Ladder: If required, provide OSHA approved handrails, guardrails, platforms, and ladders for inspection and maintenance of the tank.

2.3 SURGE TANK

A. Manufacturers:
    1. Superior Boiler Works

B. Type: The surge tank shall be of atmospheric design and be able to accept all condensate returns from the entire steam system including gravity returns, pumped returns, and high pressure returns from steam traps if necessary. All returns to the surge tank shall be identified and discussed with the manufacturer to accommodate the system.

C. Construction:
   10. Material: Welded carbon steel.
   11. Factory-Applied Insulation and Jacket: Minimum thickness of 2 inches for mineral-fiber pipe and tank insulation. Cover insulation with preformed and removable sections of painted steel jacket to uniformly follow the contour of the tank. Jacket nominal thickness is not less than 0.030 inch.
   12. Manway: Surge tank shall have a 12" by 16" elliptical manway in storage tank, located below the normal water level, but near the tank centerline, and away from internal piping. Manway location must allow unrestricted access to tank interior with no interference from internal equipment and piping and with easy access from outside the tank.
   13. Support: Steel saddles or legs welded to storage tank with minimum height to provide for the net positive suction head required of the pumps selected. Coordinate location with structural design of building.
   14. Rigging and Jacking: The surge tank is to be equipped with two lifting eyes, located on the top center line. Provisions for jacking. Jacking locations shall be clearly marked.

D. Finish: The entire surge tank is to be painted with a high temperature, 400 degrees Fahrenheit minimum, silicone-based enamel.

2.4 SURGE TANK TRIM (ACCESSORIES)

A. The surge tank is to be fully trimmed by the manufacturer including the following:
   1. Companion flanges.
   2. Lifting eyes.
   3. Pump suction piping with isolation valve, strainer, and flexible connector.
   4. Pump discharge piping with check valve, isolation valve, and liquid-filled pressure gauge graduated in pounds force per square inch.
   5. Pump-discharge bypass relief valve with orifice plate sized to provide continuous pump operation with boiler feedwater valve closed.
   6. Tank Overflow Drain: Sized to relieve full capacity at operating pressure.
   7. Drum level transmitter with PID loop control mounted to the vessel and wired to work seamlessly with the pneumatic makeup water valve.
   8. Makeup Water: Pneumatic, modulating valve for field mounting with water-level controller factory mounted on tank. Provide three-valve bypass and inlet strainer with blowdown valve for field mounting, include a ½" NPT connection upstream and downstream and provide gauges to measure pressure before and after. Equip strainer with a drain to remove pressure for servicing.
   9. Alarms: High-water-level alarm switch, low-water-level alarm switch, low water cut-off and one alarm bell with silence switch.
   10. Meters and Gauges: Full-height, Gems Mini Suresite® or similar stainless-steel float column with plastic flags. Liquid-filled thermometer and pressure gauge graduated in pounds' force per square inch accurate to 1% or better.
       a. Gauges shall be panel mounted easily readable by operator standing at grade adjacent to unit.
   11. Alarms: High-water-level alarm switch, low-water-level alarm switch, low water cut-off and one alarm bell with silence switch.
   12. Provision for chemical injection quill.
   13. Vent: connection for vent shall be on top centerline of the receiver.

B. Pump(s): Two or more stages, centrifugal diffuser type, direct-coupled, vertical shaft, in-line, base-mounted, motor-driven.

1. A total of ___ transfer pumps shall be furnished. Pump to be electric motor driven and to have a capacity of _____ gpm with a discharge pressure of _____ psig.
2. Motors shall be non-overloading type of sufficient horsepower, drip proof, suitable for operation on 3 phase, 60 cycle, _____ volts, AC. Sealing and/or cooling water shall be provided in accordance with pump manufacturer's recommendations.
3. Pump size shall be based on pump schedule.

C. Platform and Ladder: If required, provide OSHA approved handrails, guardrails, platforms, and ladders for inspection and maintenance of the tank.

2.3 CONTROLS

A. The major components of the SSD control system shall consist of:

1. Programmable Logic Controller (PLC).
2. 6", 10", 12" or 15" Touchscreen operator interface.
3. 24 VDC power supply.
4. Individual pump current switches.
5. Pressure sensors, differential pressure transducers, and temperature sensors.
6. Single loop PID controllers for water level and/or pressure control.
7. FieldServer ProtoNode protocol translator shall translate Modbus TCP/IP to BACnet MS/TP, LonWorks, or Johnson Metasys N2.

B. The SSD control system shall have the following functionality:

1. The system shall maintain an adjustable water level setpoint in the deaerator and surge tank.
2. The system shall maintain an adjustable deaerator tank pressure set point.
3. The system shall start and stop feedwater pumps based on the following:

a. An adjustable ON/OFF pressure setpoint, sensed via a transducer in the common feedwater header.
b. Feedwater pressure setpoint, sensed via a transducer in the common discharge header.
c. Feedwater control based on the main steam header pressure, and a setpoint offset between the main steam header pressure and feedwater header pressure.
d. Boiler start/stop command to feedwater pumps, one pump start per boiler.

4. The system shall provide appropriate information on functionality and status of all pumps by monitoring the following:
   a. Tank pressure.
   b. Temperature.
   c. Feedwater pump common header pressure.
   d. Current transformer switches.

C. The SSD control system shall have the following features:

1. Ability to maintain feedwater manifold pressure, based on an adjustable setpoint.
2. Ability to maintain deaerator and surge tank water level, based on an adjustable setpoint.
3. Ability to transfer water from condensate tank to deaerator, based on condensate water level.
4. Ability to monitor high, low, low/low water switch levels.
5. Ability to monitor pump status via current switches or differential pressure switches.
6. Ability to monitor the system and actuate alarms.
7. Ability to monitor and /or control deaerator steam pressure.
8. Ability to monitor deaerator water levels and perform PID water level control.
9. Ability to control pumps via motor starter or VSDs.
10. Touchscreen human machine interface (HMI).
11. Ability to externally add redundant deaerator water level control.
12. Display graphics representing job specific pump configurations.

13. Ability to display low and high-water level alarms off of the water level controller when low/high floats are not available.