SECTION 23 50 11
BOILER PLANT MECHANICAL EQUIPMENT

PART 1 - GENERAL

1.1 DESCRIPTION

Feedwater deaerator, condensate pumps, condensate storage tank, blowoff tank and other equipment that supports the operation of the boilers.

1.2 RELATED WORK

A. Section 09 91 00, PAINTING.

B. Section 23 05 11, COMMON WORK RESULTS FOR HVAC and STEAM GENERATION.

C. Section 23 05 51, NOISE and VIBRATION CONTROL FOR BOILER PLANT.

D. Section 23 07 11, HVAC, PLUMBING, and BOILER PLANT INSULATION.

E. Section 23 21 11, BOILER PLANT PIPING SYSTEMS.

F Section 23 08 11, DEMONSTRATIONS and TESTS FOR BOILER PLANT.

1.3 SUBMITTALS

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.

B. Condensate Storage Tank and Accessories:

1. Drawings showing arrangement and overall dimensions of tank and supports. Show locations and sizes of all pipe connections and access openings.
2. Weight of entire assembly empty and flooded.
3. Design and construction (including pressure and temperature limitations) of tank, continuous blowdown heat exchanger (if provided), control valves, water level control system, level alarm switches and all accessories.
4. Performance data on control valves and continuous blowdown heat exchanger (if provided). Refer to drawings (Schedules) for requirements.
5. Interior Coating: Material specification, service limitations, instructions for application, experience record under the required service conditions.

C. Blowoff Tank and Accessories, Flash Tank:

1. Drawing showing outline dimensions, arrangement and weight of tank and accessories. Locations and sizes of all pipe connections and access openings.
2. Design and construction of tank, supports and accessories.
3. Design and performance of blowoff tank temperature control valve.

D. Condensate Transfer Pumps:

1. Drawings with dimensions of assemblies of pumps and drivers.
2. Catalog data and specification sheets on design and construction of pumps, drivers and couplings (flexible-coupled units).
3. Motor efficiency and power factor at full load.

4. Performance curves showing discharge head, required flow plus recirculation, NPSH required, efficiency, driver power, impeller diameter to be furnished. Refer to drawings for requirements.
5. Pressure and temperature limitations of pump unit and accessories.
6. Size and capacity of recirculation orifice.

E. Condensate Return Pumps (Electrical and/or Mechanical Types) Units:
1. Drawings with dimensions of entire unit. Drawing shall include locations and sizes of all pipe connections.
2. Catalog data and specification sheets on design and construction of pumps, receiver and accessories.
3. Catalog cuts and schematic diagram of controls.
4. Electric pump performance curves showing discharge head, flow, NPSH required, efficiency, motor power and impeller diameter to be furnished. Mechanical pump performance showing discharge head, flow, required inlet head and steam pressure. Refer to drawings for requirements.
5. Pressure and temperature limitations of pump unit.

1.4 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.

B. American Society for Testing and Materials (ASTM):

A53/A53M-07.....Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

A106/A106M-08.....Standard Specification for Seamless Carbon Steel Pipe for High Temperature Service

A234/A234M-10.....Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service

A285/A285M-03(2007).....Standard Specification for Pressure Vessel Plates, Carbon Steel, Low- and Intermediate – Tensile Strength

A414/A414M-10.....Standard Specification for Steel, Sheet, Carbon, and High-Strength, Low-Alloy for Pressure Vessels

A515/A515M-03(2007).....Standard Specification for Pressure Vessel Plates, Carbon Steel, for Intermediate- and Higher-temperature Service

A516/A516M-06.....Standard Specification for Pressure Vessel Plates, Carbon Steel, for Moderate-and Lower-Temperature Service

C. American Society of Mechanical Engineers (ASME):
Boiler and Pressure Vessel Code: 2007 Edition with Amendments.
Section VIII.....Pressure Vessels, Division I and II. Performance Test Code:
PTC 12.3-1997.....Performance Test Code for Deaerators
B16.9-2007.....Factory-Made Wrought Butt Welding Fittings
B16.34-2009.....Valves, Flanged, Threaded and Welding End

D. National Board of Boiler and Pressure Vessel Inspectors:
NB-23-2007.....Inspection Code

E. American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE):
ASHRAE Handbook.....2008 HVAC Systems and Equipment

F. Society for Protective Coatings (SSPC):
SP 5-2007.....White Metal Blast Cleaning

F. Underwriters Laboratories (UL):
574-03.....Standard for Electric Oil Heaters

PART 2 - PRODUCTS

2.1 CONDENSATE STORAGE TANK AND ACCESSORIES

A. Horizontal cylindrical welded steel tank, including accessory equipment, suitable for rigging into the available space. Comply with overall dimensions and arrangement of the tank and accessories shown on contract drawings. Accessories include make-up water controls and control valves, thermometer, water level gage, and other devices as specified.

B. Service: Receiving and storing steam condensate and make-up water. Vent the tank to the atmosphere. Contents of tank may vary in temperature from 4 °C to 100 °C (40 °F to 212 °F).

C. Construction:

1. Construct tank and appurtenances in accordance with ASME Boiler and Pressure Vessel Code, Section VIII. Tank shall have cylindrical shell and dished heads.
2. Material of construction shall be carbon steel ASTM A285, A414, A515, or A516.
3. Design tank for 170 kPa (25 psi) working pressure with a minimum material thickness of 10 mm (3/8 inch). Thickness of head material at any point shall not vary more than 10 percent from the nominal thickness.
4. Tank joints shall be double-welded butt joints or single-welded butt joints with backing strips.
5. Provide 300 mm by 400 mm (12 inches by 16 inches) elliptical manway located as shown.

6. Provide nozzles for piping connections located as shown. Nozzles shall have threaded pipe connections for pipe sizes 50 mm (2 inches) and under, flanged connections for pipe sizes over 50 mm (2 inches). Flanged nozzles shall have 1025 kPa (150 psi) ASME flanges. Tank opening for pump suction pipes shall include vortex spoilers.
7. Furnish completed ASME Form U-1 or U-1A MANUFACTURERS' DATA REPORT FOR PRESSURE VESSELS. Hydrostatically test tank at 1-1/2 times the design pressure.
8. Horizontal tank shall be supported by steel saddles, supplied by the tank manufacturer, welded to tank and anchored to the concrete bases. Design saddles to support tank (full of water), accessories, and portions of connecting piping to first hanger.
9. Affix tank nameplate to bracket that projects beyond the field-applied tank insulation. Nameplate shall include ASME stamp and data to show compliance with design, construction and inspection requirements of the Code, and tank manufacturer information.

D. Provide overflow pipe inside tank with siphon breaker as shown.

E. Overflow and vent pipe sizing (minimums):

Boiler Plant Capacity* (kg/sec)	Boiler Plant Capacity* (klb/hr)	Overflow Pipe Size (mm)	Overflow Pipe Size (in)	Vent Pipe Size (mm)	Vent Pipe Size (in)
0 – 3.8	0 – 30	75	3	60	2.5
3.9 – 8.3	31 – 70	100	4	75	3
8.4 – 12.6	71 – 100	150	6	100	4

*"Boiler Plant Capacity" refers to one boiler on standby and all other boilers at high fire.

F. Cleaning and Painting: Remove all foreign material to bare metal from interior and exterior of tank. In preparation for interior coating, sandblast interior to white metal in accordance with SSPC-SP5. Coat exterior of tank with rust-resisting primer (See Section 09 91 00, PAINTING).

G. Interior Coating: Coat entire interior surface, including nozzles, with water-resistant epoxy polymerized with amine adduct-type curing agent. Coating shall be suitable for continuous service at 100 °C (212 °F) immersed in demineralized water and exposed to steam vapor. Surface preparation, application of coating, number of coats, and curing shall comply with printed instructions of coating manufacturer. Ingredients of coating shall comply with U.S. Food and Drug Regulations as listed under

Title 21, Chapter 1, 175.300. Coating shall be smooth, even thickness, with no voids. Holiday test at low voltage with wet sponge method and repair all holidays.

H. Insulation: Field apply insulation as specified in Section 23 07 11, HVAC, PLUMBING, and BOILER PLANT INSULATION.

I. Water Level Indicators:

1. Magnetic Float-Flag Type Water Level Gage:
   a. Tubular level gage with internal float using concentric magnet with stiffening rings. Float sequentially actuates magnetic flags to indicate water level. Flags anodized black on one side, gold on the other, with internal magnet.
   b. Flags magnetically interlocked with mechanical stops to allow only 180 degree rotation.
   c. Standpipe to be Schedule 40, Type 304 stainless steel.
   d. Process connections 1030 kPa (150 lb) weld neck flanges. Connections side type for maximum visibility.
   e. Bottom connection 100 mm (4 inch) flange with drain plug. Clearance between floor and bottom flange sufficient for removal of float.
   f. Switches for signals to be SPDT, 5 amp rating.
2. Vertical pipe type header shall be connected to top and bottom of storage tank with tank isolation valves and valved header drain. Viewable gages shall cover entire diameter of tank.
3. Minimum rating 120 degrees C, 200 kPa (250 degrees F, 30 psi).

J. High and Low Level Alarm Switches:

1. Low Level Alarm Switch: Integral unit consisting of float, float housing, hermetically sealed mercury switch. Locate external to tank on a vertical header with valved tank connections and valved drain. Switch elevation shall be 150 mm (6 inches) below the soft water make up level.
2. High Level Alarm Switch: Integral unit consisting of conductivity probes, probe housing. Float type not acceptable. Locate external to tank on a vertical header, along with the low level switch, with valved tank connections and valved drain. High level alarm indication shall occur 100 mm (4 inches) below the overflow level. Probes shall be AC, not DC, stainless steel with virgin Teflon insulation.
3. Provide signals to computer workstation specified in Section 23 09 11, INSTRUMENTATION AND CONTROL FOR BOILER PLANT.
4. All devices exposed to tank service conditions, including sensing devices and transmitters shall be rated for 120 degrees C, 200 kPa (250 degrees F, 30 psi) minimum.

K. Automatic Water Level Controls:

1. Separate pneumatic-type modulating water inlet flow control valves for normal soft water make-up and for emergency city water makeup. Actuated by electronic controller with input signals from water level transmitter. Manual/auto control capability.
2. Performance: Maintain a minimum water level, plus or minus 25 mm (1 inch), in the tank by controlling the flow of soft water to the tank. Soft water makeup shall be activated if water level falls to 30% of tank diameter plus 300 mm (12 inches). If water level falls to 30% of tank diameter, automatically operate the emergency city water makeup valve to bring the water level up 150 mm (6 inches).
3. Water Level Transmitter: Programmable electronics, sealed diaphragms, direct sensing electronics, no mechanical force or torque transfer devices, external span and zero adjustment.
4. Controller: Proportional plus reset control, adjustable proportional band, reset rate and level set points. Provide manual-automatic control station on main instrument panel. Control station shall indicate actual water level, soft water and emergency city water level set points and valve positions. Provide same indicating and control features on computer workstation specified in Section 23 09 11, INSTRUMENTATION AND CONTROL FOR BOILER PLANT. If new boiler combustion controls are furnished as part of this contract, the water level controller and transmitter shall be the same makes and models as furnished for the combustion controls.
5. Water Flow Control Valves:
   a. Pneumatically-actuated, globe style.
   b. Bronze or cast iron bodies, threaded ends for pipe sizes 50 mm (2 inches) and under rated at 1700 kPa (250 psi), ASME flanged ends for pipe sizes over 50 mm (2 inches) rated at 850 kPa (125 psi) or 1025 kPa (150 psi).
   c. Replaceable Type 316 stainless steel plugs and seats. RTFE seal for bubble-tight shut off. Linear flow characteristics.
   d. Flow pressure loss 35 kPa (5 psi) maximum at maximum flow rating. Unless otherwise shown, maximum flow rate shall be equivalent to 50% make-up rate with plant at maximum load (2 boilers at high fire).
   e. Diaphragm-type actuator, sized for 550 kPa (80 psi) air supply, fail closed spring pack, elastomers suitable for 120 degrees C (250 degrees F) continuous service.
   f. Electropneumatic positioner with 4 - 20 ma DC control input. Mounted integral with actuator. Digital positioner with

capability to self-calibrate. Maintenance diagnostic data retained in memory. Design for 120 degrees C (250 degrees F) continuous service.

g. Compressed Air Supply: Provide filter-regulator rated for flow of 150 percent of control valve requirement. Filter shall be two-stage coalescing color change type in transparent housing with automatic drain. Regulator shall be diaphragm operated, 15 percent maximum proportional band, composition diaphragm and seats.

2.2 BOILER BLOWOFF TANK AND ACCESSORIES

A. Type: Cylindrical welded steel tank mounted vertically. Tank shall include accessory equipment and shall be suitable for rigging into the available space. Overall dimensions and arrangement of the tank and accessories shall conform to the drawings. Tank volume shall be twice the volume of a 100 mm (4 inch) blowoff (reduction in boiler water level) from the largest boiler connected to the tank.

B. Service: Suitable for receiving, venting, storing, cooling and discharging into the drain the effluent from the boilers resulting from the intermittent operation of the boiler bottom blowoffs, boiler accessory drains, and the use of continuous blowdowns.

C. Construction:

1. Construct tank and appurtenances in accordance with ASME Boiler and Pressure Vessel Code, Section VIII. Tank shall have cylindrical shell and dished heads.
2. Material of construction shall be carbon steel ASTM A285, A414, A515 or A516.
3. Design tank for 275 kPa (40 psi) working pressure; the minimum material thickness shall be 10 mm (3/8-inch). Thickness of head material at any point shall not vary more than 10 percent from the nominal thickness.
4. All tank joints shall be double-welded butt joints or single-welded butt joints with backing strips.
5. Provide 300 mm by 400 mm (12 inches by 16 inches) elliptical manhole located at the vertical centerline of the tank.
6. Provide 10 mm (3/8-inch) thick carbon steel wear plate welded to interior of tank adjacent to tangential blowoff inlet as shown.
7. Provide nozzles for piping connections and provide tangential blowoff inlet located above the normal water level. Tangential pipe for blowoff inlet shall be Schedule 80, ASTM A53 or A106, seamless steel pipe with beveled end for field-welding of blowoff from boilers. All other nozzles shall have threaded pipe connections for pipe sizes 50 mm (2 inches) and under, 1025 kPa (150 psi) ASME flanged connections

for pipe sizes over 50 mm (2 inches). Nozzle sizes listed below are based on "National Board" recommendations.

Pipe Connection Sizes, mm (inches)

Boiler Blowoff	Water Outlet	Vent
25(1)	25(1)	63(2.5)
32(1.25)	32(1.25)	80(3)
38(1.5)	38(1.5)	100(4)
50(2)	50(2)	130(5)
64(2.5)	64(2.5)	64(6)

8. Furnish completed ASME Form U-1 or U-1A MANUFACTURERS' DATA REPORT FOR PRESSURE VESSELS. Hydrostatically test tank at 1.3 times the design pressure.
9. Tank nameplate shall be affixed to bracket which projects beyond the tank insulation that will be applied in the field. Apply ASME data stamp to nameplate to show compliance with design, construction and inspection requirements of the Code.
10. Support tank by steel legs welded to shell of tank. Design saddles or legs to support tank (full of water), accessories, and portions of connecting piping to first hanger.

D. Cleaning and Painting: Remove all dirt, heavy rust, mill scale, oil, welding debris from interior and exterior of tank. Prime exterior of tank with rust-resisting paint (See Section 09 91 00, PAINTING).

E. Insulation: Field apply insulation as specified in Section 23 07 11, HVAC, PLUMBING, AND BOILER PLANT INSULATION.

F. Accessories:
1. Install red line type gage glasses with protecting rods. Provide off set type gage valves with ball-check feature to automatically prevent flow when glass is broken. Provide drain cock on lower gage valve. Glass shall be at least 300 mm (12 inches) long and centered at the overflow level.
2. Provide thermometer and pressure gage. Conform to Section 23 09 11, INSTRUMENTATION AND CONTROL FOR BOILER PLANT.
3. Water Outlet Temperature Control Valve:
   a. Type: Self-contained, reverse-acting thermal bulb-operated water flow control valve.
   b. Performance: Control valve shall operate automatically to control blowoff tank water outlet temperature to 60 °C (140 °F) maximum by regulating the flow of cold water which mixes with the blowoff

water and reduces the temperature of the blow-off water. Provide valve designed for modulating and tight shut-off service. Valve flow rates and pressure drops shall be as shown. Temperature control range shall be adjustable, 38 to 77 °C (100 to 170 °F) minimum.

c. Service: Provide valve designed to control the flow of city water with temperature 4 to 27 °C (40 to 80 °F), and pressure up to 690 kPa (100 psi). Thermal bulb will be inserted in blowoff tank outlet pipe and will be subjected to water temperatures up to 100 °C (212 °F).

d. Construction: Cast iron or bronze valve body designed for 850 kPa (125 psi) minimum WOG. Design of valve shall permit access to internal valve parts. Thermal bulb shall be separable socket type with well.

4. Provide blowoff water outlet pipe inside tank as shown to provide a water seal. Locate a 20 mm (3/4-inch) hole in top of this pipe inside tank to act as siphon breaker.

2.3 CENTRIFUGAL CONDENSATE TRANSFER PUMPS

A. Type: Centrifugal diffuser type, direct-coupled, vertical shaft, in-line, base-mounted, motor-driven, arranged as shown.

B. Service: Design pumps and accessories for continuous service, 116 °C (240 °F) water, with flow rates ranging from maximum scheduled on the drawings (plus manufacturer's recommended recirculation) to 10 percent of maximum (plus manufacturer's recommended recirculation). Pumps shall be suitable for parallel operation without surging or hunting.

C. Performance: Refer to schedules on drawings. Pump head-flow performance curve shall slope continuously upward to shut-off.

D. Control – Boiler Feed: Flow rates will be controlled by automatic modulating feedwater valves on each boiler. Pumps shall be started and stopped manually. Pumps shall be constant speed. Control the header pressure at ___kPa (___psi). E. Control - Condensate Transfer: Constant speed operation. Flow rate will be controlled by automatic modulating water level control valve on condensate transfer inlet to deaerator.

F. Construction:

1. Rotating elements shall be designed and balanced to conform to sound and vibration limits specified in Section 23 05 51, NOISE and VIBRATION CONTROL FOR BOILER PLANT.

2. Mechanical seals shall have sealing face materials of carbon and tungsten or silicon carbide.
3. Design bearings for two-year minimum life with continuous operation at maximum pump operating load. Bearings and shaft seals shall be water-cooled if recommended by pump manufacturer for the service.
4. Materials of Construction:
   Chambers: Stainless steel
   Impellers: Stainless steel
   Diffusers: Stainless steel
   Shaft: Stainless steel
   Suction-Discharge Chamber: Cast iron or stainless steel

G. Recirculation Orifice: Provide stainless steel recirculation orifice selected by pump manufacturer to protect pump from overheating at shut-off and designed for low noise under the service conditions. Orifices must not exceed sound level limits in Section 23 05 51, NOISE and VIBRATION CONTROL FOR BOILER PLANT.

H. Spare Parts: Provide complete rotating assembly for each pump size and type suitable for field installation by plant personnel. Assembly shall include impellers, diffusers, chambers, shaft, seals, bearings.

I. Shaft Couplings: Pump manufacturers standard. Provide coupling guard.

J. Electric Motor Drives: High efficiency type, open drip proof. Select motor size so that the motor is not overloaded at any point on the pump head-flow performance curve. Design motor for 40 °C ambient temperature. For efficiency and power factor requirements refer to Section 23 05 11, COMMON WORK RESULTS FOR HVAC and STEAM GENERATION.

K. Interface with Computer Workstation: Provide devices to signal computer work station that motor is on or off.

2.4 CONDENSATE TRANSFER PUMPS, FLEXIBLE-COUPLED, END SUCTION, CENTRIFUGAL

A. Type: Single stage, end suction, centrifugal with volute casing, horizontal shaft, frame-mounted, flexible-coupled, driven by constant speed motor, arranged as shown. Pump frames and motors shall be base-mounted.

B. Service: Design pumps and accessories for continuous condensate transfer service, 93 °C (200 °F) water, with flow rates ranging from maximum shown on drawings (plus manufacturer's recommended recirculation) to 10 percent of maximum, (plus manufacturer's recommended recirculation). Pumps shall be suitable for parallel operation without surging or hunting.

C. Performance: Refer to schedules on drawings. Pump head-flow characteristic curve shall slope continuously upward to shutoff.

D. Pump Size: Shall be such that a minimum of 10 percent increase in head can be obtained at the maximum required flow rate by installing larger impellers.

E. Construction:

1. Bolt pump casing to a frame that supports the pump shaft and shaft bearings. Casing shall have back pull-out feature or bolted front suction cover to allow access to impeller.
2. Frame which supports shaft and bearings shall provide easy access to seal.
3. Rotating elements shall be designed and balanced so that vibration is limited to requirements of Section 23 05 51, NOISE and VIBRATION CONTROL FOR BOILER PLANT.
4. Provide mechanical seal. Seal shall be exposed only to pump suction pressure.
5. Provide replaceable shaft sleeve, water slinger on shaft, vent cock and drain on casing. Provide casing wearing rings at all locations of tight clearance between casing and impeller.
6. Bearings: Rated for two year minimum life with continuous operation at maximum pump load.
7. Material of construction:

Casing	cast iron
Impeller	bronze
t	carbon steel
Shaft sleeve	bronze
Casing wear rings	bronze

F. Recirculation Orifice: Provide stainless steel recirculation orifice selected by pump manufacturer to protect pump from overheating at shutoff. Refer to Section 23 05 51, NOISE and VIBRATION CONTROL FOR BOILER PLANT for sound level limitations.

G. Spare Parts: Provide sufficient types and quantities to allow complete replacement of all such parts in one pump at one time:

1. Casing wear rings
2. Shaft sleeve
3. Pump bearings
4. Mechanical seal

H. Shaft Couplings: Shall be all metal, grid-type, flexible design which permits parallel, angular, and axial misalignment. Coupling shall be sufficiently flexible to reduce transmission of shock loads significantly. Coupling size selection shall be based on coupling

manufacturer's recommendations for the service. Coupling shall include no spacers made from organic material.

1. Pumps having back pull-out disassembly feature shall be provided with spacer couplings designed to allow disassembly of pump without moving the motor.
2. Provide coupling guard bolted to base plate.

I. Electric Motor Drives: High efficiency, open drip proof designed for the service. Select motor size so that the motor is not overloaded at any point on the pump head-flow performance curve. Design motor for 40 °C ambient temperature. For efficiency and power factor requirements, refer to Section 23 05 11, COMMON WORK RESULTS FOR HVAC and STEAM GENERATION.

J. Mounting: Mount pumps and motors on steel or cast iron base plates with drip-catching configuration. Align pumps and motor in the factory.

K. Sound and Vibration: Each pump and motor assembly shall conform to sound and vibration limits specified in Section 23 05 51, NOISE and VIBRATION CONTROL FOR BOILER PLANT.

L. Interface with Computer Workstation: Provide devices to signal computer workstation that motor is on or off.

2.5 CONDENSATE TRANSFER PUMPS, CLOSE-COUPLED, END SUCTION, CENTRIFUGAL

A. Type: Single stage, end suction, centrifugal with volute casing, horizontal shaft, close-coupled with impeller mounted on motor shaft, motor driven, constant speed, arranged as shown.

B. Service: Design pumps and accessories for continuous condensate transfer service, 93 °C (200 °F) water, with flow rates ranging from maximum scheduled on drawings (plus manufacturer's recommended recirculation) to 10 percent of maximum (plus manufacturer's recommended recirculation). Pumps shall be suitable for parallel operation without surging or hunting.

C. Performance: Refer to schedules on the drawings. Pump head-flow performance curve shall slope continuously upward to shutoff.

D. Pump Size: Shall be such that a minimum of 10 percent increase in head can be obtained at the maximum required flow rate by installing larger impellers.

E. Construction:

1. Mount pump casing on a frame attached to the motor housing. Casing shall have back pull-out feature or bolted front suction cover to allow access to impeller.
2. Frame on which pump is mounted shall provide easy access to seal.
3. Rotating elements shall be designed and balanced so that vibration is limited to requirements of Section 23 05 51, NOISE and VIBRATION CONTROL FOR BOILER PLANT.

4. Provide mechanical seals. Seal shall be exposed to pump suction pressure only.
5. Provide replaceable shaft sleeve, water slinger on shaft, vent cock and drain on casing. Provide casing wearing rings at all locations of tight clearances between casing and impeller.
6. Bearings: Rated for two year minimum life with continuous operation at maximum pump load.
7. Materials of Construction:

Casing	cast iron
Impeller	bronze
Shaft	carbon steel
Shaft sleeve	bronze
Casing wear rings	bronze

F. Recirculation Orifice: Provide stainless steel recirculation orifice selected by pump manufacturer to protect pump from over-heating at shutoff. Refer to Section 23 05 51, NOISE and VIBRATION CONTROL FOR BOILER PLANT for sound level limitations.

G. Spare Parts: Provide sufficient types and quantities to allow complete replacement of all such parts in one pump at one time:
1. Casing wearing rings
2. Shaft sleeve
3. Motor bearings
4. Mechanical seal

H. Electric Motor Drives: Joint NEMA-Hydraulic Institute design Type JM or JP approved motors, high efficiency, open drip proof, designed specifically as close-coupled pump motors. Motor bearings shall be grease-lubricated designed to carry all radial and thrust loads of the pump and motor assemblies. Select motor size so that the motors are not overloaded at any point on the pump head-flow performance curve. Design motors for 40 °C ambient temperature. For efficiency and power factor requirements, refer to Section 23 05 11, COMMON WORK RESULTS FOR HVAC and STEAM GENERATION.

I. Sound and Vibration: Each pump and motor assembly shall conform to sound and vibration limits specified in Section 23 05 51, NOISE and VIBRATION CONTROL FOR BOILER PLANT.

J. Interface with Computer Workstation: Provide devices to signal computer workstation that motor is on or off.

2.8 CONDENSATE RETURN PUMP UNITS (ELECTRIC, PAD-MOUNTED)

A. Type: Factory-assembled units consisting of vented horizontal pad-mounted receiver tank, simplex or duplex motor-driven pumps as

shown, interconnecting piping, motor controls, and accessories. Arrangement of pumps, tank and accessories shall be as shown or specified.

B. Service: Unit shall be designed to receive, store, and pump steam condensate having temperature as shown. Pumps and motors shall be suitable for continuous service.

C. Performance: Refer to schedules on the drawings.

D. Pumps: Centrifugal or turbine-type as shown.

1. Centrifugal Pumps: Bronze-fitted, vertical shafts, with mechanical shaft seals. Stainless steel or alloy steel shafts with bronze shaft sleeves. Pump shall be designed to allow removal of rotating elements without disturbing connecting piping or pump casing mounting. Bearings shall be grease-lubricated ball or roller type. Provide casing wearing rings.

2. Turbine-type Pumps: Shall be split-case, base-mounted, flexible-coupled, horizontal shaft, bronze fitted, with mechanical shaft seals. Pumps shall be designed to allow removal of rotating elements without disturbing connecting piping. Bearings shall be grease-lubricated ball or roller type. Provide replaceable channel rings to protect casing from wear. Shaft coupling shall be flexible type, designed for the service. Provide coupling guard bolted to base plate. Provide relief valves on pump discharge lines ahead of gate valves. Set at 690 kPa (100 psi). Pipe relief vents to receiver tank. Valve capacity shall equal or exceed pump capacity at set pressure.

E. Electric Motor Drives: Open drip proof. Select motor sizes so that the motors are not overloaded at any point on the pump head-flow performance curve. Motor shall be designed for 40 °C ambient temperature.

F. Receiver Tank: Cast iron or galvanized steel, with storage capacity and height of inlet connection as shown. Provide threaded or flanged openings for all pipe connections and facilities for mounting float switches. Openings for pipe sizes above 50 mm (2 inch) must be flanged. Receivers for simplex pumps shall include all facilities required for future mounting of additional pump and controls.

G. Controls:

1. Pump Operation: Provide float switches mounted on receiver tank to start and stop water pumps in response to changes in the water level in the receiver. Float switches shall be adjustable to permit the controlled water levels to be changed. Floats and connecting rods shall be copper, stainless steel or bronze. When a duplex pump unit is used, provide an alternator and a control to automatically start

the second pump, when the first pump fails in keeping the receiver water level from rising.

2. Starters: Provide combination magnetic starters with fusible disconnect switches or circuit breakers. Provide low voltage control circuits (120 volt maximum).
3. Indicating Lights: Provide red light for each pump to show that the pump is running, green lights to show power is on.
4. Manual Selector Switches: Provide "on-off-automatic" switch for each pump.
5. Electrical Wiring: Shall be enclosed in liquid-tight flexible metal conduit. Wiring shall be suitable for 93 °C (200 °F) service.
6. Control Cabinet: NEMA 250, Type 2 or 4, enclosing all controls, with manual switches and indicating lights mounted on the outside of the panel. Attach to pump set with rigid steel framework unless other mounting is shown on the drawings.

H. Accessories Required:

1. Thermometer on receiver below minimum water level. Thermometer must conform to requirements in Section 23 09 11, INSTRUMENTATION and CONTROL FOR BOILER PLANT.
2. Basket-type inlet strainer with bolted cover, designed for 275 kPa (40 psi), 100 °C (210 °F). Provide basket with 3 mm (1/8-inch) diameter perforations.
3. Water level gage on receiver. Provide gage cocks that automatically stop the flow of water when the glass is broken. Provide gage glass protection rods, and drain on lower gage cock.

I. Sound and Vibration: Pump units shall conform to sound and vibration limits specified in Section 23 05 51, NOISE and VIBRATION CONTROL FOR BOILER PLANT.

2.7 CONDENSATE RETURN PUMP UNITS (ELECTRIC, SUMP-TYPE)

A. Type: Factory-assembled units consisting of vertical, extended shaft, submerged, simplex or duplex (as shown), motor-driven condensate pumps mounted on a horizontal cover plate. Bolt cover plate to a vented underground sump-type receiver. Cover plate shall be flush with the floor. Motors shall be above the cover plate.

B. Service: Design units to receive, store, and pump steam condensate having temperatures of 82 degrees C (180 degrees F). Pumps and motors shall be suitable for continuous service.

C. Performance: Refer to schedules on the drawings.

D. Pumps: Centrifugal or turbine-type, vertical extended shaft, bronze-fitted, flexible-coupled, designed for submerged operation. Provide regreaseable ball thrust shaft bearings located at least six

inches above the cover plate, bronze shaft bearings adjacent to the pump designed for water lubrication, intermediate water-lubricated shaft bearings where required by length of shaft. Shaft shall be stainless steel. Provide mechanical shaft seal at cover plate with bronze packing gland. Pump manufacturer shall terminate the pump discharge pipes above the cover plate. Bolt pump-motor units to brackets that are bolted to the cover plate. Removal of one pump shall not affect operation of second pump in duplex units. When turbine-type pumps are furnished, provide relief valves on pump discharge lines ahead of gate valves. Set at 690 kPa (100 psi). Pipe relief vents to receiver tank. Relief valve capacity shall equal or exceed pump capacity at set pressure.

E. Electric Motor Drives: Open drip proof, standard HP base. Select motor size so that the motors are not overloaded at any point on the pump head-flow performance curve. Motor shall be designed for 40 °C ambient temperature.

F. Receiver Tank: Drawings will show when an existing sump or receiver is to be reused. Unless otherwise noted, a new receiver is required. New receiver shall be vertical, cylindrical, cast iron sides and bottom, designed for service underground or below the floor. Receiver capacity and size shall be as shown. Locate inlet connection 230 mm (9 inches) below the cover plate.

G. Receiver Cover Plate: Heavy gage steel designed to support weight of pumps, motors, and accessories with no deflection. Cover plate shall include provisions for mounting of pumps, motors and accessories by bolting and shall be designed to allow easy removal of same. Provide threaded or flanged openings for piping connections. Openings for pipe sizes above 50 mm (2 inches) must be flanged. Cover plate shall be designed to fit new or existing receiver tank or sump as shown. Provide bolted inspection plate for viewing interior of receiver. All bolted connections to cover plate and between cover plate and receiver shall be gasketed so that no vapor will escape into the room.

H. Controls:

1. Pump Operation: Provide float switches mounted on receiver cover plate to start and stop the pumps in response to changes in the water level in the receiver. Float rod penetrations of the receiver cover plate shall be sealed to prevent the escape of vapor. Floats and connecting rods shall be copper, stainless steel or bronze. When a duplex pump unit is required, provide an alternator and a control to automatically start the second pump, when the first pump fails in keeping the receiver water level from rising.

2. Starters: Provide combination magnetic starters with fusible disconnect switches or circuit breakers. Provide low voltage control circuits (120 volt maximum).
3. Indicating Lights: Provide red light for each pump to show that the pump is running, green lights to show power is on.
4. Manual Selector Switches: Provide "on-off-automatic" switch for each pump.
5. Electrical Wiring: Enclose in liquid-tight flexible metal conduit. Wiring shall be suitable for 93 °C (200 °F) service.
6. Control Cabinet: NEMA 250, Type 2 or 4, enclosing all controls, with manual switches and indicating lights mounted on the outside of the panel. Provide rigid mounting to adjacent building wall or column as shown on the drawings.

I. Sound and Vibration: Pump unit shall conform to sound and vibration limits specified in Section 23 05 51, NOISE and VIBRATION CONTROL FOR BOILER PLANT.

2.9 FLASH TANK

A. Type: Cylindrical welded steel tank with accessories as shown. Refer to detail on drawings.

B. Service: Suitable for receiving, venting, storing and discharging to condensate return pump the effluent discharged from steam traps on high and medium pressure steam systems.

C. Construction:

1. Conform to ASME Boiler and Pressure Vessel Code, Section VIII. Fabricate from steel sheets and plates or from steel pipe and pipe caps.
2. Material of Construction:
   a. Steel sheets and plates: ASTM A285, A414, A515, A516.
   b. Steel pipe and pipe caps: Pipe ASTM A53A-S, A53A-E, A53B-S, A53B-E. Pipe Caps ASTM A234, ASME B16.9.
3. Design tank for 850 kPa (125 psi), 178 °C (353 °F).
4. Piping Connections: Threaded half couplings for pipe sizes under 65 mm (2-1/2 inches). Flanged 1025 kPa (150 psi) ASME for pipe sizes over 50 mm (2 inches).
5. ASME Forms: Furnish U-1 or U-1A, MANUFACTURERS' DATA REPORT FOR PRESSURE VESSELS.
6. Supports: Unless shown otherwise, provide floor-mounted frame constructed with steel angles.
7. Condensate Pipe: Provide perforated Schedule 80 steel pipe inside tank as shown.

D. Cleaning and Painting: Remove all dirt, heavy rust, mill scale, oil, welding debris from interior and exterior of tank. Coat exterior with rust-resisting primer (See Section 09 91 00, PAINTING).

E. Insulation: Do not insulate.

PART - 3 EXECUTION

3.1 INSTALLATION

A. Feedwater Deaerator with Storage Tank and Accessories, Condensate Storage Tank, Blowoff Tank, Flash Tank.

1. Coordinate location with structural requirements of the building.
2. Location shall permit access to and removal of all internal and external features without removing other items of equipment or piping.
3. Bolt to building as recommended by manufacturer or as shown..
4. Clean interior of equipment before placing in service.
5. Deaerator vent pipes must extend vertically through roof. Horizontal runs not permitted.
6. All controls, safeties, set points, etc must conform to the most recent edition of the VHA Boiler Plant Safety Device Testing Manual.

B. Boiler Feed and Condensate Transfer Pumps:

1. For base-mounted horizontal-shaft pumps, connect base drain to 20 mm (3/4-inch) pipe. Extend pipe to nearest open sight or floor drain.
2. Align pumps and drivers at the factory. At job site, a millwright shall level, shim, bolt, and grout the base plates or base frames onto the concrete pads, and shall also check the alignments of flexible-coupled pumps and drivers and make corrections necessary. Check alignment when both pump and driver are at normal operating temperature.
3. Where packaged deaerator-feed pump unit is required, boiler feed pump base plates shall be welded or bolted to deaerator support frame.
4. If water-cooled bearings or quenched or flushed or water-cooled stuffing boxes are provided on pumps, contractor shall install on each pump valved 15 mm (1/2-inch) piping connections to cold water supply, and 15 mm (1/2-inch) drains to nearest open sight drain. Provide unions at all connections to pumps.

C. Mechanical Condensate Pump (Pumping Trap): Provide sufficient elevation difference between the receiver condensate inlet and outlet and the trap inlet to assure the required head for proper functioning and capacity. Steam supply line shall include gate valve and Y-type strainer.

D. Condensate Return Pump Units (Sump Type): Provide the exterior of new receiver tanks with two heavy coats of asphalt or bituminous waterproofing compound. Mounting into the floor shall include

waterproofing gaskets and grouting that will prevent ground water from entering the building from around the receiver. Unit shall be level.

E. Fuel Oil Pumping Equipment and Fuel Oil Heaters and Accessories: Locate equipment to permit access to all valves and controls, and to permit removal and cleaning of heat exchanger tubes.

F. Compressed Air System: Pipe all drain connections individually to nearest floor drain. Use 15 mm (1/2-inch) piping. Provide union at each drain connection on the equipment.

G. Automatic Continuous Boiler Blowdown Control System: Locate controller on floor-supported angle at four feet above the floor at the boiler adjacent to the continuous blowdown valves. Keypad and indicator must face aisle.

3.2 TESTING AND BALANCING FEEDWATER DEAERATOR WITH STORAGE TANK AND ACCESSORIES:

A. Demonstrate the ability of the deaerator to perform as specified in regard to oxygen removal and outlet temperature, over the required output flow range and input temperature range of unit. Test performance at 5 percent and 100 percent of capacity, and at two intermediate points to be selected by the COR. Repeat test two times at each load point.

B. Determine temperatures and pressures by calibrated thermometers and pressure gages.

C. Utilize the specified colorimetric comparator type dissolved oxygen test kit. After completion of tests, clean the test kit apparatus, replace all ampoules used and parts missing or broken, and deliver the kit to the COR.

D. Various impurities in feed water can interfere with the colorimetric test. When impurities are present, the Contractor shall be prepared to test for dissolved oxygen using the titration test as described in ASME PTC 12.3. RE may permit other test methods.

E. This test shall be performed in conjunction with any boiler tests that are specified.

F. Prior to requesting final tests, pretest unit using method specified for final test. All final test must include at the minimum the test listed in the most recent edition of the VHA Boiler Plant Safety Device Testing Manual. Submit test data for review.

3.3 STARTUP AND TESTING

A. The Commissioning Agent will observe startup and contractor testing of selected equipment. Coordinate the startup and contractor testing schedules with the Contracting Officer’s Representative (COR) and Commissioning Agent. Provide a minimum of 7 days prior notice.

3.4 DEMONSTRATION AND TRAINING

A. Provide services of manufacturer's technical representative for four hours to instruct each VA personnel responsible in operation and maintenance of units.

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