SECTION 235313 - BOILER FEEDWATER PUMPS

Revise this Section by deleting and inserting text to meet Project-specific requirements.

This Section uses the term "Architect." Change this term to match that used to identify the design professional as defined in the General and Supplementary Conditions.

Verify that Section titles referenced in this Section are correct for this Project's Specifications; Section titles may have changed.

1. GENERAL
	* + 1. RELATED DOCUMENTS

Retain or delete this article in all Sections of Project Manual.

* + - * 1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
			1. SUMMARY
				1. Section includes packaged, factory-assembled, boiler feedwater pumps.
			2. DEFINITIONS

Retain terms that remain after this Section has been edited for a project.

* + - * 1. NPSHR: Net-positive suction head required.
			1. SUBMITTALS
				1. Submittals for this section are subject to the re-evaluation fee identified in Article 4 of the General Conditions.
				2. Manufacturer's installation instructions shall be provided along with product data.
				3. Submittals shall be provided in the order in which they are specified and tabbed (for combined submittals).
				4. Product Data: For each unit to include the following:

Equipment performance and operating characteristics, such as rated makeup water, feedwater, steam condensate, and steam flow rates; working pressure; tank capacities; temperature and NPSHR; and pump performance curves with selection points clearly indicated.

Furnished specialties and accessories.

Construction details, material descriptions, dimensions and weight of individual components, and profiles and finishes.

Force and moment capacity of each field piping connection.

Dimensioned location of low, high, and normal water level showing operating set point and each alarm set point.

Temperature and pressure rating, size, and materials of construction for trim components including piping, fittings, flanges, unions, and valves. Provide valve manufacturer Product Data for each valve furnished. For safety valves, include trip and reset settings and flow capacity.

Manufacturer Product Data showing size, scale range, and accuracy of thermometers and pressure gages.

Detailed information of controls including Product Data with technical performance, operating characteristics, and sequence of operation.

Product Data for each motor, including performance, operating characteristics, and materials of construction.

* + - * 1. Shop Drawings:

Include plans, elevations, sections, and [**mounting**] [**attachment**] details.

Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

Include diagrams for power, signal, and control wiring. Differentiate between factory and field installation.

Include piping diagrams of factory-furnished piping that indicate size and each piping component.

Retain "Coordination Drawings" paragraph below for situations where limited space necessitates maximum utilization for efficient installation of different components or if coordination is required for installation of products and materials by separate installers. Coordinate paragraph with other Sections specifying products listed below. Preparation of coordination drawings requires the participation of each trade involved in installations within the limited space.

* + - * 1. Coordination Drawings: Plan and elevation views, drawn to <**Insert scale**> scale, indicating equipment manufacturer's service clearances, structure and base attachment, piping, power, and controls. Each view to show screened background with the following:

Column grids, beams, columns, and concrete equipment bases.

Room layout with walls, floors, and roofs, including each room name and number.

Equipment and products located in vicinity of boiler feedwater pumps and part of final installation including products of other trades, such as lighting, fire suppression systems, and plumbing systems.

Retain "Seismic Qualification Data" paragraph below if required by seismic criteria applicable to Project. Coordinate with Section 230548 "Vibration and Seismic Controls for HVAC." See ASCE/SEI 7 for certification requirements for equipment and components.

* + - * 1. Seismic Qualification Data: Certificates, for feedwater equipment, accessories, and components, from manufacturer.

Basis of Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

Detailed description of equipment anchorage devices on which certification is based and their installation requirements.

* + - * 1. Source quality-control reports.

Retain "Field quality-control reports" paragraph below if Contractor is responsible for field quality-control testing and inspecting.

* + - * 1. Field quality-control reports.
			1. CLOSEOUT SUBMITTALS
				1. Operation and Maintenance Data: For feedwater equipment to include in emergency, operation, and maintenance manuals.
				2. Instructional Videos: Including those that are prerecorded and those that are recorded during training.
			2. MAINTENANCE MATERIAL SUBMITTALS
				1. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

Gaskets: Furnish [**one**] <**Insert number**> replacement gasket(s) for each gasketed opening.

Gage Glass: Furnish [**one**] <**Insert number**> replacement glass(es) for each gage glass.

Pump Mechanical Seal Set: Furnish [**one**] <**Insert number**> replacement mechanical seal set(s) for each unique pump mechanical seal.

<**Insert extra materials**>.

* + - 1. DELIVERY, STORAGE, AND HANDLING
				1. Preparation for Shipping:

Clean flanges and exposed-metal surfaces and treat with anticorrosion compound after assembly and testing.

Protect flanges, pipe openings, and nozzles with flange covers or with screwed-in plugs.

Ship boiler feedwater pumps from the factory free of water. Drain water and blow pumps dry with compressed air if required to remove all water before shipping.

Cover and protect electrical and control devices and open connections.

* + - * 1. Protect bearings and couplings against damage from sand, grit, and other foreign matter.
				2. Comply with manufacturer's written rigging instructions.
1. PRODUCTS

Manufacturers and products listed in SpecAgent and MasterWorks Paragraph Builder are neither recommended nor endorsed by the AIA or Deltek. Before inserting names, verify that manufacturers and products listed there comply with requirements retained or revised in descriptions and are both available and suitable for the intended applications. For definitions of terms and requirements for Contractor's product selection, see Section 016000 "Product Requirements."

* + - 1. PERFORMANCE REQUIREMENTS

Retain "Seismic Performance" Paragraph below with "Seismic Qualification Data" Paragraph in "Informational Submittals" Article for projects requiring seismic design. Delete paragraph if performance requirements are indicated on Drawings. Model building codes and ASCE/SEI 7 establish criteria for buildings subject to earthquake motions. Coordinate requirements with structural engineer.

* + - * 1. Seismic Performance: Boiler feedwater pumps shall withstand the effects of earthquake motions determined according to [**ASCE/SEI 7**] <**Insert requirement**>.

Retain subparagraph below to define the term "withstand" as it applies to this Project. Definition varies with type of building and occupancy and is critical to valid certification. Option is used for essential facilities where equipment must operate immediately after an earthquake.

The term "withstand" means "the boiler feedwater pumps will remain in place without separation of any parts when subjected to the seismic forces specified[**and the boiler feedwater pumps will be fully operational after the seismic event**]."

For life-safety components required to function after an earthquake (such as fire-sprinkler systems, components that contain hazardous content, and storage racks in structures open to the public), the Component Importance Factor is 1.5. For other components, the Component Importance Factor is 1.0 unless the structure is in Seismic Use Group III and component is necessary for continued operation of facility or failure of component could impair continued operation of facility, in which case the Component Importance Factor is 1.5.

Component Importance Factor: [**1.5**] [**1.0**].

See ASCE/SEI 7, Coefficients for Architectural Component Table and Seismic Coefficients for Mechanical and Electrical Components Table for requirements to be inserted in subparagraph below.

<**Insert requirements for Component Amplification Factor and Component Response Modification Factor**>.

* + - * 1. ASME Compliance:

Fabricate and label unit receivers of boiler feedwater pumps according to ASME Boiler and Pressure Vessel Code: Section VIII, "Pressure Vessels," Division 1.

Retain first option in first subparagraph below for systems operating at more than 15 psig (104 kPa); retain second option for systems operating at 15 psig (104 kPa) and less.

Factory-installed piping that connects pumps to receivers shall comply with [**ASME B31.1, "Power Piping."**] [**ASME B31.9, "Building Services Piping."**]

Safety valves and pressure vessels shall bear the appropriate ASME label.

Retain "Operation Following Loss of Normal Power" Paragraph below if uninterrupted boiler feedwater pump operation is required without operator intervention.

* + - * 1. Operation Following Loss of Normal Power:

Equipment, associated factory- and field-installed controls, and associated electrical equipment and power supply connected to backup power system shall automatically return equipment and associated controls to the state in which equipment was operating immediately before loss of normal power. This shall be accomplished without need for manual intervention by an operator when power is restored either through a backup power source or through normal power if restored before backup power is brought on-line.

See Drawings for equipment served by backup power systems.

Provide means and methods required to satisfy requirement even if not explicitly indicated.

* + - * 1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
			1. FEEDWATER UNITS
				1. Description: Factory-assembled and -tested unit consisting of a receiver, feedwater pumps, controls, and the following features and accessories:

[**Liquid-filled industrial**] [**Bimetal dial-type**] thermometer graduated in [**Fahrenheit**] [**and**] [**Celsius**].

Level gage glass[**, reflex flat type,**] with stops at top and bottom.

Lifting eyes.

Companion flanges.

Pump, suction and discharge isolation valve, inlet strainer, discharge check valve, and liquid-filled pressure gage.

Coordinate "Makeup Water Assembly" Subparagraph below with sequence of operation.

Makeup Water Assembly: [**Float operated with integral valve**] [**Electric level controller and valve**]; with inlet strainer and three-valve bypass.

Feedwater Heater: Sparge tube, thermostat, and control valve.

Factory-Installed Pipe, NPS 2-1/2 and Smaller: ASTM A53/A53M, Type S (seamless), Grade B; or ASTM A106/A106M, Type S, Grade B, [**Schedule 40**] [**Schedule 80**]; with threaded joints and fittings.

Retain one or more of first three subparagraphs below.

Cast-Iron Threaded Fittings: ASME B16.4; Class [**125**] [**250**].

Malleable-Iron Threaded Fittings: ASME B16.3, Class [**150**] [**300**].

Forged-Steel Fittings: ASME B16.11, Class 3000.

Retain "Malleable-Iron Unions" or "Forged-Steel Unions" Subparagraph below, or both.

Malleable-Iron Unions: ASME B16.39; Class [**150**] [**300**].

Forged-Steel Unions: MSS SP-83, Class 3000.

Factory-Installed Pipe, NPS 3 and Larger: ASTM A53/A53M, Type E (electric-resistance welded), Grade B; or ASTM A106/A106M, Type S, Grade B, Schedule [**40**] [**80**]; with welded joints and carbon-steel fittings and flanges.

Wrought-Steel Fittings: ASME B16.9, wall thickness to match adjoining pipe.

Wrought Cast- and Forged-Steel Flanges and Flanged Fittings: ASME B16.5, Class [**150**] [**300**], including bolts, nuts, and gaskets.

Retain first subparagraph below for continuously operating pumps to maintain circulation of pumped water during times the boiler feedwater modulating valve is throttled closed.

Pump-discharge bypass with relief valve or orifice plate sized to provide continuous pump operation with boiler feedwater valve closed.

Threaded connection and provision for chemical injection quill.

Sample cooler.

<**Insert accessory**>.

* + - * 1. Receiver:

If more than one feedwater unit is required, delete "Material" Subparagraph below and indicate material in a schedule on Drawings.

Material: [**Close-grain cast iron**] [**Welded carbon steel**] [**Welded carbon steel galvanized after fabrication**] [**Stainless steel**].

Retain first subparagraph below for carbon-steel tanks only.

Additional corrosion protection:

Retain one or both of first two subparagraphs below.

[**0.07-inch**] [**0.13-inch**] [**0.19-inch**] <**Insert dimension**> thickness allowance.

Electrolytic corrosion-inhibitor anode.

Retain "Finish" Subparagraph below for cast-iron and carbon-steel receivers only. First option is most common.

Finish: [**Primer**] [**Primer under enamel topcoat**] [**Primer under epoxy topcoat**].

Factory-applied insulation is unavailable from all manufacturers listed. Consult manufacturer.

Factory-Applied Insulation and Jacket: Minimum thickness of [**2 inches**] <**Insert dimension**> for mineral-fiber pipe and tank insulation. Cover insulation with [**painted steel**] [**stucco-embossed aluminum**] [**stainless-steel**] jacket.

If more than one feedwater unit is required, delete first subparagraph below and indicate mounting arrangement in a schedule on Drawings.

Mounting Arrangement: [**Recessed below floor**] [**Floor mounted**].

Mounting Frame: Structural-steel stand to support receiver and pumps.[**Fabricate stand with bracing adequate for seismic forces, according to authorities having jurisdiction, and to allow anchoring mounting frame to floor.**]

Drain connection with valve.

Retain "Vertical Feedwater Pump" or "Horizontal Feedwater Pump" Paragraph below and revise for desired pump construction.

* + - * 1. Vertical Feedwater Pump: Flange-mounted, close-coupled, [**single-stage,**] [**multistage,**] radially split-case-design centrifugal pump; rated for [**175-psig**] <**Insert value**> minimum working pressure and a continuous water temperature of at least [**225 deg F**] <**Insert temperature**>; with the following features:

Impeller: [**Bronze**] [**Stainless steel**].

Seals: Mechanical.

Consult manufacturer on availability of third option in "Motor" Subparagraph below. Some pump configurations may exclude the third option and necessitate the second.

Motor: [**Open dripproof**] [**Totally enclosed**] [**Totally enclosed fan-cooled**] enclosure. Comply with requirements in Section 230513 "Common Motor Requirements for HVAC Equipment."

* + - * 1. Horizontal Feedwater Pump: Base-mounted, [**single-stage,**] [**multistage,**] radially split-case-design centrifugal pump; rated for [**175-psig**] <**Insert value**> minimum working pressure and a continuous water temperature of at least [**225 deg F**] <**Insert temperature**>; with the following features:

Impeller: [**Bronze**] [**Stainless steel**].

Coupling: [**Close**] [**Flexible**].

Seals: Mechanical.

Consult manufacturer on availability of third option in "Motor" Subparagraph below. Some pump configurations may exclude the third option and necessitate the second.

Motor: [**Open dripproof**] [**Totally enclosed**] [**Totally enclosed fan-cooled**] enclosure. Comply with requirements in Section 230513 "Common Motor Requirements for HVAC Equipment."

* + - * 1. Control panel shall be unit mounted and factory wired and shall include the following:

Type 1 in first subparagraph below is most common and a standard product offering. Type 12 is second most common. Type 4X is used primarily in corrosive environments.

NEMA 250, [**Type 1**] [**Type 4**] [**Type 4X**] [**Type 12**] <**Insert type**> enclosure.

Retain first subparagraph below for single-point field power connection to unit.

Single-point field power interface to [**fused disconnect switch**] [**nonfused disconnect switch**] [**circuit breaker**]. Withstanding rating of disconnecting means shall protect equipment. Coordinate requirements with field electrical power source.

Branch power circuit to each motor and to controls[**with a disconnect switch or circuit breaker**].

NEMA-rated motor controller for each motor, and include a hand-off-auto switch and overcurrent protection.

Alternating controls for multiple-pump units with intermittent operation as indicated by control sequence.

Provide variable-frequency controller [**with manual bypass**]and line reactors for each variable-speed motor.

Terminal blocks with numbered and color-coded wiring to match wiring diagram.

Wiring outside of an enclosure in a [**metal**]raceway. Make connections to motor with liquid tight conduit.

Removable control mounting plate.

Visual indication of status and alarm[**with momentary test push button**].

Retain first subparagraph below for audible alarm. Coordinate with control sequence.

Audible alarm and silence switch.

Visual indication of elapsed run time, graduated in hours.

Fused control-circuit transformer.

Retain subparagraph below for nonstandard requirement.

Microprocessor-based controller.

Retain one of first three paragraphs below. Retain first for feedwater system with single feedwater pump. Retain second for multiple-pump units with operating and standby pump. Retain third for multiple-pump units with continuous pump operation and modulating control valve. Coordinate with boiler operation and controls. See the Evaluations for further discussion.

* + - * 1. Feedwater Single-Pump Control Sequence:

Boiler water-level controller starts and stops pump to maintain boiler water-level set point.

Visual indication of pump on[**and off**] status.

Visual[**and audible**] alarm indication of pump failure.

* + - * 1. Feedwater Multiple-Pump with Intermittent Operation Control Sequence:

Boiler water-level controller starts and stops lead pump to maintain boiler water-level set point.

Lead and lag pumps alternate [**after each start**] [**to equalize run time**].

Lead pump failure [**automatically starts lag pump if lead pump cannot maintain set point**] [**manually starts lag pump**].

Visual indication of pump on[**and off**] status.

Visual indication of pump lead/lag status.

Visual[**and audible**] alarm indication of pump failure.

* + - * 1. Feedwater Multiple-Pump with Continuous Operation Control Sequence:

Pump runs continuously while boiler operates. Electric interlock with boiler control starts lead pump when boiler starts.

Boiler water-level controller modulates feedwater control valve to maintain boiler water-level set point. Valve closes when boiler is off.

Lead and lag pumps alternate [**after each start**] [**to equalize run time**].

Lead pump failure automatically starts lag pump.

Retain one of first two subparagraphs below.

Feedwater pressure controller starts and stops lag pump to maintain feedwater pressure set point.

Feedwater pressure controller controls operating feedwater pump(s) speed and starts and stops lag pump(s) to maintain feedwater pressure set point.

Visual indication of pump on[**and off**] status.

Visual indication of pump lead/lag status.

Visual[**and audible**] alarm indication of pump failure.

* + - * 1. Receiver Makeup Water Control Sequence:

Retain one of first two subparagraphs below.

Electric level controller operates electric control valve to maintain receiver water-level set point.

Mechanical float operates integral valve to maintain water-level set point.

Visual[**and audible**] alarm indication of low[**and high**] receiver-water level.

Retain "Control System Interface" Paragraph below if unit controls interface with a control system for remote monitoring.

* + - * 1. Control System Interface: Factory install hardware to enable remote monitoring.

Hardwired Monitoring Points: On/off status for each pump[**, failure alarm for each pump**] [**, receiver low-water-level alarm**] [**, receiver high-water-level alarm**] [**, feedwater temperature**] <**Insert monitoring**>.

If Project has more than one type or configuration of feedwater unit, delete "Capacities and Characteristics" Paragraph below and schedule feedwater units on Drawings. If retaining below, retain "Basis-of-Design Product" Paragraph in this article and insert manufacturer's name and product name or designation there.

* + - * 1. Capacities and Characteristics:

Condensate Receiver:

Volume: <**Insert gal.**>.

Retain "Volume" Subparagraph above or "Diameter" and "Length" subparagraphs below.

Diameter: <**Insert inches**>.

Length: <**Insert inches**>.

Height to Condensate Inlet: <**Insert inches**>.

Condensate Return Minimum Inlet Size: <**Insert NPS**>.

Makeup Water Minimum Inlet Size: <**Insert NPS**>.

Sparge-Tube Steam Supply: <**Insert lb/h**>.

Feedwater Pumps:

No. of Pumps: [**Simplex**] [**Duplex**] <**Insert number**>.

Flow Rate: <**Insert gpm**>.

NPSHR: <**Insert psig**>.

Rated Operating Temperature: <**Insert deg F**>.

Head Pressure: <**Insert psig**>.

Horsepower: <**Insert horsepower**>.

Speed: <**Insert value**> rpm.

Unit Single-Point Power Electrical Characteristics:

Volts: [**208**] [**460**] <**Insert value**> V.

Phase: Three.

Hertz: 60.

Full-Load Amperes: <**Insert value**>.

Minimum Circuit Ampacity: <**Insert value**>.

Maximum Overcurrent Protection: <**Insert amperage**>.

See the Evaluations for discussion of feedwater unit with an integral vacuum producer.

* + - 1. FEEDWATER UNIT WITH VACUUM PRODUCER

* + - * 1. [Manufacturers:](http://www.specagent.com/Lookup?ulid=6128) Subject to compliance with requirements, provide products by one of the following:

[Domestic Pump](http://www.specagent.com/Lookup?uid=123457138933).

[Lockwood Products](http://www.specagent.com/Lookup?uid=123457138936).

[MEPCO, LLC](http://www.specagent.com/Lookup?uid=123457138939).

Approved equivalent.

* + - * 1. Description: Receiver mounted, consisting of multijet vacuum producer, centrifugal pump and motor assembly mounted on separation chamber, and automatic pressure and water temperature controls. Include the following accessories:

[**Liquid-filled industrial**] [**Bimetal dial-type**] thermometer graduated in [**Fahrenheit**] [**and**] [**Celsius**].

Vacuum Gage: Dial-type register in inches of mercury.

Level Gage Glass: Stops top and bottom.

Air-suction check valve.

Lifting eyes.

Companion flanges.

Low-water cutoff switch.

Cooling-Water Control: Aquastat, inlet strainer, and electric valve.

Air vent.

Overflow drain from vacuum-producer receiver.

Factory-Installed Pipe, NPS 2-1/2 and Smaller: ASTM A53/A53M, Type S (seamless), Grade B; or ASTM A106/A106M, Type S, Grade B, [**Schedule 40**] [**Schedule 80**]; with threaded joints and fittings.

Retain one or more of first three subparagraphs below.

Cast-Iron Threaded Fittings: ASME B16.4; Class [**125**] [**250**].

Malleable-Iron Threaded Fittings: ASME B16.3, Class [**150**] [**300**].

Forged-Steel Fittings: ASME B16.11, Class 3000.

Retain "Malleable-Iron Unions" or "Forged-Steel Unions" Subparagraph below, or both.

Malleable-Iron Unions: ASME B16.39; Class [**150**] [**300**].

Forged-Steel Unions: MSS SP-83, Class 3000.

Factory-Installed Pipe, NPS 3 and Larger: ASTM A53/A53M, Type E (electric-resistance welded), Grade B; or ASTM A106/A106M, Type S, Grade B, Schedule [**40**] [**80**]; with welded joints and carbon-steel fittings and flanges.

Wrought-Steel Fittings: ASME B16.9, wall thickness to match adjoining pipe.

Wrought Cast- and Forged-Steel Flanges and Flanged Fittings: ASME B16.5, Class [**150**] [**300**], including bolts, nuts, and gaskets.

Retain first subparagraph below for continuously operating pumps to maintain circulation of pumped water during times the boiler feedwater modulating valve is throttled closed.

Pump-discharge bypass with relief valve or orifice plate sized to provide continuous pump operation with boiler feedwater valve closed.

Threaded connection and provision for chemical injection quill.

Sample cooler.

<**Insert accessory**>.

* + - * 1. Vacuum-Producer Reservoir and Vacuum Receiver:

If more than one feedwater unit is required, delete "Material" Subparagraph below and indicate material in a schedule on Drawings.

Material: [**Close-grain cast iron**] [**Welded carbon steel**] [**Welded carbon steel galvanized after fabrication**] [**Stainless steel**].

Retain first subparagraph below for carbon-steel tanks only.

Additional corrosion protection:

Retain one or both of first two subparagraphs below.

[**0.07-inch**] [**0.13-inch**] [**0.19-inch**] <**Insert dimension**> thickness allowance.

Electrolytic corrosion-inhibitor anode.

Retain "Finish" Subparagraph below for cast-iron and carbon-steel receivers only. First option is most common.

Finish: [**Primer**] [**Primer under enamel topcoat**] [**Primer under epoxy topcoat**].

Factory-applied insulation is unavailable from all manufacturers listed. Consult manufacturer.

Factory-Applied Insulation and Jacket: Minimum thickness of [**2 inches**] <**Insert dimension**> for mineral-fiber pipe and tank insulation. Cover insulation with [**painted steel**] [**stucco-embossed aluminum**] [**stainless-steel**] jacket.

If more than one feedwater unit is required, delete "Mounting Arrangement" Subparagraph below and indicate mounting arrangement in a schedule on Drawings.

Mounting Arrangement: [**Recessed below floor**] [**Floor mounted**].

Mounting Frame: Structural-steel stand to support receiver and pumps.[**Fabricate stand with bracing adequate for seismic forces, according to authorities having jurisdiction, and to allow anchoring mounting frame to floor.**]

Drain connection with valve.

Retain "Vertical Vacuum-Producer Pump" or "Horizontal Vacuum-Producer Pump" Paragraph below and revise for desired pump construction.

* + - * 1. Vertical Vacuum-Producer Pump: Flange-mounted, close-coupled, single-stage, radially split-case-design centrifugal pump; rated for [**175-psig**] <**Insert value**> minimum working pressure and a continuous water temperature of at least [**225 deg F**] <**Insert temperature**>; with the following features:

Impeller: Bronze.

Shaft: Stainless steel.

Seals: Mechanical.

Consult manufacturer on availability of third option in "Motor" Subparagraph below. Some pump configurations may exclude the third option and necessitate the second.

Motor: [**Open dripproof**] [**Totally enclosed**] [**Totally enclosed fan-cooled**] enclosure. Comply with requirements in Section 230513 "Common Motor Requirements for HVAC Equipment."

* + - * 1. Horizontal Vacuum-Producer Pump: Base-mounted, single-stage, radially split-case-design centrifugal pump; rated for [**175-psig**] <**Insert value**> minimum working pressure and a continuous water temperature of at least [**225 deg F**] <**Insert temperature**>; with the following features:

Impeller: Bronze.

Shaft: Stainless steel.

Coupling: [**Close**] [**Flexible**].

Seals: Mechanical.

Consult manufacturer on availability of third option in "Motor" Subparagraph below. Some pump configurations may exclude the third option and necessitate the second.

Motor: [**Open dripproof**] [**Totally enclosed**] [**Totally enclosed fan-cooled**] enclosure. Comply with requirements in Section 230513 "Common Motor Requirements for HVAC Equipment."

Retain "Vertical Feedwater Pump" or "Horizontal Feedwater Pump" Paragraph below and revise for desired pump construction.

* + - * 1. Vertical Feedwater Pump: Flange-mounted, close-coupled, [**single-stage,**] [**multistage,**] radially split-case-design centrifugal pump; rated for [**175-psig**] <**Insert value**> minimum working pressure and a continuous water temperature of at least [**225 deg F**] <**Insert temperature**>; with the following features:

Impeller: [**Bronze**] [**Stainless steel**].

Seals: Mechanical.

Consult manufacturer on availability of third option in "Motor" Subparagraph below. Some pump configurations may exclude the third option and necessitate the second.

Motor: [**Open dripproof**] [**Totally enclosed**] [**Totally enclosed fan-cooled**] enclosure. Comply with requirements in Section 230513 "Common Motor Requirements for HVAC Equipment."

* + - * 1. Horizontal Feedwater Pump: Base-mounted, [**single-stage,**] [**multistage,**] radially split-case-design centrifugal pump; rated for [**175-psig**] <**Insert value**> minimum working pressure and a continuous water temperature of at least [**225 deg F**] <**Insert temperature**>; with the following features:

Impeller: [**Bronze**] [**Stainless steel**].

Coupling: [**Close**] [**Flexible**].

Seals: Mechanical.

Consult manufacturer on availability of third option in "Motor" Subparagraph below. Some pump configurations may exclude the third option and necessitate the second.

Motor: [**Open dripproof**] [**Totally enclosed**] [**Totally enclosed fan-cooled**] enclosure. Comply with requirements in Section 230513 "Common Motor Requirements for HVAC Equipment."

* + - * 1. Control panel shall be unit mounted and factory wired and include the following:

Retain one of first two subparagraphs below.

Vacuum Switches for Simplex Vacuum-Producer Pumps: Include pressure adjustment, and test push button. Factory set to operate pump between 3 and 6 inches of mercury.

Vacuum Switches for Duplex Vacuum-Producer Pumps: Include pressure adjustment, and test push button. Factory set so one pump operates for 3 to 5 inches of mercury and both pumps operate for 4 to 6 inches of mercury.

Type 1 in first subparagraph below is most common and a standard product offering. Type 12 is second most common. Type 4X is used primarily in corrosive environments.

NEMA 250, [**Type 1**] [**Type 4**] [**Type 4X**] [**Type 12**] <**Insert type**> enclosure.

Retain first subparagraph below for single-point field power connection to unit.

Single-point field power interface to [**fused disconnect switch**] [**nonfused disconnect switch**] [**circuit breaker**]. Withstanding rating of disconnecting means shall protect equipment. Coordinate requirements with field electrical power source.

Branch power circuit to each motor and to controls[**with a disconnect switch or circuit breaker**].

NEMA-rated motor controller for each motor and include a hand-off-auto switch and overcurrent protection.

Alternating control for multiple pump units with intermittent operation as indicated by control sequence.

Provide variable-frequency controller [**with manual bypass**]and line reactors for each variable-speed motor.

Terminal blocks with numbered and color-coded wiring to match wiring diagram.

Wiring outside of an enclosure in a [**metal**]raceway. Make connections to motor with liquid tight conduit.

Removable control mounting plate.

Visual indication of status and alarm[**with momentary test push button**].

Retain first subparagraph below for audible alarm. Coordinate with control sequence.

Audible alarm and silence switch.

Visual indication of elapsed run time, graduated in hours.

Fused control-circuit transformer.

* + - * 1. Vacuum-Producer Control Sequence:

Cycle pumps to maintain vacuum-pressure set point.

Visual indication of pump on[**and off**] status.

Visual[**and audible**] alarm indication of pump failure.

Retain one of first three paragraphs below. Retain first for feedwater system with single feedwater pump. Retain second for multiple-pump units with operating and standby pump(s). Retain third for multiple-pump units with continuous pump operation and modulating control valve. Coordinate with boiler operation and controls. See the Evaluations for further discussion.

* + - * 1. Feedwater Single-Pump Control Sequence:

Boiler water-level controller starts and stops pump to maintain boiler water-level set point.

Visual indication of pump on[**and off**] status.

Visual[**and audible**] alarm indication of pump failure.

* + - * 1. Feedwater Multi-Pump with Intermittent Operation Control Sequence:

Boiler water-level controller starts and stops lead pump to maintain boiler water-level set point.

Lead and lag pumps alternate [**after each start**] [**to equalize run time**].

Lead pump failure [**automatically starts lag pump if lead pump cannot maintain set point**] [**manually starts lag pump**].

Visual indication of pump on[**and off**] status.

Visual indication of pump lead/lag status.

Visual[**and audible**] alarm indication of pump failure.

* + - * 1. Feedwater Multi-Pump with Continuous Operation Control Sequence:

Pump runs continuously while boiler operates. Electric interlock with boiler control starts lead pump when boiler starts.

Boiler water-level controller modulates feedwater control valve to maintain boiler water-level set point. Valve closes when boiler is off.

Lead and lag pumps alternate [**after each start**] [**to equalize run time**].

Lead pump failure automatically starts lag pump.

Retain one of first two subparagraphs below.

Feedwater pressure controller starts and stops lag pump to maintain feedwater pressure set point.

Feedwater pressure controller controls operating feedwater pump(s) speed and starts and stops lag pump(s) to maintain feedwater pressure set point.

Visual indication of pump on[**and off**] status.

Visual indication of pump lead/lag status.

Visual[**and audible**] alarm indication of pump failure.

* + - * 1. Makeup Water Control Sequence:

Electric level controller operates electric control valve to maintain water temperature set point.

Visual[**and audible**] alarm indication of low[**and high**] water level.

Retain "Control System Interface" Paragraph below if unit controls interface with a control system for remote monitoring.

* + - * 1. Control System Interface: Factory install hardware to enable remote monitoring.

Hardwired Monitoring Points: On/off status for each pump[**, failure alarm for each pump**] [**, receiver low-water-level alarm**] [**, receiver high-water-level alarm**] [**, feedwater temperature**] <**Insert monitoring**>.

If Project has more than one type or configuration of feedwater unit, delete "Capacities and Characteristics" Paragraph below and schedule feedwater units on Drawings. If retaining below, retain the "Basis-of-Design Product" Paragraph in this article and insert manufacturer's name and product name or designation there.

* + - * 1. Capacities and Characteristics:

Vacuum-Producer Reservoir:

Volume: <**Insert gal.**>.

Retain "Volume" Subparagraph above or "Diameter" and "Length" subparagraphs below.

Diameter: <**Insert inches**>.

Length: <**Insert inches**>.

Cooling Makeup Water Supply: <**Insert NPS**>.

Overflow Drain: <**Insert NPS**>.

Vacuum-Producer Pumps:

No. of Pumps: [**Simplex**] [**Duplex**] <**Insert number**>.

Air Capacity: <**Insert cfm**>.

Head Pressure: <**Insert inches of mercury**>.

Horsepower: <**Insert horsepower**>.

Speed: <**Insert value**> rpm.

Vacuum Receiver:

Volume: <**Insert gal.**>.

Retain "Volume" Subparagraph above or "Diameter" and "Length" subparagraphs below.

Diameter: <**Insert inches**>.

Length: <**Insert inches**>.

Height to Condensate Inlet: <**Insert inches**>.

Condensate Return Minimum Inlet Size: <**Insert NPS**>.

Feedwater Pumps:

No. of Pumps: [**Simplex**] [**Duplex**] <**Insert number**>.

Flow Rate: <**Insert gpm**>.

NPSHR: <**Insert psig**>.

Rated Operating Temperature: <**Insert deg F**>.

Head Pressure: <**Insert psig**>.

Horsepower: <**Insert horsepower**>.

Speed: <**Insert value**> rpm.

Unit Single-Point Power Electrical Characteristics:

Volts: [**208**] [**460**] <**Insert value**> V.

Phase: Three.

Hertz: 60.

Full-Load Amperes: <**Insert value**>.

Minimum Circuit Ampacity: <**Insert value**>.

Maximum Overcurrent Protection: <**Insert amperage**>.

* + - 1. SOURCE QUALITY CONTROL

Retain "Factory Tests" Paragraph below for factory-assembled units. Factory tests are an added cost option and may not be available from some manufacturers. Verify requirement with Director’s Representative.

* + - * 1. Factory Tests: Test performance and submit test results on packaged boiler feedwater pump units, according to ASME PTC 12.1, before shipping to Project.

Retain "Witness Testing" Paragraph below if Director’s Representative wants to witness source quality-control testing.

* + - * 1. Witness Testing:

Allow Director’s Representative access to witness source quality-control testing.

Notify [**Architect**] [Director’s Representative] [**15**] <**Insert time**> days in advance of testing.

1. EXECUTION
	* + 1. EXAMINATION
				1. Examine conditions for compliance with requirements for installation tolerances and other conditions affecting feedwater unit performance, maintenance, and operations.

Boiler feedwater pump unit locations indicated on Drawings are approximate. Determine exact locations before roughing-in for piping, control, and electrical connections.

* + - * 1. Examine roughing-in for concrete equipment bases, anchor-bolt sizes and locations, and piping to verify actual locations of piping connections before installation of boiler feedwater pumps.
				2. Examine areas for suitable conditions where boiler feedwater pumps will be installed.
				3. Proceed with installation only after unsatisfactory conditions have been corrected.
			1. INSTALLATION
				1. Coordinate size and location of bases. Cast anchor-bolt inserts into concrete bases. Concrete, reinforcement, and formwork requirements are specified with concrete.
				2. Equipment Mounting:

Retain first subparagraph below to require equipment to be installed on cast-in-place concrete equipment bases.

Install feedwater units on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete."

Retain one of two subparagraphs below. Retain first for projects in seismic areas; retain second for projects not in seismic areas. Indicate vibration isolation and seismic-control device type and minimum deflection in supported equipment schedule on Drawings.

Comply with requirements for vibration isolation and seismic-control devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."

Comply with requirements for vibration isolation devices specified in Section 230548.13 "Vibration Controls for HVAC."

* + - * 1. Install unit to permit access for maintenance.
				2. Support piping independent of equipment.
				3. Install parts and accessories shipped loose.
				4. Install control and electrical devices furnished with units that are not factory mounted.
				5. Install control and power wiring to field-mounted control and electrical devices furnished with units that are not factory installed.
				6. Protect units from corrosion.

Before filling with water, protect by dry storage method recommended by manufacturer.

After filled with water, protect by wet storage method recommended by manufacturer.

* + - * 1. Chemical Treatment: Quality of water in units shall be maintained by a professional water treatment organization that shall provide on-site supervision to maintain the required water quality during periods of storage, operating, standby, and test conditions. Comply with requirements in [**Section 232500 "HVAC Water Treatment,"**] [**Section 232519 "Water Treatment for Steam System Feedwater,"**] for additional requirements.
			1. PIPING CONNECTIONS

Coordinate piping installations and specialty arrangements with schematics on Drawings and with requirements specified in piping systems. If Drawings are explicit enough, these requirements may be reduced or omitted.

* + - * 1. Comply with requirements for piping specified in Section 232213 "Steam and Condensate Heating Piping" and Section 232216 "Steam and Condensate Heating Piping Specialties." Drawings indicate general arrangement of piping, fittings, and specialties.
				2. Where installing piping adjacent to boiler feedwater pumps, allow space for service and maintenance.
				3. Connect makeup water piping and cooling-water piping with reduced-pressure backflow preventers.
				4. Install overflow drain piping to nearest floor drain.
				5. Install piping from unit drain connections and extend to nearest floor drain. Piping shall be at least full size of connection. Provide an isolation if required.
				6. Install vents and extend to outdoors; terminate with elbow turned down and an insect screen.
				7. Hot equipment drains connected to sanitary drainage system shall be cooled before discharging into the system if required to comply with more stringent of governing code requirements and requirements indicated.

Provide a temperature-controlled, non-potable, domestic cold water source to cool hot equipment drains to deliver a discharge temperature of <**Insert temperature**>.

Retain paragraph below for boiler feedwater pump units with a direct connection to chemical treatment system.

* + - * 1. Connect chemical treatment piping to each boiler feedwater pump unit chemical treatment connection with check valve and isolation valve.
			1. ELECTRICAL POWER CONNECTIONS
				1. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
				2. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
			2. CONTROLS CONNECTIONS
				1. Install control and electrical power wiring to field-mounted control devices.
				2. Connect control wiring between boiler feedwater pump units and other equipment to interlock operation as required to provide a complete and functioning system.

Retain paragraph below to connect boiler feedwater pump units to control system for remote monitoring. Coordinate with "Control System Interface" Paragraph in "Feedwater Units" and "Feedwater Unit with Vacuum Producer" articles.

* + - * 1. Connect control wiring between boiler feedwater pump unit control interface and control system to provide remote monitoring.
			1. FIELD QUALITY CONTROL

Retain "Manufacturer's Field Service" and "Perform the following tests and inspections" paragraphs below to identify who shall perform tests and inspections. If retaining second option in "Manufacturer's Field Service" or "Perform the following tests and inspections" Paragraph, retain "Field quality-control reports" Paragraph in "Informational Submittals" Article.

Retain "Manufacturer's Field Service" Paragraph below to require a factory-authorized service representative to perform tests and inspections.

* + - * 1. Manufacturer's Field Service: Engage a Company Service Advisor to test and inspect components, assemblies, and equipment installations, including connections.

Retain "Perform the following tests and inspections" Paragraph below to require Contractor to perform tests and inspections.

* + - * 1. Perform the following tests and inspections[**with the assistance of a Company Service Advisor**]:

Inspect field-assembled components, equipment installation, and piping and electrical connections for compliance with manufacturer's written instructions.

Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

Check bearing lubrication.

Verify proper motor rotation.

Startup service.

Report results in writing.

See Section 014000 "Quality Requirements" for retesting and reinspecting requirements and Section 017300 "Execution" for requirements for correcting the Work.

* + - * 1. Boiler feedwater pump will be considered defective if it does not pass tests and inspections.
				2. Prepare test and inspection reports.
			1. ADJUSTING
				1. Adjust boiler water-level controls to properly stage unit.
				2. Set field-adjustable controls.
			2. CLEANING
				1. Clean equipment internally; remove coatings applied for protection during shipping and storage, foreign material, and oily residue according to manufacturer's written instructions. Following cleaning procedures, unit shall be washed and flushed until water leaving unit is clear.
				2. Clean strainers.
			3. DEMONSTRATION
				1. [**Engage a Company Service Advisor to train**] [**Train**] Director’s Representative's maintenance personnel to adjust, operate, and maintain boiler feedwater units.

Retain paragraph below for video training session.

* + - * 1. Video training sessions, and provide electronic copy of video to Director’s Representative.

END OF SECTION 235313