

University of Houston Master Specification

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SECTION 23 5710 – CLEAN STEAM GENERATORS AND ACCESSORIES

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

This Section uses the term "Engineer." 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.

Delete hidden text after this Section has been edited for the Project.

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The Contractor's attention is specifically directed, but not limited, to the following documents for additional requirements:
 - 1. The current version of the *Uniform General Conditions for Construction Contracts*, State of Texas, available on the web site of the Texas Facilities Commission.
 - 2. The University of Houston's *Supplemental General Conditions and Special Conditions for Construction*.

1.2 DESCRIPTION OF WORK

- A. Work Included: Provide unfired steam generators as specified, scheduled, and indicated herein to provide clean steam supply to the building.

1.3 QUALITY ASSURANCE

- A. Manufacturer: Provide clean steam generators as manufactured by RECO USA, DHT, Heat & Power, Inc., or approved equal.

1.4 SUBMITTALS

- A. Shop drawing submittals shall include, but not be limited to, the following:
 - 1. Clean Steam Generator
Design Data; Data Sheets, Wiring Diagrams, Piping Diagrams
Clean Steam Generator: Heating surface and volume measurements, Heat release calculations, Performance data at minimum, 25 percent, 50 percent, 75 percent, and 100 percent load.
Control Module
[Boiler feed Unit]
Analog Boiler Controller
[Clean Steam Piping]
[Clean Steam Condensate Piping]
 - 2. Submit evidence that the clean steam generator meets the requirements of standards specified. Include with the certificate of compliance acceptable evidence that standards are met. Acceptable evidence will be the official UL listing mark prescribed in the UL gas and oil equipment list for oil-fired, or gas and oil-fired boiler assemblies, as applicable plus the

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appropriate official ASME symbol stamp. In lieu of the above certification, acceptable evidence will be a test report from an independent testing laboratory, indicating that the boilers and accessories have been inspected and tested and meet requirements of the applicable standards specified.

3. Additional information as required in Section 23 0100 "Mechanical General Provisions."

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING:

- A. Deliver unfired steam generator in factory-fabricated water-resistant wrapping.
- B. Handle boiler carefully to avoid damage to material components, enclosure and finish.
- C. Store unfired steam generator in a clean, dry space and protect from the weather.

PART 2 - PRODUCTS

2.1 GENERAL

- A. General: Furnish materials, equipment, and labor to install clean steam generator packages as shown on drawings and specified herein. Provide complete packaged clean steam generators of the type, size, and capacities required.

2.2 GENERAL CLEAN STEAM GENERATOR DESIGN

- A. Clean steam generators shall be a horizontal or vertical configuration as specified on the drawings. The unfired steam generators shall be ASME code constructed and stamped for unfired steam generators. Unfired steam generators shall be registered with the National Board and Pressure Vessel Inspectors, and signed copy of the shop inspection report shall be furnished to the Owner. Unfired steam generators shall be built in accordance with unfired steam generators rated for 150 psig working pressure. The complete packaged unfired steam generators shall be approved as a unit by Underwriters' Laboratories, Inc. (UL) and shall bear the UL label. The unit shall comply with all applicable sections of the ASME Boiler and Pressure Vessel Code and be suitably stamped.
- B. Boiler shall be completely preassembled and fire-tested at factory. Unit shall be ready for immediate mounting on floor or simple foundation and ready for attachment of water, fuel, electrical, and vent connections.
- C. The generators and all components subject to steam side shall be 316-L grade stainless steel.
- D. The generators shall be insulated with not less than **[3 inches]** of fiberglass insulation, which shall be protected by not less than **[20]** ga. thick enameled steel jacket.
- E. The generators shall be mounted on a suitable I-beam support skid, which shall be permanently mounted to the shell.
- F. The generators shall have a submerged coil of 316 stainless steel tubes expanded into a 316 stainless steel tube sheet with cast iron heads.
- G. The generators shall be furnished with an electric operated control valve to modulate the incoming steam to maintain the desired output of steam **[+2 psig]**. The control valve shall be suitable for **[150]** psig. The equipment control shall monitor output steam pressure and modulate the steam valve to maintain constant output pressure.
- H. The generators shall be factory supplied with dual float and thermostatic traps, one for the coil and one for the drip before the control valve. The generators shall have an incoming strainer.
- I. The generators shall be furnished with an ASME Code pressure relief valve or valves with a capacity to relief the total BTU of output of the generators.

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- J. The generators shall be furnished with a vessel steam gauge, electronic level controller, and the water column shall be furnished with gauge glass. The generators shall be furnished with tandem blow off valves.
- K. All components for the unfired steam generators shall be factory mounted, piped, and tested and the units shall be shipped from the factory as complete packages ready for installation. The units shall be furnished with steam separators.
- L. The generators shall be supplied with solid-state control modules with LED backlit LCD displays and LED pilot lights to indicate on/off, high pressure, low pressure, low water, and water feed. Solid – state control modules shall allow the Owner to set pressure limits on the display screen.
- M. The solid-state control module shall have a flashing red alarm light and alarm horn with built-in alarm silence relay. **[Solid-state control modules shall be supplied with dry contact closure outputs to indicate building management system (BMS), the occurrence of power on, high pressure, low pressure, low water, and water feed. The control module shall allow the BMS to turn the unfired steam generator on or off through a remote relay suitable for 24 VAC, 1 amp. The control module shall allow the BMS to remotely monitor the operating pressure]**. The control module shall be supplied with an on/off switch and shall be mounted in a NEMA 1 panel. All solenoids and limits shall be 24 VAC.
- N. When the level sensor calls for feed water, the boiler feed pumps shall turn on as indicated by the sequence of operations.
- O. The steam generator packages shall include a vacuum breaker.
- P. The steam generator packages shall include an alarm bell and light to signal low water or high pressure. Alarm silence relay shall be provided to silence the bell but not the light.
- Q. The steam generator packages shall be provided with relays with 120-volt coils to remotely start or stop the generators.
- R. The steam generator packages shall be equipped with a conductivity controlled automatic blow-down, set to maintain purity of less than **[1500]** ppm total dissolved solids (TDS) in the clean steam system.
- S. The blow-down discharge shall be piped to a new blow-down separator.
- T. The steam generator packages shall include a centrifugal blow off condensate cooler.
- U. The high pressure condensate from the clean steam generator shall discharge to a flash tank producing low pressure condensate and low pressure flash steam.
- V. The steam generators shall be factory-furnished with high water shut-off. High water shut-off shall include an electronic probe mounted in the top of the unit connected to an electric operated power to open spring to close ball valve. In the event of high water, the ball valve shall close.

2.3 CLEAN STEAM GENERATOR CONNECTIONS

- A. Requirements for interconnecting piping, insulation, steam supply, vibration isolation, and other related work necessary to provide a complete and operable steam system, whether or not specifically mentioned above, shall conform to applicable requirements of other sections of Division 23. Clean steam generator shall be completely packaged and skid mounted with all necessary instrument controls, arranged for single point connection for all utilities.

2.4 CLEAN STEAM GENERATOR CONTROL MODULE

- A. Provide Solid State Steam Control Module with the following features:

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1. Remote start/stop.
2. On/Off switch.
3. Alarm horn with alarm silence relay.
4. Low water cut-off.
5. Timer for timed blow-down.
6. Relay for water feed.
7. Operating pressure readout LCD display.
8. High pressure cut-out and alarm.
9. Low pressure alarm.
10. LED Display of functions: power on, low water, high water, low pressure, high pressure, blow-down operating, water feed.
11. **[Contacts to notify building management system (BMS) of functions and alarms: power on, low water, high water, low pressure, high pressure, blow-down operating, water feed, operating pressure, any alarm.]**
12. **[The input shall be 120 VAC, 60 Hz. The output contact shall be 1 amp at 24 VAC. The BMS outputs shall be dry contacts, NO/NC, 0.5 amp maximum, non-inductive. The display shall be LED with a resolution of 0.3% of scale.]**
13. **[The available pressure ranges shall be 0-30, 0-60, and 0-150.]**
14. **[The unit shall operate within the following ambient temperature range: min 32 degrees F to a maximum of 140 degrees F. The operating humidity shall be 5%-95% relative humidity non-condensing.]**
15. The unit shall be provided in a **[NEMA 4]** enclosure.
16. **[Contacts to notify BMS of functions and alarms: power on, low water, high water, low pressure, high pressure, blow down operating, water feed, operating pressure, any alarm.]**

2.5 CABINERY

- A. Provide steam generator control and instrument cabinet (s) and mount either on the steam generator front(s) or adjacent thereto. The arrangement may consist of steam generator mounted cabinet containing controls normally provided by the manufacturer and a supplementary cabinet containing additional controls and instruments required herein.

2.6 CONTROL PANEL CONSTRUCTION

- A. Construct control panel of not less than 11 gage reinforced steel for face, top, and sides. The enclosed panel shall not less than 24 inches in depth with inside rigidly welded braces. Design control panel so that all indicating and recording devices and manually operated switches shall be flush mounted in a gasketed, removable-top front panel with indicating and recording devices at eye-level. Provide a similar removable-top rear panel located opposite front panel to facilitate wiring, piping, and maintenance. Install other operating controls on a sub-panel within the enclosure. Access to panel enclosure shall be through gasketed, double piano-hinged doors of not less than 16 gage steel. The doors shall be reinforced to prevent sagging and shall be provided with a three point compression type fastener and polished key lock handle. Include a full width lighting canopy also. Prime coat complete control panel and lighting canopy also. Prime coat complete control panel and lighting canopy and finished in baked enamel. Identify flush-mounted devices on panel with engraved

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lamicore nameplates. Adequately reinforce, skirt, and suitably design panel base to permit anchoring to the floor or foundation.

2.7 CONTROL PANEL WIRING AND PIPING

- A. Control panel shall be factory pre-wired in accordance with NFPA 70. Wire shall be thermoplastic Type THW, THWN, XHHW, or UL approve for the intended use, color or number coded, and run in plastic ducts to numbered terminal blocks. Control circuits shall be separately fused with properly rated cartridge type fuses. Power leads to and from magnetic starters and contractors shall terminate at terminal blocks so that field wiring is necessary only from terminal blocks to external equipment. Control leads to and from external control devices shall terminate at separate terminal blocks from power leads. Steam, draft, and air operated devices shall be factory piped to permanently affixed, external connections. Pneumatic signals shall be either 3 to 15 psig or 3 to 30 psig. Piping connections to indicators shall be copper tubing conforming to ASTM B 88. The boiler operating switch shall be a dust-tight sealed snap-action type. The precision switches shall have cadmium, silver, or platinum contacts, wiring action type, rated at 10 amperes. Electrically or pneumatically tested, controls and equipment shall be to simulate complete operational sequence.

2.8 [INSTRUMENTATION

- A. **[Provide a steam flow recorder: to remotely indicate, record and totaling the steam flow per hour through the steam header. Provide the panel-mounted indicating feed water pressure.]**

2.9 [BOILER FEED UNIT

- A. **Provide a triplex (3-pump) pumping boiler feed unit, ITT Industries, Bell & Gossett, Domestic Series, Seller or approved equal. The boiler feed unit shall include tanks, pumps, etc. and shall completely of stainless steel construction. The boiler feed unit shall have the following features:**
- 1. The unit shall be provided as a complete factory-assembled package.**
 - 2. The unit shall have horizontal welded stainless steel receiver, minimum 3/16 inch thickness with dished heads and inlet cascade baffle. The receiver shall be sized for 10 minute net storage of system water requirements.**
 - 3. The unit shall have gauge glass with a shutoff valve, dial thermometer, and low level cut-off float switch.**
 - 4. The unit shall be provided with centrifugal pumps with open drip-proof motors. The pump capacity shall be sized for 2 times the system return rate. The pumps shall be stainless steel.**
 - 5. The unit shall have a float switch, ¾ inch or 1 inch solenoid valve and “Y” strainer water make-up assembly.**
 - 6. The receiver shall have an inlet, vent and an overflow opening to provide means of secondary venting.**
 - 7. A suction isolation valve shall be installed between each pump suction and receiver to permit servicing of the pumps without draining the receiver.**
 - 8. The receiver shall be provided with lifting eye bolts, companion flanges, stainless steel inlet strainer with vertical self-cleaning stainless steel screen and large dirt pocket. The screen shall be easily removable for cleaning, requiring no additional floor space for servicing.**
 - 9. The unit shall also include the following items (all internal components shall be stainless steel): inlet basket strainer, suction butterfly valves, manhole, NEMA 2 UL Listed controls**

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panels, manual bypass assembly around solenoid water make-up valve, discharge pressure gauges, and high and low water alarms and required controls, and sparging tube. The feed water shall be pre-heated to 160 degrees F by introducing low pressure steam through the sparging tube, as indicated.

10. The water pumps shall be two-staged, centrifugal design, stainless steel construction, permanently aligned and flanged mounted for vertical operation. Each pump shall be sized for 2 times the boiler evaporation rate.
11. Each pump shall be close-coupled to a 3500 rpm, vertical, drip-proof motor and shall deliver its full capacity with condensate temperatures up to 210 degrees F at sea level, at 2 ft. NPSH. The carbon/ceramic mechanical shaft seal shall be rated for 250 degrees F.
12. Each pump shall include: axial flow first stage dynamically balanced impeller, straightening vanes, renewable case ring, shaft, discharge gauge port tapping, and drain tapping.
13. The water make-up assembly shall be installed on the receiver of capacity equal to one boiler feed pump. The assembly shall consist of; level control switch, electric solenoid valve (packless, piston pilot-operated type with cushioned closing feature and epoxy resin molded water proof coil and a manual bypass.)
14. The unit shall be sized for [XXXXXXXX sq.ft EDR], [XXXXXX lbs/hr], [XX gpm], and a pump discharge pressure of [XXX psig].
15. The control panel shall be a mounted and wired NEMA 2 control cabinet with drip lip and piano hinged door enclosing the following: combination magnetic contactor with adjustable thermal overload protection with fused disconnect and cover interlock for each pump, HOA selector switch for each pump, numbered terminal strip, fused control circuit transformer when the voltage exceeds 230 V, and a pump running light for each pump.
16. The control panel shall be equipped with all control points as listed in the Drawings.]

2.10 ANALOG BOILER CONTROLLER

- A. The Contractor shall provide and install an analog boiler controller, or approved equal. The controller, or approved equal, shall be used to control total dissolved solids in the steam generating system:
 1. The controller shall be used conductivity timed samples to determine blow-down and shall be provided with a blow down valve, solenoid and strainer or motor operated ball valve, needle valve or orifice union and plates for throttling blow down, a full-port gate valve for isolation of blow down assembly, and a flush valve for the sensor.
 2. A flow rate of a least [1] gpm is required at the electrode for proper operation. Hand valves shall be installed on both sides of the electrode to relieve pressure at the electrode for easy removal and period maintenance.
 3. The specified controller is configured to physically separate the low and high voltage connections. Use only 16 or 18 AWG wire for conduit power and load connections.
 4. The controller panel shall include the following: control LED, power LED, calibration adjustment knob, test switch, and set/read switch, trip point knob, analog scale, and range switch.

2.11 BOILER BLOW DOWN SEPARATOR

- A. Provide, as indicated, boiler blow-down separators with the following features:

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1. The tank shall be constructed of 316 stainless steel with tangential inlet pipe and stainless steel striking plate, vent opening, and discharge opening with spiral formed discharge directing plate, supported on 3 legs of indicated height.
2. Provide a cold water inlet in the discharge pipe and 2 thermometer wells.
3. Provide a temperature regulating valve in the water inlet with a temperature sensing bulb in lower thermometer well, bi-metallic thermometer in upper thermometer well, and Y-type strainer in cold water inlet line upstream of temperature regulating valve. Provide backflow prevention device in water inlet.
4. The boiler blow down separator shall be equipped with a thermostatically controlled domestic cold water connection as well as an auxiliary line piped from the new Reverse Osmosis (RO) water system providing a continuous blow-down of **[8 gpm of 500 ppm] TDS water**. The **[8 gpm RO water blow-down]** should be sufficient to properly cool the clean steam generator blow-down discharge. In a shortage of cooling however, the thermostatically controlled domestic water shall provide supplemental cooling. The clean steam generator blow-down discharge shall be cooled to at least **[140 degrees F]** before discharging into the building drainage system.
5. Acceptable manufacturers: **[Cemline, Penn Separator Corp., Wessels Co., York Shipley, Inc.,]** or approved equal.

2.12 [FLASH TANK

A. Provide a flash tank, as indicated, with the following:

1. **The tank shall be ASME code constructed and stamped for 150 lb. working pressure with 150 psig flanges.**
2. **Acceptable manufacturers: Cemline, Penn Separator Corp., Wessels Co., York Shipley, Inc., or approved equal.]**

2.13 CLEAN STEAM SUPPLY PIPING

- A. Clean steam piping shall be designed for a minimum service pressure of **[80 psig]** at **[250 degrees F.]** and be manufactured of Type 316 Stainless Steel conforming of ASTM A269 & A270. Tubing shall be fully annealed after welding. Tubing wall thickness shall be as follows:
 - B. Tube Size Wall Thickness
 - ¼ inch OD 0.035 inches**
 - 3/8 inch OD 0.035 inches**
 - ½ inch through 3 inch OD 0.065 inches**
 - 4 inch OD 0.083 inches**
- C. Clean Steam tubing shall be finished as follows:
 1. Interior finish shall be standard mill finish.
 2. Exterior finish shall be standard mill finish, except where un-insulated and exposed to view in finished, sanitary and classified areas. In these areas, exterior finish shall be 180 grit mechanical polished.
- D. Acceptable manufacturers: **[Colt Industries, Trent Tube Division, All-Tube Corp., Rath, United Industries,]** or approved equal.

2.14 BASIC PIPE FITTINGS

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- A. Provide tube fittings complying with the requirements of this section as follows:
1. Fittings: Clean steam and clean steam condensate tube fittings shall be suitable for fabrication into the system by the tank shall be ASME code constructed and stamped for **[150 lb.]** working pressure with **[150 psig]** flanges.
 2. Joints: Only automatic machine butt-welded and Tri-Clamp type joints shall be provided. Tri-Clamp type joints shall be used when connecting to valves, equipment, and accessories with Tri-Clamp type ends; otherwise, joints shall be automatic machine butt-welded. Exceptions shall be shown on the drawings. Flange type joints shall be provided only when absolutely necessary to mate up to flanged appurtenance. Threaded joints shall be provided only where Tri-Clamp to threaded adapters are indicated on the drawings. Teflon tapes shall be used on male pipe threaded joints. Pipe dope will not be permitted.
 3. Clamps: Tri-Clamp type for use in connecting to fittings, valves, equipment, and accessories with Tri-Clamp type ends.
 - a. ½ inch thru ¾ inch – Type 304 stainless steel, two segment, heavy construction with metal wing nut as manufactured by **[Tri-Clover, Inc.]**
 - b. 1 inch thru 4 inch – Type 304 stainless steel, two piece high pressure cast clam with Type 304 stainless steel bolts and aluminum-bronze nuts as manufactured by **[Tri-Clover, Inc.]**
 4. Gaskets (For Tri-Clamps specified above): For sizes less than 1" – provide flange molded one piece gasket of steam-resistant Viton as manufactured by **[Ladish Co., Tri-Clover division]**. For sizes 1 inch and greater, provide steam resistant Teflon envelope gasket with PTFE outer jacket and Viton rubber insert as manufactured by **[Ladish Co., Tri-Clover division.]**
 5. Manufacturers: Fittings shall be as manufactured in strict accordance with all product standards established for sanitary piping systems. All fittings shall be furnished by a sole manufacturer, and the mixing of different manufacturers in order to supply the necessary quantity of fittings required for the complete and entire Clean Steam systems installation is expressly prohibited and unacceptable.
 6. Fittings manufactured by the following suppliers are acceptable: **[Ladish Co. Inc., Tri-Clover Division, Valex Corporation, Cherry Burrell Corporation, TCI-Superior, Inc., ITT-Sherotec, Rober-James Sales, Inc.,]**or approved equal.

2.15 PRESSURE GAUGES

- A. Provide pressure gauges complying with the requirements of this section as follows:
1. Pressure Gauges: Pressure Gauges shall be sanitary pharmaceutical design, glycerine-filled, with stainless steel diaphragm, 3 inch diameter dial, 0-100 PSIG range, back or stem connection of sanitary clamp design.
 2. Pressure gauges manufactured by the following suppliers are acceptable: **[Ladish Co. Inc., Tri-Clover Division, Valex Corporation, Andersen Corporation, TCI-Superior, Inc., or approved equal.]**

2.16 BALL VALVES

- A. Provide valves in sizes and numbers as indicated on the drawings and schedules, complying with the requirements of this section as follows:

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1. Ball valves with 316 stainless steel tube I.D. full-port ball, 316 stainless steel stem, and 316L stainless steel body, with Tri-Clamp ends to match ferrules to which they are attached, TFE seat, packing and cavity filler, USDA approved, manual operation, stem extensions, 400 psig max. WP. Finish shall be same as finish specified for tubing. Maximum working temperature 450 degree F. **[Pittsburgh Brass Manufacturing SP Series.]**

2.17 CHECK VALVES

- A. ½ inch and ¾ inch – Spring loaded plug check valves with Type 316L (low carbon) stainless steel body, Viton plug and body gasket. Type 316 stainless steel spring, Type 304 stainless steel body clamp, Tri-Clamp type ends to match ferrules to which they are attached, finish same as specified for tubing, 230 psig – 72 degree F, 100 psig – 250 degree F, **[Tri-Clover, Inc. C45MPS.]**
- B. 1 inch thru 2-1/2 inches – Spring loaded disc check valves with type 316L (low carbon) stainless steel body, Viton body gasket, Type 316 stainless steel spider, spring, and disc, Type 304 stainless steel body clamp, Tri-Clamp type ends to match ferrules to which they are attached, finish same as specified for tubing, 150 psig – 70 degree F, 125 psig – 250 degree F, **[Tri-Clover, Inc. B45MP.]**

2.18 STEAM TRAPS

- A. Provide thermostatic type steam trap(s) on pure steam system as shown on the drawings.
 1. Acceptable manufacturers include; **[Spirax Sarco, Inc. – Thermostatic Type BT-6, Nickolson Division of Dartron Systems, Inc.,]** or approved equal.
 2. Steam trap shall be designed in conformance with 3-A sanitary fitting standards.
 3. Unit body, inlet side and outlet side, and elements shall be type 316L (low carbon) stainless steel. Unit two-part body shall be sealed with PTFE gasket sandwiched between inlet and outlet sides. Body Tri-Clamp shall be type 304 stainless steel two-piece, bolted high pressure cast clamp. Unit shall have polished type 316L stainless steel construction with internal finish of 180 grit. Unit shall have Tri-Clamp inlet and outlet connections with sizes shown on drawings.
 4. Unit shall be rated for maximum allowable pressure of 145 psi and maximum allowable temperature of 350 deg. F.
 5. Element shall have liquid filling with boiling point for operation approximately 10 degrees F below saturated steam temperature.
 6. Unit shall be self-draining when installed in vertical position as directed by manufacturer

2.19 NOISE LEVELS

- A. Noise measurements and exposure analyses should be conducted under the overall supervision of an industrial hygienist. Safety personnel engineers and others who have been approved by the Owner also may supervise the work. Maintain exposure limits of **[60]** dBA at the equipment and **[40]** dBA within lab areas. The sound level meter shall conform as a minimum to the Type 2 requirements cited in ANSI S1.4.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Arrange work in a neat and orderly manner so that minimum storage of equipment and material is required at the project site. Install equipment and material in accordance with the best commercial practices. A competent installation engineer or technician as stated in paragraph "Qualifications of Engineer" shall assemble an unassembled steam generator package in strict accordance with the

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manufacturer's instructions. Systems shall be neat in appearance, compact, adequate in construction and assembly, and installed for long and continuous service. Parts shall be readily accessible for inspection, repair, and renewal. Inspect equipment and material upon delivery and test after installation. Protect material and equipment from the weather. Repair damage caused by the Contractor in execution of the work and leave in a condition equal to that existing before work was started.

- B. Equipment foundations locate as shown and construct of sufficient size weight and of proper design to preclude shifting of equipment under operating conditions or under abnormal conditions that could be imposed upon the equipment. Foundations shall meet requirements of equipment manufacturer. Grout equipment mounted on concrete foundations before installing piping. Install piping in such a manner so as not to place a strain on equipment.
- C. Welding work shall be accordance with applicable Sections 23 0100 "Mechanical General Provisions" and 23 0300 "Basic Materials and Methods."
- D. Equipment shall be factory finished to withstand the intended end use environment in accordance with the specifications for the particular end item. Field paint equipment not factory finished as directed by Owner or specified in Division 09. Retouch damaged areas of factory-finished equipment on which the finish has been damaged and then give a complete finish coat to restore the finish to its original condition. The finish coat shall be suitable for exposure in the intended end-use environment.
- E. Cleaning and application to remove dirt, rust, oil, and grease by wire brushing and solvent degreasing prior to application of paint. Apply paint to clean and dry surfaces only. Where more than one coat of paint is specified, apply the second coat after the first coat is thoroughly dry. Retouch damaged painting before applying the succeeding coat. Finished surfaces shall be smooth. The painting of zinc coated and other corrosion-resistant metal surfaces is not required unless otherwise specified herein.
- F. Control module installation, operation, and maintenance procedures shall be performed by trained/certified personnel. All personnel performing these procedures should completely and carefully read and understand product literature before attempting installation, and maintenance procedures. Personnel shall be trained in and familiar with correct piping and electrical procedures and methods and shall be experienced in working with hot boiler water systems and steam systems.
- G. **[Boiler feed unit shall be installed in accordance with the manufacturer's instructions. Power wiring, as required, shall be the responsibility of the Contractor. All wiring shall be performed per the manufacturer's instructions and applicable state, federal, and local codes. All factory wiring shall be numbered for easy identification and the numbers shall coincide with those shown on the wiring diagram. All interconnecting wiring between the pump controls and control panel shall be enclosed in liquid tight flexible conduit. The unit shall be factory tested as a complete package and the unit manufacturer shall provide elementary and connection wiring diagrams, piping diagrams, installation and operation instructions. The unit manufacturer shall furnish, mount on the unit, and wire a NEMA 2 control cabinet with drip lip and piano hinged door. A certified test report shall be provided by the factory.]**
- H. Analog boiler controller shall be mounted in a location convenient to electrical and plumbing connections and easily accessible by the operator for cleaning and maintenance. Installation shall comply with all local, state, and national codes. The controller shall be mounted vertically on a wall or a permanent vertical support with adequate lighting and a comfortable height for accessibility. Installation shall be in accordance with the manufacturer's instructions.

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- I. Steam generator cleaning after installation, each steam generator shall be boiled out, under supervision of the manufacturer, with soda ash or equivalent solution to clean internal surfaces of oil, grease, mill scale, and dirt. Following treatment, the generators shall be flushed, drained and then opened and washed down and inspected to ensure that no traces of oil or foreign matter are present. The steam generators and associated piping shall then be drained and refilled with treated softened water. At all times after initial cleaning, the Contractor shall protect the steam generators, tank, and piping against internal corrosion until testing is completed and the steam generators are accepted. Provide chemicals, labor for introducing chemicals, and professional services for control and supervision of the treatment process.

3.2 FIELD QUALITY CONTROL

- A. Perform inspections and tests as specified herein to demonstrate that the steam generators and auxiliary equipment, as installed, are in compliance with contract requirements. During steam generator system start-up tests, factory-trained engineers or technicians employed by individual suppliers of such components as the feed water treatment equipment, and other auxiliary equipment shall be present, as required, to ensure the proper functioning, adjustment, and testing of individual components and systems. No bypassing, use of jumpers, or other disablement of control systems will be allowed unless specified elsewhere. Labor, equipment, and test apparatus required for testing shall be furnished by the Contractor. Rectify defects disclosed by the tests by the Contractor within time period specified by the Owner.
- B. Inspection and tests make inspections and tests at the site under direction of and subject to the approval of the Owner. The Contractor shall operate each steam generator and appurtenances prior to final testing and shall ensure that necessary adjustments have been made. A 48-hour written notice shall be submitted to the Owner indicating the equipment is ready for inspection and testing. Provide testing equipment, including gages, thermometers, calorimeter, Orsat apparatus, thermocouple pyrometers, water meters, and other test apparatus and set up and calibrate prior to the test. Steam flow may be measured by permanent gages and meters installed under the contract. Tests shall include the following, and shall be performed when feasible, in the sequence listed:
 1. Strength and Tightness Tests: Subject steam generators to the following strength and tightness tests.
 2. Hydrostatic Test: After installation and connection, subject each steam generator to an inspection and hydrostatic test to determine that the units and appurtenances have not been damaged in transit or handling. The hydrostatic test shall be in accordance with the ACME Code with the latest test pressure applied for a period required by the Owner. This test shall be in addition to the hydrostatic tests performed at the factory.
 3. Pneumatic Tests: Pneumatically test air casing exterior to the steam generator at the maximum working pressure. Use the soap bubble method to verify tightness.
 4. Safety Valves: The high pressure limited switch shall be locked out or otherwise made inoperative, and the steam generator safety valves shall be lifted by steam. Determine the relieving capacity, popping pressure, blow-down, and reseating pressure by observation and measurement to be in accordance with the ASME Boiler and Pressure Vessel Code. The ASME standard symbol will be accepted only as indicating compliance with the design and material requirements of the code.
 5. Operation Test: Continuously test the steam generators under varying load conditions to demonstrate proper operability of the programming control and safety interlocks. Conduct this

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Clean Steam Generators and Accessories

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test after the adjustment of the controls has been completed. The operational test shall continue for a period of at least 8 hours and shall include the following:

Sequencing: The steam generators shall start, operate, and stop in strict accordance with the specified operating sequence.

Preliminary Operational Test: Operate each steam generator and appurtenances prior to the final testing and ensure that necessary adjustments have been made. Provide testing equipment required to perform tests. During this testing period, provide operating instructions and training to persons tasked with operation of the steam generator.

6. Auxiliary Equipment and Accessory Tests: Observe and check blow-down valves, stop valves, try cocks, draft fans, pumps, electric motors, and other accessories and appurtenant equipment during the operational and capacity tests for leakage, malfunctions, defects, noncompliance with referenced standards, or overloading, as applicable.

3.3 MANUFACTURER'S SERVICES AND FIELD QUALITY CONTROL

- A. Warranty: The entire unit and components shall have a minimum one year warranty.
- B. Start-up Service: Entire unit shall have a start-up service and one year service period by factory-trained personnel.

END OF SECTION 23 5710