SECTION 15518 – PACKAGED HIGH PRESSURE STEAM FIRE-TUBE BOILERS AND ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 WORK INCLUDED

A. Furnish and install fire-tube boilers of the size, type, capacity and quantity as shown on the contract drawings.

B. Each boiler shall have all self-contained controls and safety devices and shall be capable of independent operation.

C. Each boiler shall include an UL certified and listed burner and controls. The boiler shall bear the UL package B label.

D. The gas train shall be IRI accepted, including all controls.

E. All boilers shall be installed in accordance with all local, State and Federal codes.

F. Secure all permits and local/State approvals for the installation of the boilers including all operating and installation permits.

1.3 RELATED SECTIONS

A. Examine all drawings and criteria sheets and all other Sections of the Specifications for requirements, which affect work under this Section whether or not such work is specifically mentioned in this Section.

1.4 REFERENCES

A. Applicable provisions of the following Codes and Trade Standard Publications shall apply to the work of this Section, and are hereby incorporated into, and made a part of the Contract Documents.

B. Material standards shall be as specified or detailed hereinafter and as follows:

1. AGA (DIR) – Directory of Certified Appliances and Accessories.
2. ANSI Z21.13 – Gas-Fired Low-Pressure Steam and Hot Water Boilers.
3. ASME (BPV I) – Boiler and Pressure Vessel Code, Section I, Rules for Construction of Power Boilers.
4. ASME (BPV IV) – Boiler and Pressure Vessel Code, Section IV – Rules for Construction of Heating Boilers.
5. ASME (BPV VIII, 1) – Boiler and Pressure Vessel Code, Section VIII, Division 1 – Rules for Construction of Pressure Vessels.
6. HI (TRS) – Testing and Rating Standard for Boilers; Hydronics Institute.
7. NEMA 250 – Enclosures for Electrical Equipment (1000 Volts Maximum).
8. NFPA 31 – Installation of Oil Burning Equipment.
9. NFPA 54 – National Fuel Gas Code.
10. NSPA 58 – Storage and Handling of Liquefied Petroleum Gases.
11. NFPA 70 – National Electrical Code.
12. UL 726 – Oil-Fired Boiler Assemblies.
13. UL (GOED) – Gas and Oil Equipment Directory; current edition.

1.5 SUBMITTALS

A. See Section 15050 and General Conditions for Additional Requirements.

B. Product Data: Provide data indicating general assembly, components, controls, safety controls and wiring diagrams with electrical characteristics and connection requirements.

C. Manufacturer's Instructions: Indicate assembly, support details, connection requirements and include start up instructions.

D. Manufacturer's Field Reports: Indicate condition of equipment after start-up including control settings and performance chart of control system.

E. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, cleaning procedures, replacement parts list and maintenance and repair data.

F. Warranty: Submit manufacturers warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

G. Drawings

1. Control Panel layout and physical dimensions.
2. System Schematic.
3. All field instruments including pressure temperature, level, flow devices.
4. All control devices and instruments for the control panel.
5. Combustion safeguard system schematic, wiring diagram and related control devices.

6. Interconnection diagram of control panel.
7. Sequence of operation for each Instrument component.
8. Dimensioned drawings showing all connections.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum ten (10) years of documented experience.

B. The boiler manufacturer shall submit a statement of guaranteed fuel to steam efficiency at 25, 50, 75, and 100% for each fuel to be burned, as scheduled.

1.7 REGULATORY REQUIREMENTS

A. Conform to all applicable code and NFPA 70 for internal wiring of factory wired equipment.

B. Conform to ASME/BPV I, BPV IV, BPV VIII and ANSI Z21.13 for boiler construction.

C. Units: UL labeled and listed.

D. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.8 DELIVERY, STORAGE AND HANDLING

A. Protect units before, during and after installation from damage to casing by leaving factory shipping packaging in place until immediately prior to final acceptance.

1.9 WARRANTY

A. See Division 1 – Contract Closeout for additional warranty requirements.

B. Provide a one (1) year warranty to include coverage for pressure vessels.

C. Installation shall be guaranteed free from defective materials and workmanship for a period of (1) year from date of acceptance by the Owner. Any repairs required during guarantee period shall be done by the Contractor at his own expense.

D. The Contractor shall provide service to all elements of the system free of charge to the Owner for (1) year from the date of acceptance by the Owner.

PART 2 – PRODUCTS

2.1 PACKAGED FIRE-TUBE HIGH PRESSURE BOILERS

A. General

1. Furnish and install as scheduled and detailed on the drawings and in strict accordance with manufacturer's recommendations and all State and Local Codes, high pressure steam boilers quantity and rated capacities as scheduled. Each unit shall produce high pressure steam at the scheduled design pressure.
2. Acceptable manufacturers subject to compliance with the specifications shall be as follows:

    a. Cleaver Brooks
    b. Johnston Company
    c. Kewanne
    d. If the Contractor elects to submit on other named equipment, the Contractor shall be fully responsible for costs and labor for all revised engineering, calculations, revised submittals to governing authorities. The Contractor shall also be responsible for any delays or stack modifications (if necessary), due to the revision.
    e. The specified boiler utilizes built in flue gas recirculation. If an external flue gas recirculation system is proposed by the Contractor, the Contractor shall be responsible for all costs associated with extra engineering work for configuration and spacing. In addition, the Contractor shall pay for all extra costs for breeching modifications, FGR ductwork, external FGR fan, power and control wiring, disconnect switches and any motorized controllers that may be required. Any external fan must fit the space, preferably over head on a structural stand by the Contractor. Any FGR external ductwork and fan must be insulated with 2” thick thermal insulation with aluminum wrap.

3. Boilers shall be designed for the electric power characteristics, as scheduled, including a control transformer mounted on the boiler.
4. The boiler shall be 4-pass dryback horizontal firetube design with 5 sq.ft. heating surface per rated boiler horsepower, mounted on a heavy steel base frame and complete with integral forced draft blower, burner controls, trim and refractory. The complete packaged boiler shall be completely preassembled and fire tested at the factory, and shall be ready for attachment of water, fuel, blowdown, electrical and breeching connections. Each boiler shall come complete with a UL listed motorized damper end switch and relay with terminals for fresh air/combustion air intake interlocking.
5. All boilers shall be constructed in accordance with ASME and all applicable State Boiler Codes and shall receive authorized boiler inspection prior to shipment. A copy of the inspection reports shall be furnished for Owner's use. The front and rear doors shall be hinged or davitted.

The doors or heads shall be sealed with fiberglass tadpole gaskets and fastened tightly using heavy duty capscrews that thread into replaceable brass nuts. Front tube sheet and all flues shall be fully accessible for inspection of cleaning when the doors are swung open. Observation ports for the inspection of flame conditions shall be provided at each end of the boiler.

6. Rear refractory and insulation shall be contained in the rear door, which shall swing open for any inspection of the refractories and tube sheet. The exhaust vent shall be located in the rear of the boiler on the top center line and shall contain a stack thermometer. The boiler insulation shall consist of a 2" fiber glass blanket under a sectional preformed sheet metal lagging. Lagging and insulation shall be readily removable and replaceable.
7. The entire boiler base frame and other components shall be factory painted prior to shipment using a hard finish enamel.
8. The following items and accessories shall be furnished and mounted on the boiler:

    a. Low water cutoff and pump control, McDonnell Miller 157 mounted on the righthand side and an auxiliary low water cutoff, McDonnell Miller 150 M.R. on the left side.
    b. 8" dial pressure gauge.
    c. Solid state operating high limit and modulating pressure controls.
    d. Safety valves of type and size, as scheduled, to comply with ASME Code requirements.
    e. Insulation and lagging consisting of 2" fiberglass blanket under a removable preformed l6 gauge jacket.
    f. Self check scanner, CB Hawk or Honeywell BC7700 with enhancer.
    g. Stack thermometer.
    h. Provide an overflow drain connection 8" above normal water level, 1 1/2" screwed tap.
    i. Feedwater tapings with adjacent 3/4" chemical feed tapings with dispersion tube.
    j. Complete IRI Gas Train with gas pressure regulators mounted. HVAC Contractor to vent valves to atmosphere.

B. The boiler shall be equipped with a low emission (LE) option for guaranteed NOx performance at 30PPM, dry volume basis and corrected to 3% O2 when firing natural gas. The low emission option shall include an integral front head, burner, and boiler package, providing NOx reduction through an internal flue gas recirculation system using the combustion air fan, internal recirculation valve, and enhanced boiler design to achieve the guaranteed NOx levels. The emission control system shall not use an external fan, control valve, and piping. Boiler fuel-to-steam efficiency and rated capacity shall be guaranteed while the boiler is operating at low NOx performance levels. Burner, boiler and low NOx system shall be manufactured as a package by a single manufacturer. The low emission option to the specified boiler shall include factory testing as a package, and bear the UL package label.

The boiler nameplate shall include the approved UL low NOx boiler model designation. No field assembly of the burner or low NOx equipment shall be required.

1. Light Oil or Gas Fired

    a. Burner Type – The burner, integral with the front head of the boiler, shall be a combination of the low-pressure air atomizing type for oil and high radiant multi-port type for gas. The burner shall be approved for operation with either #2 oil or natural gas. The burner shall be equipped with a LE option.

    b. Gas Pilot – The gas pilot shall be a premix type with automatic electric ignition. An electronic detector shall monitor the pilot so the primary gas valve cannot open until pilot flame has been established. The pilot train shall include two manual shutoff valves, solenoid valve, pressure regulator and pressure gauge.

    c. Oil Burner

        1) Oil Pump – An oil pump with a capacity of approximately twice the burning rate shall be included. Separate motor driven pump set, shipped loose to be installed in a location favorable to the oil storage tank, shall be provided.

        2) Oil Burner Piping – Fuel oil piping on the unit shall include oil pressure regulating devices, oil metering controls, solenoid shutoff valves, pressure gauges and fuel strainer, all integrally mounted on the unit. A fuel oil controller shall be provided to combine all of the fuel oil controls into a single casting, which is mounted on the front door of the unit. A single tip retractable nozzle shall be used for the low-pressure air atomizing burner. A low oil pressure switch shall be included in the oil piping.

        3) Low Pressure Air Atomizing – Separate air compressor module mounted on the boiler base rail with low atomizing air pressure switch.

    d. Gas Burner –

        1) Gas Burner Piping – Gas burner piping on all units shall include primary gas shutoff valve, motor operated with proof of closure switch and plugged leak test connection. The main gas valves shall be wired to close automatically in the event of power failure, flame failure, low water or any safety shutdown condition. A lubricating plug cock or butterfly shutoff valve shall be provided as a means for a tightness check of the primary shutoff valve. An additional plug cock or butterfly valve shall be furnished at entrance to gas train. High and low gas pressure switches shall be provided. A second motorized safety shutoff valve, plus an additional plugged leakage test connection shall be provided. A vent valve shall be located between safety shutoff valves.

2) Turndown Range – Turndown range of the burner shall be 10:1 when firing natural gas and 8:1 on #2 oil.

C. Each boiler shall be factory equipped with a boiler management control providing technology and functions listed below. The system shall consist of a computer based control system with the following attributes:

1. Automatic sequencing of the boiler system during all phases of operation.
2. Flame proving and lockout on flame failure from pilot proving through run.
3. Low damper motor position for main flame ignition trials.
4. Full modulating control of fuel and combustion air as well as firing rate control.
5. Programmable non-jumperable solid state control and limit sensors.
6. On/off and proportioning control.
7. Monitoring of oil temperature and hi/low limits.
8. Monitoring of the 400-position damper motor.
9. The system shall also be capable of detecting a bad sensor. The system shall also incorporate a boiler characterization program for each individual boiler model number to tailor pre and post purge cycles, limit on/off cycling, allow for precise rate control and load tracking, in addition to integrated thermal stress protection and assured low fire cutoff when terminal power is removed.
10. An 80-character 2-line keyboard display for single-point control setting and display of (73) Fault Messages, (47) Status Messages and (34) Historical Messages as well as system operating pressures and temperatures. Boiler firing rate shall also be displayed in addition to the last (6) lockouts and boiler operating information when the lockout occurred. Provisions for a security access code shall be provided.
11. A 2-way communications module with built in modem to allow for remote control of non-safety settings and monitoring of up to (6) boilers shall also be available. Up to (3) preprogrammed telephone numbers shall also be available to be called in the event of a fault condition. Provide lead/lag controls system. This module shall be able to interface with a standard IBM PC or compatible system.

D. Major functions of the boiler management system shall provide:

1. Automatic sequencing of the boiler system through standby, prepurge, pilot flame establishing period, main flame establishing period, run and postpurge.
2. Flame proving and lockout on flame failure during pilot flame proving, main flame providing, or run.
3. Low damper motor position for flame ignition trails.
4. Full modulating control of fuel and combustion air as well as firing rate controls.
5. Utilize solid state control and limit sensors providing the following control functions:

    a. Steam on/off and proportioning control.
    b. Gas pressure high and low pressure limit
    c. Damper motor high and low fire damper motor position

d. Manual control of the damper motor utilizing slewing keys to increment and decrement the damper motor position status LEDs indicating:

1) Demand present (Green LED)
2) Main fuel valve energized (Yellow LED)
3) Alarm (Red LED [2])
4) Proper programmer operation (Pulsing Green LED)

e. Field replaceable 10A fuse in the valve and ignition control circuit for short circuit protection.
f. NEMA 1 rated enclosure
g. Line voltage terminal inputs for lockout, pre-ignition, and recycle limits and interlocks
h. (73) Separate annunciation faults including damper motor operation, gas pressure limit operation, and hot water sensor control operation.
i. Self test for proper operation
j. Monitor system circuits status
k. Tamper resistant safety logic and timing
l. First out annunciation and diagnostics via a LCD
m. Thermal stress delayed release to modulation
n. Non-volatile lockout and history files with last (6) lockouts readable through integral LCD display
o. Dynamic Ampli-Check as standard flame amplification protection
p. Characterization to the applied boiler for firing rate control, cycling control, and system prepurge
q. A configurable rate linearization parameter which defines the relationship between motor position and firing rate and including drive to purge rate
r. Capability for remote or local communications to a personal computer, including the capability to change non-safety related parameters remotely
s. Ability to be able to be installed in a continuous 0.5G environment

E. Major System Components are:

1. Chassis Module
2. Program Module
3. Keyboard and Display Module
4. Flame Amplifier, Dynamic Ampli-Check Infrared
5. Damper Motor (90° stroke, 400-position)
6. Flame Sensors (Steam pressure 0 to 15 psig range)
7. Limit Sensors (Gas Pressure Limit 30 psi range)

F. All boiler management control wiring shall be in accordance with the NEC and local electrical codes.

G. The boiler management control shall provide the following safety provisions:

1. Dynamic self check safety circuit. The boiler management controls' microcomputer should continuously test itself and related hardware for proper circuit operation.
2. Examine all load terminals to assure it is capable of recognizing the true status of external controls, limits and interlocks. If any input fails this test, the boiler management control should lockout on safety shutdown.
3. Closed loop logic test of all safety critical loads (oil main valve, ignition transformer and pilot valve) and must be able to lockout on safety shutdown if any safety critical load is identified as operating improperly.
4. Dynamic safety relay and contact. The control shall check the proper operation of the safety circuit, ability to open and close relay contact. This will assure the boiler management control is capable of de-energizing all safety critical terminals (main oil valve and ignition transformer).
5. Dynamic amplifier check of the flame signal amplifier. The control flame signal amplifier must be able to recognize a no flame signal during this dynamic amplifier check.
6. Safe start check and expand check to include monitoring flame signal during standby.
7. Monitoring the damper motor via a feedback circuit to assure the damper motor is at the required position within 60 seconds, the damper motor is slewing properly, and the damper motor is within 0° to 90° and ensures proper amount of prepurge air.
8. Will automatically return the burner to the low fire position before shutting off when power is interrupted.
9. Tamper resistant timing and safety logic.
10. Require mandatory reprogramming when being installed in another boiler.

H. The boiler management control system shall provide these annunciation and diagnostics:

1. First out annunciation plus time and cycle in sequences of fault occurrence.
2. Indication of sequence failures at start-up or during normal sequence operation.
3. Test itself for failure, detect and isolate an alarm, and report internal circuit faults.
4. The ability of reading limit sensor voltages and resistance at connector interface.
5. English text description of the system fault, while maintaining the last (6) faults in historical memory, which are readable through the LCD display.
6. The boiler management control shall be able to operate in these environmental conditions:

    a. 32°F to 130°F temperature range
    b. 85% RH continuous, non-condensing, humidity
    c. 0.5G continuous vibration
    d. 120 VAC (+10/-15%) 50/60 Hz voltage/frequency
    e. Maximum connected load of 2000 VA

I. Boiler management control system component functions follows:

1. Chassis Module: Provides mounting means and line voltage I/O for the boiler room control.
2. Program Module: Provides boiler sequence logic to meet FM/IRI approval body requirements. The program module is the location of the system microcomputer, which generates fault messages and descriptions and processes boiler room I/O.
3. Keyboard and Display: Provides user interface to the system for sequence status fault history, and system configuration interface, all via a 2-row by 40-character LCD.
4. Infrared Flame Amplifier or UV Amplifier: Provides flame signal amplification. A dynamic ampli-check of the flame signal amplifier's circuitry is conducted to assure the amplifier responds to loss of flame.
5. Gas Pressure Sensor: Provides a 1 VDC to 6 VDC signal to the boiler room control. The oil pressure sensor provides high and low oil pressure limit with gas pressure range of 25 to 150 psi.
6. Steam Pressure: Provides a resistance signal to the boiler room control indicating steam pressure at the sensor well assemble. Provides on/off and release to modulation control of the burner. The sensor has a range of 0 to 150 psig.
7. Damper Motor: Drives firing rate valve and combustion air damper based on input from the boiler controller to purge the combustion chamber, provide fuel and air in proper proportion, and vary burner firing rate to meet the load demand on the boiler.

J. Each boiler will be forced draft design and the fan shall be located in the front door of the boiler and shall be caseless, cast aluminum design, non-overloading with backwardly curved vane. The air damper shall be rotary discharge type assuring precise airflows at all loads. The boiler burner operating noise level shall comply with ratings established by the Walsh-Healy Act with sound levels not exceeding the scheduled dBA on high fire gas. The boiler manufacturer shall submit a sound level data as part of the boiler submission. If the forced draft fan is external in front of unit, it shall be supplied with intake silencer and acoustical tile lined sound retention box to insure quiet operation. If the atomizing air compressor is a reciprocating type, it shall be mounted in an acoustical tile lined box to deaden sound levels.

K. Control Panel

1. A control panel shall be provided for the boiler and be mounted at eye level on the front door of each boiler. The hinged metal cabinet shall have a NEMA IA enclosure with neoprene dust seal and Yale cabinet key lock. The panel shall contain the boiler Management control, blower motor starter, self-blocking plug-in fuel modules.

2. The boiler management system shall incorporate the following:

   a. Automatic sequencing of the boiler system through standby, purge, pilot flame establishing period, main flame establishing period, run, and postpurge.
   b. Flame proving and lockout on flame failure during pilot flame proving, main flame proving, or run.
   c. Low fire damper motor position for flame ignition trials.

d. Full modulating control of fuel and combustion air as well as firing rate control.
e. Utilize solid state control and limit sensors providing the following control functions:

1) Steam On/Off and Proportioning Control
2) Gas Pressure High and Low Pressure Limit
3) Oil Temperature High and Low Temperature Limit
4) Damper Motor High and Low Fire Damper Position

f. Manual control of the damper motor utilizing slewing keys to increment (+) and decrement (-) the damper motor.
g. Status LEDs indicating:

1) Demand present (Green LED)
2) Main Valve energized (Yellow LED)
3) Alarm (Red LED [2])
4) Proper programmer operation (Pulsing Green LED)

h. Field replaceable 10A fuse in the valve and ignition control circuit for short circuit protection.
i. NEMA 1 rated enclosure
j. Line voltage terminal inputs for lockout, pre- ignition, and recycle limits and interlocks.
k. (73) Separate annunciation faults including damper motor operation, oil pressure limit operation, oil temperature limit operation, and hot water sensor control operation. steam pressure sensor control operation.
l. Self test for proper operation
m. Monitor system circuits status
n. Tamper resistant safety logic and timing
o. First out annunciation and diagnostics via a LCD
p. Thermal stress delayed release to modulation
q. Non-volatile lockout and history files
r. Dynamic ampli-check as standard flame amplifications protection.
s. Characterization to the applied boiler for firing rate control, cycling control, and system prepurge.
t. Capability for remote or local communication to a personal computer.
u. Ability to be able to be installed in a continuous 0.5G environment.

3. A manual/automatic selector switch and damper motor position switch shall be provided. This switch shall permit automatic firing in accordance with load demand, or manual control of the firing rate at any desired point between low fire and maximum rating.

2.2 SINGLE TANK DEAERATOR

A. Furnish and install as shown on the schedule a spray type, pressurized horizontal deaerator. The system shall be of the single tank design and shall guarantee oxygen removal to not more than 0.005 ccs/liter in the effluent throughout all load conditions between 5 and 100 percent. Two-compartment designs are not acceptable. The deaerator shall be designed for operation at 5 psig, but shall be suitable for use from 2 to 15 psig. Atmospheric operating designs are not acceptable.

B. Feedwater and condensate shall be admitted to the deaerator through a single spring-loaded, self-cleaning, adjustable stainless steel spray valve, which shall provide proper internal vent condensing and water distribution at any load between 5 and 100 percent of rated capacity. The water temperature in the primary heating and vent concentrating section is to be raised within 2 or 3°F of steam temperature and most of the gases released. The water is then to be collected in a conical water collector. From there, it is to flow to an atomizing valve where high velocity steam strikes it, breaks it down into a fine mist, and heats it to a full steam saturation temperature. The mixture is to strike a deflecting baffle, which separates water and steam. Hot, gas-free water is to then drop to the storage compartment to complete the cycle. The steam and non-condensables are to flow upward, through the primary heating spray, into the internal vent concentrating section, where they contact the cold influent water. Here, the steam is to be condensed to continue the cycle. Release gasses are discharged to atmosphere through the vent outlet. All internal surfaces, which come in contact with un-deaerated water, shall be constructed of Type 316 stainless steel.

C. Automatic vent valve shall be thermostatically controlled to provide a fast means of venting when a sudden buildup of gases occurs, such as seen at start up. The manual vent valve shall have an orifice for continuous minimum venting. Venting rate shall not exceed 0.1 of 1% of the rated deaerator capacity at 5 psig.

D. The deaerated water storage tank shall have 10 minutes of storage and have a gallon capacity as scheduled measured to overflow. An 11” x 15” elliptical manhole shall be provided for access. All nozzles 3” and under shall be 3000 lbs. forged steel couplings and over 3” shall be 150 lbs. flat face flanges. Heads to be ASME torispherical type constructed of ASTM A516 GR 70 carbon steel with a minimum thickness of 0.25 inches. Shell plate to be fabricated of ASTM A516 GR 70 carbon steel with a minimum thickness of 0.25 inches. The tank shall be designed in accordance with ASME, Section VIII of the Pressure Vessel Code for 50 psig at 650°F and stamped accordingly. Certification shall be required. Joint efficiencies to be 70% circumferential per Table UW-12, which does not require stress relieving or nondestructive examination.

E. The deaerator loads shall be a combination of returns as defined below. Low temperature returns are defined as condensate with a temperature below that of the deaerator operating temperature. High temperature returns are defined as condensate with a temperature above that of the deaerator operating temperature.

F. Insulation

1. The tank shall be factory insulated and lagged with blanket insulation, pins, clips and a durable steel jacket. Block-type insulation is not acceptable. The blanket insulation is to be fiberglass, 2" thick, 1 lb./cubic foot, and have a rating of R3.85. Pins are to be located on 18" centers and holding clips attached. The steel jacket or lagging shall have a shell thickness of 22 gauge (0.299") minimum and head thickness of 12 gauge (0.1046") minimum.
2. The tank shall be factory-lined with a high quality baked epoxy lining. The lining is to be applied to a sandblasted (SSPC-SP-5) white metal surface. Spray-apply 4 to 6 coats with each dry coat being approximately 1.5 mils dry for a total thickness of 6 mils dry minimum. Baking schedule for intermediate coats to be 10 minutes at 250 to 300°F and final baking to be 1-1/2 hours at 350 to 400°F. Lining to be Holiday spark tested using low voltage and a wet sponge to ensure uniform coating free of pinholes. Magnesium anodes shall not be acceptable in this application. The lining is to meet requirements of FDA and MID of the USDA. The lining is to be suitable for temperatures up to 250°F.

G. Diffuser

1. The high temperature diffuser or sparge tube shall be located beneath the normal tank water level. The tube shall be constructed of 2-inch pipe. This tube shall provide even distribution and blending of high-temperature condensate returns.

H. Make Up Valve and Controller

1. Electronic Make-Up Valve

a. Inlet water motorized regulating valve with steel body and threaded NPT connections. Motor shall be 110V bi-directional, with a permanently lubricated gear train, and be directly coupled to the valve stem. Valve shall not exceed a delta-P of 10 psig. This valve shall have teflon seats and be suitable for temperatures up to 300°F. This valve shall be electronically controlled by a solid state control with internally mounted capacitance probes. The electronic solid state control shall be able to set desired level point and acceptable deviation. The electronic solid state control shall include a selection for automatic and manual operating mode. The internals shall include two additional probes for high and low water alarm. The controller shall be similar to Cleaver-Brooks Model TW82. A solenoid valve and float switch are not acceptable.

2. 3-Valve Bypass

a. The make up valve shall include an ANSI Class 150 lb. three –valve bypass with inlet U-type cast iron strainer. Strainer screen to be removable and of stainless steel construction.

I. Steam Pressure Reducing Station

1. Mechanical Steam Regulating Valve

a. Steam pressure reducing valve with cast iron body and threaded NPT connections. The valve shall be normally closed on loss of air. The valve shall be a self-contained unit capable of reducing saturated steam to the operating pressure of the deaerator at a flow rate as scheduled. The valve shall be 250 lb. class and have stainless steel trim and adjustable pilot. The valve shall be Spence.

2. 3-Valve Bypass

a. The steam pressure-reducing valve shall include an ANSI class 150-lb. three-valve bypass with Y-type strainer. Strainer screen to be removable and of stainless steel construction.

3. Relief Valves

a. Relief valves sized to relieve full capability of the pressure-reducing valve in the event of its failure. Valves to meet Paragraph UG-125 of ASME Unfired Pressure Vessel Code, Section VII. Valve body to be of bronze construction. Relieving set pressure to be 50 psig. Relief valve manufacturer to be Kunkle.

J. High Level Alarm

1. Audible and visual high and low water alarm function shall be provided by a bell or horn with silence switch and individual red oil-tight lights.

K. Overflow Drainer

1. Overflow drainer sized to relieve full capacity at the operating pressure of the deaerator. The overflow drainer shall be a float type trap. The construction is to be a steel housing with stainless steel float ball. The overflow drainer manufacturer shall be Warren.

L. Suction Piping

1. Suction piping for pumps shall consist of a gate valve, cast-iron Y-type strainer wit replaceable stainless steel screen and flexible connector or hose. This piping assembly shall be 125 lb. class construction. The vortex breaker shall be located in the tank nozzle. Manifold suction lines are not acceptable.

M. Boiler Feedwater Pump and Motor Set

1. Two (2) centrifugal type boiler feedwater pumps and motor sets. Turbine type pumps are not acceptable in this application. Pumps shall be rated for as scheduled with

three (3) feet NPSH required. Pumps to have mechanical seals for a maximum water temperature of 250F. Pump impeller to be hydraulically balanced. The pump shall be mounted on a steel baseplate and flexibly coupled with an OSHA type coupling guard to a TEFC motor. Motors to be non-overloading at the rated condition without using any portion of the service factor. Pump and motor set to be factory aligned prior to shipment. Pump manufacturer shall be as scheduled. A stainless recirculation orifice is to be supplied with the pump and shipped loose for field installation to provide minimum bypass flow.

2. Stand

   a. The stand shall elevate the deaerator tank to provide the net positive suction head required by the pump at the rated condition to prevent caviation plus a 1-1/2 foot safety factor. The stand shall be constructed of heavy square steel tubing for the legs and ¼" steel plate covering the floor. Stand shall be no more than 6' in height.

3. Control Panel

   a. Control panel shall be in a NEMA 1 enclosure and wire to the National Electric Code. The wire shall be black number coded. The assembly is to contain individual motor starters with 120 Volt holding coil and fuse protection. Individual green oil-tight pump run lights shall be provided. All switches and lights to have nameplate identification. The assembled panel shall be given a factory continuity test prior to shipment.
   b. Control circuit transformer to supply 110-120 Volts, single-phase power supply. The transformer shall be mounted, wired and fused.

N. The deaerator shall have a gauge glass assembly that covers the entire tank diameter. The gauge glass shall be quartz 0.625 inch diameter by 24 inch maximum length. Each length of glass shall be furnished with a bronze gauge cock set and protector rods.

O. The deaerator shall be supplied with a pressure gauge that has a 4-1/2 inch dial with 0-60 psig range and a thermometer with a 50 to 300°F range. Packaged units are required to have both gauges bracket-mounted at eye level.

P. The deaerator is to be hand cleaned with a solvent to SSPC-SP-1 standards prior to painting. Prime coated to not less than 1mil thick and finish coated with an enamel paint to not less than 1 mil thick prior to shipment.

Q. The deaerator unit is to be knocked down for shipment. Piping is to be matched marked. Three bound Operating and Maintenance manuals to be provided. Warranty period to be twelve months after start-up or eighteen months after shipment, whichever comes first.

2.3 SURGE TANK

A. Provide atmospheric, horizontal surge tank size and capacity as scheduled similar to Cleaver Brooks Clever Brooks

B. The surge tank shall receive returning condensate and supplement make-up water to maintain the desired operating level. Condensate and make-up water mix into a blended temperature as determined by the percentage of each. The surge tank shall be vented to atmosphere. The collected water is then transferred to the deaerator.

C. The surge tank shall have (15) minutes of storage and a minimum capacity as scheduled gallons flooded. An elliptical manhole shall be provided for access. All nozzles shall be 3,000 lbs. forged steel couplings. Heads shall be ASME torispherical type (flat heads are not acceptable) constructed of ASTM A516 GR 70 carbon steel with a minimum thickness of 0.25". Shell plate to be fabricated of ASTM A36 carbon steel with a minimum thickness of 0.25".

D. Tank shall be factory insulated and lagged with blanket insulation, pins, clips, and a durable steel jacket. Block type insulation is not acceptable. The blanket insulation is to be fiberglass, 2" thick, 1 lb./cu.ft., and have a rating of R3.85. Pins are to be located on 18" centers and holding clips attached. The steel jacket or lagging shall have a shell thickness of 22 gauge (0.299") minimum and head thickness of 12 gauge (0.1046") minimum.

E. The tank shall be factory lined with a high quality plastic #3066 epoxy lining. The lining is to be applied to a sandblasted (SSPC-SP-5) white metal surface. Spray applied (4) to (6) coats, with each dry coat being approximately 1.5 mils dry, for a total thickness of 6 mils dry, minimum. Lining to be Holiday spark tested using low voltage and a wet sponge to ensure uniform coating fee of pin holes. Magnesium anodes shall not be acceptable in this application. The lining is to be suitable for temperatures up to 250°F. The tank shell and the internal epoxy lining shall have an extended warranty to cover (5) years.

F. The high temperature diffuser or sparge tube shall be located beneath the normal tank water level. The tube shall be constructed of 2" pipe. This tube shall provide uniform distribution and blending of high-temp condensate returns.

G. The chemical feed quill shall be located beneath the normal tank water level. The quill material shall be constructed of stainless steel. The tube shall provide uniform distribution and blending of condensate and chemicals.

H. The basic surge tank shall be equipped with the following trim and accessories. Piping on packaged units shall comply with ANSI Power Piping K Code B31.1.

1. Make-up Valve and Controller

a. An electronic inlet water motorized regulating valve with steel body and threaded NPT connections. Motor shall be 110V bi-directional type, with a permanently lubricated gear train, and directly coupled to the valve stem. The

valve Cv shall not exceed 15 and be rated for 50 gpm at 40 psig inlet pressure. Valve shall not exceed a delta-P of 10 psig. This valve shall have teflon seats and be suitable for temperatures up to 300°F. This valve shall be electronically controlled by a solid state control with internally mounted capacitance probes. The electronic solid state control shall be able to set desired level point and acceptable deviation. The electronic solid state control shall include a selection for automatic and manual operating mode. The internals shall include two additional probes for high and low water alarm. The controller shall be similar to Cleaver-Brooks, Model TW82. A solenoid valve and float switch is not acceptable.

b. The makeup valve shall include an ANSI Class 125 lb. 3-valve bypass with inlet "Y" type cast iron strainer. Strainer screen to be removable and of stainless steel construction.

2. Suction piping for pumps shall consist of a gate valve, cast iron "Y" type strainer with replaceable stainless steel screen and flexible connector or hose. This piping assembly shall be 125 lbs. class construction. The vortex breaker shall be constructed of stainless steel and located in the tank nozzle. Manifold suction lines are not acceptable.

3. Transfer Pump and Motor Set

   a. Provide centrifugal type transfer pumps and motor sets. Turbine type pumps are not acceptable in this application. Each pump to be rated as scheduled. Pump to have a mechanical seal for a maximum water temperature of 212°F. Pump impeller to be hydraulically balanced. The pump shall be mounted on a steel baseplate and flexibly coupled with an OSHA type coupling guard. Motor to be non-overloading at the rated condition without using any portion of the service factor. Pump and motor set to be factory aligned prior to shipment. A stainless steel recirculation orifice is to be supplied with the pump and shipped loose for field installation to provide minimum bypass flow.

   b. The stand shall elevate the surge tank to provide the net positive suction head required by the pump at the rated condition to prevent cavitation. The stand shall be constructed of heavy square steel tubing for the legs and 1/4" steel plate covering the floor.

   c. Control Panel

      1) Control panel shall be in a NEMA 1 enclosure and wired in accordance with the National Electric Code. The wire shall be black number coded. The assembly is to contain individual motor starter with 120V holding coil and fuse protection. Individual green oil-tight pump run lights shall be provided. All switches and lights to have nameplate identification. The assembled panel shall be given a factory continuity test prior to shipment. The panel will have a single power connect point that distributes to each combination starter disconnect switch.

2) Audible and visual high and low water alarm function shall be provided by a bell or horn with silence switch and individual red oil-tight lights.
3) Control circuit transformer to supply 120V, single-phase power supply. The transformer shall be mounted, wired and fused.
4) Auxiliary contacts shall be furnished for chemical feed pump initiation. Contacts shall be normally open.
5) The surge tank shall have a gauge glass assembly that covers the entire tank diameter. The gauge glass shall be quartz 0.625" diameter by 24" maximum length. Each length of glass shall be furnished with bronze gauge cock set and protector rods.
6) The surge tank shall be supplied with a thermometer with a 50 to 300°F range.
7) The surge tank is to be hand cleaned with a solvent to SSPC-SP-1 standards prior to painting. Prime coated to not less than 1 mil thick and finish coated with an enamel paint to not less than 1 mil thick prior to shipment.
8) Unit is to be knocked down for shipment. Piping is to be matched marked and boxed. Warranty period to be (12) months after start-up or (18) months after shipment, whichever comes first.

2.4 BLOWDOWN SEPARATOR

A. Furnish and install blowdown separator, as scheduled similar to Cleaver Brooks.

B. The separator shall be manufactured in accordance with ASME Code for 250 psig design and tested to 375 psig.

C. Minimum thickness shall be 5/16" plate.

D. Provide separator with National Board stamping and "U" symbol.

E. The separator shall be furnished with screwed connections and 2” inlet.

F. The separator shall include a stainless steel striking plate at the point of inlet impingement and shall be furnished by Cleaver Brooks.

G. Furnish a bi-metal thermometer with necessary adapter bushing for use with 18” DF aftercooler.

H. Provide a temperature regulator valve, as scheduled, to automatically control the flow of cold water by responding to temperature changes sensed at the thermostatic bulb in the aftercooler fitting.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Boilers shall be installed with manufacturer's recommendations, Contract Drawings, and reviewed submittals.

B. Boilers shall be installed so as to ensure easy accessibility for service or removal and replacement of all components such as, but not limited to, impellers, motors, drive couplings, bearings, strainers, other boiler appurtenances, isolators, and flex connections.

C. The Contractor shall receive and inspect all boilers, equipment, pumps and motors to ensure they are received without defect. All defective or damaged boilers, equipment, pumps and motors shall be returned to the manufacturer by the Contractor for replacement.

D. The Contractor shall properly protect all equipment to prevent damage from water, dirt, etc. Protection shall include temporary plastic wrap to keep equipment in original factory condition.

E. Installation Supervision shall be provided by the respective manufacturers on a continuous basis to insure that wiring between burner/boiler units, Master Control Cabinet, and field mounted equipment is performed properly. Burner manufacturer shall supervise installation of burner and related refractory work. Control system manufacturer shall verify and supervise installation of field devices.

F. Service and Supervision shall be provided by trained personnel employed by the burner manufacturer and the control system manufacturer to assure coordination of installation, start-up, calibration and training enclosures.

G. Install in accordance with NFPA 54 and NFPA 58.

H. Install boilers on 4 inch concrete housekeeping pads.

I. Provide connections to the natural gas service connection in accordance with NFPA 54, AGA Z223.1 and NFPA 58. Pipe all gas train vents to the outdoors in accordance with all local and State codes.

J. Provide piping connections and accessories as indicated.

K. Connect each boiler to breaching and stack system.

L. Pipe relief valves to outside in a safe location.

M. Provide complete electrical connections to all boilers.

3.2 BOILER START-UP AND TESTING

A. The burner manufacturer shall furnish a factory service technician to start up and adjust burners and to instruct the owner's operating personnel in the proper maintenance and operation of the equipment. The manufacturer shall also provide service as provided in the standard factory warranty for (2) years following the date the equipment is first placed in operation.

B. Test procedures shall include, but not be limited to:

1. Determine, set and adjust burner inputs. Combustion air dampers shall be set in unison with the firing rate.
2. Control operating tests of all temperature controllers, low water cutoff, all manual reset functions, interlocks, combustion controls and switches.
3. CO_2 at high fire. Gross and net stack temperatures at the boiler outlet. Any and all oil and gas burner adjustments for optimum combustion efficiency with not greater than a No. 1 Ringleman smoke and at least 10% CO_2 in the flue gas at high fire.
4. Submit all test results to the Owner. Final payment will not be made to the Contractor until tests have been reviewed by the Owner.

3.3 ELECTRICAL WIRING

A. This Contractor is responsible for providing all control power to boiler controls.

B. Electrical wiring shall be completed in accordance with burner manufacturer’s specifications and all state and local codes by a licensed electrician.

3.4 START UP AND SERVICE

A. Start-Up and Service: The manufacturer shall furnish a factory trained service technician to start-up and adjust the burner’s cabinet, and to instruct the owner's operating personnel in the proper maintenance and operation of the equipment. The manufacturer shall also provide service as required for (1) year following the date the equipment is first placed in operation. The following minimum amounts of service shall be provided:

1. (8) Days Startup
2. (5) Days Training
3. (5) Days Service

3.5 BOILER SERVICE

A. The boiler manufacturer shall furnish (1) year burner service to commence from the date of boiler acceptance by the Owner. Burner service shall be performed by the boiler manufacturer who will be ready to answer any and all service calls with no charges to the Owner.

B. Service shall include the entire combustion system of the boiler and burner furnished, including the free replacement of any controls or components or other parts which become faulty within the operative dates.

C. A letter of transmittal from the boiler manufacturer to the Owner shall be required attesting the fact of successful lightoff and shall also orient the Owner's Representative of all pertinent data regarding system operation, the identity of the manufacturer and shall include all telephone numbers for emergency service.

D. The boiler manufacturer shall be located within the immediate local area to allow for reasonable quick response to a call for service and he shall have on hand an adequate supply of parts to service the boilers without delay. The service company shall employ at least (2) full-time people, licensed by the state in which the boiler/burner is installed to be available for technical questions. Also, the service company shall maintain at their expense a personal computer with module programmed to interface with the burner management controls as previously described in this specification. This shall be available for troubleshooting during normal business hours at standard hourly billable rates.

END OF SECTION