

## Scope of Work

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### I. SCOPE OF SOLICITATION

Clemson University Facilities is requesting proposals to purchase three (3) high pressure steam boilers initially and with an option to purchase the fourth (4<sup>th</sup>) high pressure steam boiler with the successful offeror within a six (6) month period providing budgetary funds are available. The successful bidder agrees that the pricing would be the same as the initial boilers. Should an agreement not be reached, Clemson reserves the right to publically bid out the fourth (4) boiler. All price adjustments are to be governed by the Price Adjustment clause in the Purchase Terms and Conditions associated with this solicitation. Providing that budgetary funds are available for the fourth (4<sup>th</sup>) boiler, a separate purchase order would be released for this purchase, referencing this bid.

All boilers are to meet the specifications that are detailed in Section III – Scope of Work/Specifications. The proposal is to include a factory personnel to supervise the installation connection of the boiler pieces, components, and accessories to assure that the sub-assemblies are properly connected.

The award will be made to one Offeror that is responsive and responsible and most Advantageous to Clemson University.

Clemson University requires the boilers outlined in this scope to be delivered upon standard manufacturing delivery time.

### II. INSTRUCTIONS TO OFFERORS

Regardless of specific requirements below or in this document, Offerors are required to submit their proposal electronically through the Clemson University online bidding system. To do so you must login (registering first) at <https://sciguest.ionwave.net/prod/default.aspx?company=Clemson>, and follow specific instructions for this solicitation. You should register several days in advance of the bid closing date so you can be approved and login in time to submit a response.

1. INFORMATION FOR OFFERORS TO SUBMIT - In addition to information requested elsewhere in this solicitation, Offerors should submit the following information for purposes of evaluation:
  - a. The successful Offeror shall provide satisfactory evidence of all required insurance coverage and licenses PRIOR TO PERFORMANCE.
  - b. Offerors are required to provide appropriate submittals with technical proposal that include: Specification table, boiler assembly diagrams, dimensional and electrical drawings; system diagrams and pipe connections/orientation drawings.

ASME contraction forms and shop test reports shall be provided upon receipt of purchase order and delivery of boilers. This should be as an attachment to the bid submittal in buyWays. These documents are to be attached in buyWays.

- c. Be sure to see the Event Activities in the online bidding system.
- d. Your cost proposal must include the pricing required in Section III – Scope of Work. However, you may go into more details on pricing on a separate page as you see fit. Your bid price must be all inclusive and include any travel, lodging, or other indirect expenses.

### **III. SCOPE OF WORK / SPECIFICATIONS**

All Offerors are required to meet the specifications as detailed. Boilers shall be as manufactured by “Miura” or approved equal.

#### **1.0 GENERAL**

##### **1.1 GENERAL DESCRIPTION**

A. The three (3) boilers shall be Low NOx (less than 20 ppm), high-pressure steam boilers with a design pressure of 170 PSIG for operation for 70 to 125 PSIG with full steam output within five (5) minutes from a cold start-up. The boilers shall come complete with a step-fired burner, forced draft fan, gas train, valves, Microprocessor Boiler Control System control, boiler trim and refractory. All factory assembled and tested for full steam performance prior to shipping. The boilers and economizer shall meet ASME Section I, be registered with National Board, and be approved and listed as a package by UL. The boiler shall be able to meet regulatory requirements of FM and ASME-CSD1. The boiler shall also conform to the requirements of **NFPA 85**: “Boiler and Combustion Systems Hazards Code”, where not incorporated by reference elsewhere in this specification.

B. The boilers shall be vertical, fast recovery, multi-water tube design with rectangular headers attached to both ends. The design shall incorporate a "floating" header, which allows for fast expansion and contraction of the boiler tubes, regardless of feed water temperature or heating requirements. The burner/boiler packages shall utilize the flame-quenching method of a natural, cool, radiant flame, which is immediately cooled via contact with water tubes for Low NOx emissions. The boilers can be nested into a series of up to multiple boilers, which turn on and off, varies lead/lag and communicate through multiple point central controller panel, keeping boilers down and cold when not needed; and online and hot when needed for optimal fuel savings. Any one of these boilers can be taken off line by a flip of a switch for maintenance service or inspection – with a back-up boiler automatically brought on line.

##### **1.2 RESTRICTIONS**

In addition to the hereinafter descriptions, the boiler shall incorporate the following requirement restrictions due to floor space limitations.

A. The boiler shall be shipped as a factory package. Package shall include the boiler, feed water

economizer, steam separator, and any pre-piped accessories, and foundation frame. Frame to be constructed to accept (by way of field connection) the economizer section. Boiler dimensions shall not exceed 127 inches high x 63 inches wide x 153-1/2 inches long.

B. The overall footprint for the installed boiler shall not exceed 63 inches wide x 153-1/2 inches long.

C. The flooded weight of the boilers shall not exceed 13,200 lbs. each.

D. The successful boiler manufacturer shall include in his price a factory personnel to supervise the installation connection of the boiler pieces, components, and accessories to assure the sub-assemblies are properly connected.

### **1.3 MANUFACTURER**

A. Boilers shall be as manufactured by "Miura" or approved equal.

### **1.4 SUBMITTALS**

A. Submittals shall be provided with the proposal and shall include: Specification table, boiler assembly diagrams, dimensional and electrical drawings; system diagrams and pipe connection/orientation drawings. ASME construction forms and shop test reports shall be provided upon receipt of purchase order and delivery of boiler.

## **2.0 PRODUCTS**

### **2.1 SPECIFICATIONS**

A. Basis of Design is "Miura" Model-LX-300 SG with feedwater economizers  
Boiler Type: Multiple water tube, once through, forced flow, steam boiler  
Quantity – 3 with option to purchase the fourth one  
Boiler Horsepower rating (each) – 250 BHP  
Equivalent Steam Output (lb/hr) (each) – 8,620 lb/hr (see Note 1)  
Heat Input (BTU/hr) (each) - 9,820,000 BTU/hr  
Heat Output (BTU/hr) (each) - 8,365,400 BTU/hr  
Boiler heating surface area – 574 sq ft  
Maximum Pressure – 170 PSI  
Efficiency (fuel to steam) – 85% (at 220°F feed water temperature, 70 PSIG steam, and higher heating value for fuel)  
NOx Rating: < = 20 PPM  
Fuel Gas Consumption – 9,800 SCFH (see Note 2)  
Required Air volume – 118,100 SCFH  
Blower Motor size – 25 HP  
4-position step burner HIGH-LOW-IGNITE-OFF  
Flue Gas Temperature = 279 F

Note 1: Equivalent Output calculated base on conversion of 212°F (100°C) feedwater to 212°F (100°C) steam.

Note 2: Gas consumption based on Natural Gas with High heating value 1,000 Btu/SCF.

- B. Fuel Type: Natural gas
- C. Gas Supply Pressure: 3-5 PSIG (at high fire)
- D. Electrical Supply: 460 volts, 3 Phase, 60 Hertz

## **2.2 BOILER CONSTRUCTION**

- A. Multiple, vertical water tube. Once through, forced flow steam generator with no fixed steam or water line.
- B. The water tubes shall be of straight, vertical construction being swaged at both ends. The water tubes shall be 2-3/8" size, seamless pipe, conforming to ASME SA – 178 specifications. All water tubes shall be welded to the top and bottom headers.
- C. The boiler shall be furnished with an adequate number of inspection openings to facilitate internal inspection and cleaning.
- D. Lifting lugs shall be provided to facilitate rigging.
- E. Boiler shall come with a skid mounted, steel frame.
- F. The boiler shall come complete with an inner and outer casing, pressurized gas tight. The inner casing must be fabricated of minimum 16 gauge steel. There shall be insulation between the inner and outer casings such that the outer casing temperature will not exceed 140°F at maximum boiler capacity.
- G. The outer casing will be finished with a heat resistant paint.

## **2.3 CODES AND REFERENCE STANDARDS**

- A. Design, documentation, fabrication, and testing shall comply with ASME, ASTM, ANSI, CSA, CGA, AND UL standards.
- B. Boiler package is to bear UL or CGA label.
- C. Pressure piping and fittings shall comply with the ANSI B31.1 Code.
- D. Flanges and fittings shall comply with the ANSI B16.5, B16.11, or B16.9 Code.

## **2.4 BURNERS**

- A. Burner operation shall be four stages (Hi-Low-Ignite-Off), step-fire control suitable for operation on Natural Gas.
- B. The burner shall be complete with integral motor and blower (forced draft fan of the centrifugal type) for supplying adequate combustion air with normal vent.
- C. The following items shall be incorporated to the boiler/burner:
  - 1. A gas-electric igniter, an observation port and mounting brackets for pilot and main flame

scanner.

2. The main gas train shall be completely piped to each boiler and shall include: two main gas actuator valves, ball valve type shut off valve, a main and pilot gas pressure regulator (suitable for 3 to 5 PSIG gas supply pressure).

D. Other equipment furnished on the gas train shall include high and low gas and air pressure switches.

## **2.5 STEAM BOILER TRIM**

A. Water volume control shall consist of a low water cut-off and feed water pump control probe in the boiler body tube; as well as three additional probes in a modified water column, two for feed water pump control and one for low water cut-out with manual reset.

B. Two water tube thermocouples located on selected water tubes shall be included to detect temperature rise due to scale build-up or due to low water volume. This sensor when activated will shut down the boiler and trigger an alarm.

C. ASME Code rated safety relief valve.

D. Steam pressure gauge and a pressure sensor with additional digital display.

E. Operating steam pressure switches, one high limit steam pressure switch with manual reset.

F. Each boiler must have an adequate horizontal separator to eliminate carry-over due to load swings and provide boiler steam quality of 99+% dry saturated steam.

G. There shall be no "manholes" but two inch inspection plugs for internal inspection of the header and tubes.

H. Sampling cock for boiler water.

## **2.6 BLOWDOWN SYSTEM**

A. The boilers shall be equipped with an automatic surface blowdown with strainer and manual shut off valve and manual blowdown system on each boiler. The automatic continuous blowdown systems shall include a sensor, solenoid valve, and a strainer. Bottom blowdown to have quick opening blowdown valve.

## **2.7 FORCED DRAFT FAN**

A. Sized to provide all air required for combustion by blower with normal vent conditions.

B. Complete with air inlet register for connection to a damper control motor. Blower outlet shall be located to facilitate connection to the combustion air duct.

C. Noise levels shall not exceed 80 dbA one meter from the front of the boiler.

## **2.8 CONTROLS**

- A. Control panel shall be mounted in the front of the boiler for easy access.
- B. Control panel shall be steel, with hinged door, NEMA 1 enclosure with dust seal.
- C. Panel shall contain an electronic programming relay, feed water pump control, and blower motor starter control switch, control circuit transformer, indicating light, alarm.
- D. Flame safeguard controller shall be a "Miura" BL controller (or equivalent).
- E. The boiler shall be equipped with the "Miura" BL Micro Controller (or equivalent) Boiler Control System expanded enunciator, a 9 point boiler condition, 8 point boiler status data, 21 point boiler settings, 17 point alarm, 10 point caution, 5 point alarm history, and 3 point combustion history.
- F. The panel cover shall clearly display the BL Micro Controller (or equivalent) with controls to scroll through burner information. It shall also have an ON-OFF rocker switch, and an ONOFF push button combustion control.
- G. A selector switch shall be provided inside the panel to permit automatic firing in accordance with load demand or a low fire hold.
- H. The panel shall contain the BL Micro controller (or equivalent) series programming relay, blower motor starter, relays and control switch, and control circuit breakers. All electrical equipment shall be in conformity with the National Electrical Code. Oil, heat, and moisture resistant wiring materials must be used throughout.
- I. Provide an alarm to sound on "flame failure" and other error situations.
- J. Wiring inside the panel shall be through clearly identified terminal strip.
- K. Boiler control shall feature the following communication capabilities:
  - 1. *Modbus*-based signal communications:
    - RS-485 based system data
    - Data speeds up to 19200 baud
    - Connection type: D-Sub 9 socket
  - 2. *BACNET*-based signal communications:
    - Ethernet based system data
    - Data speeds up to 100 Mbits/second
    - Connection type: RJ-45
  - 3. Points List through communications:
    - Read Only Analog Measurements
    - Steam pressure
    - Flue gas temperature
    - Feed water temperature
  
    - Read Only Digital Measurements
    - Common Caution

Common Alarm  
Water pump "ON"  
Blower motor "ON"  
Fuel high fire valve "ON"  
Fuel Main Valve "ON"  
Operation switch "ON"  
Oil pump "ON"

Write signal from user  
Boiler Emergency Stop

4. Boiler control shall feature the following hard-wired communication capabilities:

Boiler input:

Emergency stop  
Alarm check  
All combustion  
All stop

Boiler output:

Sensor failure  
Communications status  
Boiler operation  
Common alarm  
Emergency stop  
Boiler trouble / caution  
Pressure alarm L  
Pressure Alarm H

## **2.9 ECONOMIZER**

A. Economizers shall be supplied for each of the boilers. The economizer shall be gas to liquid heat exchanger, designed to utilize heat in the boiler flue gasses to preheat boiler feed water.

B. Economizers shall be completely piped with minimal field assembly required. The economizer shall be floor mounted and attached directly to the boiler flue gas outlet.

C. Economizers shall consist of a gas-tight, inner seal welded type steel casing and shop painted. It shall be drainable and suitable for dry operation in an emergency.

D. The tube assembly shall be suitably arranged for external cleaning pressure.

## **2.10 ACCESSORIES**

A. Multiple Point Isolation Control Panel for staging boilers for lead/lag and communication capabilities between boilers.

B. Automated Water Hardness checking system that can communicate with and alarm boiler system.

C. Intake filter and intake elbow with extension for sound attenuation for each boiler.

D. Vertical in-line feed water pump, Grundfos Model CR10-12. There shall be one (1) feed water pump dedicated to each steam boiler.

## **2.11 START-UP AND COMMISSIONING**

A. Manufacturer's factory trained service representative shall:

1. Check the installation, start the boilers, calibrate controls, and train the owner's operators in the proper operation and maintenance of the equipment.
2. Demonstrate operation of all safety controls to the satisfaction of the engineer.
3. Demonstrate operation of the boilers over the entire firing range of the burners on both fuels. Record water temperature, steam pressure, flue gas temperature, percent of O<sub>2</sub> and other relevant data on Miura's standard start-up reports. These reports will be submitted to and witnessed by the engineer on completion.

## **2.12 WARRANTY**

A. Boiler Pressure Vessel: Boiler Manufacturer will repair or replace, at its discretion, the boiler pressure vessel which is found to be defective in workmanship or material within seven years from date of shipment from the factory, provided said pressure vessel has been operated in accordance with conditions of service outlined by the Boiler Installation and Operation manuals, and that the quality of water used in the pressure vessel has at all times met the standards required in the aforementioned manuals.

B. Parts Warranty: The Boiler Manufacturer, at its sole option, will repair and replace at no charge any boiler component, if found to be defective in workmanship or material within twelve months from the date of commissioning or eighteen months from the date of shipment from the factory, whichever occurs first.

C. Boiler Manufacturer shall provide replacement reagent cartridges on feed water conductivity tester for a period of two (2) years from successful boiler startup and owner acceptance.

## **2.13 FREIGHT:**

The vendor shall ship the boilers FOB job site to: Central Energy Facility  
Clemson University  
Klugh Avenue  
Clemson, South Carolina

The vendor shall be responsible that delivered equipment is free from damage during shipment (either concealed or exposed). Vendor is responsible for claims against carrier in the event there is damage.