WINSTON-SALEM STATE UNIVERSITY

WSSU Boiler 1 Replacement

WSSU PO No.: P0024112

RMF Project No.: 224028.A0

SCO ID: 21-23049-01

SCO Code: 42032 Item: 327

PREPURCHASE PACKAGE

April 8, 2022

RMF Engineering
Reliability. Efficiency. Integrity.

8081 Arco Corporate Dr. Ste. 300 OFFICE 919.941.9876
Raleigh, North Carolina 27617 WEB rmf.com

NOTICE TO BIDDERS

Sealed proposals from boiler manufacturers for boiler prepurchase will be received by Alexis Bauman, at 1604-C Lowery Street, Winston-Salem, NC 27101 up to 2:00 PM on 4/28/2022. Immediately thereafter, bids will be publicly opened at 1604-C Lowery Stree large conference room and read for the furnishing of a boiler for the WSSU Boiler 1 Replacement project.

Proposals shall be enclosed in an opaque, sealed envelope. Sealed proposals delivered by mail, Federal Express, United Parcel Service, etc. shall be placed within the carrier's package. Send sealed proposal within the delivery envelope, so when opening the carrier's delivery package, the bid will not be exposed. Print one of the following on the face of each proposal envelope:

Bid:

Proposal for Boiler Prepurchase
Name of Bidder
Bidder's License Number

Winston-Salem State University
WSSU Boiler 1 Replacement
SCO ID#: 21-23049-01
Winston-Salem, North Carolina 27101
Bid Date: 4/28/2022

If mailed, mark as shown above and address to:

Bids shall be delivered to:
Attn: Alexis Bauman
1604-C Lowery Street
Winston-Salem, NC 27101

Winston-Salem State University – WSSU Boiler 1 Replacement

Event	Date
Advertisement	4/13/2022
RFIs/Substitutions due	4/15/2022
Addendum Issued	4/21/2022
Bid	4/28/2022

The scope of work for the WSSU Boiler 1 Replacement Project includes replacing boiler 1 in the existing steam plant at WSSU. Refer to documents for full scope.

Bids will be received for Boiler Prepurchase. All proposals shall be lump sum.

No bid may be withdrawn after the scheduled closing time for the receipt of bids for a period of 60 days.

The owner reserves the right to reject any or all bids and to waive informalities.

Designer:
RMF Engineering, Inc.
8081 Arco Corporate Drive
Suite 300
Raleigh, NC 27617
(919) 941-9876
Michael Wilkins, PE

Owner:
Winston-Salem State University
1604-C Lowery Street
Winston-Salem, NC 27101
336-750-2877
Alexis Bauman

SECTION 235234 – STEAM GENERATORS (PRE-PURCHASE)

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.

1.2 SUMMARY

A. Section includes packaged, factory-fabricated and -assembled boilers, trim, and accessories for generating steam with the following configurations and burners:

1. Boiler/Steam Generator.
2. Combination gas and oil burner.

B. Boiler will be pre-purchased from the Manufacturer by the University, prior to bidding the project to a single prime Contractor. Once the project is bid and a Contractor is selected, the University will transfer the purchase to the Contractor.

C. Boiler manufacturer shall provide all products and components identified in this specification section, as well as services specifically identified. All services to be provided by the boiler manufacturer's representative or service representative are specified in this Section and should be included in the scope of the boiler purchase.

D. The installing Contractor shall obtain any required permits from the applicable jurisdiction to license the boiler as a pressure vessel or boiler.

E. Scope Delineation: The boiler manufacturer shall provide the following items as required to provide a complete and operational boiler system.

1. Feedwater level control valve.
2. Fuel control valves.
3. Steam backpressure control valve
4. Forced draft fan VFD drive.
5. Combustion control and feedwater level control logic.
6. Trap separator
7. Booster pump(s) and control panel.
8. Automatic blowdown control valve and TDS controller.
9. Electronically actuated backdraft damper.
10. The boiler manufacture shall provide the remaining required trim and accessories required to provide a complete and operational boiler system.

1.3 ACTION SUBMITTALS

A. Boiler Life-Cycle Bid Form: To be included with bid form of proposal. Refer to the LCCA paragraph at the end of this Section.

B. Description of Submittal Phasing: The boiler manufacturer shall not begin fabrication until the submittal package is approved by the Engineer. If through the submittal process it is found that the boiler manufacturer cannot satisfy the specification requirements, a new manufacturer shall be selected. Submittals will be required at shipping as specified herein.

C. Completeness: The submittals must be provided complete and show evidence of proper coordination as a system with respect to all components including the boiler, burner, fan, controls, burner management system, etc. Separate major items will not be reviewed by the Engineer until all major components are submitted.

D. Product Data and Shop Drawings: Provide product data for boiler and all accessories. Include performance data, operating characteristics, furnished specialties, and accessories. Provide shop drawings for boiler and all accessories. Include plans, elevations, sections, details, and attachments to other work. Submit the following at a minimum:

1. Boiler:

a. Dimensioned outline drawings of boiler, burner, and accessories with dimensions. Identify center of gravity and locate and describe mounting and anchorage provisions. Show tube pull length and door opening space requirements.
b. Provide a coordination drawing showing building walls, clearly showing the boilers will fit in the space as shown on the design drawings provided and tubes can be pulled, and the doors can be opened.
c. Arrangement and description of construction of pressure parts, casing, internals, and support frame.
d. Piping connection sizes, locations, and construction.
e. Technical data including temperature rating and arrangement of refractory and insulation.
f. Steam nozzle construction. Capability of steam nozzle and attachment to boiler shell to withstand forces and moments imposed by connecting piping.
g. Amount of heating surface and combustion volume per ASME calculations.
h. Weight of boiler, empty and flooded.
i. Design pressures (Maximum Allowable Working Pressure) and temperatures.
j. Loading diagram of support frame.
k. Recommended anchorage of boiler support frame to foundation.
l. Furnace viewport construction and locations.
m. Dimensioned location of normal water line, lowest and highest permissible water level, set points of water level alarms and cutoffs.
n. Predicted external surface temperature of front, rear, and sides of boiler.

2. Boiler Trim: Includes bottom blowoff valves, water level alarm and cutoff devices, water level gauge, auxiliary low water cutoff, piping, feedwater pumps, steam traps, all valves

and fittings furnished by boiler manufacturer, feedwater control system, safety valves, steam pressure gauge, stack thermometer, and steam pressure switches.

a. Design, construction, arrangement on the boiler.
b. Pressure and temperature design.
c. ASTM numbers and schedule numbers of piping.
d. Type and pressure ratings of pipe fittings.
e. Flow and pressure drop data on feedwater control valves. Force required to operate valve.
f. Technical data on water level control system.
g. Scale ranges of gauges, thermometers and pressure switches.
h. Location of water level sensing and indicating devices in relation to normal water line of boiler.
i. Set pressures and capacities of safety valves.

3. Burner and Fuel Trains:

a. Drawings showing construction of burner parts and assembly of complete system.
b. Catalog data and outline drawings of forced draft fan, damper, motor, and sound attenuator on forced draft fan intake.
c. Drawings showing assembly of throat refractory into furnace.
d. Type and temperature rating of throat refractory.
e. Drawings and catalog data on all equipment in Igniter (pilot) train, main fuel trains, and atomizing media train. Include data on pressure and temperature ratings, flow versus pressure drop, performance characteristics. Include complete data on air compressor (for oil atomizing) with sound attenuators and motors.
f. ASTM numbers and schedule numbers on all piping.
g. Type and pressure ratings of pipe fittings.
h. Burner flow and pressure data:

    1) Main burner fuel and atomizing media pressures and flows at maximum required firing rate.
    2) Igniter (pilot) fuel flow and burner pressure.
    3) Natural gas main fuel pressure at outlet of burner-mounted pressure regulator.
    4) Igniter (pilot) fuel pressures at outlet of burner-mounted pressure regulators.
    5) Forced draft fan static pressure, horsepower and air flow at maximum firing rate.

i. Full load efficiency and power factor of all motors.
j. Predicted sound level at maximum firing rate.
k. Drawings showing location and arrangement of drive units for controlling fuel and airflow. Data on torque required to operate fuel and airflow control systems.
l. Weight of burner assembly.

4. Boiler and Burner Performance Data: Predicted performance, on each fuel at site altitude, service, at 15 percent excess air, for output levels of 25, 50, 75, and 100 percent of

maximum required boiler capacity. Data must include fuel and steam flow, feedwater temperature, boiler outlet flue gas temperature, boiler combustion efficiency (utilizing the ASME Standard method and based on Higher Heating Valve), windbox and furnace pressures, excess air, and predicted radiation.

5. Burner Control (Flame Safeguard) System: Includes all components within control panel enclosure and all sensors and switches mounted on boiler, burner, and fuel trains.

    a. Data on construction and performance of all individual components.
    b. Drawing showing panel and enclosure arrangement, construction, and finish.
    c. Schematic diagram with description of operating sequence.
    d. Wiring diagram.

6. Burner Management System (BMS)

    a. Manufacturer's product data for BMS including BMS programmer controller, flame amplifier, system power supply, relays, terminal blocks, display, alarm horn, annunciator, and flame scanner. Product data shall describe how the BMS shall function including start-up and shut-down procedures, permissives, display messages, and required operator interface. All features of equipment specific to this project shall be clearly identified.
    b. Logic Diagrams: Shall clearly identify interlocks and sequences for all modes of boiler operations including but not limited to pre-firing cycle, light-off cycle, operation and shutdown cycle.

7. Boiler Combustion Control:

    a. Manufacturer's product data for the control system including system power supply, cabinet, and display. Product data shall describe how the control system shall function including procedures for operator intervention for start-up and shutdown and alarms. All features of equipment specific to this project shall be clearly identified.
    b. Logic Diagrams: Shall clearly identify the logic of the system.

8. Boiler Control Panels:

    a. Drawings showing panel, instrument and control locations, mounting details, and door swing.
    b. Description and details of panel construction.
    c. Panel wiring and piping diagrams.

9. Control Valves: Natural Gas, Fuel Oil:

    a. Manufacturer's product data for each valve including design, materials, and dimensions.
    b. Identify each by device ID number as indicated on the Contract Drawings.

10. Pressure Regulating Valves: Air Pressure, Igniter Gas Pressure, Burner Gas Pressure, and Oil Pressure Regulating Valves.

a. Manufacturer's product data for each valve including design, materials, and dimensions.
b. Identify each by the device ID number as indicated on the Contract Drawings.

11. Safety Shut-Off and Vent Valves:

a. Manufacturer's product data for each valve including design, materials, and dimensions.
b. Electrical requirements for each valve.
c. Identify each by device ID number as indicated on the Contract Drawings.

12. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Source quality-control reports.

B. Quality Assurance: Documentation as necessary to provide conformance with requirements listed in paragraph “Quality Assurance” below.

C. Warranty: Special warranty specified in this Section.

D. ASME Stamp Certification and Report: Submit "A," "S," or "PP" stamp certificate of authorization, as required by authorities having jurisdiction, and document hydrostatic testing of piping external to boiler.

E. ASME Forms: Fabrication and assembly forms required by Code, including Form P-2, P-6, and P-7 at a minimum.

F. Pre-Shipping Test Report: Start-up report at factory prior to shipping as specified in Part 3 of this Section.

G. Performance/Efficiency and Emissions Test: Data may be submitted after the contract is awarded but at least 2 weeks before the test. See paragraph 3.3 of this specification section for testing requirement details. Include the following information:

1. Detailed performance/efficiency and emissions test procedures and protocols including blank forms to be in during testing.
2. Method of measuring required parameters.
3. Instrument calibration and accuracy data for proposed measurement devices.
4. Completed performance and emissions test report, (submit after testing).

H. Manufacturer’s Pre-Start Up field report.

I. Manufacturer’s Startup service reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For boilers, components, and accessories to include in emergency, operation, and maintenance manuals. Include the following at a minimum:

1. Operation and Maintenance Manual shall include a general description of the entire system, clearly identifying the operation and functional features of each component.
2. Provide spare parts list. The manual shall include operating instructions and recommended maintenance schedules and procedures. A complete bill of materials and manufacturer's bulletins, general information drawings and installation drawings shall be provided.
3. Provide name, address, and phone number for manufacturer's representative responsible for aftermarket equipment support.
4. Control Valves: Natural Gas, Fuel Oil, Feedwater, Steam

    a. Manufacturer product data indicating model, type, and construction, etc.
    b. Name, address, and phone number of manufacturer's representative for aftermarket support.

5. Safety Shut-Off and Vent Valves:

    a. Manufacturer product data indicating model, type, and construction, etc.
    b. Name, address, and phone number of manufacturer's representative for aftermarket support.

1.6 QUALITY ASSURANCE

A. The model and size of the proposed burner shall have been applied to at least three boilers, which are similar in size, proportion, and arrangement to the proposed boiler. In each of the three installations, main flame characteristics shall have conformed to requirements specified in Section 2. Provide list of these installations, and name, address, and telephone number of person familiar with each project who will serve as a reference source.

B. All work associated with the boilers shall be in compliance with the current edition of the National Fire Protection Association (NFPA) 8501 Standard for the Prevention of Furnace Explosions in Fuel Oil and Natural Gas Fired Single Burner Boiler Furnaces. This standard is considered a minimum requirement for operation and control of a fully functional burner management system.

C. Regardless of fuel input rating, the equipment, installation, and operation shall conform to NFPA 85 Boiler and Combustion Systems Hazards Codes for single burner boilers. As required by fuel input rating, all work shall also be in compliance with the ASME CSD-1.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

E. ASME Compliance: Fabricate and label boilers to comply with ASME Boiler and Pressure Vessel Code.

F. ASHRAE/IESNA 90.1 Compliance: Boilers shall have minimum efficiency according to "Gas and Oil Fired Boilers - Minimum Efficiency Requirements."

G. UL Compliance: Test Boilers for compliance with UL 726, "Oil-Fired Boiler Assemblies" and UL 795, "Commercial-Industrial Gas Heating Equipment." Boilers shall be listed and labeled by a testing agency acceptable to authorities having jurisdiction.

H. The Manufacturer shall designate an employee as his boiler technician expert who shall represent the Manufacturer in dealing with the technical issues related to the boiler including rigging, installation, boil-out, start-up, testing, and inspection. This person shall be qualified to be able to communicate effectively and challenge (if necessary) the boiler manufacturer's field representative. This person shall demonstrate experience in starting-up and testing firetube boilers.

1.7 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.

B. Coordinate the entire assembly of boiler, boiler trim, burner, fuel trains (including gas and oil pressure regulators), compressed air system for oil atomization burner control system, and combustion control system.

C. Coordinate all assemblies that require field coordination for installation including loose items provided by the boiler manufacturer, combustion air make-up fans, emergency shut-off push buttons, etc.

D. Coordinate items of other disciplines involved with the physical geometry of the boilers so that the design intent shown on the drawings is maintained with the actual boilers.

E. Boiler Size: Boiler shall fit within the minimum area as shown on the drawings. If you do not have the drawings, get them. Boiler must fit in the space provided while simultaneously allowing for tube removal, space for other equipment in the facility, rear door removal, access platform design, and personnel walkway space. This requirement must be satisfied due to the existing geometry of the building and will not be overlooked in the evaluation of the submittals by the Engineer.

1.8 WARRANTY AND SERVICE CONTRACT

A. All equipment shall be guaranteed against defects in materials and/or workmanship for a period of 12 months from date of start-up or 30 months from date of shipment, whichever comes first. Warranty shall be 5 years for materials and workmanship on pressure-related parts.

B. Manufacturer shall provide a 5-year service contract to maintain and service all components provided in this Section.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver boilers with burners, fuel trains, and boiler trim shall be installed as much as possible. Provide protective crating and covering.

B. Boiler manufacturer shall maintain responsibility until the inspected boiler has been removed from the delivery truck.

C. Deliver boiler to the Boiler Plant on Cromartie St, Winston-Salem, NC 27110 across from Carolina Hall. Deliver to the parking lot to the east of the plant. Coordinate exact day/time of delivery with Contractor to ensure smooth handoff.

D. Entire boiler and burner assembly shall be shipped covered with shrink wrap to protect components from water. Provide desiccant in waterside and fireside. Clearly label so Contractor removes prior to filling or firing boiler.

E. Obtain approval from Contractor before shipping any boiler. No boiler can be shipped on-site until an air permit is obtained by the Owner/GC.

F. All equipment shall be stored in accordance with the manufacturer's recommendations and State Construction requirements. If boiler arrives before the plant is prepared to receive it, Contractor shall store in a bonded warehouse, or in their own storage facility until the boiler can be installed. Alternatively, the Contractor may request the boiler manufacturer delay delivery to line up with construction timing.

G. Contractor to inspect equipment immediately upon arrival, before assuming responsibility. Any irregularities or damage shall be immediately reported to the manufacturer/supplier and Owner.

H. Manufacturer to provide rigging instructions for installing Contractor, and to oversee assembly of boiler components.

1.10 APPLICABLE PUBLICATIONS

A. The regulatory codes and standards listed below, publication issue in effect at date of invitation for bids, form a part of this specification. All applicable components of the boiler shall be designed and constructed in accordance with these codes with additions or modifications as required by this specification.

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

a. A106-94: Seamless Carbon Steel Pipe for High Temperature Service
b. D396-92: Fuel Oils

2. American Society of Mechanical Engineers (ASME):

a. Boiler and Pressure Vessel Code
b. CSD-1: Controls and Safety Devices for Automatically Fired Boilers
c. B31.1: Power Piping

d. PTC 4.1: Steam Generating Units
e. PTC 19.10: Flue and Exhaust Gas Analyses

3. National Fire Protection Association (NFPA):

a. 8501: Standard for Prevention of Furnace Explosions in Fuel Oil and Natural Gas Fired Single Burner Boiler Furnaces.
b. 31: Standard for the Installation of Oil-Burning Equipment.
c. 54: National Fuel Gas Code
d. 85: Boiler and Combustion Systems Code

4. North Carolina Department of Labor (NCDOL):

a. Boiler Safety Bureau: Uniform Boiler and Pressure Vessel Act of North Carolina

PART 2 - PRODUCTS

2.1 STEAM BOILERS/GENERATORS

A. Basis-of-Design Product: Subject to compliance with performance requirements in this section, provide boiler by one of the following manufacturers:

1. Clayton Industries SE604-FGR (basis of design)
2. Cleaver Brooks
3. Miura
4. Approved Equal

B. Shipping Size Requirements: The largest shipping component must be no larger than 11’x11’x12’ (LxWxH).

C. General: The steam generator shall have a forced circulation, counterflow, mono-watertube configuration with a forced draft burner. The complete steam generator package shall include a monotube heating coil with a waterwall-cooled combustion chamber and integral burner assembly; a motor-driven forced draft blower; a motor-driven positive displacement boiler feedwater pump; fuel train with ignition and flame supervisory controls; separate ASME code stamped steam separator with trap assembly, pressure relief valve(s) and blowdown for dissolved solids control; an integral control panel for automatic and manual control of the steam generator, including continuous monitoring safety annunciators. The steam generator shall be provided with the following safety controls in addition to the burner supervisories: coil low water safety control, auxiliary thermostat low water safety switch, steam pressure limit switch, steam safety relief valve(s), and feed water pump safety relief valve. All components, except the feedwater pump and motor, shall be mounted on a single structural steel base and shall be factory fire-tested as a complete unit. The feedwater pump and motor shall be on a separate, manufacturer provided skid.

D. Performance

1. Steam generator shall be rated at 600 Boiler Horsepower and capable of producing a rated heat output of 20,085,000 MMBTU/Hr. The unit shall have a maximum (design) steam outlet pressure of 150psig and an operating outlet pressure of 100 psig in conformance with ASME Power Boiler Code, Section I.
2. The pressure vessel shall be constructed to a rating of saturated steam at 300 psig.
3. The primary fuel to be used shall be natural gas and will be supplied to the unit at a pressure of no less than 10 psig.
4. The unit shall be capable of burning #2 diesel oil as a backup fuel.
5. The steam generator shall be capable of accepting feedwater with a total dissolved solids (TDS) concentration of up to 8550 ppm. (Normal Operating range of 3000-6000 ppm).
6. The Steam Generator efficiency, defined as the total heat added to the feedwater divided by the total heat input of the fuel (i.e., net heat output divided by gross heat input based upon Higher Heating Value) shall not be less than 85% when averaged across operating the full modulating range of 20% to 100% of rated load.
7. Steam Generator shall be provided with a feedwater economizer and feedwater piping that can provide 2-3% efficiency gains.
8. Steam Generator shall be provided with flue gas recirculation. Emissions when burning gas shall be <30 ppm NOx. Emissions when burning No. 2 oil shall be <90 ppm NOx.

E. Component Requirements

1. General: All pressure related components shall be constructed at a minimum to Class 150 specifications, and shall be rated for steam service.
2. Heating Coil: The heating coil shall be designed, built, and stamped per ASME Section I specifications. The coil shall be a monotube design and manufactured from SA192 steel tubing. The assembly shall be stress relieved and shall be hydrostatically tested at 1.5 times the design pressure per ASME guidelines. The heating coil shall be encased in a mild steel jacket, which shall contain all combustion gases. The Jacket shall be insulated to maintain a cool outer skin temperature. The Entire coil assembly shall be covered with a (.048") 18-gauge sheet metal jacket secured in place with pop rivets and/or sheet metal screws.
3. Burner**:** The Burner shall be a modulating forced-draft design capable of burning natural gas and #2 oil. The Burner and the associated control system shall be capable of modulating from 20% to 100% of the rated load. The unit will cycle into standby mode when the steam demand falls below 20%.

    a. The burner shall meet the requirements of Underwriters Laboratory (UL). The Burner shall be a packaged design with all components mounted, piped and wired on the steam generator frame.
    b. The Burner Management System shall be Autoflame.
    c. Control of the combustion air and fuel flow shall be via the Burner Management System using independent servo-motor controls for the combustion air damper and fuel valves.

4. Combustion Air Blower: Combustion air shall be provided by a squirrel-cage blower, complete with duct and damper assembly. The Blower shall be connected to an AC, TEFC, motor suitable for the service. Blower shall be operated on a VFD, and the speed shall modulate with the feedwater pump to maintain steam pressure.

5. Steam Separator: The steam separator shall be designed, built, tested and stamped per ASME Section I. The unit shall be sized to properly separate steam from water and solids and to provide a minimum of 99.5 % dry steam at the outlet nozzle. The separator shell shall be made from SA53 black pipe. The heads shall be SAE 285 carbon steel. Excess water and solids shall exit the separator through an inverted bucket steam trap for return to the feedwater vessel. The separator shall have openings provided for steam outlet, safety relief valve(s), coil connection, drain, pressure/temperature indicators, and an inspector's test cock.
6. Feedwater Pump

    a. The steam generator shall have a diaphragm type, positive displacement feedwater pump. The pump shall be capable of delivering the required volume of water to the coil. The pump shall be equipped with replaceable diaphragms, and check valve seats and discs.
    b. The pump materials shall be as follows: The crankcase, pump head, and check valve housings to be cast iron. The check valve discs are to be stainless steel and the seat is to be made of Rulon (modified Teflon). The Diaphragm material is to be Nitrile rubber / nylon cloth lamina.
    c. The Feedwater Pumps shall be connected to a variable frequency AC, TEFC, motor(s) suitable for the service. The pump and motors shall be capable of a 5:1 turndown to allow for feedwater modulation from 20% to 100% of rated output.

7. Control Panel: Each steam generator shall have its own control panel mounted and wired on its frame. The steam generator shall utilize a PLC system of the level indicated below. The primary operating voltage shall be 208V. A 110V control voltage transformer will be supplied as an integral component of the control panel. Utilize Autoflame controller and 12" touchscreen Operator Interface Unit. The following read-outs shall be available through the Operator Interface Unit:

    a. Firing Rate
    b. Steam Pressure
    c. Steam Pressure Set Point
    d. Machine Run Hours

8. Control Panel Integration: The Autoflame controller must be capable of outputting communication to integrate with the existing Autoflame Universal I/O Module (Mk.8, Part # DTI80022) and Autoflame D.T.I. System (Mk.7, Part # DTI70100) in the control room.
9. Steam Generator Components: Provide steam generator with the following:

    a. Economizer section
    b. Installation valve kit
    c. Line reactors
    d. Low NOx burner system
    e. Pump head cooling
    f. Pump oil level switch
    g. Soot blower
    h. Universal alarm

10. Performance Testing: Gas-fired Steam Generators shall be factory tested including a functional test of all components, test firing of the unit, on gas, throughout it output range and tuning of the burner for optimal performance. A factory test report must be provided.
11. Shipping: Boiler shall be shipped and delivered in containers no larger than 11'x11'x12' (LxWxH) to fit through the sliding boiler plant doors and into place without taking the plant or boiler 2 offline.

F. Additional Components

1. General: Boiler manufacturer shall provide the components below, designed to work with the boiler provided.
2. Booster Pumps and Controller: Provide (2) booster pumps and a pump controller to provide feedwater to the boiler from the Deaerator.

    a. Booster pumps shall be centrifugal style, rated for 300 °F continuous fluid temperature.
    b. Design point: 150 gpm @ 45 ft.
    c. NPSHr: 3.5 ft
    d. Control Panel: Powers the pump with hand/off/auto switches. Control panel shall integrate to the boiler control panel to engage pumps when the boiler engages. Panel shall be powered by 208V 3ph power.

3. Continuous Blowdown Kit:

    a. General: The blowdown kit controls the concentration of total dissolved solids (TDS) in the steam generator system.
    b. Description: Continuous Blowdown Kit shall consist of a shutoff valve, strainer, needle valve and associated pipe fittings, as well as a TDS controller. The assembly, which is shipped loose for customer reconnection, is mounted in the discharge line from the steam trap on the steam separator. The outlet of the needle valve should be connected to a blowdown tank. Operation is based on diverting a small percentage of the trap discharge to drain.
    c. Design: Valving configuration is provided to divert a portion of the trap return to drain to maintain system TDS to acceptable levels for operation with existing firetube and watertube boilers. Operator should adjust needle valve, based on daily TDS readings to maintain recommended levels.

4. Backpressure Control Valve: Provide backpressure control valve to regulate steam pressure in the separator. Valve shall be pneumatically actuated, with a control signal from the boiler skid PLC. Valve shall be constructed of carbon steel, to a minimum ASME Class 150 rating.
5. Trap Separator Flash Tank: ASME coded tank designed to receive saturated condensate, flash steam to atmosphere, and recover the low-pressure condensate to the condensate tank. Tank must be constructed of carbon steel, with ASME class 150 flanges on all pipe connections. Tank shall have a tangential inlet, gauge glass connection, and cleanout drain on the bottom.

PART 3 - EXECUTION

3.1 OFCI EQUIPMENT CONTRACTOR RESPONSIBILITY

A. General: Except where specifically stated otherwise, the Contractor is responsible for Part 3 Execution. The Manufacturer is responsible for providing the product and all factory testing reports and for delivery. The Contractor is responsible for offloading, rigging and installation. Manufacturer field reports are detailed below.

B. Equipment Examination: The Contractor is responsible for examining equipment for damage and reporting to Owner, Engineer and Manufacturer. The Manufacturer is responsible for correcting all damage that may occur prior to offloading. Reject all equipment that are damaged.

C. The Contractor shall be responsible for off-loading and installation of the equipment.

3.2 SITE EXAMINATION

A. Before boiler installation, examine roughing-in for concrete equipment bases, anchor-bolt sizes and locations, and piping and electrical connections to verify actual locations, sizes, and other conditions affecting boiler performance, maintenance, and operations.

1. Final boiler locations indicated on Drawings are approximate. Determine exact locations before roughing-in for piping and electrical connections.

B. Examine mechanical spaces for suitable conditions where boilers will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 BOILER INSTALLATION

A. General:

1. Boiler manufacturer’s representative shall oversee the handoff and assembly of the boiler and its components.
2. Rig boiler in accordance with boiler manufacturer’s instructions.
3. Install all loose components provided by boiler manufacturer in accordance with boiler manufacturer’s instructions.
4. Follow requirements of Part I of this Section with respect to delivery, storage, and handling of boilers.
5. Mount boiler on concrete pads with one end fixed (bolted down) so that the boiler does not squirm off the pads.

B. Boiler and Burner Access Openings: Arrange all equipment and piping to allow access to openings without disassembly of equipment or piping.

C. Drainage Facilities for Boiler Water Column, Gauge Glass, Low Water Cutoffs, Water Level Alarms: Locate and orient sight flow indicators so that an operator can view the fluid flow while simultaneously operating drain valves and low water cutoff shunt switches.

D. Boiler Flue Gas Outlet Location: Drawings show a location for the flue gas outlet. If the boiler submitted has a different flue gas outlet location, the Contractor shall redesign and relocate the stack and breeching systems at no additional cost. A Professional Engineer licensed in the State of the project location shall stamp the redesign drawings provided by the Contractor.

E. Wiring to Boiler-Mounted Water Level Controls and Switches: Provide length of flexible conduit sufficient to permit removal of float and probe assemblies without disconnecting wiring.

F. Electrical:

1. Provide wire and conduit for the items listed below in accordance with applicable Division 26 Sections and the boiler manufacturer's instructions.

    a. Single point boiler power connection from electric power source.
    b. Steam header pressure sensing device(s) provided by boiler manufacturer to boiler control panels.
    c. Emergency shut-off pushbuttons to boiler control panels and fuel oil pumps.

G. Anchor the boiler to the mounting pad as recommended by the boiler manufacturer.

H. Contractor shall assemble and install the boiler per the manufacturer's recommendations, and with their firsthand oversight.

1. Install gas-fired boilers according to NFPA 54.
2. Install oil-fired boilers according to NFPA 31.
3. Assemble and install boiler trim.
4. Install electrical devices furnished with boiler but not specified to be factory mounted.
5. Install control wiring to field-mounted electrical devices.

3.4 CONNECTIONS

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

B. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

C. Install piping adjacent to boiler to allow service and maintenance.

D. Connect gas piping to boiler gas-train inlet with union. Piping shall be at least full size of gas train connection. Provide a reducer if required.

E. Connect oil piping full size to burner inlet with shutoff valve and union.

F. Retain paragraph above for hot-water boilers and first paragraph below for steam boilers.

G. Connect steam and condensate piping to supply-, return-, and blowdown-boiler tappings with shutoff valve and union or flange at each connection.

H. Install piping from safety valves to drip-pan elbow and to nearest floor drain.

I. Install piping from equipment drain connection to nearest floor drain. Piping shall be at least full size of connection. Provide an isolation valve if required.

J. Contractor shall connect breeching full size to boiler outlet. Comply with requirements in Section 235100 "Boiler Breechings" for venting materials.

K. Contractor shall install flue-gas recirculation duct from vent to burner. Comply with requirements in Section 235100 "Boiler Breechings" for recirculation duct materials.

L. Contractor shall ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

M. Contractor shall connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.5 FIELD QUALITY CONTROL – INSTALLATION

A. Field Report: Prior to start up, the manufacturer’s rep shall issue a field report about the installation which shall include, but not be limited to, the following:

1. Dates observed onsite.
2. Statement that the boiler is assembled per the manufacturer’s instructions.
3. Statement that the connections are installed per the manufacturer’s instructions.
4. Statement that the installation is ready for start up.
5. Report any site/installation conditions not critical to start up that need to be corrected to complete the installation (e.g. field insulation).

B. Start up of the boiler shall not proceed without this documentation.

3.6 FIELD QUALITY CONTROL – START UP

A. Perform the following tests and inspections with the assistance of a manufacturer’s service representative:

1. Perform installation and startup checks according to manufacturer's written instructions.
2. Operational Test: Start units to confirm proper motor rotation and unit operation. Adjust air-fuel ratio and combustion.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
4. Burner Test: Adjust burner to eliminate excess oxygen, carbon dioxide, oxides of nitrogen emissions, and carbon monoxide in flue gas and to achieve combustion efficiency.
5. Check and adjust initial operating set points and high- and low-limit safety set points of fuel supply, water level, and steam pressure.
6. Set field-adjustable switches and circuit-breaker trip ranges as indicated.
7. Boiler boil-out and dry-out.

B. Remove and replace malfunctioning units and retest as specified above.

C. Prepare test and inspection reports.

3.7 CLEANING AND PROTECTION FROM CORROSION:

A. Boiler Cleaning: Upon completion of installation, the initial firing of the burner shall be done to boil out, under supervision of boiler manufacturer, all internal surfaces with chemical solution recommended by boiler manufacturer, to remove all mill scale, corrosion products and other foreign material. Following boil out, boiler shall be washed and flushed until water leaving the boiler is clear. Drain boiler, inspect internal surfaces for cleanliness, then refill boiler with softened and treated water. The Contractor shall consult with the Owner's boiler chemical company to select the type of chemical solution for boil-out. The Contractor is not required to purchase the solution through the Owner's chemical company but must provide the chemical for this project. The Contractor shall properly dispose the chemical and chemical waste. Coordinate with boiler manufacturer's field representative to have the person on-site just prior to and during boil-out.

B. Protection from Corrosion:

1. General: Protect the boilers from fireside and water-side corrosion at all times.
2. Wet Storage: If, after water is placed in the boilers, they are not fired for equipment adjustment or testing for more than one month, the boilers shall be protected with a wet storage method recommended either by the boiler manufacturer or the ASME Code, Section VII, or the Owner's chemical treatment company.
3. Chemical Treatment: The quality of the water in the boilers shall be maintained by the Owner's professional water treatment organization. This organization shall provide on-site supervision to maintain the required water quality during periods of boiler storage, operating, standby and test conditions. Except for boil-out related chemicals and labor, all chemicals, labor and professional services shall be provided by the Owner's professional water treatment organization. Coordinate timing of services with Owner so he has given proper notification on his end.

3.8 INSPECTIONS:

A. Condition of Boiler After Delivery: After receiving boiler on-site and prior to making any connections to boiler, the Contractor and boiler manufacturer's field representative shall jointly inspect interior and exterior for damage. The boiler manufacturer shall correct all damage by repair or replacement to achieve a like new condition.

B. Demonstrate that boilers, burners, controls, instruments, and accessories comply with the specifications. When test results are not acceptable, make corrections and repeat tests at no additional cost to the Owner.

C. Condition of Boiler After Delivery, Rigging, Placement: After setting boiler on foundation and prior to making any connections to boiler, the Designer and Owner jointly shall inspect interior and exterior for damage. Correct all damage by repair or replacement to achieve a like new condition.

D. Internal Inspection of Pressure Parts and Furnace:

1. After all operational tests are satisfactorily completed, the Owner's boiler inspector will determine if the boiler is free from corrosion, deposits, and any other type of damage or defect.
2. In preparation for the inspection, open all manways, handhole, and access doors or panels at the ends of the boiler. Drain and clean the interior of all pressure parts and clean all soot and debris from furnace.
3. Any corrosion, damage or defect shall be corrected to a like new condition in the judgment of the boiler inspector.
4. After the boiler inspector has approved the boiler, all manways, handholes, and the access doors shall be closed with new gaskets.

3.9 HYDROSTATIC TESTING

A. Boiler: Shall be performed by the boiler manufacturer prior to shipping and is not required to be repeated by the Contractor, unless required by law. Do not perform any work that will require the Contractor to have to perform hydrostatic testing. In the event that the Contractor is required to perform work that requires a hydrostatic test (i.e. he damages a Code part, modifies a Code part, etc.), he shall perform the hydrostatic test in compliance with the manufacturer's instructions and in the witness of the Authorized Inspector and the Engineer. Any related repair work shall be immediately identified in writing to the Engineer prior to performing such work.

B. Boiler External Piping (as defined by ASME B31.1, Power Piping): Shall be performed by the boiler manufacturer prior to shipping and is not required to be repeated by the Contractor, unless required by law. Do not perform any work that will require the Contractor to have to perform hydrostatic testing. In the event that the Contractor is required to perform work that requires a hydrostatic test (i.e. he damages a Code part, modifies a Code part, etc.) he shall perform the hydrostatic test in compliance with the manufacturer's instructions and in the witness of the Authorized Inspector and the Engineer. Any related repair work shall be immediately identified in writing to the Engineer prior to performing such work.

C. Identify and remove any connecting equipment that is not rated for the test pressure. Cap the openings left by the disconnected equipment. Reinstall the equipment after tests are completed.

3.10 BURNER FLAME SAFEGUARD TESTING:

A. Most of this shall be performed by the boiler manufacturer prior to shipping. The Contractor shall document and demonstrate operation of control, interlock, and indicating functions as described below. Evidence shall consist of itemized, signed check list of control, indicating, and interlock functions described. Check list shall certify that all functions are properly operational. Conduct tests by experienced Contractor personnel in witness of the boiler manufacturer's field representative.

1. Verify flame scanner operation for both fuels. Test for light-off flame. Test for loss of flame.
2. Verify natural gas and fuel oil high and low pressure switch operation.
3. Verify emergency pushbutton shut-off operation.

3.11 PERFORMANCE, EFFICIENCY, AND EMISSIONS TESTING

A. Perform testing after burner flame safeguard testing is performed and after the burner has been tuned.

1. Certain portions of different tests can be conducted at the same time only if approved by the Engineer. The boiler must be tuned prior to the official records being made. If tuning is required during the official recording period to satisfy performance or emissions specification requirements, the entire process shall be re-started so that the official record reflects the boiler as tuned and turned over to the Owner. The boiler cannot be tuned to satisfy performance and then be re-tuned to satisfy emissions.
2. If testing is scheduled to occur during the summer when campus steam demand is below the capacity of one new boiler, the Contractor shall utilize the steam pressure vent station.
3. Testing shall be performed by the Contractor with the boiler manufacturer’s representative on-site performing tuning activities.

B. Test No. 1:

1. Check current draw of forced draft fan motor at prepurge and at 100 percent of maximum boiler load.
2. Current draw shall not exceed full load current stamped on motor nameplate.

C. Test No. 2:

1. Demonstrate smooth operation of burner and feedwater controls by ramping firing demand quickly and then lowering firing demand quickly. This portion will be considered complete when it is passed successfully.
2. Demonstrate proper start-up and shut down procedure of each boiler. Start-up a boiler from a cold start, ramp the boiler to high fire, relax the load, and then turn it off. The sequence shall prove purge procedures and limits are functioning properly.
3. Demonstrate turndown of boiler.

D. Test No. 3:

1. Test No. 3 shall be performed by the Contractor with the boiler manufacturer's representative on-site performing tuning activities and shall test the efficiency of each boiler. At the same time, the boiler emissions test shall take place.
2. Efficiencies shall be calculated in fuel to steam efficiency (based on higher heating valve of the fuel) based on the stack loss method. Use arithmetic averages of the readings to determine efficiency computation input variables. Efficiencies shall NOT be stated in combustion efficiency, and the combustion efficiency report provided by a flue gas analyzer is not sufficient testing procedure. As necessary, follow the testing procedures given by ASME PTC 4.1.
3. Conduct boiler tests in strict accordance with the ASME Power Test Code PTC 4.1, using the ASME Test Form for Abbreviated Efficiency Test bound therein. Use the heat loss method to determine the Actual Gross Efficiency. Approximate, Line 69 of the Test Form

("Heat Loss Due to Radiation") by use of the ABMA Standard Radiation Loss Chart, bound in PTC 4.1. Assume Line 70 of the Test Form ("Unmeasured Losses") to be 1.0 percent.

4. The Contractor shall perform the emissions testing himself or he shall hire a third party not affiliated with the boiler manufacturer or the service representative who is qualified to do such testing.
5. Emissions testing is not required to be performed in accordance with any specific EPA certified method, however, it shall be done professionally with calibrated instruments (such as a Bacharach device) so that it can be used as a reasonable accurate method. The report will be copied to the applicable governing emission agency if they request it so it must be clear, professional, and satisfy any of their requirements.
6. Utilize flow meters, pressure and temperature gauges, and transmitters provided under this project. Provide flue gas emissions, opacity, and oxygen instruments. Provide air temperature and barometric pressure instruments. The Contractor shall submit a report which indicates efficiencies and emissions.
7. Just prior to emissions and performance testing, the Contractor shall obtain a sample of fuel oil from the Owner's fuel supply and send it to a lab and test it for higher heating value, nitrogen content, and sulfur content. Submit certified lab test report with efficiency and emissions test report.
8. Perform test on both fuels. Test data sheets shall list the following data for at least five points on the fuel/air ratio curve starting at minimum position and proceeding in steps to the maximum position. Points shall be at minimum turndown, 25, 50, 75, and 100 percent firing rate. Positions shall be held for a minimum of ten minutes at each position or longer as required for emissions testing.
9. The following data shall be recorded at each test firing rate:

    a. Firing rate.
    b. Fuel pressures: At burner, upstream of fuel flow control valve and upstream of regulating valve.
    c. Fuel flow rate.
    d. Boiler feedwater pressure, upstream of feedwater control valve.
    e. Boiler feedwater temperature
    f. Flue gas temperature at boiler outlet.
    g. Flue gas oxygen, carbon monoxide (CO), carbon dioxide (CO_2), and NO_x. Test SO_x for fuel oil only.
    h. Opacity of flue gas.
    i. Steam flow rate.
    j. Steam pressure of boiler and header.
    k. Combustion air temperature dry bulb and wet bulb, inside steam plant.
    l. Barometric pressure inside steam plant.
    m. Damper positions and burner draft.

10. Submit a report indicating efficiencies and emissions.

E. Failure to Attain Guaranteed Efficiency: Should the boiler fail to attain the guaranteed efficiency required, corrective measures shall be made at no expense to the Owner and as approved by the Owner. When these corrective measures have been made, perform an unofficial test to determine the results of the corrective measures. When the unit meets the guaranteed efficiency, notify the Owner's Representative who will designate a time for a new acceptance

test, which shall be in strict accordance with all of the aforementioned specified requirements. Proven corrective measures made on one unit shall then be made on all other units. All costs of re-testing shall be covered by the manufacturer.

3.12 TRAINING AND DEMONSTRATION

A. The boiler company startup technician shall conduct training of facility personnel. The training shall be in the amount described under Section 017900 Demonstration and Training. The training may be done in conjunction with boiler startup; however, at least 75% must be separate from start-up work. Classroom training where the startup technician walks the owner personnel through the training manual(s) shall be included. Conduct the classroom training before the "hands-on" training.

B. The training shall be done for both fuels and shall include training on installation and removal of the burner oil gun. Take the owner personnel through the complete startup and shutdown on both fuels. Allow owner personnel to conduct a startup on each burner and on each fuel with the help of the boiler company startup technician.

C. Provide written training materials that owner personnel will use to guide the training process. The material shall include but are not limited to basic system overview, details on each component, details of the overall system including detailed piping and wiring diagrams, troubleshooting guides for all components and the whole system, and any other material to allow the owner to use the material as a reference for any and all system operations.

D. Submit a training plan to the Designer for approval at least 4 weeks prior to the commencement of the training. The training plan should include a copy of the training manual and a detailed schedule of training activities.

E. The Owner will not accept the boiler until the Owner is satisfied with the amount of training.

3.13 BOILER LIFE-CYCLE BID FORM

A. General: Boilers will be selected as vendor specific base bids as indicated in Division 1. Boiler life cycle bid forms and manufactures proposals shall be submitted with the bid form of proposal and will be reviewed by Engineer and Owner, and be selected at will.

B. Life-Cycle Cost Parameters:

1. Efficiency: Includes combustion efficiency, thermal efficiency, and radiant losses
2. Fuel: Natural Gas as specified in this Specification.
3. Fuel Cost: $8.0 per DekaTH
4. Electric Cost: $0.11/kWh, using 208V power
5. Steam: Saturated at 100 psig
6. Feedwater: 227 F
7. Excess Air: 15%
8. Combustion Air Temp: 85F
9. Emissions Corresponding to Performance: As specified in this Specification.
10. Term of Evaluation: 20 Years

C. Bid Table: Boiler MFG to fill out and include in submission

Steaming Rate	Annual Hours	Efficiency (%)	Annual Fuel Use (SCF)	Annual Fuel Cost ($)	Annual Electric Use (kW)	Annual Electric Cost ($)
600 BHP (20,083 MBH)	720					
450 BHP (15,062 MBH)	1,464					
300 BHP (10,041 MBH)	2,580					
150 BHP (5,021 MBH)	372					
Total	5,136	NA				

D. Equipment Lead Time: Provide the following equipment delivery dates, based on the Notice to Proceed date, and considering a 2-week submittal review period.

1. Standard Delivery: _____
2. Expedited Delivery: _____
3. Expedited Delivery Cost Add: _____

E. Bid Tab Form (at the end of this section): Engineer to fill out at bid opening

END OF SECTION 235239

RMF Engineering
Reliability. Efficiency. Integrity.

SCO ID #: 21-23049-01
RMF Proj #: 221402.A0
Bid Date: 4/28/2022

BOILER PREPURCHASE BID TAB FORM

WSSU BOILER 1 REPLACEMENT

BOILER MANUFACTURER AND MODEL NUMBER	CAPACITY (BHP)	FIRST COST ($)	20 YEAR LIFE CYCLE COST ($)	LEAD TIME (WEEKS)	EXPEDITED DELIVERY LEAD TIME (WEEKS)	EXPEDITED DELIVERY COST ADD ($)