ADDENDUM NUMBER 2

Date: May 1, 2014

Re: West Energy No. 2 Boiler Replacement (H27-Z080)
University of South Carolina

A/E Proj. No.: 133036

Submitted By: Danny Wilds, PE
Mechanical Design, Inc.
4403 Broad River Road
Columbia, S.C. 29210
(803)731-9834 Fax: (803)731-9837

The following items take precedence over referenced portions of the Contract Documents for the referenced project dated February 14, 2014, and, in executing a contract, shall become a part thereof.

Where any item called for in the documents is supplemented hereby, the original requirements shall remain in effect. All supplemental conditions shall be considered as added thereto.

Where any original item is amended, voided, or superseded hereby, the provision of such items not so specifically amended, voided, or superseded shall remain in effect.

Clarifications:

1. The bid date has be been changed from May 6th to May 12th at 1:00 pm. Refer to the revised SE-310 form.

2. Removal and re-installation of the storefront entrance including louver to the West Energy Facility shall be by the Contractor's qualified glass installer.

3. Tree in east drive to the West Energy Facility shall be trimmed by USC.

4. Owner does not intend to keep the boiler to be removed.

Drawings:

5. Refer to drawing M5 included with Addendum No.1 and add the attached sketch MS1.

6. Refer to drawing M5 included with Addendum No.1 and add the attached sketch MS2.

7. Refer to drawing M5 included with Addendum No.1, END ELEVATION VIEW - BOILER, and modify the concrete pad note to read "concrete pad, see BOILER PAD DETAIL (MS2)".

Specifications:

8. Delete SE-310 Request For Advertisement and replace with SE-310 Request For Advertisement revised 04/30/14.

9. Delete SE-330 Lump Sum Bid and replace with the attached SE-330 Lump Sum Bid revised

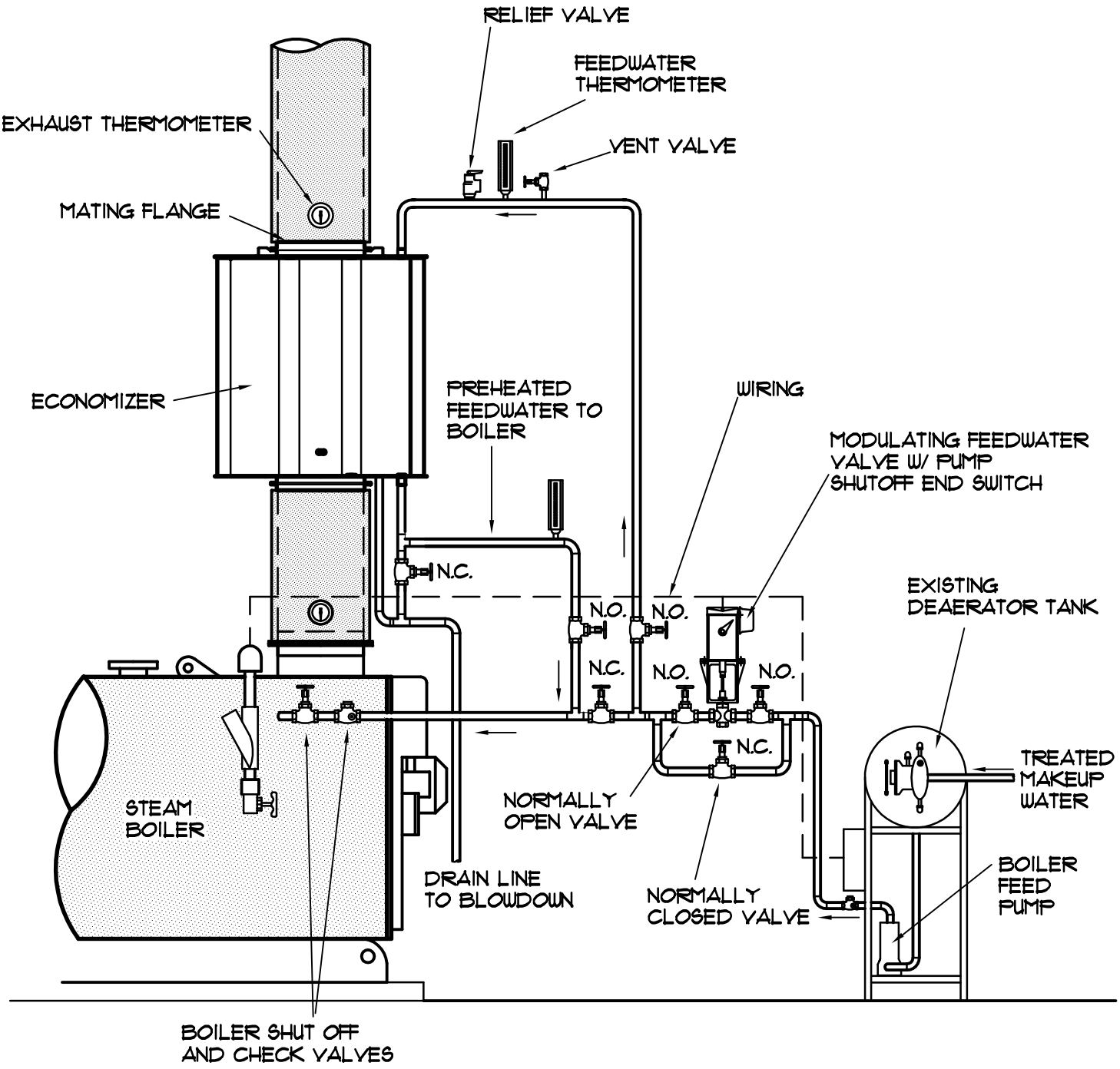
04/30/14.

10. Delete section 23 52 39 Steam Boiler entirely, and replace with the attached section 23 52 39 revised 04/30/14.

11. Add section 23 52 39A Steam Boiler (Alternate No. 3).

12. Delete section 25 55 00 Automatic Temperature Controls, and replace with the attached section 25 55 00 Automatic Temperature Controls revised 04/30/14.

END OF ADDENDUM NO. 2



ECONOMIZER PIPING DETAIL - ALTERNATE #1

NO SCALE

SOUTH CAROLINA REGISTERED PROFESSIONAL ENGINEER No. 11155 DANNY WILDS

MECHANICAL DESIGN INC.
4403 Broad River Road
Columbia, S.C. 29210
(803) 731-9634
(803) 731-9637 FAX
CONTACT: Danny Wilds

UNIVERSITY of SOUTH CAROLINA

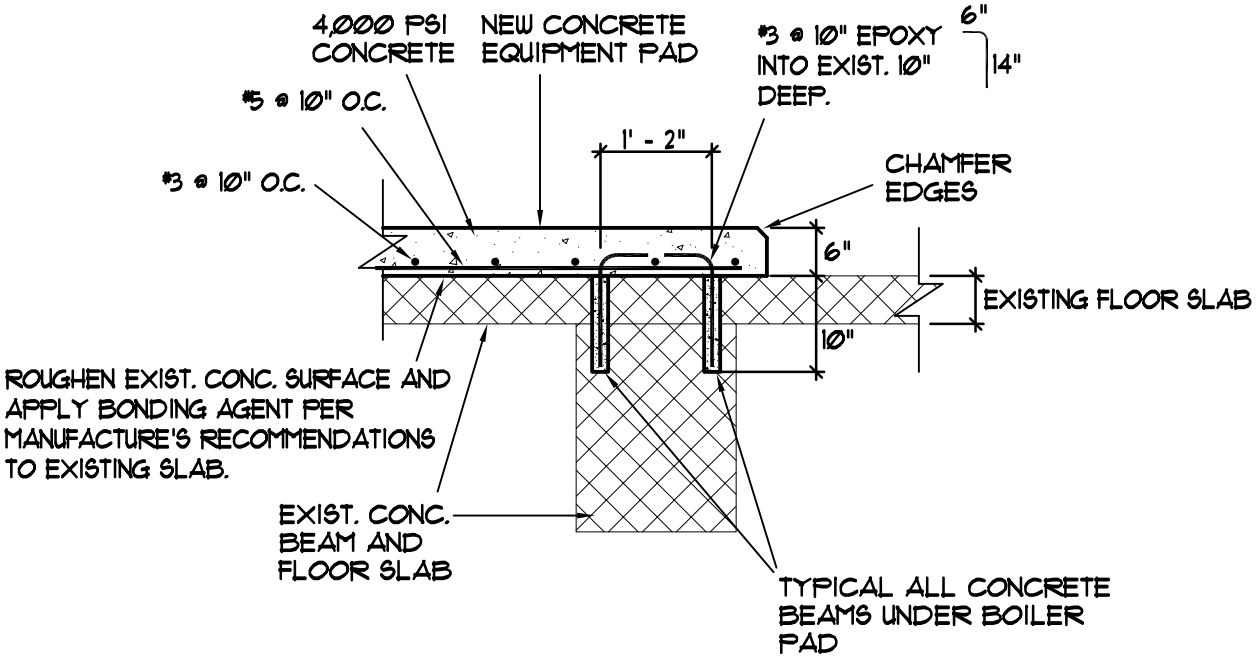
WEST ENERGY NO. 2 BOILER REPLACEMENT

S.C. State Job Number: H27-Z080
Comm No. 133036

April 30, 2014

MS1

CONCRETE PAD SIZE:
CONCRETE PAD SHALL 12" LARGER THAN FOOTPRINT OF NEW BOILER ALL (4) SIDES.



BOILER PAD DETAIL

NO SCALE

SOUTH CAROLINA REGISTERED PROFESSIONAL ENGINEER
No. 11155
DANNY WILDS

MECHANICAL DESIGN INC.
4403 Broad River Road
Columbia, S.C. 29210
(803) 731-9834
(803) 731-9837 FAX
CONTACT: Danny Wilds

UNIVERSITY of SOUTH CAROLINA
WEST ENERGY NO. 2 BOILER REPLACEMENT
S.C. State Job Number: H27-Z080
Comm No. 133036

April 30, 2014

MS2

SE-310 **2011 Edition**

REQUEST FOR ADVERTISEMENT

PROJECT NAME: West Energy No. 2 Boiler Replacement

PROJECT NUMBER: H27-Z080

PROJECT LOCATION: Columbia, SC

Contractor may be subject to performance appraisal at close of project

BID SECURITY REQUIRED? Yes ☒ **No** ☐

PERFORMANCE & PAYMENT BONDS REQUIRED? Yes ☒ **No** ☐

CONSTRUCTION COST RANGE: $800,000 - $900,000

DESCRIPTION OF PROJECT: Remove Boiler No. 2 in the West Energy Facility, and replace with (2) 800 hp horizontal scotch marine firetube steam boilers. Alternates include adding boiler exonomizers and water softners. It is the Contractor's responsibility to check the website for plans, specs, and all adenda. Small and minority business participation is encouraged.

A/E NAME: Mechanical Design, Inc.

A/E CONTACT: Danny Wilds, PE

A/E ADDRESS: Street/PO Box: 4403 Broad River Road
City: Columbia
State: SC ZIP: 29210-4011

EMAIL: danny@mdi9834.com

TELEPHONE: 803-731-9834 **FAX:** 803-731-9837

All questions & correspondence concerning this Invitation shall be addressed to the A/E.

BIDDING DOCUMENTS/PLANS MAY BE OBTAINED FROM: purchasing.sc.edu

PLAN DEPOSIT AMOUNT: $0.00 **IS DEPOSIT REFUNDABLE: Yes** ☐ **No** ☐

Only those Bidding Documents/Plans obtained from the above listed source(s) are official. Bidders rely on copies of Bidding Documents/Plans obtained from any other source at their own risk.

BIDDING DOCUMENTS/PLANS ARE ALSO ON FILE FOR VIEWING PURPOSES ONLY AT *(list name and location for each plan room or other entity)***:**

No Other Source (website only)

PRE-BID CONFERENCE? Yes ☒ **No** ☐ **MANDATORY ATTENDANCE? Yes** ☐ **No** ☒

DATE: 4/22/2014 **TIME:** 10:00 am **PLACE:** 743 Greene Street, Conference Room #53

AGENCY: University of South Carolina

NAME OF AGENCY PROCUREMENT OFFICER: Juaquana Brookins

ADDRESS: Street/PO Box: 743 Greene Street
City: Columbia
State: SC ZIP: 29208-____

EMAIL: jlbrookin@fmc.sc.edu

TELEPHONE: 803-777-3596 **FAX:** 803-777-7334

BID CLOSING DATE: 5/12/2014 **TIME:** 1:00 pm **LOCATION:** 743 Greene Street

BID DELIVERY ADDRESSES:

HAND-DELIVERY:

Attn: Juaquana Brookins
University of South Carolina
743 Greene Street
Columbia, SC 29208

MAIL SERVICE:

Attn: Juaquana Brookins
University of South Carolina
743 Greene Street
Columbia, SC 29208

IS PROJECT WITHIN AGENCY CONSTRUCTION CERTIFICATION? ***(Agency MUST check one)*** **Yes** ☒ **No** ☐

APPROVED BY *(Office of State Engineer)*: _____ **DATE:** _____

Addendum Two

2011 Edition

SE-330 – LUMP SUM BID
BID FOR

Bidders shall submit bids on only Bid Form SE-330.

BID SUBMITTED BY:_____
(Bidder's Name)

BID SUBMITTED TO: University of South Carolina
(Owner's Name)

FOR PROJECT: PROJECT NAME West Energy No. 2 Boiler Replacement

PROJECT NUMBER H27-Z080

OFFER

§ 1. In response to the Invitation for Construction Bids and in compliance with the Instructions to Bidders for the above-named Project, the undersigned Bidder proposes and agrees, if this Bid is accepted, to enter into a Contract with the Owner on the terms included in the Bidding Documents, and to perform all Work as specified or indicated in the Bidding Documents, for the prices and within the time frames indicated in this Bid and in accordance with the other terms and conditions of the Bidding Documents.

§ 2. Pursuant to Section 11-32-3030(1) of the SC Code of Laws, as amended, Bidder has submitted Bid Security as follows in the amount and form required by the Bidding Documents:

☐ Bid Bond with Power of Attorney ☐ Electronic Bid Bond ☐ Cashier's Check
(Bidder check one)

§ 3. Bidder acknowledges the receipt of the following Addenda to the Bidding Documents and has incorporated the effects of said Addenda into this Bid:

ADDENDUM No:_____

§ 4. Bidder accepts all terms and conditions of the Invitation for Bids, including, without limitation, those dealing with the disposition of Bid Security. Bidder agrees that this Bid, including all Bid Alternates, if any, may not be revoked or withdrawn after the opening of bids, and shall remain open for acceptance for a period of 60 Days following the Bid Date, or for such longer period of time that Bidder may agree to in writing upon request of the Owner.

§ 5. Bidder herewith offers to provide all labor, materials, equipment, tools of trades and labor, accessories, appliances, warranties and guarantees, and to pay all royalties, fees, permits, licenses and applicable taxes necessary to complete the following items of construction work:

§ 6.1 BASE BID WORK ***(as indicated in the Bidding Documents and generally described as follows)*****:** Remove Boiler No. 2 in the West Energy Facility, and replace with (2) 800 hp horizontal scotch marine firetube steam boilers. Alternates include adding boiler econimizers and water softners.,

_____, which sum is hereafter called the Base Bid.
(Bidder - insert Base Bid Amount on line above)

Addendum Two

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SE-330 – LUMP SUM BID
BID FOR

§ 6.2 BID ALTERNATES - as indicated in the Bidding Documents and generally described as follows:

ALTERNATE # 1 *(Brief Description)*: Provide a flue gas heat recovery economizer for each of the (2) new boilers complete as specified in section 23 52 39 Steam Boiler.

☐ **ADD TO** or ☐ **DEDUCT FROM BASE BID:**_____

(Bidder to Mark appropriate box to clearly indicate the price adjustment offered for each alternate)

ALTERNATE # 2 *(Brief Description)*: Remove existing water softener complete and replace with new water softener as shown and described on the drawings.

☐ **ADD TO** or ☐ **DEDUCT FROM BASE BID:**_____

(Bidder to Mark appropriate box to clearly indicate the price adjustment offered for each alternate)

ALTERNATE # 3 *(Brief Description)*: Provide (2) 4-pass wet back boilers with external burners as described in section 23 52 39A in lieu of the (2) 4-pass dry back boilers described in section 23 52 39.

☐ **ADD TO** or ☐ **DEDUCT FROM BASE BID:**_____

(Bidder to Mark appropriate box to clearly indicate the price adjustment offered for each alternate)

Addendum Two

2011 Edition

SE-330 – LUMP SUM BID
BID FORM

§ 7. LISTING OF PROPOSED SUBCONTRACTORS PURSUANT TO SECTION 3020(b)(i), CHAPTER 35, TITLE 11 OF THE SOUTH CAROLINA CODE OF LAWS, AS AMENDED – ***(See Instructions on the following page BF-3A)***

Bidder shall use the below-listed Subcontractors in the performance of the Subcontractor Specialty work listed:

SUBCONTRACTOR SPECIALTY **By License Classification and/or Subclassification** (Completed by Owner)	**SUBCONTRACTOR'S PRIME CONTRACTOR'S NAME** (Must be completed by Bidder) **BASE BID**	**SUBCONTRACTOR'S PRIME CONTRACTOR'S SC LICENSE NUMBER**
ALTERNATE 1		
ALTERNATE 2		
ALTERNATE 3		

If a Bid Alternate is accepted, Subcontractors listed for the Bid Alternate shall be used for the work of both the Alternate and the Base Bid work.

SE-330 – LUMP SUM BID
BID FORM

INSTRUCTIONS FOR SUBCONTRACTOR LISTING

1. Section 7 of the Bid Form sets forth a list of subcontractor specialties for which bidder is required to identify by name the subcontractor(s)Bidder will use to perform the work of each listed specialty. Bidder must identify only the subcontractor(s) who will perform the work and no others.

2. For purposes of subcontractor listing, a Subcontractor is an entity who will perform work or render service to the prime contractor to or about the construction site. Material suppliers, manufacturers, and fabricators that will not perform physical work at the site of the project but will only supply materials or equipment to the bidder or proposed subcontractor(s) are not subcontractors and Bidder should not insert their names in the spaces provided on the bid form. Likewise, Bidder should not insert the names of sub-subcontractors in the spaces provided on the bid form but only the names of those entities with which bidder will contract directly.

3. Bidder must only insert the names of subcontractors who are qualified to perform the work of the listed specialties as specified in the Bidding Documents and South Carolina Licensing Laws.

4. If under the terms of the Bidding Documents, Bidder is qualified to perform the work of a specialty listed and Bidder does not intend to subcontract such work but to use Bidder's own employees to perform such work, the Bidder must insert its own name in the space provided for that specialty.

5. If Bidder intends to use multiple subcontractors to perform the work of a single specialty listing, Bidder must insert the name of each subcontractor Bidder will use, preferably separating the name of each by the word **"and"**. If Bidder intends to use both his own employees to perform a part of the work of a single specialty listing and to use one or more subcontractors to perform the remaining work for that specialty listing, bidder must insert his own name and the name of each subcontractor, preferably separating the name of each with the word **"and"**.

6. Bidder may not list subcontractors in the alternative nor in a form that may be reasonably construed at the time of bid opening as a listing in the alternative. A listing that requires subsequent explanation to determine whether or not it is a listing in the alternative is non-responsive. If bidder intends to use multiple entities to perform the work for a single specialty listing, bidder must clearly set forth on the bid form such intent. Bidder may accomplish this by simply inserting the word "**and**" between the name of each entity listed for that specialty. Owner will reject as non-responsive a listing that contains the names of multiple subcontractors separated by a blank space, the word "or", a virgule (that is a /), or any separator that the Owner may reasonably interpret as a listing in the alternative.

7. If Bidder is awarded the contract, bidder must, except with the approval of the owner for good cause shown, use the listed entities to perform the work for which they are listed.

8. If bidder is awarded the contract, bidder will not be allowed to substitute another entity as subcontractor in place of a subcontractor listed in Section 7 of the Bid except for one or more of the reasons allowed by the SC Code of Laws.

9. Bidder's failure to insert a name for each listed specialty subcontractor will render the Bid non-responsive.

SE-330 – LUMP SUM BID
BID FORM

§ 8. LIST OF MANUFACTURERS, MATERIAL SUPPLIERS, AND SUBCONTRACTORS OTHER THAN SUBCONTRACTORS LISTED IN SECTION 7 ABOVE ***(FOR INFORMATION ONLY):*** Pursuant to instructions in the Invitation for Bids, if any, Bidder will provide to Owner upon the Owner's request and within 24 hours of such request, a listing of manufacturers, material suppliers, and subcontractors, other than those listed in Section 7 above, that Bidder intends to use on the project. Bidder acknowledges and agrees that this list is provided for purposes of determining responsibility and not pursuant to the subcontractor listing requirements of SC Code Ann § 11-35-3020(b)(i).

§ 9. TIME OF CONTRACT PERFORMANCE AND LIQUIDATED DAMAGES

a. CONTRACT TIME: Bidder agrees that the Date of Commencement of the Work shall be established in a Notice to Proceed to be issued by the Owner. Bidder agrees to substantially complete the Work within **120** calendar days from the Date of Commencement, subject to adjustments as provided in the Contract Documents.

b. LIQUIDATED DAMAGES: Bidder further agrees that from the compensation to be paid, the Owner shall retain as Liquidated Damages the sum of $250.00for each calendar day the actual construction time required to achieve Substantial Completion exceeds the specified or adjusted time for Substantial Completion as provided in the Contract Documents. This sum is intended by the parties as the predetermined measure of compensation for actual damages, not as a penalty for nonperformance.

§ 10. AGREEMENTS

a. Bidder agrees that this bid is subject to the requirements of the law of the State of South Carolina.

b. Bidder agrees that at any time prior to the issuance of the Notice to Proceed for this Project, this Project may be canceled for the convenience of, and without cost to, the State.

c. Bidder agrees that neither the State of South Carolina nor any of its agencies, employees or agents shall be responsible for any bid preparation costs, or any costs or charges of any type, should all bids be rejected or the Project canceled for any reason prior to the issuance of the Notice to Proceed.

§ 11. ELECTRONIC BID BOND

By signing below, the Principal is affirming that the identified electronic bid bond has been executed and that the Principal and Surety are firmly bound unto the State of South Carolina under the terms and conditions of the AIA Document A310, Bid Bond, included in the Bidding Documents.

Electronic Bid Bond Number: _____

Signature and Title: _____

Addendum Two

2011 Edition

SE-330 – LUMP SUM BID
BID FORM

BIDDER'S TAXPAYER IDENTIFICATION

FEDERAL EMPLOYER'S IDENTIFICATION NUMBER:_____

OR

SOCIAL SECURITY NUMBER:_____

CONTRACTOR'S CLASSIFICATIONS AND SUBCLASSIFICATIONS WITH LIMITATIONS

Classification(s)& Limits: _____

Subclassification(s) & Limits:_____

SC Contractor's License Number(s):_____

BY SIGNING THIS BID, THE PERSON SIGNING REAFFIRMS ALL REPRESENTATIONS AND CERTIFICATIONS MADE BY BOTH THE PERSON SIGNING AND THE BIDDER, INCLUDING WITHOUT LIMITATION, THOSE APPEARING IN ARTICLE 2 OF THE INSTRUCTIONS TO BIDDER. THE INVITATION FOR BIDS, AS DEFINED IN THE INSTRUCTIONS TO BIDDERS, IS EXPRESSLY INCORPORATE BY REFERENCE.

SIGNATURE

BIDDER'S LEGAL NAME: _____

ADRESS: _____

_____

BY:_____ **DATE:**_____
(Signature)

TITLE:_____

TELEPHONE:_____

EMAIL: _____

SECTION 23 52 39 - STEAM BOILER

PART 1 - GENERAL

1.1 Section 23 00 00 Mechanical, General applies to the work specified in this section of specifications.

1.2 The firetube boiler shall have a rated steam capacity of 27,600 lb/hr from and at 212 degrees F, or 800 HP. The boiler shall fire natural gas at 1000 Btu/CuFt or No. 2 fuel oil. The ASME Section I design pressure shall be 150 psig. The operating steam pressure shall be 100 psig.

1.3 The boiler shall be a 4-pass horizontal scotch marine dry-back firetube design. It shall be mounted on a heavy steel base frame, with an integrally mounted forced draft burner and controls.

1.4 The boiler manufacturers shall be:

A. Cleaver-Brooks 4-Pass **Dry-Back** Scotch Marine Firetube
B. Johnston 4-Pass **Dry-Back** Scotch Marine Firetube
C. Superior 4-Pass **Dry-Back** Scotch Marine Firetube
D. Hurst 4-Pass Dry-Back Scotch Marine Firetube

1.5 The complete packaged boiler with burner and 30 ppm low NOx system be approved as a package by Underwriters Laboratories, bearing the UL Assembly label.

1.6 The boiler shall be completely preassembled and fire tested at the factory. The unit shall be ready for immediate mounting on the floor or foundation, and ready for attachment of feedwater, steam, fuels, electrical, vent, and blowdown piping.

1.7 FUEL OIL PUMP: The system is provided as a complete mechanical assembly with factory mounted pumps, motors, valves, and accessories piped and ready for use. Unit will be hydrostatically tested and fluorescent leak inspected at the factory. The system includes a motor control panel mounted and wired as specified below.

PART 2 - PRODUCTS

2.1 The boiler shall be constructed in accordance with ASME Code Section I, and shall receive authorized ASME testing and inspections prior to shipment. A copy of the ASME Data Report shall be furnished to the Owner.

2.2 At least two (2) lifting eyes shall be welded to the boiler, to facilitate rigging the unit into place. Front and rear doors shall be hinged, davited, or otherwise mechanically supported by the boiler itself, to simplify door opening.

2.3 Full access shall be available to all front and rear tubesheets, for inspection, cleaning, and tube repair/replacement, without requiring OSHA Confined Space Entry Permitting.

2.4 The boiler tubes shall not include turbulators, swirlers or other add-ons.

2.5 The boiler shall be furnished with multiple handholes and one (1) manhole, to facilitate boiler inspection and cleaning.

2.6 O2 Probe and installed in stack and temp in boiler outlet.

2.7 Observation ports for inspection of flame conditions shall be provided at the front and rear ends of the boiler.

2.8 Boiler shell insulation shall consist of 2" thick high-temperature blanket, beneath a preformed steel lagging.

2.9 The boiler, base rails, and other components shall be factory-painted before shipment using a high-temperature primer and a hard finish enamel coating.

2.10 BOILER TRIM:

A. Safety valves of the type and size required by the ASME Code shall be provided and mounted at the boiler's top center-line. They shall have a set pressure of 150 psig.

B. An 5" main steam pressure gauge shall be located at the front of the boiler. It shall include a siphon, an isolation cock, and a test connection.

C. Steam pressure **transmitter (reading) and** controls to regulate burner firing rate and cycling shall be provided. (Refer to the Boiler Management System section below, for further details). Additionally, a separate high pressure limit switch with manual reset shall be provided.

D. WATER COLUMN/LOW WATER CUTOFF AND WATER LEVEL CONTROL SYSTEM: Shall be a CB LEVEL MASTER Water level control system and shall be comprised of a microprocessor-based electronic controller, a non-contact, non-wearing, continuously reading absolute level sensor and pressure chamber. The control system shall be designed as follows: The electronic controller shall be mounted in the common control panel and operate in ambient temperatures from 32 degrees F to 125 degrees F. The pressure chamber shall be boiler mounted and operate to pressures of 250 PSIG and the level sensor shall operate to pressures of 250 PSIG and temperatures to 400 degrees F. The pressure-containing components shall be constructed in accordance with ASME Code. A shielded, four conductor cable with ground shall be run in metal conduit between the level sensor and the controller. Supply power shall be 115VAC-1 phase- 60 Hz. All wiring shall be in compliance with the National Electrical Code.

E. The pressure chamber shall have a sight glass mounted on the side. The level sensor shall have an accuracy of .01" or greater. The electronic controller shall have level and error indicating lights, alphanumeric display for messaging, reset/ menu switch and the following features:

a. Continuous Level Indication
b. Low Water Cutoff & Alarm
c. High Water Alarm
d. Low & High Water Warning
e. Full Modulating Control of Modulating Feedwater Control Valve
f. Continuous Monitoring of Float Operation
g. Column Blowdown Detection and Reminder
h. Auto or Manual Reset
i. Real Time Clock
j. Alarm Annunciation
k. Alarm History Files with Time Stamp
l. Water Column Blowdown Record
m. Auxiliary Low Water Cutoff Check
n. RS 232 Interface
o. Maximum Contacts Rating 15 amps Resistive Load

F. A separate externally-piped auxiliary low water cutoff shall also be provided, to prevent burner operation if the primary low water cutoff fails to perform during a low water occurrence. This secondary cutoff shall also have a manual reset.

G. To limit the need for automatic shutdowns, the boiler shall be equipped with high and low water alarms. These controls shall provide visible and audible alarms prior to burner shutdown, thus allowing for immediate corrective action by the operator.

H. For local verification of water level, the boiler shall be furnished with a gauge glass set. This assembly shall include ball-check isolation cocks, for immediate containment of steam and hot water if a glass insert fails during boiler operation.

I. The boiler modulating feedwater control valve shall be included to automatically maintain the boiler water level within normal limits.

2.11 ADDITIONAL BOILER TRIM:

The boiler manufacturer shall include the following:

- 8" ANSI 300# flanged steam outlet, at boiler top center-line
- 8"x6"x48" welded spool piece for steam outlet, 300# flanged, 48" spool length, stamped per ANSI Power Piping Code B31.1, with appropriate documentation furnished to the Owner
- 6" flanged main steam stop valve, per ANSI Power Piping Code B31.1
- 6" flanged main steam stop-check (non-return) valve, angle-type, per ANSI Power Piping Code B31.1
- Steam free-blow drain valve, per ANSI Power Piping Code B31.1
- Bottom blowdown valves, two quick-opening and one slow-opening, factory-piped per ANSI Power Piping Code B31.1, with appropriate documentation furnished to the Owner
- Surface blowdown skimmer tube, factory installed within boiler shell

- Automatic surface blowdown system: This system shall include a ship-loose electronic TDS controller. It shall also include factory-piped surface blowdown isolation valves and trim (3/4" minimum size), to consist of an isolation valve, a conductivity probe, a motorized control valve, and a needle-type flow control valve with percent-open scale (not an orifice union). All items shall be factory-piped per ANSI Power Piping Code B31.1, with appropriate documentation furnished to the Owner.
- Alarm bell with silencing switch in boiler control panel

The factory shall furnish mounting brackets for future installation of a platform, handrails and chain guard. The future platform will be mounted directly above the boiler. An OSHA approved steel ladder will be provided. The boiler factory shall weld mounting brackets to the pressure vessel, welded in accordance with the ASME Code.

2.12 EMISSION CONTROLS: The boiler shall be equipped with low NOx equipment and controls for guaranteed NOx reduction to 30 ppm, dry volume basis and corrected to 3% O2 when firing natural gas. "Standard NOx" burners with no FGR equipment shall not be utilized. NOx reduction shall be via flue gas recirculation (FGR). FGR ducting, if required, shall be factory-installed and insulated by the boiler manufacturer. If an external fan is required for forced FGR, it shall be factory-mounted, piped, and wired. The low NOx system shall be capable of being retrofitted for 20 ppm NOx performance, without requiring burner change-out or additional ducting.

2.13 FORCED DRAFT BURNER: The forced draft burner shall be a combination low pressure air atomizing type for No. 2 oil firing and high radiant multi-port type for natural gas firing.

2.14 BURNER TURNDOWN: The desired turndown range is 10:1 for natural gas and 8:1 for No. 2 oil. The boiler manufacturer shall furnish manufacturer-guaranteed and published burner turndown ranges for both fuels with the submittal data.

2.15 COMBUSTION AIR shall be supplied by a forced draft dan mounted at the front head of the boiler. Desired maximum sound level for the boiler/burner/low NOx package is 88 dbA, measured in accordance with ABMA Sound Test Standards. The bidder shall furnish the manufacturer's published maximum sound levels for both fuels with the bid.

2.16 THE COMBUSTION AIR FAN MOTOR shall be TEFC high efficiency, with a 1.15 SF, and NEMA Class F motor insulation. It shall also be inverter duty.

2.17 FUEL PIPING AND CONTROLS:

A The gas pilot shall be of the premix interruptible type with automatic electric ignition. An electronic flame scanner shall monitor the pilot so that the primary fuel valve cannot open until the pilot flame has been established. The factory-piped pilot gas train shall include manual shut-off valves, a solenoid valve, a pressure regulator, and a pressure gauge.

B. The main gas train shall be factory-piped per IRI and Factory Mutual requirements. It shall include a primary motorized shutoff valve with proof of closure and a leakage test

connection. A secondary motorized shutoff valve with proof of closure and leakage test connection shall also be provided (both valves to be factory-piped in series). A solenoid vent valve shall be located between the primary and secondary motorized shutoff valves. If a safety shutdown condition occurs, the two motorized gas valves shall automatically close, and the solenoid vent valve shall simultaneously open. These automated measures shall effectively isolate the fuel from the burner. In addition to automatic shutoff valves, the main gas train shall include two manual shutoff valves. High and low gas pressure switches shall also be provided, to shut down the burner if a gas pressure fluctuation occurs.

C. No. 2 oil supply and return trains shall be factory-piped per IRI and Factory Mutual requirements. This piping shall include oil pressure regulating devices, oil metering controls, two motorized automatic shutoff valves with proof of closure, pressure gauges, relief valve, and inlet strainer, all factory-located adjacent to the burner. The oil supply train shall preferably be equipped with a single tip retractable oil gun with flex hoses, facilitating quick gun removal without shutting down the boiler and/or disturbing the burner. The manufacturer shall provide oil gun assembly details with the submittal data.

D. No. 2 oil shall be atomized via a factory-mounted atomizing air compressor, with integral filtration and lube oil equipment. The compressor motor shall be TEFC high efficiency, with a 1.15 SF and Class F insulation. The compressor system shall be wired and piped to the burner by the factory. This system shall include a low atomizing air pressure switch.

2.18 BOILER CONTROLS AND CONTROL PANEL

A. Control/Entrance Panel - A common enclosure shall house the control panel and the entrance panel. Enclosure shall be NEMA 4/12 rated and shall be mounted at the side of the boiler in a location convenient to the operator. Enclosure shall consist of upper and lower sections divided by a partition with a separate hinged door for each section. Upper section (low voltage) will house boiler controls including flame safeguard and water level system controller. Lower panel section (high voltage) will house entrance panel.

B. Cleaver Brooks Combustion Control System - Hawk 4000 with parallel positioning with separate actuators for each fuel and combustion air shall be used to provide proper fuel air ratio control.

C. CB780E Flame Safeguard - Each boiler shall be factory equipped with flame safeguard controller incorporated into the Hawk control.

Oil, heat and moisture resistant wire shall be used and identified with circuit numbers corresponding to the electrical wiring diagram.

Boiler to be supplied with a control circuit transformer and fuse protection for the control circuit.

D. Boiler Controls:

1. Major Components:

a. **Shall be PLC based w/ a** 10" color touch screen monitor mounted no more than 66" above floor
b. Modbus, BACNET, or LON based network for communication with the various boiler components and existing Building Automation System (BAS)
c. Burner Management Controller
d. Infrared Flame Scanner
e. Flame amplifier
f. Various temperature and pressure sensors
g. Alarm Bell
h. Entire control system shall be capable of operating in up to 85% non-condensing relative humidity
i. Economizer operation including soot blow

2. Major functions:

a. Automatic sequencing of boiler through standby, pre-purge, pilot flame establishment, main flame establishment, and pre- and post purge cycles
b. Flame proof and lockout on flame failure during pilot proving, main flame proving and running mode
c. Low fire damper/valve positioning for flame ignition trials
d. Parallel positioning combustion control for air and 2 different fuels
e. Sensing and controls for parallel positioning full modulation and actuation of all low and high limit alarms and shutdowns
f. Manual control of boiler firing rate
g. Interface for commissioning boiler set points and configuring alarms
h. On screen display of alarms and faults
i. On screen display of water level and alarm
j. Interface with existing **JCI** Building Automation System (BAS)
k. Sense and display stack gas temperature out of economizer:
   (1) shut down boiler on excess temperature
   (2) maintain minimum stack gas temperature out of economizer by modulating economizer bypass damper
l. Display boiler feedwater temperature to boiler
m. Display boiler feedwater temperature in and out of economizer
n. Provide automatic lead/lag control for 2 boilers
o. Provide assured low fire cut-off for remote start/stop
p. Maintain lag boiler in warm standby
q. Manually silence alarms
r. Store historical alarm information for previous 100 alarms including date, time and cycle of occurrence, and date and time of acknowledgment
s. Indicate failures at start-up or during operation
t. Self-checking/self-diagnosing of controller internal faults

u. Primary and secondary low water shutdown and alarm
v. Economizer damper control to maintain minimum stack gas temperature out of economizer (temperature adjustable).
w. Display steam pressure.
x. Sense and display stack gas temperature.

3. Other Attributes
   a. 4 spare 4-20ma inputs for future flow meters

4. Controls shall be Cleaver-Brooks Hawk 4000

E. Lead lag Master Panel with either Lead/Lag or Unison Modulation **for operation of new Boiler #2 & #3, as well as existing Boiler #1.**
   a. Master panel shall be **BACnet MS/TP based for direct communication with the existing JCI Metasys FMS**, and include a HMI for display and selection of the following parameters:
   b. Display
      1. Available boilers
      2. Number of boilers required
      3. Selected sequence of firing
      4. Control output to each boiler
      5. Header steam pressure
      6. Setpoint
      7. Elapsed time from last rotation
   c. Selection
      1. Number of boilers
      2. Sequence of firing
      3. Automatic or manual rotation
      4. Individual boiler start and stop points with timers
      5. Setpoint
      6. PI&D for control algorithm

2.19 FLUE GAS HEAT RECOVERY (Alternate No. 1)

A. Furnish and install an exhaust gas economizer in the vertical exhaust duct of the boiler**. Economizer shall be furnished by same vendor as new steam boilers.** The economizer shall be a light weight design for easier installation, rectangular, and manufactured and tested in accordance with the requirements of Section VIII, Division I of the ASME Boiler and Pressure Vessel Code. The economizer shall be designed to include as standard, an internal, high temperature heat resistant design flue gas bypass diverter to provide emergency by-pass, requiring no additional ductwork for controlling stack corrosion, turndown performance, or excessive flue gas back pressure due to fouling. The economizer shall have a hinged, full face, gas tight, inspection door, providing access to the heating surface for inspection and/or cleaning. The economizer must be completely drainable when mounted in the vertical position or horizontal position.

Header manifolds for low liquid flow pressure drop shall be provided. The liquid header manifolds shall also contain 3/4" NPT connections for venting, draining, and/or safety relief valves as required. 2" thick 1000 degree F thermofiber factory installed, high temperature insulation shall cover the shell less the header. Exterior surfaces shall be 10ga. carbon steel and shall be primed and painted with a high temperature metallic. Furnish with bimetal, 3" adjustable dial, water temperature thermometers with wells, 150-750 degree F bi-metallic flue gas temperature thermometers, 5" dial, and 300 psig safety relief valve.

B. **Install economizer in accordance with the manufacture's written instructions. Furnish supplemental steel, hangers and supports to facilitate installation.**

2.20 FUEL-TO-STEAM EFFICIENCY GUARANTEE:

A. Guaranteed boiler fuel-to-steam efficiencies shall be furnished with the bid, for evaluation by the Engineer and the Owner. Guaranteed efficiency data shall be furnished at firing rates of 25%, 50%, 75%, and 100%. The efficiencies shall consider stack losses as well as radiant losses. Efficiencies and rated boiler capacity shall be guaranteed while the boiler is operating at the specified low NOx level. There shall be no reduction in burner turndown performance.

B. Manufacturer shall furnish the boiler manufacturer's published monetary efficiency guarantee with the submittal data.

C. Guaranteed fuel-to-steam efficiencies shall be 83% at 25% through 100% firing (when firing natural gas).

2.21 FACTORY TESTS: The boiler and its factory-installed ASME Power Piping shall receive factory tests to certify ASME construction, and fire testing to check controls and operation of the unit. All factory tests may be witnessed by the Owner/Purchaser if desired.

2.22 FUEL OIL PUMP: (Field installed by contractor, refer to drawings)

A. Viking Pump, Inc. Model: HL4124B or equal by Webster, Critical Fuel Systems, or approved equal.

B. ODP motor.

C. Enclosed OSHA approved guard.

D. Permanent alignment brackets with flexible coulplings.

E. Simplex inlet basket strainer, 1/16" perforated baskets, with DP switch/indicator. Inlet/Outlet full port valves.

F. Flexible hose connections for suction and discharge. Discharge flow and pressure

switches.

G. External relief valves.

H. Check valve.

I. All equipment factory assembled and mounted on formed steel base with drip pan.

J. Motor control panel in Nema #4 enclosure complete with magnetic across the line starters, running lights, HOA switches, fused disconnect switches with external operator, fuse blocks, control circuit transformer (if required).

K. Single point alarm system with light and horn.

L. Panel to be mounted on wall adjacent to pump or on pump set base and wired to motors and accessories.

PART 3 - EXECUTION

3.1 START-UP AND FIELD SERVICE:

A. The manufacturer or its authorized sales and service representative shall provide start-up and combustion set-up of the boiler and low NOx system. Start-up service shall include field set-up of the boiler management PLC and its periphery devices. A factory-authorized start-up report shall be furnished to the Owner.

B. Boiler system start-up shall include field set-up and adjustment of the boiler management PLC and its periphery devices.

C. Boiler system start-up shall be included in the boiler price. Limited number of days or per-diem shall not be acceptable.

D. Two (2) full days of factory-authorized operator training shall be provided, and shall be separate from start-up. Training shall be hands-on, in the boiler room. The training date shall be scheduled in advance with the Owner.

E. Boilout chemicals and labor shall be by the Contractor. However, the boiler manufacturer's representative shall provide boilout supervision and assistance in flushing the boiler after boilout.

3.2 The factory-authorized service company shall have an established service and parts shop within **120** miles of the jobsite, for fast response to service and emergency needs. The manufacturer's representative shall furnish location and contact information for the nearest authorized service and parts shop.

3.3 Contractor is responsible for the installation of all parts, pieces, controls and piping shipped

loose with the boiler.

3.4 FOB AND FREIGHT: The boiler manufacturer shall include FOB jobsite, dedicated freight allowed to Columbia, SC. Insurance covering damage during shipment shall be the responsibility of the boiler manufacturer.

3.5 Pipe all vents from fuel regulators or any other fuel related equipment associated with the boiler to outdoors as directed by the 2012 International Fuel Gas Code and the manufacturer's installation instructions. Vent piping shall be schedule 40 black steel.

3.6 Contractor shall mount modulating feedwater valve to the boiler. This piping shall include a three-valve bypass, as well as the ASME-required feed globe and check valves. The feed check valve shall be of the in-line spring-check type. Swing-check valves shall not be utilized.

3.7 A main gas pressure regulator shall be provided to reduce 15 psig supply gas pressure to that required by the burner. The regulator shall be Fisher model 1098-EGR or approved equal.

3.8 Install boiler, piping, fuel train, gas vent, etc. in strict accordance with manufacturer's written installation instructions.

3.9 Provide all sensors, contactors, relays, transformers, wiring, conduit, and any other control component required for boiler controller per the manufacturer’s written installation instructions and wiring diagrams.

3.10 Bolt new boiler supports to new concrete pad (see detail on drawings) per the seismic requirements of the 2012 International Building Code.

3.11 Mount, install, and pipe fuel oil set in accordance with manufacturer’s printed installation instructions. Mount unit in compliance with the seismic requirements of the 2012 International Building Code.

END OF SECTION 23 52 39

SECTION 23 52 39A - STEAM BOILER (Alternate No. 3)

PART 1 - GENERAL

1.1 Section 23 00 00 Mechanical, General applies to the work specified in this section of specifications.

1.2 The firetube boiler shall have a rated steam capacity of 27,600 lb/hr from and at 212 degrees F, or 800 HP. The boiler shall fire natural gas at 1000 Btu/CuFt or No. 2 fuel oil. The ASME Section I design pressure shall be 150 psig. The operating steam pressure shall be 100 psig.

1.3 The boiler shall be a 4-pass Wet-Back horizontal scotch marine firetube design. It shall be mounted on a heavy steel base frame, with externally mounted forced draft burner and controls.

1.4 The boiler manufacturers shall be:

A. Cleaver-Brooks 4-Pass Wet-Back Scotch Marine Firetube
B. Johnston 4-Pass Wet-Back Scotch Marine Firetube
C. Superior 4-Pass Wet-Back Scotch Marine Firetube
D. Hurst 4-Pass Wet-Back Scotch Marine Firetube

1.5 The complete packaged boiler with burner and 30 ppm low NOx system be approved as a package by Underwriters Laboratories, bearing the UL Assembly label.

1.6 The boiler shall be completely preassembled and fire tested at the factory. The unit shall be ready for immediate mounting on the floor or foundation, and ready for attachment of feedwater, steam, fuels, electrical, vent, and blowdown piping.

1.7 FUEL OIL PUMP: The system is provided as a complete mechanical assembly with factory mounted pumps, motors, valves, and accessories piped and ready for use. Unit will be hydrostatically tested and fluorescent leak inspected at the factory. The system includes a motor control panel mounted and wired as specified below.

PART 2 - PRODUCTS

2.1 The boiler shall be constructed in accordance with ASME Code Section I, and shall receive authorized ASME testing and inspections prior to shipment. A copy of the ASME Data Report shall be furnished to the Owner.

2.2 At least two (2) lifting eyes shall be welded to the boiler, to facilitate rigging the unit into place. Front and rear doors shall be hinged, davited, or otherwise mechanically supported by the boiler itself, to simplify door opening.

2.3 Full access shall be available to all front and rear tubesheets, for inspection, cleaning, and tube repair/replacement, without requiring OSHA Confined Space Entry Permitting.

2.4 The boiler tubes shall not include turbulators, swirlers or other add-ons.

2.5 The boiler shall be furnished with multiple handholes and one (1) manhole, to facilitate boiler inspection and cleaning.

2.6 O2 Probe and installed in stack and temp in boiler outlet.

2.7 Observation ports for inspection of flame conditions shall be provided at the front and rear ends of the boiler.

2.8 Boiler shell insulation shall consist of 2" thick high-temperature blanket, beneath a preformed steel lagging.

2.9 The boiler, base rails, and other components shall be factory-painted before shipment using a high-temperature primer and a hard finish enamel coating.

2.10 BOILER TRIM:

A. Safety valves of the type and size required by the ASME Code shall be provided and mounted at the boiler's top center-line. They shall have a set pressure of 150 psig.

B. An 5" main steam pressure gauge shall be located at the front of the boiler. It shall include a siphon, an isolation cock, and a test connection.

C. Steam pressure transmitter (reading) and controls to regulate burner firing rate and cycling shall be provided. (Refer to the Boiler Management System section below, for further details). Additionally, a separate high pressure limit switch with manual reset shall be provided.

D. WATER COLUMN/LOW WATER CUTOFF AND WATER LEVEL CONTROL SYSTEM: McDonnell & Miller 157.

E. The pressure chamber shall have a sight glass mounted on the side. The level sensor shall have an accuracy of .01" or greater. The electronic controller shall have level and error indicating lights, alphanumeric display for messaging, reset/ menu switch and the following features:
   a. Continuous Level Indication
   b. Low Water Cutoff & Alarm
   c. High Water Alarm
   d. Low & High Water Warning
   e. Full Modulating Control of Modulating Feedwater Control Valve
   f. Continuous Monitoring of Float Operation
   g. Column Blowdown Detection and Reminder
   h. Auto or Manual Reset
   i. Real Time Clock
   j. Alarm Annunciation

k. Alarm History Files with Time Stamp
l. Water Column Blowdown Record
m. Auxiliary Low Water Cutoff Check
n. RS 232 Interface
o. Maximum Contacts Rating 15 amps Resistive Load

F. A separate externally-piped auxiliary low water cutoff shall also be provided, to prevent burner operation if the primary low water cutoff fails to perform during a low water occurrence. This secondary cutoff shall also have a manual reset.

G. To limit the need for automatic shutdowns, the boiler shall be equipped with high and low water alarms. These controls shall provide visible and audible alarms prior to burner shutdown, thus allowing for immediate corrective action by the operator.

H. For local verification of water level, the boiler shall be furnished with a gauge glass set. This assembly shall include ball-check isolation cocks, for immediate containment of steam and hot water if a glass insert fails during boiler operation.

I. The boiler modulating feedwater control valve shall be included to automatically maintain the boiler water level within normal limits.

2.11 ADDITIONAL BOILER TRIM:

The boiler manufacturer shall include the following:

- 8" ANSI 300# flanged steam outlet, at boiler top center-line
- 8"x6"x48" welded spool piece for steam outlet, 300# flanged, 48" spool length, stamped per ANSI Power Piping Code B31.1, with appropriate documentation furnished to the Owner
- 6" flanged main steam stop valve, per ANSI Power Piping Code B31.1
- 6" flanged main steam stop-check (non-return) valve, angle-type, per ANSI Power Piping Code B31.1
- Steam free-blow drain valve, per ANSI Power Piping Code B31.1
- Bottom blowdown valves, two quick-opening and one slow-opening, factory-piped per ANSI Power Piping Code B31.1, with appropriate documentation furnished to the Owner
- Surface blowdown skimmer tube, factory installed within boiler shell
- Automatic surface blowdown system: All items shall be factory-piped per ANSI Power Piping Code B31.1, with appropriate documentation furnished to the Owner.
- Alarm bell with silencing switch in boiler control panel

The factory shall furnish mounting brackets for future installation of a platform, handrails and chain guard. The future platform will be mounted directly above the boiler. An OSHA approved steel ladder will be provided. The boiler factory shall weld mounting brackets to the pressure vessel, welded in accordance with the ASME Code.

2.12 EMISSION CONTROLS: The boiler shall be equipped with low NOx equipment and controls

for guaranteed NOx reduction to 30 ppm, dry volume basis and corrected to 3% O2 when firing natural gas. "Standard NOx" burners with no FGR equipment shall not be utilized. NOx reduction shall be via flue gas recirculation (FGR). FGR ducting, if required, shall be factory-installed and insulated by the boiler manufacturer. If an external fan is required for forced FGR, it shall be factory-mounted, piped, and wired.

2.13 FORCED DRAFT BURNER: The forced draft burner shall be a combination low pressure air atomizing type for No. 2 oil firing and high radiant multi-port type for natural gas firing.

2.14 BURNER TURNDOWN: The desired turndown range is 10:1 for natural gas and 8:1 for No. 2 oil. The boiler manufacturer shall furnish manufacturer-guaranteed and published burner turndown ranges for both fuels with the submittal data.

2.15 COMBUSTION AIR shall be supplied by a forced draft dan mounted at the front head of the boiler. Desired maximum sound level for the boiler/burner/low NOx package is 95 dbA, measured in accordance with ABMA Sound Test Standards. The bidder shall furnish the manufacturer's published maximum sound levels for both fuels with the bid.

2.16 THE COMBUSTION AIR FAN MOTOR shall be TEFC high efficiency, with a 1.15 SF, and NEMA Class F motor insulation. It shall also be inverter duty.

2.17 FUEL PIPING AND CONTROLS:

A The gas pilot shall be of the premix interruptible type with automatic electric ignition. An electronic flame scanner shall monitor the pilot so that the primary fuel valve cannot open until the pilot flame has been established. The factory-piped pilot gas train shall include manual shut-off valves, a solenoid valve, a pressure regulator, and a pressure gauge.

B. The main gas train shall be factory-piped per IRI and Factory Mutual requirements. It shall include a primary motorized shutoff valve with proof of closure and a leakage test connection. A secondary motorized shutoff valve with proof of closure and leakage test connection shall also be provided (both valves to be factory-piped in series). A solenoid vent valve shall be located between the primary and secondary motorized shutoff valves. If a safety shutdown condition occurs, the two motorized gas valves shall automatically close, and the solenoid vent valve shall simultaneously open. These automated measures shall effectively isolate the fuel from the burner. In addition to automatic shutoff valves, the main gas train shall include two manual shutoff valves. High and low gas pressure switches shall also be provided, to shut down the burner if a gas pressure fluctuation occurs.

C. No. 2 oil supply and return trains shall be factory-piped per IRI and Factory Mutual requirements. This piping shall include oil pressure regulating devices, oil metering controls, two motorized automatic shutoff valves with proof of closure, pressure gauges, relief valve, and inlet strainer, all factory-located adjacent to the burner. The oil supply train shall preferably be equipped with a single tip retractable oil gun with flex hoses, facilitating quick gun removal without shutting down the boiler and/or disturbing the

burner. The manufacturer shall provide oil gun assembly details with the submittal data.

D. No. 2 oil shall be atomized via a factory-mounted atomizing air compressor, with integral filtration and lube oil equipment. The compressor motor shall be TEFC high efficiency, with a 1.15 SF and Class F insulation. The compressor system shall be wired and piped to the burner by the factory. This system shall include a low atomizing air pressure switch.

2.18 BOILER CONTROLS AND CONTROL PANEL

A. Control/Entrance Panel - A common enclosure shall house the control panel and the entrance panel. Enclosure shall be NEMA 4/12 rated and shall be mounted at the side of the boiler in a location convenient to the operator. Enclosure shall consist of upper and lower sections divided by a partition with a separate hinged door for each section. Upper section (low voltage) will house boiler controls including flame safeguard and water level system controller. Lower panel section (high voltage) will house entrance panel.

B. Combustion Control System - parallel positioning with separate actuators for each fuel and combustion air shall be used to provide proper fuel air ratio control.

C. Flame controller - Each boiler shall be factory equipped with flame safeguard controller incorporated into the Boiler controller.

Oil, heat and moisture resistant wire shall be used and identified with circuit numbers corresponding to the electrical wiring diagram.

Boiler to be supplied with a control circuit transformer and fuse protection for the control circuit.

D. Boiler Controls:

1. Major Components:

a. Shall be PLC based w/ a 10" color touch screen monitor mounted no more than 66" above floor
b. Modbus, BACnet, or LON based network for communication with the various boiler components and existing Building Automation System (BAS)
c. Burner Management Controller
d. Infrared Flame Scanner
e. Flame amplifier
f. Various temperature and pressure sensors
g. Alarm Bell
h. Entire control system shall be capable of operating in up to 85% non-condensing relative humidity
i. Economizer operation including soot blow

2. Major functions:

    a. Automatic sequencing of boiler through standby, pre-purge, pilot flame establishment, main flame establishment, and pre- and post purge cycles
    b. Flame proof and lockout on flame failure during pilot proving, main flame proving and running mode
    c. Low fire damper/valve positioning for flame ignition trials
    d. Parallel positioning combustion control for air and 2 different fuels
    e. Sensing and controls for parallel positioning full modulation and actuation of all low and high limit alarms and shutdowns
    f. Manual control of boiler firing rate
    g. Interface for commissioning boiler set points and configuring alarms
    h. On screen display of alarms and faults
    i. On screen display of water level and alarm
    j. Interface with existing JCI Building Automation System (BAS)
    k. Sense and display stack gas temperature:
        (1) shut down boiler on excess temperature
        (2) maintain minimum stack gas temperature out of economizer by modulating economizer bypass damper
    l. Display boiler feedwater temperature to boiler
    m. Display boiler feedwater temperature in and out of economizer
    n. Provide automatic lead/lag control for 2 boilers
    o. Provide assured low fire cut-off for remote start/stop
    p. Maintain lag boiler in warm standby
    q. Manually silence alarms
    r. Store historical alarm information for previous 100 alarms including date, time and cycle of occurrence, and date and time of acknowledgment
    s. Indicate failures at start-up or during operation
    t. Self-checking/self-diagnosing of controller internal faults
    u. Primary and secondary low water shutdown and alarm
    v. Economizer damper control to maintain minimum stack gas temperature out of economizer (temperature adjustable).
    w. Display steam pressure
    x. Sense and Display stack gas temerature.

3. Other Attributes
    a. 4 spare 4-20ma inputs for future flow meters

4. Controls shall be furnished by same vendor as new steam boilers.

E. Lead lag Master Panel with either Lead/Lag or Unison Modulation for operation of new Boiler #2 & #3, as well as existing Boiler #1.
    a. Master panel shall be BACnet MS/TP based for direct communication with the existing JCI Metasys FMS, and include a HMI for display and selection of the following parameters:
    b. Display

1. Available boilers
2. Number of boilers required
3. Selected sequence of firing
4. Control output to each boiler
5. Header steam pressure
6. Setpoint
7. Elapsed time from last rotation

c. Selection
1. Number of boilers
2. Sequence of firing
3. Automatic or manual rotation
4. Individual boiler start and stop points with timers
5. Setpoint
6. PI&D for control algorithm

2.19 FLUE GAS HEAT RECOVERY (Alternate No. 1)

A. Furnish and install an exhaust gas economizer in the vertical exhaust duct of the boiler. Economizer shall be furnished by same vendor as new steam boilers. The economizer shall be a light weight design for easier installation, rectangular, and manufactured and tested in accordance with the requirements of Section VIII, Division I of the ASME Boiler and Pressure Vessel Code. The economizer shall be designed to include as standard, an internal, high temperature heat resistant design flue gas bypass diverter to provide emergency by-pass, requiring no additional ductwork for controlling stack corrosion, turndown performance, or excessive flue gas back pressure due to fouling. The economizer shall have a hinged, full face, gas tight, inspection door, providing access to the heating surface for inspection and/or cleaning. The economizer must be completely drainable when mounted in the vertical position or horizontal position. Header manifolds for low liquid flow pressure drop shall be provided. The liquid header manifolds shall also contain 3/4" NPT connections for venting, draining, and/or safety relief valves as required. 2" thick 1000 degree F thermofiber factory installed, high temperature insulation shall cover the shell less the header. Exterior surfaces shall be 10ga. carbon steel and shall be primed and painted with a high temperature metallic. Furnish with bimetal, 3" adjustable dial, water temperature thermometers with wells, 150-750 degree F bi-metallic flue gas temperature thermometers, 5" dial, and 300 psig safety relief valve.

B. Install economizer in accordance with the manufacture’s written instructions. Furnish supplemental steel, hangers and supports to facilitate installation.

2.20 FUEL-TO-STEAM EFFICIENCY GUARANTEE:

A. Guaranteed boiler fuel-to-steam efficiencies shall be furnished with the bid, for evaluation by the Engineer and the Owner. Guaranteed efficiency data shall be furnished at firing rates of 25%, 50%, 75%, and 100%. The efficiencies shall consider stack losses as well as radiant losses. Efficiencies and rated boiler capacity shall be guaranteed while the boiler is operating at the specified low NOx level. There shall be no reduction in burner

turndown performance.

B. Manufacturer shall furnish the boiler manufacturer's published monetary efficiency guarantee with the submittal data.

C. Guaranteed fuel-to-steam efficiencies shall be 83% at 25% through 100% firing (when firing natural gas).

2.21 FACTORY TESTS: The boiler and its factory-installed ASME Power Piping shall receive factory tests to certify ASME construction, and fire testing to check controls and operation of the unit. All factory tests may be witnessed by the Owner/Purchaser if desired.

2.22 FUEL OIL PUMP: (Field installed by contractor, refer to drawings)

A. Viking Pump, Inc. Model: HL4124B or equal by Webster, Critical Fuel Systems, or approved equal.

B. ODP motor.

C. Enclosed OSHA approved guard.

D. Permanent alignment brackets with flexible coulplings.

E. Simplex inlet basket strainer, 1/16" perforated baskets, with DP switch/indicator. Inlet/Outlet full port valves.

F. Flexible hose connections for suction and discharge. Discharge flow and pressure switches.

G. External relief valves.

H. Check valve.

I. All equipment factory assembled and mounted on formed steel base with drip pan.

J. Motor control panel in Nema #4 enclosure complete with magnetic across the line starters, running lights, HOA switches, fused disconnect switches with external operator, fuse blocks, control circuit transformer (if required).

K. Single point alarm system with light and horn.

L. Panel to be mounted on wall adjacent to pump or on pump set base and wired to motors and accessories.

PART 3 - EXECUTION

3.1 START-UP AND FIELD SERVICE:

A. The manufacturer or its authorized sales and service representative shall provide start-up and combustion set-up of the boiler and low NOx system. Start-up service shall include field set-up of the boiler management PLC and its periphery devices. A factory-authorized start-up report shall be furnished to the Owner.

B. Boiler system start-up shall include field set-up and adjustment of the boiler management PLC and its periphery devices.

C. Boiler system start-up shall be included in the boiler price. Limited number of days or per-diem shall not be acceptable.

D. Two (2) full days of factory-authorized operator training shall be provided, and shall be separate from start-up. Training shall be hands-on, in the boiler room. The training date shall be scheduled in advance with the Owner.

E. Boilout chemicals and labor shall be by the Contractor. However, the boiler manufacturer's representative shall provide boilout supervision and assistance in flushing the boiler after boilout.

3.2 The factory-authorized service company shall have an established service and parts shop within 100 miles of the jobsite, for fast response to service and emergency needs. The manufacturer's representative shall furnish location and contact information for the nearest authorized service and parts shop.

3.3 Contractor is responsible for the installation of all parts, pieces, controls and piping shipped loose with the boiler.

3.4 FOB AND FREIGHT: The boiler manufacturer shall include FOB jobsite, dedicated freight allowed to Columbia, SC. Insurance covering damage during shipment shall be the responsibility of the boiler manufacturer.

3.5 Pipe all vents from fuel regulators or any other fuel related equipment associated with the boiler to outdoors as directed by the 2012 International Fuel Gas Code and the manufacturer's installation instructions. Vent piping shall be schedule 40 black steel.

3.6 Contractor shall mount modulating feedwater valve to the boiler. This piping shall include a three-valve bypass, as well as the ASME-required feed globe and check valves. The feed check valve shall be of the in-line spring-check type. Swing-check valves shall not be utilized.

3.7 A main gas pressure regulator shall be provided to reduce 15 psig supply gas pressure to that required by the burner. The regulator shall be Fisher model 1098-EGR or approved equal.

3.8 Install boiler, piping, fuel train, gas vent, etc. in strict accordance with manufacturer's written

installation instructions.

3.9 Provide all sensors, contactors, relays, transformers, wiring, conduit, and any other control component required for boiler controller per the manufacturer's written installation instructions and wiring diagrams.

3.10 Bolt new boiler supports to new concrete pad (see detail on drawings) per the seismic requirements of the 2012 International Building Code.

3.11 Mount, install, and pipe fuel oil set in accordance with manufacturer's printed installation instructions. Mount unit in compliance with the seismic requirements of the 2012 International Building Code.

END OF SECTION 23 52 39A

SECTION 25 55 00 - AUTOMATIC TEMPERATURE CONTROLS
PART 1 - GENERAL

1.1 Section 23 00 00 Mechanical, General applies to the work specified in this section of specifications.

1.2 SCOPE OF WORK

A. Provide and install new DDC controls as specified **for integration of Lead Lag Master Panel, as described in sections 23 53 39 Steam Boilers, for existing Boiler #1, new Boiler #2, and new Boiler #3.** DDC controls must be capable of directly communicating with, and be completely compatible with, METASYS controllers as manufactured by Johnson Controls, Inc.

B. New DDC controls shall be capable of directly interfacing and communication with the existing campus METASYS Facilities Management System.

C. **All new PLC controls associated with Lead Lag Master Panel shall have seamless communication with the existing Metasys energy management system. See section 23 53 29 Steam Boiler or 23 53 39A Steam Boiler (Alternate No. 3).**

1.3 FACILITIES MANAGEMENT SYSTEM

A. All necessary hardware and software shall be provided to allow for remote monitoring of the **existing Boiler #1, new Boiler #2, and new Boiler #3 through the Lead Lag Master Panel** from the University of South Carolina existing Johnson Controls campus FMS system. The FMS system software, hardware and communication protocol shall be compatible with the existing Johnson Controls FMS system in every respect.

B. The existing Johnson Control FMS system will be expanded as required to accomplish the sequence of operation as described herein. Provide all necessary software and hardware to allow for monitoring and override of all input/output points. All new control points, monitoring points and software points will be added to the existing FMS database. Separate or parallel systems are not acceptable.

C. Full graphics capabilities will be provided at the campus FMS computer. It shall be possible to monitor, override and adjust setpoints from any graphic screen. Provide data archiving capabilities on the FMS computer harddrive for storage of alarms, trends and all other data associated with this system. It shall be possible to download and upload field panel software from the campus FMS computer. Provide all necessary software and hardware needed to accomplish the graphics, archiving and downloading and uploading requirements.

1.4 CONTROL SYSTEM

A. Combination pneumatic/direct digital control (DDC) system, as specified herein, shall be provided for **monitoring** of the following:

- **Existing Boiler #1, new Boiler #2, and new Boiler #3**

B. The system shall be complete in all respects and shall be installed by trained mechanics in the direct employ of the control equipment manufacturer who is to be responsible for the proper installation and operation of the control equipment. The control manufacturer shall furnish the services of an experienced engineer or superintendent to supervise the installation of the work and to insure job coordination. All components not specifically indicated or specified, but necessary to make the system function within the intent of the specification, are to be included. Size all control apparatus to properly supply and/or operate and control the apparatus served. All electrical products shall be listed and labeled by UL and comply with NEMA Standards.

1.5 SUBMITTALS

The control system manufacturer/installer shall provide the following SUBMITTALS prior to commencement of any work:

- Sequence of operation
- Bill of material
- Hardware system diagrams
- Point to point installation drawings
- Manufacturer's product data sheets.

1.6 OPERATING AND MAINTENANCE INSTRUCTIONS

A. The automatic temperature controls sub-contractor shall furnish to the U.S.C. project manager, upon completion of the work, but before final acceptance of the system, five (5) bound copies of typewritten instructions covering complete maintenance and operation of the system and a complete set of as-built drawings of control diagram.

B. Contractor shall instruct the Owner on the care, operation, and maintenance of all parts of the system.

1.7 All electrical work required under this section of specifications shall comply with the latest National Electrical Code. Control system power supply shall be served by a separate breaker and fused in control center for secondary protection.

1.8 Provide all wiring, conduits, breakers, transformers, etc. required to power all control components requiring a power source.

1.9 All control wiring shall be run in Galvanized EMT with compression fittings. No screws will be allowed. Control wiring shall be color coded #16 TFF or TFFN wire with 600 volt insulation.

PART 2 - PRODUCTS

2.1 BUILDING FACILITIES MANAGEMENT SYSTEM (FMS)

A. The Facility Management System shall be capable of integrating multiple building functions including equipment supervision and control, alarm management, energy management, and historical data collection and archiving.

B. The Facility Management System shall consist of the following:

- Interface to existing campus FMS computer
- Network Automation Engine (NAE),
- Field sensors and devices
- Other temperature control devices.

C. The system shall be modular in nature, and shall permit expansion of both capacity and functionality through the addition of sensors, actuators, Standalone DDC panels, and operator devices.

2.2 Supervisory Panel - Network Automation Engines (NAE)

A. Network Automation Engine (NAE)

1. The NAE shall be a fully user-programmable, supervisory controller. The NAE shall monitor the network of distributed application-specific controllers, provide global strategy and direction, and communicate on a peer-to-peer basis with other Network Automation Engines.

2. Automation network - The NAE shall reside on the automation network and shall support a subnet of system controllers.

3. Processor - The NAE shall be microprocessor-based with a minimum word size of 32 bits. The NAE shall be a multi-tasking, multi-user, and real-time digital control processor. Standard operating systems shall be employed. NAE size and capability shall be sufficient to fully meet the requirements of this Specification.

4. Memory - Each NAE shall have sufficient memory to support its own operating system, databases, and control programs, and to provide supervisory control for all control level devices.

5. Diagnostics - The NAE shall continuously perform self-diagnostics, communication diagnosis, and diagnosis of all panel components. The Network Automation Engine shall provide both local and remote annunciation of any detected component failures, low battery conditions, or repeated failures to

establish communication.

6. Power Failure - In the event of the loss of normal power, The NAE shall continue to operate for a user adjustable period of up to 10 minutes after which there shall be an orderly shutdown of all programs to prevent the loss of database or operating system software.

a. During a loss of normal power, the control sequences shall go to the normal system shutdown conditions. All critical configuration data shall be saved into Flash memory.

b. Upon restoration of normal power and after a minimum off-time delay, the controller shall automatically resume full operation without manual intervention through a normal soft-start sequence.

2.3 FIELD SENSORS AND DEVICES

~~A. Analog Input Devices:~~

~~Water Temperature Sensors shall be Resistor Temperature Detectors (RTD). RTD's shall have a range of minus 50F to plus 250F, with a resistance tolerance of .25% at 70F. The RTD shall be encapsulated in epoxy, series 300 stainless steel, or a copper sheath. The RTD's shall be provided in either probe mounting, averaging element, or for mounting in a separable well for liquid sensing applications.~~

B. Binary Input Devices:

~~Current Sensors: Provide relays monitoring status of motor loads. Switch shall be self-wiping, snap-acting Form C contacts rated for the application. The setpoint of the contact operation shall be field adjustable. Motor current shall be sensed, not control current.~~

C. Output Devices:

~~Control Relays: Control relay contacts shall be rated for the application, with a minimum of two sets of Form C contacts, enclosed in a dustproof enclosure. Relays shall have silver alloy contact material. Relay operation shall be in 20 milliseconds or less, with release time of 10 milliseconds or less. Relays shall be equipped with coil transient suppression (limiting transients to nondamaging levels). All control relays shall be of the plug-in style with a separate base. All wiring shall be terminated to the base and not the relay itself.~~

PART 3 - EXECUTION

3.1 Install all control equipment and wiring in a neat and workmanlike manner.

3.2 All immersion wells, pressure tappings and any associated shutoff cocks, flow switches, level switches and other such items furnished by the control manufacturer shall be installed by the mechanical contractor under the coordinating control and supervision of the control contractor. Install all control devices in an accessible location.

3.3 ELECTRICAL WIRING

A. All control wiring shall be furnished and installed by the control contractor (unless specified under the Division 26 or shown on the electrical drawings) in accordance with all applicable electrical codes.

B. Control panels serving equipment fed by emergency power shall be fed by emergency power.

C. Power wiring to all control panels shall be provided under Division 15. Power circuits to control panels shall not be shared with any other electrical equipment.

3.4 POINTS: Provide the following points of monitoring/control:

Digital Inputs:
~~Boiler #2 - High Water~~
~~Boiler #3 - High Water~~
~~Boiler #2 - Low Water~~
~~Boiler #3 - Low Water~~
~~Transfer Pump #1 Status (existing)~~
~~Transfer Pump #2 Status (existing)~~
~~Transfer Pump #3 Status (existing)~~
~~Boiler Feed Pump #1 Status (existing)~~
~~Boiler Feed Pump #2 Status (existing)~~
~~Boiler Feed Pump #3 Status (existing)~~

Analog Inputs:
~~Boiler #2 Gas Flow~~
~~Boiler #3 Gas Flow~~
~~Boiler #2 Steam Flow~~
~~Boiler #3 Steam Flow~~
~~Boiler #2 Feed Water Valve~~
~~Boiler #3 Feed Water Valve~~
~~Surge Tank Make-up Water Flow (existing)~~
~~Condensate Flow to Surge Tank (existing)~~
~~Storage Tank Level (existing)~~
~~DA Tank Level (existing)~~
~~DA Tank Pressure (existing)~~
~~Common Feed Water Pressure (existing)~~
~~Common Feed Water Temperature (existing)~~
~~Steam Header Pressure (existing)~~
~~Boiler #2 Steam Supply Pressure~~
~~Boiler #3 Steam Supply Pressure~~

~~Surge Tank Temperature (existing)~~
~~Surge Tank Feed Pressure (existing)~~
~~Boiler #2 Stack Temperature~~
~~Boiler #3 Stack Temperature~~
~~DA Tank Steam Supply Pressure (existing)~~

Digital Outputs: ~~Transfer Pump #1 (existing)~~
~~Transfer Pump #2 (existing)~~
~~Transfer Pump #3 (existing)~~
~~Boiler Feed Pump #1 (existing)~~
~~Boiler Feed Pump #2 (existing)~~
~~Boiler Feed Pump #3 (existing)~~

3.4 SEQUENCE OF OPERATION

A. The **Lead Lag Master Panel** (PLC) control panel shall control each of three (3) boilers ~~and associated transfer pumps (total of 3) and boiler feed pumps (total of 3)~~. The Metasys Integrator shall allow the operator to monitor, ~~adjust, and override certain~~ points of the **Lead Lag Master Panel**.

B. ~~The Johnson Controls FEC controller shall energize the lead boiler feed pump when any boiler is energized or any boiler indicates a low water alarm. The lag feed water pump will be energized when the remaining boiler indicates low water alarm or when the total fire rate for both boilers is greater than 150% (adjustable). A standby boiler feed pump will energize if either the lead or lag boiler feed water pump fails or cannot handle the feedwater flow requirement. The lag boiler feed water pump will de-energize when one of the two low water relays is de-energized or the total fire rate is below setpoint. The lead boiler feed water pump will de-energize when all three boilers are de-energized.~~

C. ~~The Johnson Controls FEC controller will energize the lead transfer pump when the DA tank level indicates low water. The lag transfer pump shall energize whenever the lag boiler feed pump is energized. If the lead water pump can not maintain the low water level after a period of 60 seconds (adjustable), an alarm shall be issued to the BMS and the lag pump shall start.~~

D. ~~Boiler feed water control valves for all three boilers shall be monitored.~~

3.5 Furnish to engineer four copies of certifications signed by authorized representative that:

1. Control system has been checked-out and operates according to drawings and specifications.

2. All controls are warranted unconditionally for one year from date of acceptance and will be serviced for this period free of charge.

3. Maintenance personnel or responsible party has been instructed as to the operation of control system.

4. Furnish four (4) copies of record control drawings, instructions, equipment and maintenance manuals.

END OF SECTION 25 55 00