Table of Contents

1. General 3
2. Specification 3
3. Scope Of Work 3
4. Boiler Control System Description 4
4.1 Boiler Combustion Control System 4
4.2 Operator’s Interface For Combustion Control 4
4.3 Burner Management System 5
4.4 Operator Interface for Burner Management System 5
5. Boiler Control Hardware Description 6
6. Engineering Services 6
7. Documentation 7
1. General
A. This specification defines the requirements for the boiler control system. The boiler control system shall consist of both a Combustion Control System (CCS) and a Burner Management System (BMS). The CCS shall control the boiler's fuel and air levels and drum water levels. The BMS shall control the burner startup and shutdown sequencing and all boiler safety systems.

B. The specification defines the requirements for the assembled and tested hardware, design engineering, logic programming, MMI configuration, documentation, and field startup services and training.

C. Reference documentation includes the following:
   1) DSBoilerSH1 - P&ID. This drawing contains the field devices that shall be incorporated in the Boiler Control System and the tag designations which shall be used.
   2) DSBoilerSH2 - Enclosure dimension drawing

2. Specification
A. The boiler control system shall meet as a minimum the following specifications:
   • NEMA
   • NFPA
   • NEC
   • ANSI
   • EPA
   • ISA
   • UL

3. Scope Of Work
A. Furnish labor, materials, engineering services to design, fabricate, test, deliver, and place in service the boiler control system. The work shall include, but not be limited to, the following:

   1) Boiler control enclosure with programmable logic controllers (PLC), power distribution protective devices, loop power supplies, field terminals, and Man Machine Interface (MMI).
   2) Engineering to design boiler control system including PLC programming, MMI configuration, electrical drawings, enclosure drawing, P&ID.
   3) In house test of control equipment
   4) Engineering services to startup system at plant site including field instrument configuration, field wiring checkout, boiler control checkout and tuning.
   5) Control system documentation
4. Boiler Control System Description

A. The control system shall include a Boiler Combustion Control (BCC) and a Burner Management System (BMS). The two systems shall be located in separate PLC's.

B. A single Man Machine Interface (MMI) shall be provided for the control system.

4.1 Boiler Combustion Control System

A. The Boiler Combustion Control System shall be a full metered cross limited control system with oxygen trim. The BCS shall provide the following control functions:

1) Boiler Master shall provide the firing rate to the fuel and air control loops based on an input from the Plant Master header pressure controller. The operator shall be able to bias the plant master signal by plus or minus 10%. The Boiler Master shall provide the set points to the air and fuel controllers via a look up table. The lookup table contents shall be based on boiler load tests.

2) The Fuel Controller shall be full metered and cross limited with the air controller. The control shall have an automatic, manual, and remote modes of operation. Fuel controller shall be scaled in engineering units (SCFH).

3) The Combustion Air controller shall be full metered and cross limited with the Fuel Controller. The Air Controller shall have a automatic, manual, and remote modes of operation. The Air Controller shall incorporate a oxygen trim signal. Air Controller shall be scaled in percent of full scale.

4) The Oxygen Controller shall provide a trim signal to the Air Controller based on O₂ level from the oxygen analyzer. The controller shall have an automatic, manual, and remote modes of operation. The remote set point for the controller shall be based on a look up table. The contents of the lookup table shall be based on boiler load tests. The Oxygen Controller shall be scaled in percent of O₂.

5) The Drum Level Controller shall be three element, controlling drum level, feed water flow with feed forward control based on steam flow. The steam feed forward control shall incorporate a lookup table. The Drum Level Controller shall have automatic and manual modes of operation.

4.2 Operator’s Interface For Combustion Control

A. The operator’s MMI shall contain all screens required to properly operate the boiler and all screens required to tune the boiler system. The following screens shall be included:

1) The Combustion Control screen shall contain loop controller faceplates for the fuel, air, and oxygen controllers.
2) The Boiler Master screen shall contain a controller faceplate for the boiler master controller.
3) The Feed water screen shall contain controller faceplates for the drum level and feed water controllers.
4) The Boiler Data screen shall contain real time display of all boiler process variables in a tabular form.
5) The Alarm Screen shall contain a list of active and not acknowledged alarms. The alarms shall include the time and date and descriptive text. The alarm screen shall have capability to silence the alarm horn and acknowledge an alarm.
6) A screen shall be provided to tune each control loop. The screen shall include a trend that contains pens for the loop’s set point, output, and process variable.
7) Screens shall be provided to enter values in the lookup tables required by the system.
8) A Main screen shall be provided which contains a pictorial display of the boiler with real time display of all boiler process variables. The screen shall be a representation of the system P&I drawing referenced in this specification.

B. The screens used for tuning the control loops and configuring lookup tables shall be password protected.
C. Each screen shall contains buttons at the button for navigating to the main screen and to other screens which are directly associated with the active screen.

4.3 Burner Management System
A. The Burner Management System (BMS) shall meet all NFPA 8501 specification. The BMS shall have the following features:
1) Burner startup sequencing shall be performed by a PLC.
2) The BMS PLC shall monitor all safety interlocks and master fuel trips for purposes of shutting down the boiler on safety trips and providing diagnostic information.
3) The BMS shall contain a relay based master fuel trip circuit that is independent of the PLC.
4) The BMS shall contain an external watchdog timer circuit which monitors the PLC logic scan and trips the boiler if the watchdog fails.

4.4 Operator Interface for Burner Management System
A. The Operators MMI shall contain all screens required to properly operate the burner. The following screens shall be included:
1) A Burner Startup screen shall be provided which contains button to start and stop the fan and to start and stop the burner. This screen shall contain indicator of burner status: Purge, low fire, pilot valves energized, main valves energized, water level, etc. The screen shall also contain a real time updated purge timer indicating time remaining in purge phase.
2) A lockout indicator and reset button shall be provided on the Burner Startup screen.
3) A burner Limit Check screen shall be provided. The screen shall contain a status indicator for each safety trip in the master fuel trip circuit.
4) All alarms and shut downs for the BMS shall be displayed on the alarm screen.
5) On/Off status of the BMS valves shall be displayed on the Boiler Main pictorial screen.

B. Each screen shall contains buttons at the button for navigating to the main screen and to other screens which are directly associated with the active screen.
5. Boiler Control Hardware Description

A. The Boiler Control System shall be mounted in an single door floor standing enclosure. The
   enclosure shall be meet NEMA 12 specifications.
B. The boiler control system shall use Allen-Bradley SLC-05/04’s or Modicon Compact A984-145
   PLC’s.
C. The enclosure shall be designed for 480 VAC 60 Hz.
D. The enclosure shall contain a lighting transformer. The lighting transformers shall be a daykin
   MDGTA-13 and power both internal lighting and the PLC’s.
E. Separate PLC’s shall be provided for the Combustion Control and the Burner Management
   System.
F. All I/O boards shall be wired to field terminals. Fused terminals shall be provided for all analog
   inputs and outputs and for gas train solenoids.
G. Analog and 24 VDC wiring shall be run separately from AC wiring. Analog wiring shall be
   shielded twisted pairs with drain wire. Field terminals shall be provided for the drain wire. Shield
   and drain wire shall be contiguous from analog board to field terminal.
H. Master Relay shall be Allen-Bradley 700 series other miscellaneous relays shall be PB KUP
   series.
I. Dual 24 VDC loop power supplies shall be provided. Each power supply shall be sized to handle
   total load for system. The Combustion Control PLC shall monitor the power supply ready
   condition. Phoenix power supplies shall be supplied.
J. The operator MMI screens shall be a 14" color Allen-Bradley 1400E series PanelView with touch
   screen or an Cutler-Hammer 4000 PanelMate Plus with touch screen. PanelMate shall be used
   with Modicon systems, PanelView shall be used with Allen-Bradley system. The MMI shall be
   mounted on the door of the enclosure.
K. The following shall be mounted on the door of the enclosure:
   - Operator’s MMI
   - Alarm Horn which shall be a Edwards 870-N5
   - Alarm Bell which shall be a Edwards 340-4N5 Adaptable
   - Master On/Off Push buttons with indicating light. Master Off push-button shall be push-
     pull with jumbo head
   - Flame scanner flame strength meter
L. The BMS flame scanner shall be Fireye MBUV-1100 with 60-2537 mounting base.
M. PLC I/O shall be provided for all analog and digital I/O required of the Boiler Control System.
   As a minimum, I/O shall be provided for all devices shown on P&ID DSBoilerSH1.
N. As a minimum, 10% spare digital and analog I/O shall be provided. Spare I/O shall be wired to
   field terminals.

6. Engineering Services

A. Engineering services shall be provided to define requirements of system, provide detail design,
   and equipment configuration, logic design, MMI configuration, and documentation
   implementation.
B. On site startup services shall be provided. The startup services are to include:
   1) Check and verify all I/O connections.
   2) Apply power to control system.
   3) Adjust, calibrate, and configure all field instrumentation.
   4) Verify correct operation of boiler control system and make any necessary adjustment to
      insure proper operation of boiler.
C. Provide training course for operating personnel. The course shall include classroom training
   that covers overall configuration of system including location and interconnection of equipment,
   and function of equipment. Course shall include hands on training of boiler startup and
   shutdown procedures and MMI operation.
7. Documentation
   A. The following documentation shall be provide:
      1) Control enclosure electrical diagrams including enclosure power distribution and I/O
         diagrams.
      2) Control enclosure dimension drawings with enclosure layout and detail bill-of-material.
      3) Description of system operation including functional description and operating procedures.
      4) PLC logic documentation supplied on floppy disk. Allen-Bradley SLC to be documented with
         RSLogix 500. Modicon PLC to be documented with Modsoft.
      5) MMI configuration supplied on floppy disk.
      6) Drawings are to be supplied in ACAD 14 format.