BurnerMate TS Boiler Control System

Overview

BurnerMate® TS

BurnerMate TS is a custom-programmable boiler control and flame safeguard system that includes one or two DCS-III loop controllers and a flame safeguard microprocessor communicating via Modbus with a 10” or 15” OIT touch screen. The system provides an industrial enclosure with necessary pushbuttons, selector switches, power supplies, terminal blocks; factory wired and tested with other field devices for a complete system. Each system is programmed to the job specific requirements of the project.

Advanced Combustion Control Options

- Single Point Positioning (Jackshaft) control. Effective control with remote monitoring for smaller boilers.
- Parallel Positioning control with Oxygen Trim and Variable Speed Fan Combustion Air Flow Control.
- Fully Metering control with Oxygen Trim and variable speed fan combustion air flow control creates superior control for Low NOx burner applications. Essential for simultaneous dual fuel firing, multiple burner boilers and balanced draft applications.
- Optional Drum Level, Draft and/or Flue Gas Recirculation Control

Integral Flame Safeguard

- Independent, industrial-hardened microprocessor.
- Automatic single burner, dual fuel, gas or oil firing, sequencing, ignition and flame monitoring protection.

Easy to Order, Stock and Field Upgrade

- Factory wired and tested control system.

Integrated Boiler Management

The BurnerMate TS is a combined combustion control, flame safeguard, and SCADA monitoring and control system. It incorporates Preferred’s high quality DCS-III Multiple Loop Controller for boiler control functions, an industrial-hardened microprocessor for flame safeguard functions, and a PC-based SCADA workstation for graphic monitoring and operating. BurnerMate TS is a full scope control package that assures safe and efficient control with undivided system integration responsibility.

Flexible & Expandable

A second, optional DCS-III Multiple Loop Controller can be supplied to provide draft and drum level control loops and balance of plant monitoring with up to 15 analog inputs, 6 analog outputs, 5 triac pair outputs, 6 relay outputs, 13 digital 120 VAC inputs, or combinations of these. BurnerMate TS is designed to be monitored and controlled by the optional SCADA/Flex Distributed Control System.

Easy to Operate

BurnerMate TS with its large, industrial-grade color touch screens provides an intuitive, easily used control system that displays current boiler status, alarms, and historical logging. The system is password protected for security. Historical trending is standard. An optional flash card allows historical data to be exported to MS Excel. Scalable objects enable accurate process displays. X/Y plots are provided for intuitive Fuel/ Air Curves display and commissioning. The NEMA4X front panel eliminates the need for protective viewing doors. Easily used OIT_Edit® configuration software can be used to customize graphic pages.

Integral Oxygen Analyzer

The ZP Oxygen Probe is directly connected to the DCS-III controller (eliminating the need for a field mounted transmitter), which simplifies installation. The Model ZP with DCS-III-Zxxx is a full function analyzer which includes specific analyzer diagnostic codes for rapid trouble shooting and continuous monitoring of cell impedance for predicting cell health.

Easy Commissioning

Using “Learn Mode” – F(x) characterizer curves are set by manually positioning fuel and air for safe and reliable operation and optimum Oxygen level and then pressing the “STORE” button. Air and oxygen setpoint curves are simultaneously setup. The process can be repeated for a maximum of 11 load points. Independent curves for each fuel are automatically selected.
Remote Control and Monitoring
The optional SCADA/FLEX Distributed Control System provides remote operation, graphic display of information, alarm message displays, alarm printing, and remote boiler tuning capabilities. The system is networked to the boiler control and Flame Safeguard Systems.

Standard Features
- Advanced Communication- 10 Base T/100 Base TX Ethernet
  - One RS-485, Second Optional
  - Two RS-232 Ports
  - Remote Web Access
  - Isolated, Simultaneous Modbus Master & Slave
- Real Time and Historical Trending Standard, optional Flash Card allows historical data to be exported to MS Excel.
- Scalable objects enable accurate process displays
- X/ Y Plots, for intuitive Fuel/ Air Curves display and commissioning
- NEMA 4X Front Panel eliminates the need for protective viewing doors.
- Easily used OIT_Edit® Configuration Software

Major Benefits
- Integration with DCS-III Controllers enables intuitive commissioning without the use of Laptops or PCC-III Controller Faceplate.
- BurnerMate TS Systems may be commissioned without the need for blockware training or laptops.

Specifications

Mechanical
- Enclosure Type: Windbox Mounted (optional Wall Mounted)
- Size: Typically - 30"H x 30"W x 12"D

Electrical
- Input Power: 120 VAC

Environmental
- Operating Temp: 32° F to 122° F (0° to 50° C)
- Storage Temp: -20° to 150° F (-28° to 65° C)
- Humidity Limits: 15 to 85% (noncondensing)
- Front Panel: NEMA 13/IP65

Communication
- Network: Modbus (ASCII or RTU mode)
  - Speed: 1200 to 38,400 baud
  - Type: RS485, optically isolated
- Configuration: Speed: 38,400 baud
  - Type: RS232

Configuration, DCS-III Controller
- Language: Function block style, 60 functions, 160 blocks
- Laptop (optional): PC3_Edit™ spread sheet based editor or PC3_Draw™ graphical, object-oriented editor

OIT Touch Screen
- Mechanical: 10.4" TFT 256 Color VGA
  - 640 x 480 pixel LCD
- Communication: 10 Base T/100 Base TX Ethernet
  - One RS-485, Second Optional
  - Two RS-232 Ports
  - Remote Web Access
  - Isolated, Simultaneous Modbus Master & Slave
**BURNERMATE TS BOILER CONTROL SYSTEM**

**Ordering Information**

1. Specify BurnerMate TS Control System from the table (see the following pages for system descriptions)

<table>
<thead>
<tr>
<th>Combustion Control</th>
<th>Type</th>
<th>Catalog Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steam or Hot Water Boiler</td>
<td>Steam</td>
<td>ST</td>
</tr>
<tr>
<td></td>
<td>Hot Water</td>
<td>HW</td>
</tr>
<tr>
<td>Single Point Positioning Combustion Control</td>
<td>Triac**</td>
<td>SPT</td>
</tr>
<tr>
<td></td>
<td>Current*</td>
<td>SPC</td>
</tr>
<tr>
<td>Parallel Positioning Combustion Control</td>
<td>Triac</td>
<td>PPT</td>
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<tr>
<td>Fully Metered Combustion Control</td>
<td>Current</td>
<td>FMC</td>
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<table>
<thead>
<tr>
<th>Optional Features</th>
<th>Output Type</th>
<th>Catalog Number</th>
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<tbody>
<tr>
<td>Variable Speed Drive (VSD)</td>
<td>Current</td>
<td>add &quot;-VSD&quot; suffix</td>
</tr>
<tr>
<td>Combustion Air Fan Control (PPT or FMC systems only)</td>
<td>Current</td>
<td>add &quot;-ZP&quot; suffix</td>
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<tr>
<td>Oxygen Trim Control</td>
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<td>add &quot;-FSG&quot; suffix</td>
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<tr>
<td>Flame Safeguard</td>
<td></td>
<td></td>
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<tr>
<td>Draft Control</td>
<td>Triac</td>
<td>add &quot;-DRT&quot; suffix</td>
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<tr>
<td></td>
<td>Current</td>
<td>add &quot;-DRC&quot; suffix</td>
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<tr>
<td>Drum Level (Feedwater) Control &quot;X&quot; - Feedwater (1, 2, or 3) Element</td>
<td>Triac</td>
<td>add &quot;-FWT&quot; suffix</td>
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<tr>
<td></td>
<td>Current</td>
<td>add &quot;-FWC&quot; suffix</td>
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<tr>
<td>Flue Gas Recirculation (FGR) Control</td>
<td>Triac</td>
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<td></td>
<td>Current</td>
<td>add &quot;-FGRC&quot; suffix</td>
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<tr>
<td>Wall Mounted style enclosure (instead of Burner Windbox Mounted style)</td>
<td></td>
<td>add &quot;-WM&quot; suffix</td>
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</table>

* "Current" outputs provide a 4-20 mADC signal to drive electric or pneumatic actuators.
** "Triac" outputs provide direct control of electric actuators such as the SM-15

**Additional Ordering Information (when required)**

2. Specify required pressure, temperature, or flow sensor ranges
3. Specify Variable Speed Drive (VSD) motor data
4. Specify In-Situ Oxygen Sensor probe length and cable length
5. Specify SCADA/Flex Distributed Control requirements

**Catalog Number Example:**


*Consult factory for VSD bypass or additional monitoring and control requirements.*
Application
The BurnerMate TS Model BMTS-STSP provides automatic firing rate control for new or existing steam boilers using single point positioning, combustion control. In a single point positioning system the fuel valves and air control damper are mechanically linked, and are modulated by a single control actuator. Generally, the fuel valve has a characterizable flow versus position relationship that is used to establish the fuel/air ratio over the range of modulation. Single point positioning control is recommended when the boiler size or service hours do not justify the addition of Oxygen trim and variable speed fan control logic.

- **Steam Drum Pressure is Maintained** using local PID setpoint control. PID control provides efficient, accurate control by eliminating drum pressure “offset” (error)
- **Responds to Plant Master Firing Rate and Sequencing Demand**
- **Warm Standby and Low Fire Hold** – The boiler is periodically started and held at low fire until it returns to the warm standby temperature. (Aquastat supplied by fired equipment manufacturer)
- **Oxygen Trim (optional)** – Using the Link Trim Actuator (LTA) and ZP In-Situ Oxygen Sensor, Oxygen Trim can be added to the BMTS-STSP.
### BURNERMATE TS MODEL BMATS-STSP

#### Suggested Specifications

**Specifications**

**BurnerMate TS Control Panel**

- Touchscreen: OIT-10 or OIT-15
- Controller: DCS-III-0000
- Input Power: 120 VAC (+/- 15%)

**Inputs**

- Drum Pressure: 4-20 mADC
- Plant Master: 4-20 mADC
- Warm Standby: 120 VAC, optically isolated

**Outputs**

- Boiler Modulation: 4-20 mADC or Triac

*These features are standard, but their use is selectable at time of start-up.

Consult Factory for Inputs and Outputs included with “-ZP” option.

### Ordering Information

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<tr>
<th>Description</th>
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<tbody>
<tr>
<td>Steam Boiler Control with Triac Output</td>
<td>BMATS-STSP</td>
</tr>
<tr>
<td>Steam Boiler Control with Current Output</td>
<td>BMATS-STSPC</td>
</tr>
</tbody>
</table>

### Suggested Specification

1. **Application**

Supply a self-contained, Boiler Control System with 10” (or 15”) color touch screen to provide process control of steam pressure, combustion air, and fuel flow. The control system shall be microprocessor-based and suitable for wall or windbox mounting. All the logic required to ensure that pre-purge, post-purge, light-off, and burner modulation cycles are automatic.

2. **Combustion Control**

A PID-based single point positioning combustion control logic scheme shall be used to maintain steam drum pressure at setpoint. The fuel flow control valve shall be mechanically linked to the air flow control device to assure an air rich fuel/air ratio. Mechanical linkage adjustment shall be required to adjust the fuel/air ratio. A combustion control microprocessor failure shall not prevent the continued manual operation of the boiler. Fuel valve and air damper shall be modulated in response to an external plant master demand signal or measured boiler drum pressure compared to setpoint. At minimum, the control system shall display the following: steam pressure, steam pressure setpoint, boiler firing rate and alarm messages for low pressure, high pressure, and pressure setpoint deviation. The following color touch screen graphic pages shall be provided: boiler overview, flame safeguard overview, control panel faceplate with real time and historical trending, set up and commissioning screens, and boiler alarm.

3. **Boiler Controllers**

To assure system integrity, a pre-wired and factory-tested, microprocessor-based, multiple loop controller system shall be provided. The controller shall include process variable and “first-out” annunciator, 120 VAC discrete inputs and outputs, and 4-20 mADC analog inputs and outputs. Configuration and calibration data shall be stored on redundant non-volatile EEPROM memory modules. The backup module shall automatically download into the primary memory if primary memory data is corrupted. All control logic, tuning, and fuel/air ratio curves shall be field configurable. If required to allow field modifications to the controller logic, provide one configuration tool or laptop computer per facility.

4. **Communication**

Each controller shall be equipped with an optically isolated RS485 modbus communications data highway connection to the color touch screen. The touch screen shall communicate with the plant BAS, EMS, or DCS by a Modbus over Ethernet communications data highway and shall allow: auto/manual mode change, setpoint change, variation of the manual output, sensing and silencing of alarms, change of any configuration parameter (including PID tuning constants), change of timers, etc. Provide all equipment capabilities specified in this paragraph, even if a connecting SCADA system is not included in this project.

5. **Quality Assurance**

The system shall be factory manufactured and tested according to UL508A requirements (CSA C22.2 #14 for use in Canada). The control system shall be a Preferred Instruments, Danbury, CT, BurnerMate TS Model BMATS-STSPx ('x' = “C” or “T” to denote a Current or Triac Control Output).
**Application**

The BurnerMate TS Model BMTS-HWSP provides automatic firing rate control for new or existing hot water boilers using single point positioning combustion control. In a single point positioning system the fuel valves and air control damper are mechanically linked, and are modulated by a single control actuator. Generally, the fuel valve has a characterizable flow versus position relationship that is used to establish the fuel/air ratio over the range of modulation. Single point positioning control is recommended when the boiler size or service hours do not justify the addition of oxygen rim and variable speed fan control logic.

- **Hot Water Temperature is Maintained** using local PID setpoint control. PID control provides efficient, accurate control by eliminating temperature “offset” (error)
- **Responds to Plant Master Firing Rate and Sequencing Demand**
- **Low Fire Hold** – Firing rate may be held at low fire during warm-up, or base loaded at an optimum level in response to the lead/lag controller
- **Oxygen Trim (optional)** – Using the Link Trim Actuator (LTA) and ZP In-Situ Oxygen Sensor, Oxygen Trim can be added to the BMTS-HWSP.

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Model BMTS-HWSP Combustion Control System
## Burnermate TS Model BMTS-HWSP

### Suggested Specifications

#### Specifications

**BurnerMate TS Control Panel**
- Touchscreen: OIT-10 or OIT-15
- Controller: DCS-III-0000
- Input Power: 120 VAC (+/- 15%)

**Inputs**
- Water Temperature: 4-20 mADC
- Plant Master: 4-20 mADC*
- Warm Standby: 120 VAC, optically isolated (Optional)*

**Outputs**
- Boiler Modulation: 4-20 mADC or Triac

*These features are standard, but their use is selectable at time of start-up.

Consult Factory for Inputs and Outputs included with “-ZP” option.

#### Ordering Information

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<tr>
<td>Hot Water Boiler Control with Triac Output</td>
<td>BMTS-HWSPT</td>
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<tr>
<td>Hot Water Boiler Control with Current Output</td>
<td>BMTS-HWSPC</td>
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<table>
<thead>
<tr>
<th>Order Sensors Separately (Optional)</th>
<th>Catalog Number</th>
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</thead>
<tbody>
<tr>
<td>Hot Water Transmitter, 4-20 mADC, 0 to 500°F, NEMA 4, with 4.5” depth</td>
<td>Consult Factory</td>
</tr>
<tr>
<td>Thermowell, SS, 4.5” x ½ NPT</td>
<td>Consult Factory</td>
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</tbody>
</table>

#### Suggested Specification

1. **Application**

Supply a self-contained Boiler Control System with 10” (or 15”) color touch screen to provide process control of water temperature, combustion air and fuel flow. The control system shall be microprocessor-based and suitable for wall or windbox mounting. All the logic required to ensure that pre-purge, post-purge, light-off, and burner modulate cycles are automated shall be provided.

2. **Combustion Control**

A PID based single point positioning combustion control logic scheme shall be used to maintain water temperature at setpoint. The fuel flow control valve shall be mechanically linked to the air flow control device to assure an air rich fuel/air ratio. Mechanical linkage adjustment shall be required to adjust the fuel/air ratio. A combustion control microprocessor failure shall not prevent the continued manual operation of the boiler. Fuel valve and air damper shall be modulated in response to an external plant master demand signal or measured water temperature compared to setpoint. At minimum, the control system shall display the following: water temperature, temperature setpoint, firing rate and alarm messages for low temperature, high temperature, and temperature setpoint deviation. The following color touch screen graphics pages shall be provided: boiler overview, flame safeguard overview, control panel faceplate with real time and historical trending, set-up and commissioning screens, and boiler alarm.

3. **Hot Water Temperature Setpoint**

When the controller is in the automatic mode, the control system shall establish the setpoint based on day-night and outside air temperature. When in manual mode, the operator may set the setpoint via the front panel display.

4. **Boiler Controllers**

To assure system integrity, a pre-wired and factory-tested, microprocessor-based, multiple loop controller system shall be provided. The controller shall include process variable and “first-out” annunciator, 120 VAC discrete inputs and outputs, and 4-20 mADC analog inputs and outputs. Configuration and calibration data shall be stored on redundant non-volatile EEPROM memory modules. The backup memory module shall automatically download into the primary memory if a primary memory data is corrupted. All control logic, tuning, and fuel/air ratio curves shall be field configurable. If required to allow field modifications to the controller logic, provide one configuration tool or laptop computer per facility.

5. **Communication**

Each controller shall be equipped with an optically isolated RS485 modbus communications data highway connection to the color touch screen. The touch screen shall communicate with the plant BAS, EMS, or DCS by a Modbus over Ethernet communications data highway and shall allow: auto/manual mode change, setpoint change, variation of the manual output, sensing and silencing of alarms, change of any configuration parameter (including PID tuning constants), change of timers, etc. Provide all equipment capabilities specified in this paragraph, even if a connecting SCADA system is not included in this project.

6. **Quality Assurance**

The system shall be factory manufactured and tested according to UL508A requirements (CSA C22.2 #14 for use in Canada). The system shall be designed to assure the safe start-up, on-line operation and shutdown of fuel firing equipment. The control system shall be a Preferred Instruments, Danbury, CT, Burnermate TS Model BMTS-HWSPx (‘X’ = “C” or “T” to denote a Current or Triac Control Output).
**Application**

The BurnerMate TS Model BMTS-STPPT provides automatic firing rate control for new or existing steam or hot water boilers using parallel positioning combustion control with both oxygen trim and variable speed fan combustion air flow control. Separate controller outputs are provided for each fuel flow control valve, air control damper and Variable Speed Drive (VSD). Fuel/air ratio is established and adjusted by use of a “soft” function curve of fuel valve position vs. air fan speed and damper position. Cross limiting using VSD and actuator position feedbacks is employed for safety and to prevent combustion or smoke during load changes.

- **Steam Drum Pressure Is Maintained** using local PID setpoint control. PID control provides efficient, accurate control by eliminating drum pressure “offset” (error). It also responds to plant master demand.
- **Minimum Fuel Usage** – Flue gas Oxygen is used to continuously adjust (trim) the fuel/air ratio. Oxygen trim saves fuel by fine tuning the burner to operate safely and reliably, reducing excess air levels throughout the burner firing range.
- **Minimum Fan Power Usage** – Fan speed control minimizes damper pressure drop related to fan power usage.
- **Real Time Boiler Efficiency Display** – Allows the boiler operator to instantly identify inefficiencies and potential operating problems.
- **Safety** – Flue gas temperature and oxygen are monitored. Warning alarms and burner safety shutdown interlocks are available. VSD speed and actuator position feedbacks are continuously monitored and the burner trips if any are out of position.
**Burnermate TS Model BMTS-STPPT**

Steam Boiler Parallel Positioning Combustion Control

**Specifications**

**BurnerMate TS Control Panel**
- Touchscreen: OIT-10 or OIT-15
- Controller: DCS-III-GZS0
- Input Power: 120 VAC (+/- 15%)

**Inputs**
- Drum Pressure: 4-20 mADC
- Flue Gas Temperature: T/C (Option “-ZP”)
- Flue Gas Oxygen: ZP Probe (Option “-ZP”)
- Plant Master: 4-20 mADC
- Fuel Gas Actuator Feedback: Potentiometer
- Fuel Oil Actuator Feedback: Potentiometer
- Air Actuator Feedback: Potentiometer
- VSD Speed Feedback: 4-20 mADC (Option “-VSD”)

**Outputs**
- Boiler Efficiency: 4-20 mADC
- Fuel Gas Valve Actuator: Triac
- Fuel Oil Valve Actuator: Triac
- Air Damper Actuator: Triac
- VSD Speed Demand: 4-20 mADC (Optional “-VSD”)

*These features are standard, but their use is selectable at time of start-up.

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<tbody>
<tr>
<td>Steam Boiler Control</td>
<td>BMTS-STPPT</td>
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</table>

Additional Ordering Information and Suggested Specifications
1. Model ZP In-Situ Oxygen Sensor
2. Variable Speed Drive (VSD)
3. Rotary Actuator (SM or UM)
4. Consult factory for low fire changeover, VSD bypass or pneumatic actuators

**Order Sensors Separately (Optional)**

<table>
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<tbody>
<tr>
<td>Consult Factory</td>
</tr>
</tbody>
</table>

Steam Pressure Transmitter, 4-20 mADC, 0 to 200 PSI, NEMA 4, Smart with single valve manifold
1. Application
Supply a self-contained Boiler Control System with 10” (or 15”) color touch screen to provide both electricity and fuel savings within the limits of stable burner operation. The control system shall be microprocessor-based and suitable for wall or windshield mounting. Provide all the logic required to ensure automated pre-purge, post-purge, light-off, and burner modulate cycles.

2. Combustion Control
A PID-based, parallel positioning control strategy shall position the fuel valve(s), combustion air damper, and forced draft fan speed for minimum fuel kWh usage, and shall continuously trim the fuel/air ratio based on measured flue gas oxygen levels for minimum fuel consumption. Systems that control forced draft fan speed based simply on burner windbox pressure are not acceptable. The system shall position the fuel and combustion air final control elements’ movement and VSD speed with “position cross-limiting” to ensure that a safe fuel/air ratio is maintained under all load change conditions. Fuel/air ratio shall be established and adjusted by the use of a “soft” function curve relating fuel valve position to air damper position. Provide a PID based oxygen trim control strategy with automatic adaptive gain for stable operation. Flue gas oxygen setpoint shall vary automatically based on firing rate. Fuel valve and air damper shall modulate in response to an external plant master demand signal or measured boiler drum pressure compared to setpoint. At minimum, the control system shall display the following: boiler firing rate, steam pressure, steam pressure setpoint, boiler efficiency, trim percent, flue gas oxygen setpoint, flue gas oxygen, flue gas temperature, fuel valve position, air damper position, and VSD speed and alarm messages for low pressure, high pressure, high flue gas temperature, low oxygen, low oxygen trip, fuel trip, damper trip, VSD trip, and oxygen cell fault. The following color touch screen graphic pages shall be provided: boiler overview, flame safeguard overview, control panel faceplate with real time and historical trending, set-up and commissioning screens, and boiler alarm. The control system shall include a dedicated, normally energized, fail safe relay output contact in the "running" interlock circuit of the flame safeguard that will cause a fired equipment shutdown in the event of: low oxygen, air damper actuator fault, fuel valve actuator fault, VSD fault, or controller fault.

3. Boiler Efficiency Display
Real time boiler efficiency shall be calculated and displayed, thereby allowing the boiler operator to instantly identify inefficiencies and potential operational problems. The calculation shall be based on the ASME “by losses” method and must utilize real time inputs of boiler firing rate, flue gas oxygen, flue gas temperature and fuel selected. Two sets of adjustable fuel chemistry data parameters shall be included, and firing rate scaled radiation losses shall be used for maximum accuracy. Calculations that rely on fixed constants, or manually inputted values for these conditions, are not acceptable. NOTE: Flue gas temperature transmitters must be provided and installed at each boiler outlet.

4. Boiler Controllers
To assure system integrity, a pre-wired and factory-tested, microprocessor-based, multiple loop controller system shall be provided. The controller shall include process variable and “first-out” annunciator displays. Configuration and calibration data shall be stored on redundant non-volatile EEPROM memory modules. The backup memory module shall automatically download into the primary memory if primary memory data is corrupted. All control logic, tuning, and fuel/air ratio curves shall be field configurable. If required to allow field modifications to the controller logic, provide one configuration tool or laptop computer per facility.

5. Flue Gas Oxygen Analyzer
Provide a boiler breeching mounted in-situ, zirconium oxide Oxygen analyzer for each boiler. Extractive or "wet cell" type oxygen analyzers are not acceptable. The probe shall be of a suitable length for sensing the oxygen level in the middle ⅓ of the breeching. All wetted parts shall be stainless steel. The oxygen analyzer shall include a digital controller that performs continuous self-diagnostics with diagnostic codes for at least 10 common faults. The system shall automatically send the trim actuator to the ‘null’ position and trigger the alarm dry contacts in the event of an oxygen analyzer fault. The detector shall be field replaceable without removing the probe from the stack and shall not require special tools. The analyzer shall automatically perform periodic detector cell impedance tests to be used by the operator as an indication of calibration shift. Analyzer calibration shall be pushbutton semi-automatic (no trim pots), with English language prompts and diagnostic messages. Analyzer output shall be field selectable as 0-10% or 0-21% without field recalibration.

6. Communication
Each controller shall be equipped with an optically isolated RS485 modbus communications data highway connection to the color touch screen. The touch screen shall communicate with the plant BAS, EMS, or DCS by a Modbus over Ethernet communications data highway and shall allow: auto/ manual mode change, setpoint change, variation of the manual output, sensing and silencing of alarms, change of any configuration parameter (including PID tuning constants), change of timers, etc. Provide all equipment capabilities specified in this paragraph, even if a connecting SCADA system is not included in this project.

7. Quality Assurance
The system shall be factory manufactured and tested according to UL508A requirements (CSA C22.2 #14 for use in Canada). The control system shall be a Preferred Instruments, Danbury, CT, BurnerMate Model BMTS-STPPT-ZP-VSD.
Application

The BurnerMate TS Model BMTS-HWPPT provides automatic firing rate control for new or existing hot water boilers using parallel positioning combustion control with both oxygen trim and variable speed fan combustion air flow control. Separate controller outputs are provided for each fuel flow control valve, air control damper and variable speed drive (VSD). Fuel/air ratio is established and adjusted by use of a “soft” function curve of fuel valve position vs. air fan speed and damper position. Cross limiting using VSD and actuator position feedbacks is employed for safety and to prevent combustibles or smoke during load changes.

- Hot Water Temperature is Maintained using local PID setpoint control. PID control provides efficient, accurate control by eliminating drum pressure “offset” (error). Also responds to Plant Master demand
- Minimum Fuel Usage – Flue gas oxygen is used to continuously adjust (trim) the fuel/air ratio. Oxygen trim saves fuel by fine tuning the burner to operate safely and reliably at reduced excess air levels throughout the burner firing range
- Minimum Fan Power Usage – Fan speed control minimizes damper pressure drop related to fan power usage
- Real Time Boiler Efficiency Display – Allows the boiler operator to instantly identify inefficiencies and potential operational problems
- Safety – Flue gas temperature and oxygen are monitored. Warning alarms and burner safety shutdown interlocks are available. VSD speed and actuator position feedbacks are continuously monitored, and the burner trips if any are out of position.
**Specifications**

**BurnerMate TS Panel**
- Touchscreen: OIT-10- or OIT-15
- Controller: DCS-III-GZS0
- Input Power: 120 VAC (+/- 15%)

**Inputs**
- Water Temperature: 4-20 mADC
- Flue Gas Temperature: T/C (Option “-ZP”)
- Flue Gas Oxygen: ZP Probe (Option “-ZP”)
- Plant Master: 4-20 mA DC*
- Fuel Gas Actuator Feedback: Potentiometer
- Fuel Oil Actuator Feedback: Potentiometer
- Air Actuator Feedback: Potentiometer
- VSD Speed Feedback: 4-20 mA DC (Option “-VSD”)

**Outputs**
- Boiler Efficiency: 4-20 mA DC
- Fuel Gas Valve Actuator: Triac
- Fuel Oil Valve Actuator: Triac
- Air Damper Actuator: Triac
- VSD Speed Demand: 4-20 mA DC (Option “-VSD”)

*These features are standard, but their use is selectable at time of start-up.

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<tr>
<td>Hot Water Boiler Control</td>
<td>BMTS-HWPPT</td>
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**Additional Ordering Information and Suggested Specifications**
1. Model ZP In-Situ Oxygen Sensor
2. Variable Speed Drive (VSD)
3. Actuator (SM or UM)
4. Consult factory for low fire changeover and VSD bypass

<table>
<thead>
<tr>
<th>Order Sensors Separately (Optional)</th>
<th>Catalog Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hot Water Temperature Transmitter, 4-20 mADC, 0 to 500° F, NEMA 4, Smart with 4½” depth</td>
<td>Consult Factory</td>
</tr>
<tr>
<td>Thermowell, SS, 4½” x ½ NPT</td>
<td>Consult Factory</td>
</tr>
</tbody>
</table>
1. Application
Supply a self-contained Boiler Control System with 10" (or 15") color touch screen to provide both electricity and fuel savings within the limits of stable burner operation. The control system shall be microprocessor-based and suitable for wall or windbox mounting. Provide all the logic required to ensure automated pre-purge, post-purge, light-off, and burner modulate cycles.

2. Combustion Control
A PID based, parallel positioning control strategy shall position the fuel valve(s), combustion air damper, and forced draft fan speed for minimum fan kWh usage, and shall continuously trim the fuel/air ratio based on measured flue gas oxygen levels to minimize fuel consumption. Systems that control forced draft fan speed based simply on burner windbox pressure are not acceptable. The system shall position the fuel and combustion air final control elements' movement and VSD speed with "position cross-limiting" to ensure that a safe fuel/air ratio is maintained under all load change conditions. Fuel/air ratio shall be established and adjusted by the use of a "soft" function curve relating fuel valve position to air damper position. Provide a PID based oxygen trim control strategy with automatic adaptive gain for stable operation. Flue gas oxygen setpoint shall vary automatically based on firing rate. Fuel valve and air damper shall modulate in response to an external plant master demand signal or measured hot water temperature compared to setpoint. At minimum, the control system shall display the following: boiler firing rate, hot water temperature, hot water temperature setpoint, boiler efficiency, trim percent, flue gas oxygen setpoint, flue gas oxygen, flue gas temperature, fuel valve position, air damper position, and VSD Speed and alarm messages for low temperature, high temperature, high flue gas temperature, low oxygen, low oxygen trip, fuel trip, damper trip, VSD trip, and oxygen cell fault. The following color touch screen graphic pages shall be provided: boiler overview, flame safeguard overview, control panel faceplate with real time and historical trending, set-up and commissioning screens, and boiler alarm.

The control system shall include a dedicated, normally energized, fail safe relay output contact in the "running" interlock circuit of the flame safeguard that will cause a fired equipment shutdown in the event of: low oxygen, air damper actuator fault, fuel valve actuator fault, VSD fault, or controller fault.

3. Hot Water Temperature Setpoint
When the controller setpoint is in automatic mode the control system shall establish the setpoint based on outside air temperature. When in manual mode, the operator may adjust the setpoint via the front panel display.

4. Boiler Efficiency Display
Real time boiler efficiency shall be calculated and displayed, thereby allowing the boiler operator to instantly identify inefficiencies and potential operating problems. The calculation shall be based on the ASME "by losses" method and must utilize real time inputs of boiler firing rate, flue gas Oxygen, flue gas temperature and fuel selected.

Two sets of adjustable fuel chemistry data parameters shall be included, and firing rate scaled radiation losses shall be used for maximum accuracy. Calculations that rely on fixed constants, or manually entered values for these conditions, are not acceptable. NOTE: Flue gas temperature transmitters must be provided and installed at each boiler outlet.

5. Boiler Controllers
To assure system integrity, a pre-wired and factory-tested, microprocessor-based, multiple loop controller system shall be provided. The controller shall include process variable and "first-out" annunciator displays. Configuration and calibration data shall be stored on redundant non-volatile EEPROM memory modules. The backup memory module shall automatically download into the primary memory if a primary memory data is corrupted. All control logic, tuning, and fuel/air ratio curves shall be field configurable. If required to allow field modifications to the controller logic, provide one configuration tool or laptop computer per facility.

6. Flue Gas Oxygen Analyzer
Provide a boiler breaching mounted in-situ, zirconium oxide oxygen analyzer for each boiler. Extractive or "wet cell" type oxygen analyzers are not acceptable. The probe shall be of a suitable length for sensing the oxygen level in the middle ½ of the breaching. All wetted parts shall be stainless steel. The oxygen analyzer shall include a digital controller that performs continuous self-diagnostics with diagnostic codes for at least 10 common faults. The system shall automatically send the trim actuator to the 'null' position and trigger the alarm dry contacts in the event of an oxygen analyzer fault. The detector shall be field replaceable without removing the probe from the stack and shall not require special tools. The analyzer shall automatically perform periodic detector cell impedance tests to be used by the operator as an indication of calibration shift. Analyzer calibration shall be push-button semi-automatic (no trim pots), with English language prompts and diagnostic messages. Analyzer output shall be field selectable as 0-10% or 0-21% without field recalibration.

7. Communication
Each controller shall be equipped with an optically isolated RS485 modbus communications data highway connection to the color touch screen. The touch screen shall communicate with the plant BAS, EMS, or DCS by a Modbus over Ethernet communications data highway and shall allow: auto/ manual mode change, setpoint change, variation of the manual output, sensing and silencing of alarms, change of any configuration parameter (including PID tuning constants), change of timers, etc. Provide all equipment capabilities specified in this paragraph, even if a connecting SCADA system is not included in this project.

8. Quality Assurance
The system shall be factory manufactured and tested according to UL508A requirements (CSA C22.2 #14 for use in Canada). The control system shall be a Preferred Instruments, Danbury, CT, BurnerMate Model BMTS-HWPPT-ZP-VSD.
Application
The BurnerMateTS Model BMTS-STFMC provides automatic firing rate control for new or existing steam boilers using fully metered combustion control. Both the fuel flow and the air flow are accurately measured. Measured temperature or pressure is used to generate a setpoint for fuel flow and air flow. The fuel flow setpoint is compared against actual fuel flow to control the fuel metering valves and the actual air flow is compared against the air flow setpoint to control the air control damper. Cross limiting using measured fuel and combustion air flow is employed for safety and to prevent combustibles or smoke during load changes. Fully metered control with oxygen trim minimizes excess air.

- Steam Drum Pressure is Maintained using local PID setpoint control. PID control provides efficient, accurate control by eliminating drum pressure “offset” (error). Also responds to plant master demand.
- Minimum Fuel Usage – Measured fuel, air flow and flue gas oxygen is used to continuously adjust (trim) the fuel/air ratio. Oxygen trim saves fuel by fine tuning the burner to operate safely and reliably at reduced excess air levels throughout the burner firing range.
- Minimum Fan Power Usage – Fan speed control minimizes damper pressure drop related to fan power usage.
- Real Time Boiler Efficiency Display – Allows the boiler operator to instantly identify inefficiencies and potential operational problems.
- Safe and Dependable Boiler Control – Flue gas temperature and oxygen are monitored. Warning alarms and burner safety shutdown interlocks are available.
BURNERMATE TS MODEL BMTS-STFMC
Steam Boiler Fully Metered Combustion Control

Specifications
BurnerMate TS Panel
- Touchscreen: OIT-10 or OIT-15
- Controller: DCS-III-FZ00
- Input Power: 120 VAC (+/- 15%)

Inputs
- Drum Pressure: 4-20 mADC
- Flue Gas Temperature: T/C (Option “-ZP”)
- Flue Gas Oxygen: ZP Probe (Option “-ZP”)
- Plant Master: 4-20 mADC*
- Fuel Gas Flow: 4-20 mADC*
- Fuel Oil Flow: 4-20 mADC*
- Air Flow: 4-20 mADC
- VSD Speed Feedback: 4-20 mADC (Option “-VSD”)

Outputs
- Fuel Oil Valve Actuator: 4-20 mADC*
- Fuel Gas Valve Actuator: 4-20 mADC*
- Air Damper Actuator: 4-20 mADC
- VSD Speed Demand: 4-20 mADC (Option “-VSD”)

*These features are standard, but their use is selectable at time of start-up.

Ordering Information

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<thead>
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<th>Description</th>
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<tr>
<td>Steam Boiler Control</td>
<td>BMTS-STFMC</td>
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</table>

Additional Ordering Information and Suggested Specifications
1. Model ZP In-Situ Oxygen Sensor
2. Variable Speed Drive (VSD)
3. Actuator
4. Consult factory for low fire fuel changeover and VSD bypass

Order Sensors Separately (Optional)

<table>
<thead>
<tr>
<th>Description</th>
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<tr>
<td>Steam Pressure Transmitter, 4-20 mADC, 0 to 200 PSI, NEMA 4, Smart with single valve manifold</td>
<td>Consult Factory</td>
</tr>
<tr>
<td>Oil Flow, Oval Gear type, 4-20 mADC, NEMA 4</td>
<td>Consult Factory</td>
</tr>
<tr>
<td>Gas Flow, Thermal Insertion Mass Flow, 4-20 mADC, NEMA 4</td>
<td>Consult Factory</td>
</tr>
<tr>
<td>Air Flow, differential pressure transmitter, 4-20 mADC, NEMA 4, Smart with 3 valve manifold</td>
<td>Consult Factory</td>
</tr>
</tbody>
</table>
1. Application
Supply a self-contained Boiler Control System with 10" (or 15") color touch screen to minimize consumption of both electricity and fuel within the limits of stable burner operation. The system shall use a flow meter cross-limited full metering combustion control logic scheme with oxygen trim and variable speed combustion air fan control to maintain main steam header pressure at the selected value. Positioning systems that depend on actuator feedback pots for cross limiting are not acceptable. The control system shall be microprocessor-based and suitable for wall or window box mounting. All the logic provides pre-purge, post-purge, light-off, and burner modulate cycles are automated shall be provided.

2. Combustion Control
The fuel flow control loop shall be cross-limited with the air flow control loop so that fuel demand cannot be increased until an air flow increase is proven by the air flow measurement loop and air demand cannot be decreased until a fuel flow decrease is proven by the fuel flow measurement loop. In addition, fuel demand cannot be increased beyond a certain amount above the measured air flow, and air demand cannot be decreased beyond a certain amount below the measured fuel flow. Fuel/air ratio shall be established and adjusted by the use of a "soft" function curve, relating fuel flow setpoint to air flow setpoint. Oxygen trim shall be accomplished by varying the fuel/air ratio and shall include separate characterizable oxygen setpoint curves for both oil and gas fuels. Fuel valve and air damper shall be modulated in response to an external plant master demand signal or measured steam pressure compared to setpoint. Provision shall be made to automatically switch the control mode from metering to positioning control of the air control damper whenever the firing rate of the unit is below the turndown range of the air flow transmitter. This control system shall require the burner to be shut down to change fuels. At minimum, the control system shall display the following: boiler firing rate, steam pressure, steam pressure setpoint, gas flow, oil flow, flue gas oxygen, fuel valve position, air flow, air damper position and VSD speed. The following color touch screen graphic pages shall be provided: boiler overview, Flame Safeguard overview, control panel faceplate with real time and historical trending, set-up and commissioning screens, and boiler alarm. The control system shall include a dedicated, normally energized, fail safe relay output contact in the "running" interlock circuit of the flame safeguard that will cause a fired equipment shutdown in the event of: low oxygen, low fuel flow, high flue gas temperature, VSD fault, or controller fault.

3. Boiler Efficiency Calculation
Real time boiler efficiency shall be calculated. The calculation shall be based on the ASME "by losses" method and must utilize real time inputs of boiler firing rate, flue gas oxygen, flue gas temperature and fuel selected. Two sets of adjustable fuel chemistry data parameters shall be included, and firing rate scaled radiation losses shall be used for maximum accuracy. NOTE: Flue gas temperature transmitters must be provided and installed at each boiler outlet.

4. Boiler Controllers
To assure system integrity, a pre-wired and factory-tested, microprocessor-based, multiple loop controller system shall be provided. The controller shall include process variable and "first-out" annunciator displays. Configuration and calibration data shall be stored on redundant non-volatile EEPROM memory modules. The backup memory module shall automatically download into the primary memory if primary memory data is corrupted. All control logic, tuning, and fuel/air ratio curves shall be field configurable. If required to allow field modifications to the controller logic, provide one configuration tool or laptop computer per facility.

5. Flue Gas Oxygen Analyzer
Provide a boiler breeching mounted in-situ, zirconium oxide oxygen analyzer for each boiler. Extractive or "wet cell" type oxygen analyzers are not acceptable. The probe shall be of a suitable length for sensing the oxygen level in the middle ½ of the breeching. All wetted parts shall be stainless steel. The oxygen analyzer shall include a digital controller that performs continuous self-diagnostics with diagnostic codes for at least 10 common faults. The system shall automatically send the trim actuator to the "null" position and trigger the alarm dry contacts in the event of an oxygen analyzer fault. The detector shall be field replaceable without removing the probe from the stack and shall not require special tools. The analyzer shall automatically perform periodic detector cell impedance tests to be used by the operator as an indication of calibration shift. Analyzer calibration shall be push-button semi-automatic (no trim pots), with English language prompts and diagnostic messages. Analyzer output shall be field selectable as 0-10% or 0-21% without field recalibration.

6. Communication
Each controller shall be equipped with an optically isolated RS485 modbus communications data highway connection to the color touch screen. The touch screen shall communicate with the plant BAS, EMS, or DCS by a Modbus over Ethernet communications data highway and shall allow: Auto/Manual mode change, setpoint change, variation of the manual output, sensing and silencing of alarms, change of any configuration parameter (including PID tuning constants), change of timers, etc. Provide all equipment capabilities specified in this paragraph, even if a connecting SCADA system is not included in this project.

7. Quality Assurance
The system shall be factory manufactured and tested according to UL508A requirements (CSA C22.2 #14 for use in Canada). The control system shall be a Preferred Instruments, Danbury, CT, BurnerMate TS Model BMTS-STFMC-ZP-VSD.
Application
The BurnerMate TS Model BMTS-HWFMC provides automatic firing rate controls for new or existing hot water boilers using fully metered combustion control. Both the fuel flow and the air flow are accurately measured. Measured temperature or pressure is used to generate a setpoint for fuel flow and air flow. The fuel flow setpoint is compared against actual fuel flow to control the fuel metering valves and the actual air flow is compared against the air flow setpoint to control the air control damper. Cross limiting using measured fuel and combustion air flow is employed for safety and to prevent combustibles or smoke during load changes. Fully metered control with oxygen trim minimizes extra excess air.

- **Hot Water Temperature is Maintained** using local PID setpoint control. PID control provides efficient, accurate control by eliminating drum pressure “offset” (error). Also responds to plant master demand.
- **Minimum Fuel Usage** – Measured fuel, air flow and flue gas oxygen is used to continuously adjust (trim) the fuel/air ratio. Oxygen trim saves fuel by fine-tuning the burner to operate safely and reliably at reduced excess air levels throughout the burner firing range.
- **Minimum Fan Power Usage** – Fan speed control minimizes damper pressure drop related to fan power usage.
- **Real Time Boiler Efficiency Display** – Allows the boiler operator to instantly identify inefficiencies and potential operational problems.
- **Safe and Dependable Boiler Control** – Flue gas temperature and oxygen are monitored. Warning alarms and burner safety shutdown interlocks are available.
Burnermate TS Model BMTS-HWFMC
Hot Water Boiler Fully Metered Combustion Control

Specifications
Burnermate TS Control Panel
  Touchscreen: OIT-10 or OIT-15
  Controller: DCS-III-FZ00
  Input Power: 120 VAC (+/- 15%)

Inputs
  Water Temperature: 4-20 mADC
  Flue Gas Temperature: T/C (Option “-ZP”)
  Flue Gas Oxygen: ZP Probe (Option “-ZP”)
  Plant Master: 4-20 mADC*
  Fuel Gas Flow: 4-20 mADC*
  Fuel Oil Flow: 4-20 mADC*
  Air Flow: 4-20 mADC
  VSD Speed Feedback: 4-20 mADC (Option “-VSD”)

Outputs
  Fuel Oil Valve Actuator: 4-20 mADC*
  Fuel Gas Valve Actuator: 4-20 mADC*
  Air Damper Actuator: 4-20 mADC
  VSD Speed Demand: 4-20 mADC (Option “-VSD”)

*These features are standard, but their use is selectable at time of start-up.

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Additional Ordering Information and Suggested Specifications
1. Model ZP In-Situ Oxygen Sensor
2. Variable Speed Drive (VSD)
3. Actuator
4. Consult factory for low fire fuel changeover and VSD bypass

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<td>Air Flow, Differential Pressure Transmitter, 4-20 mADC, NEMA 4, Smart with 3 valve manifold</td>
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1. Application
Supply a self-contained Boiler Control System with 10" (or 15") color touch screen to minimize consumption of both electricity and fuel within the limits of stable burner operation. The system shall use a flow meter cross-limited full combustion control logic scheme with oxygen trim and variable speed combustion air fan control to maintain water temperature at the selected value. Positioning systems that depend on actuator feedback pots for cross limiting are not acceptable. The control system shall be microprocessor-based and suitable for wall or window box mounting. All the logic required to ensure that pre-purge, post-purge, light-off, and burner modulate cycles are automated shall be provided.

2. Combustion Control
The fuel flow control loop shall be cross-limited with the air flow control loop so that fuel demand cannot be increased until an air flow increase is proven by the air flow measurement loop and air demand cannot be decreased until a fuel flow decrease is proven by the fuel flow measurement loop. Additionally, fuel demand cannot be increased beyond a certain amount above the measured air flow and air demand cannot be decreased beyond a certain amount below the measured fuel flow. Fuel/air ratio shall be established and adjusted by the use of a "soft" function curve relating fuel flow setpoint to air flow setpoint. Oxygen trim shall be accomplished by varying the fuel/air ratio and shall include separate characterizable oxygen setpoint curves for both oil and gas fuels based on firing rate. Fuel valve and air damper shall be modulated in response to an external plant master demand signal or measured steam pressure compared to setpoint. Provision shall be made to automatically switch the control mode from metering to positioning control of the air control damper whenever the firing rate of the unit is below the turndown range of the air flow transmitter. This control system shall require the burner to be shut down to change fuels. At minimum, the control system shall display the following: boiler firing rate, hot water temperature, hot water temperature setpoint, gas flow, oil flow, air flow, flue gas oxygen, fuel valve position, air damper position and VSD Speed. The following color touch screen graphic pages shall be provided: boiler overview, flame safeguard overview, control panel faceplate with real time and historical trending, set-up and commissioning screens, and boiler alarm. The control system shall include a dedicated, normally energized, fail safe relay output contact in the “running” interlock circuit of the flame safeguard that will cause a fired equipment shutdown in the event of: low oxygen, low fuel flow, high flue gas temperature, VSD fault, or controller fault.

3. Boiler Efficiency Calculation
Real time boiler efficiency shall be calculated. The calculation shall be based on the ASME "by losses" method and must utilize real time inputs of boiler firing rate, flue gas Oxygen, flue gas temperature and fuel selected. Two sets of adjustable fuel chemistry data parameters shall be included, and firing rate to efficiency losses shall be used for maximum accuracy. NOTE: Flue gas temperature transmitters must be provided and installed at each boiler outlet.

4. Boiler Controllers
To assure system integrity, a pre-wired and factory-tested, microprocessor-based, multiple loop controller system shall be provided. The controller shall include process variable and “first-out” annunciator displays. Configuration and calibration data shall be stored on redundant non-volatile EEPROM memory modules. The backup memory module shall automatically download into the primary memory if primary memory data is corrupted. All control logic, tuning, and fuel/air ratio curves shall be field configurable. If required to allow field modifications to the controller logic, provide one configuration tool or laptop computer per facility.

5. Flue Gas Oxygen Analyzer
Provide a boiler breathing mounted in-situ, zirconium oxide oxygen analyzer for each boiler. Extractive or “wet cell” type oxygen analyzers are not acceptable. The probe shall be of a suitable length for sensing the oxygen level in the middle 1/3 of the breeching. All wetted parts shall be stainless steel. The oxygen analyzer shall include a digital controller that performs continuous self-diagnostics with diagnostic codes for at least 10 common faults. The system shall automatically send the trim actuator to the ‘null’ position and trigger the alarm dry contacts in the event of an oxygen analyzer fault. The detector shall be field replaceable without removing the probe from the stack and shall not require special tools. The analyzer shall automatically perform periodic detector cell impedance tests to be used by the operator as an indication of calibration shift. Analyzer calibration shall be pushbutton semi-automatic (no trim pots), with English language prompts and diagnostic messages. Analyzer output shall be field selectable as 0-10% or 0-21% without field recalibration.

6. Communication
Each controller shall be equipped with an optically isolated RS485 modbus communications data highway connection to the color touch screen. The touch screen shall communicate with the plant BAS, EMS, or DCS by a Modbus over Ethernet communications data highway and shall allow: auto/ manual mode change, setpoint change, variation of the manual output, sensing and silencing of alarms, change of any configuration parameter (including PID tuning constants), change of timers, etc. Provide all equipment capabilities specified in this paragraph, even if a connecting SCADA system is not included in this project.

7. Quality Assurance
The system shall be factory manufactured and tested according to UL508A requirements (CSA C22.2 #14 for use in Canada). The control system shall be a Preferred Instruments, Danbury, CT, BurnerMate TS Model BMTS-HWMC-ZP-VSD.
**Application**

The BurnerMate TS Model BMTS-AC provides automatic control for drum level, boiler draft and flue gas recirculation (FGR) for new or existing boilers. A feedwater valve that is swinging from closed to open will cause the steam header pressure to swing up and down, even when the plant load is absolutely constant. This will in turn cause the burner firing rate to swing up and down. Burner load swings cause combustion control systems to operate the burner with extra excess air, thus lowering efficiency. Draft controllers modulate the boiler outlet damper in order to maintain a constant pressure in the combustion chamber. Any boiler that will be operated at a negative draft should have a draft control system. Positioning burner control systems can operate with less excess air if the furnace pressure is constant. At a given F.D. fan inlet damper position, the air flow through a burner will increase when the boiler draft goes more negative.

**Key Features**

- **Precise Draft Control** - “GAP” PID Draft Control and firing rate feedforward assure stable draft even during load changes. This is especially important for outlet draft control on boilers with induced flue gas recirculation (FGR) NOx reduction.
- **Single Element Drum Level Control** - A drum level sensor causes the feedwater valve to open or close in proportion to the deviation from desired drum level. Suitable for firetube boilers with moderate load swings and watertube boilers with slowly changing loads. Variations in the feedwater supply pressure will cause the drum level to change when the load is steady. This control strategy does not respond well to shrink and swell.
- **Two Element Drum Level Control** - A drum level sensor is the primary controller input, a steam flow sensor is a feedforward controller input. The steam flow signal allows the controller to respond properly during shrink and swell. Feedwater pressure variations also upset the drum level. Suitable for watertube boilers with substantial load swings if the feedwater pressure is consistent.
- **Three Element Drum Level Control** - A feedwater flow sensor is added to allow the controller to compensate for variations in feedwater supply pressure. Suitable for watertube boilers with substantial load swings and inconsistent feedwater pressure.
- **Flue Gas Recirculation (FGR) Control** - FGR flow rate is controller in response to boiler load.

**Ordering Information**

<table>
<thead>
<tr>
<th>Optional Features</th>
<th>Add Suffix to BurnerMate TS Catalog Number</th>
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<tbody>
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<td>Draft Control</td>
<td>add &quot;-DR&quot; suffix</td>
</tr>
<tr>
<td>Drum Level (Feedwater) Control</td>
<td>add &quot;-x-FW&quot; suffix</td>
</tr>
<tr>
<td>Flue Gas Recirculation (FGR) Control</td>
<td>add &quot;-FGR&quot; suffix</td>
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*Add "C" or "T" to denote a Current (4-20 mADC) or Triac Control Output

Refer to the Plant Engineering Data section for the “Control Signal” diagrams

<table>
<thead>
<tr>
<th>Order Sensors Separately (Optional)</th>
<th>Catalog Number</th>
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<tbody>
<tr>
<td>E-link Draft Damper Assembly</td>
<td>Consult Factory</td>
</tr>
<tr>
<td>Draft Transmitter, 4-20 mADC, NEMA 4, Smart with three valve manifold</td>
<td>Consult Factory</td>
</tr>
<tr>
<td>Drum Level Transmitter, 4-20 mADC, NEMA 4, Smart with three valve manifold</td>
<td>Consult Factory</td>
</tr>
<tr>
<td>Steam Flow, Vortex Shedding type, 4-20 mADC</td>
<td>Consult Factory</td>
</tr>
<tr>
<td>Feedwater Flow Meter, Turbine type</td>
<td>Consult Factory</td>
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</table>
1. Application
Supply a self-contained Boiler Control System with 10” (or 15”) color touch screen to provide drum level, boiler outlet draft and flue gas recirculation control. The control components shall be located in the combustion control cabinet and shall be fully integrated for automatic sequencing of light-off and shutdown.

2. Drum Level (Feedwater) Control (when required)
The Drum Level control system shall be designed to maintain boiler drum level. Drum level shall be controlled by modulating the feedwater control valve in either a single element or three element mode. In the single element mode only drum level measurement is used. In the three element mode drum level, steam flow and feedwater flow measurements are used.

3. Draft Control (when required)
Boiler Draft shall be controlled in response to changing furnace pressure, and a feed-forward signal of boiler load. The controller shall have a characterizable set-point curve for the feed-forward signal. Alarm shall be provided for low draft. All the logic required to insure that pre-purge, postpurge, light-off, and burner modulate cycles are automated shall be provided within the controller.

4. Flue Gas Recirculation Control (when required)
Flue gas recirculation (FGR) flow rate shall be controlled in response to boiler load. The controller shall have a characterizable setpoint curve for damper output signal. All the logic required to insure that pre-purge, postpurge, light-off, and burner modulate cycles are automated shall be provided within the controller.

5. Boiler Controllers
To assure system integrity, a pre-wired and factory-tested, microprocessor-based, multiple loop controller system shall be provided. The controller shall include process variable and “first-out” annunciator displays. Configuration and calibration data shall be stored on redundant non-volatile EEPROM memory modules. The backup memory module shall automatically download into the primary memory in the event of primary memory data corruption. All control logic, tuning, and fuel/air ratio curves shall be field configurable. If required to allow field modifications to the controller logic, provide one configuration tool or laptop personal computer per facility. The following color touch screen graphic pages shall be dedicated to each boiler control loop including drum level control, draft control, and FGR control, when applicable.

6. Communication
Each controller shall be equipped with an optically isolated RS485 modbus communications data highway connection to the color touch screen. The touch screen shall communicate with the plant BAS, EMS, or DCS by a Modbus over Ethernet communications data highway and shall allow: auto/ manual mode change, setpoint change, variation of the manual output, sensing and silencing of alarms, change of any configuration parameter (including PID tuning constants), change of timers, etc. Provide all equipment capabilities specified in this paragraph, even if a connecting SCADA system is not included in this project.

7. Quality Assurance
A single control system manufacturer with a minimum of 10 years experience manufacturing similar combustion control systems shall provide the specified control system complete with oxygen analyzers, variable speed drive, transmitters, and actuators. The manufacturer’s authorized representative shall provide experienced combustion control technicians that have been trained by the manufacturer for variable speed fan oxygen trim systems start-up and operator training. The system shall be factory manufactured and tested according to UL508A requirements (CSA C22.2 #14 for use in Canada). The control system shall be a Preferred Instruments, Danbury, CT, BurnerMate TS Model BMTS-AC [-DRx] [-1, -2, or -3] [-FWx] [-FGRx] (x’ = “C” or “T” to denote a Current or Triac Control Output).

Specifications
BurnerMate TS Control Panel

- Touchscreen: OIT-10 or OIT-15
- Controller: DCS-III
- Input Power: 120 VAC (+/- 15%)

Inputs
- Draft: 4-20 mADC (optional)
- Firing Rate: 4-20 mADC (optional)
- Drum Level: 4-20 mADC (optional)
- Drum Pressure: 4-20 mADC (optional)
- Feedwater Flow: 4-20 mADC (optional)
- Steam Flow: 4-20 mADC (optional)
- Outlet Damper Feedback: Potentiometer (optional)*
- FGR Damper Feedback: Potentiometer (optional)*
- Feedwater Valve Feedback: Potentiometer (optional)*

Outputs
- Outlet Damper: Triac or 4-20 mADC (optional)
- FGR Damper: Triac or 4-20 mADC (optional)
- Feedwater Valve: Triac or 4-20 mADC (optional)

* These signals are only required if Triac output is selected.
**Application**
The BurnerMate TS Model BMTS-FSG Flame Safeguard System provides automatic flame safety monitoring and control for new or existing steam or hot water boilers. The system is engineered to be in compliance with the latest factory mutual and NFPA 85 standards. The systems are manufactured, tested and labeled according to UL508A standards.

**Key Features**
- **Microprocessor-based Controller** – The Flame Safeguard System is microprocessor-based, with self-diagnostics and non-volatile memory.
- **Flame Scanners** – An infrared (IR) flame scanner is provided as a standard for water-wall furnaces. An ultraviolet (UV) self checking flame scanner is an available option for refractory lined furnaces. The Flame Safeguard System provides the proper burner sequencing, ignition and flame monitoring protection on single burner, automatically ignited oil or gas fired boilers.
- **The system uses a fail-safe “de-energize” to trip design.** Upon the loss of system power the fuel safety shutoff valves are automatically closed and ignition components are de-energized.
- **Message Display** – An externally-mounted LCD backlit display has two lines of sixteen characters each. The display provides burner status and historical information. Operation, troubleshooting and maintenance information is at the boiler front, where it is needed. On a safety shutdown, the message display will advise the operator that the control is in “lockout” and will indicate the specific cause and the state in the operating sequence where the shutdown occurred.
- **Combustion Control Sequence Interlocks** – Combustion control system interfaces are provided to ensure safe automatic fuel and air sequencing for purge, light-off and shutdown.
- **Drum level conductivity probe relays** are incorporated for an auxiliary low water cutout safety interlock, low water alarm and high water alarm.

**Specifications**

**Operator Control Panel**
- **Touchscreen:** OIT-10 or OIT-15
- **Display:** 2 line x 16 character LCD display
- **Pushbutton:** Membrane, tactile feedback
- **IR Flame Scanner:** Infrared, ½" 90° angle mount, 96" cable
- **UV Flame Scanner:** Ultraviolet 1" NPT mount, 72" lead

**Ordering Information**

<table>
<thead>
<tr>
<th>Optional Features</th>
<th>Add Suffix to BurnerMate TS Catalog Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flame Safeguard</td>
<td>Add “-FSG” suffix</td>
</tr>
</tbody>
</table>

1. Application
Integral to the control system shall be a Burner Management System (BMS) / Flame Safeguard System (FSG) with 10" (or 15") color touch screen. The system shall be designed to ensure the safe start-up, on-line operation and shutdown of fuel firing equipment. Burner management system components shall be located in the combustion control cabinet and shall be fully integrated for automatic sequencing of light-off and shutdown. Numbered terminal strips shall also be provided to permit termination of all field wiring.

2. Microprocessor
An industrial duty microprocessor-based FSG shall provide: safety interlocks, flame monitoring protection and timed sequences. Sequences shall include forced draft fan start and stop, furnace purge, burner light-off and shutdown and post-purge. The FSG shall be capable of firing two fuels, one fuel at a time. Fuel changeover shall require boiler shutdown. FSG components shall be located in the combustion control enclosure and shall be fully integrated for automatic sequencing of light-off and shutdown. The following color touch screen graphic pages shall be provided: boiler overview, flame safeguard overview, control panel faceplate with real time and historical trending, set-up and commissioning screens, and boiler alarm. Graphic pages shall display flame signal strength, startup and shutdown sequence status, alarm, system diagnostic, first-out messages and burner historical information. Historical information shall include the last six lockout conditions, number of burner cycles and burner hours. The system shall include a "system reset" pushbutton and "FD fan hand-off-auto", "burner off - fuel select gas - oil" control switches and alarm horn. Drum level conductivity probe relays for low level cutout, low level and high level alarms shall be provided. Provision shall be made to allow for water column blowdown without tripping the boiler. Provide one (1) flame scanner for each burner.

3. Communications
The flame safeguard controller shall be equipped with an optically isolated RS485 modbus communications data highway connection to the color touch screen. The touch screen shall communicate with the plant BAS, EMS, or DCS by a Modbus over Ethernet communications data highway and shall allow reading of the following information: flame signal intensity, sequence of operation messages, diagnostic messages, "first out" cause of lockout messages, last six lockout conditions, number of burner cycles and burner operating hours. Provide all equipment capabilities specified in this paragraph, even if a connecting SCADA system is not included in this project.

4. Quality Assurance
The system shall be factory manufactured and tested according to UL508A requirements. The system shall be designed to ensure the safe start-up, on-line operation and shutdown of fuel firing equipment. The system shall comply with NFPA 85. Per NFPA 85 “1.9.3.2.3 Requirement for Independence”, the flame safeguard system shall be provided with independent logic and power supplies and shall be physically separated from the combustion control logic. The control system shall be a Preferred Instruments, Danbury, CT, BurnerMate TS Model BMTS-FSG.

Specifications

**BurnerMate TS Control Panel**

<table>
<thead>
<tr>
<th>Feature</th>
<th>Controls</th>
</tr>
</thead>
<tbody>
<tr>
<td>Touchscreen:</td>
<td>OIT-10 or OIT-15</td>
</tr>
<tr>
<td>Input Power:</td>
<td>120 VAC (+/- 15%)</td>
</tr>
</tbody>
</table>

**Inputs**

- Recycling High Steam Pressure: Dry Contact
- Flame Scanner: Scanner Input
- "High Drum Level": Water Probe
- "Low Water Level": Dry Contact
- Emergency Stop Pushbutton: Dry Contact
- Low Draft Switch: Dry Contact
- Low Water Cutout: Dry Contact
- Auxiliary Low Water Cutout: Dry Contact
- Blowdown Pushbutton: Dry Contact
- Excessive High Steam Pressure: Dry Contact
- Purge Air Flow Switch: Dry Contact
- Minimum Air Flow Switch: Dry Contact
- "Low Instrument Air Pressure": Dry Contact
- Fan Motor Started: Dry Contact
- "VSD Running and No Alarms": Dry Contact
- Fuel Oil Temperature Low: Dry Contact
- "Fuel Oil Temperature High": Dry Contact
- Fuel Oil Pressure Low: Dry Contact
- Low Atomizing Medium Flow: Dry Contact
- Low Atomizing Medium Pressure: Dry Contact
- Fuel Gas Pressure High: Dry Contact
- Fuel Gas Pressure Low: Dry Contact
- Low Fire Air Switch: Dry Contact
- Air Damper Proof of Open: Dry Contact
- "Draft Damper Proof of Open": Dry Contact
- "FGR Damper Proof of Closure": Dry Contact
- Fuel Gas SSOV Proof of Closure: Dry Contact
- Fuel Oil SSOV Proof of Closure: Dry Contact
- Fuel Gas Control Valve Low Fire: Dry Contact
- Fuel Oil Control Valve Low Fire: Dry Contact

**Outputs**

- Energize Igniter: 120 VAC
- Open/Close Igniter SSOV: 120 VAC
- Open/Close Gas SSOV: 120 VAC
- Open/Close Oil SSOV: 120 VAC
- Open/Close Atomizing Valve: 120 VAC
- Limits (to Lead/Lag): 120 VAC
- Lockout (to Lead/Lag): 120 VAC

*These features are standard, but their use is selectable at time of start-up.