CHIEF DISPATCHER MODULATING LEAD/LAG CONTROLLERS

Overview

Better Steam or Hot Water System Control
- Model available for steam, hot water, and condensing boilers
- “Smart” boiler sequencing to improve response time
- Steam boiler “Base Load Auto-Shift” reduces cycling
- Hot water boiler “Header” or “Boiler” pump sequencing
- Firetube boiler thermal shock protection using blend valves
- Condensing boiler logic maximizes lower firing rate operation to increase efficiency

Easy to Use
- “Plant Overview,” “Alarm,” and “Setup” displays enable informed initial setup and process assessment
- In a single wall-mounted enclosure, the Chief Dispatcher integrates a modem for off-site monitoring, RS485 Modbus communications, 24VDC power supplies and outdoor reset functions. No external control devices are required

Easy to Order, Stock and Field Upgrade
- Complete system is ordered using a single part number
- “Plug In” option boards can be used to upgrade a system in the field

LCD Graphic Display

- **Plant Overview Display(s)**
  At a glance control and monitoring of boiler status and lead/lag sequence.

- **Alarm/Event Summary Display**
  Up to 200 Alarms, events and operator actions are logged with time, date stamp, and description.

- **Setback Display(s)**
  Simple Day/Night/Week Setback setup.

- **Outdoor Reset Display**
  Easily configure normal and setback setpoints and limits. A graphical representation is automatically generated.

- **Boiler Setup Displays**
  Simple Menu style “Fill-In-The-Blanks” setup.
“Smart” Boiler Sequencing
Boilers are automatically sequenced on/off to ensure that the number of boilers in service meets steam or hot water demand. If any boiler fails to start when called, or if a boiler trips during operation, the chief dispatcher immediately starts another boiler to replace the “faulted” boiler. The operator may manually select the lead boiler or allow the lead boiler to rotate automatically. Additionally, the total number of boilers in service may be set automatically or manually as selected by the operator or all boilers may be shutdown by a Building Automation System (BAS) “enable/disable” contact input.

“Hard Manual” Backup
Hardwired control switches and dials provide simple manual control for easy troubleshooting and service. Each boiler has an individual firing rate bargraph, “manual” firing rate output knob, and “Auto/Manual” switch.

Modbus Communication Interface
A factory configured RS485 Modbus interface is available for Building Automation or SCADA system monitoring and control.

Building Automation System (Option ‘-BAS’)
A remote Hot Water Supply (HWS) temperature setpoint is set by either a Modbus or 4-20 mADC Building Automation System (BAS) outdoor reset input signal.

Firing Rate Output (Option “-I” or “-P”)
Boiler Firing Rate Analog Output Cards may be ordered as ‘-P’ = 0-135 ohm or ‘-I’ = 4-20 mADC.
CHIEF DISPATCHER MODULATING LEAD/LAG CONTROLLERS

Specifications

**Mechanical**
- **Case Size:** 10½" H x 18" W x 8½" D
- **Enclosure Type:** Wall mounted
- **Case:** 7 Slot, (CPU + 6 I/O Slots)
- **Weight:** 55 lbs.

**Environmental**
- **Operating Temp:** 32° to 122° F (0° to 50° C)
- **Storage Temp:** -20° to 150° F (-28° to 65° C)
- **Humidity Limits:** 15% to 95% (noncondensing)
- **Enclosure:** NEMA 1

**Performance**
- **Accuracy:** 0.025% Analog I/O
- **Resolution:** 16 bit input/12 bit output
- **Microprocessor:** 32 bit, 128k EEPROM
- **Execution Cycle:** Five per second
- **Time/Date Clock:** (battery backed)

**Operator Control Panel**
- **LCD Graphic Display:** 2.9" H x 5.1" W
- **Keyboard:** Membrane, tactile feedback

**Configuration**
- **Standard Lead/Lag:** Menu style
  - "Fill-In-The-Blanks" setup.
- **Control Language:** Function block style,
  - 60 functions, 600 Blocks
- **Security:** 2 password levels
- **Custom Blockware:** Configuration Software:
  - PWC_Edit™ spread sheet based
  - or PWC_Draw™ graphical, editor.
  - (Windows PC Required)

**Communication**
- **Control Network:**
  - **Protocol:** Modbus (ASCII or RTU mode)
  - **Speed:** 1200 to 38,400 baud
  - **Type:** RS485, optically isolated
- **Programming Port:**
  - **Speed:** 38,400 baud
  - **Type:** RS232, DB9F connector

**Electrical**
- **Input Power:** 120 VAC (+/- 15%), 12 A total,
  - 0.7A internal
  - Built in surge suppressors
- **Internal Power Supply:** 24 VDC @ 300 mADC for external use
**Application**
The Chief Dispatcher Model JC-CDST optimizes steam system performance and helps extend Cast Iron Sectional, Finned-Tube, Firebox, Flexible Tube or Firetube boiler life.

**2 to 10 Modulating Boilers**
Boiler firing rates are automatically adjusted to satisfy the overall plant steam heating load using accurate PID control. When desired the operator may set the firing rate manually.

**Warm Standby**
Each off-line boiler is periodically started and held at low fire until it returns to the “warm standby” temperature (Aquastat supplied by boiler manufacturer). This helps to minimize thermal shock when called on-line.

**“Base Load Auto-Shift”**
Normally, the Lag boilers remain base loaded for peak total plant efficiency. If the lead boiler firing rate approaches high fire, the lag boiler(s) will increase their firing rate to “help” the lead boiler. If the lead boiler approaches low fire, the lag boilers will decrease their firing rate to “help” the lead boiler. This method minimizes boiler on/off cycling due to short term load swings while maximizing total boiler plant efficiency. If desired, “unison” modulation can also be field selected (all boilers fire at the same rate).
**CHIEF DISPATCHER MODEL JC-CDST**

Steam Boilers Modulating Lead/Lag Controller

![Diagram of Chief Dispatcher Model JC-CDST](image_url)

### Specifications

#### Panel Details
- **Controller:** PWC
- **Case Size:** 19¾" H X 18" W X 8½" D
- **Enclosure Type:** Wall mounted, Weight: 55 lbs.

#### Inputs
- **Steam Pressure:** 0 to 25 PSI, 0 to 200 PSI, or 0 to 500 PSI, 4-20 mADC
- **BAS, Boiler Disable Limits:** 120 VAC, optically isolated (each boiler)
- **Boiler Lockout:** 120 VAC, optically isolated (each boiler)
- **Warm Standby:** 120 VAC, optically isolated (each boiler)

#### Outputs
- **Modulation:** Isolated 4-20 mADC or 0-135 ohm (each boiler)
- **Boiler Start:** Dry contact, 8 FLA, ½ HP, 120 VAC (each boiler)

### Order Sensors Separately (Quantity as Required) | Catalog Number
--- | ---
Steam Pressure Sensor 0-25 PSI with syphon loop | 70600
Steam Pressure Sensor 0-200 PSI with syphon loop | 70601
Steam Pressure Sensor 0-500 PSI with syphon loop | 70602
1. Application
Supply a fully integrated boiler control system to coordinate the operation of two (select up to ten) fully modulating steam boilers in order to maintain Steam Header Pressure at setpoint. The control system shall be microprocessor-based and suitable for wall mounting.

2. Boiler Modulation
The control system shall provide a PID based control scheme. Modulation shall be field selectable as either “Unison” (all at the same firing rate) or as “Series”. Series modulation shall include “Base Load Auto-Shift” logic in order to minimize boiler on/off cycling. Normally the lag boilers shall be base loaded at an operator adjustable firing rate for peak efficiency. When the lead boiler’s firing rate approaches high fire, the lag boiler(s) will automatically modulate up from the base load firing rate to “help” the lead boiler without starting another lag boiler. If the lead boiler approaches low fire, the lag boilers will modulate toward low fire to “help” the lead boiler and prevent a short cycle of a lag boiler. When the lead boiler leaves the high or low fire position the lag boiler(s) resume firing at the normal base load for peak efficiency. If the load increase or decrease is long term, a lag boiler shall be cycled on or off as required. Modulation signals shall be 4-20 mADC or 0-135 ohm (as required by the boiler) and shall be electrically isolated channel-channel and channel-ground.

3. Steam Header Pressure Setpoint
The operator may set the Steam Header Pressure Setpoint via a front panel display.

4. Boiler Sequence
The control system shall use both Steam Header Pressure and Boiler Firing Rate percent to start and stop the boilers and minimize the total number of boilers in operation. The controller shall start and stop boilers when the Steam Header Pressure is outside an adjustable pressure limit band for an adjustable short time delay. To anticipate and minimize header pressure deviations, the control system shall start or stop the next boiler if the “lead” boiler has been near high or low fire for longer than the adjustable time delay. The control system shall monitor each boiler’s lockout and limit circuits and shall rapidly and automatically skip over those boilers that are powered down for maintenance, tripped or otherwise will not start. The lead boiler shall either automatically rotate on a time of day / day of week (or month) schedule, or shall be manually selected by the operator. Provide a warm standby boiler shell aquastat input for each boiler. If recommended by the boiler manufacturer, each off-line boiler shall be started and held at low fire when the temperature drops. When called to run, the boiler shall hold at low fire until the temperature rises above the warm standby setting. Provide an aquastat release to modulate over-ride timer to prevent a protracted low fire hold. The Control System shall reduce the firing rate to a minimum before stopping a boiler to prevent accumulation of fuel in the furnace.

5. Operator Controls, Trends, Indications and Alarms
The control system shall include a 16 line x 40 character (or greater) LCD display for boiler sequence control and status, alarm and event summaries, and setup menus for easy operation, tuning and troubleshooting. Alarms, events and operator actions shall be logged with time/date stamp and English language description.

6. Reliability
Include hardwired backup stations to permit manual operation of the plant should the control system require service. Manual operation must be possible when the microprocessor is not functioning. Hardwired “hand-off-auto” control switches must be wired directly into every boiler start/stop circuit. Each 4-20 mADC or 0-135 ohm modulating control output must include a hardwired manual backup station with auto/manual switch, output control knob and output level indicator ( bargraph, analog meter or digital display).

7. Communication
The Control System shall have the ability of simultaneously communicating to a Data Acquisition System (DAS), Building Automation System (BAS) or Building Management System (BMS) via RS485 Modbus protocol, and to a Personal Computer. The individual boiler limits, lockout, start/stop, warm standby, and firing rate status shall be readable. Header setpoint, plant firing rate, boiler quantity called to start, boiler selected as lead and all setup parameters shall be easily read and written.

8. Quality Assurance
The control system shall be manufactured and labeled in accordance with UL508 requirements (CSA C22.2 #14 for use in Canada). Inspection and labeling shall be supervised by UL or other OSHA approved Nationally Recognized Test Lab (NRTL). The control system shall be a Preferred Instruments, Danbury, CT, Model JC-CDST-x-P (‘x’ = boiler quantity from 2 to 10; “-P” for 0-135 ohm; “-I” for 4-20 mA)
**Application**
The Chief Dispatcher Model JC-CDHW optimizes hot water system performance and helps extend Cast Iron Sectional, Finned-Tube, Firebox or Flexible Tube boiler life.

**2 to 10 Fully Modulating Boilers**
Hot Water Supply (HWS) header temperature is maintained using accurate PID control. Multiple boilers are modulated in “Unison” (all at the same firing rate) to ensure even heat delivery. Lag boilers are brought up to the “Unison” firing rate using a predetermined Ramp Rate to meet the heating load with minimum overshoot. When desired, the operator may set the “unison” firing rate manually.

**Outdoor Reset**
Energy is saved by lowering the Hot Water Supply (HWS) temperature setpoint as the outside air temperature increases. Operating cost is reduced during warmer days. When desired, the operator may set the HWS setpoint manually.

**Time of Day / Week Setback**
This feature is used in heating applications to save energy by lowering the Hot Water Supply (HWS) temperature setpoint during times when the heating requirement is reduced, such as at night or on weekends and holidays.

**Domestic Hot Water Priority (2 to 9 boiler systems)**
A temperature switch (thermostat) contact closure input will override the “outdoor reset and “setback” portion of the program and force the HWS temperature setpoint to a domestic hot water setpoint. A relay output is available to start a domestic hot water pump if required.

**Condensing Boiler Logic (option “-C”)**
Condensing boiler logic takes full advantage of the condensing boiler design by maximizing the number of boilers running near low fire to maximize efficiency.
**CHIEF DISPATCHER MODEL JC-CDHW**

Hot Water Boilers Modulating Lead/Lag Controller

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### Specifications

**Panel Details**
- **Controller:** PWC
- **Case Size:** 19½" H X 18" W X 8½" D
- **Enclosure Type:** Wall mounted, Weight: 55 lbs.

**Inputs**
- **Hot Water Temperature:** 0° to 300° F, Thermistor
- **Outdoor Air Temperature:** Thermistor (non "BAS" version)
- **BAS Reset Setpoint:** 4-20 mADC ("BAS" version)
- **BAS Boiler Disable:** 120 VAC, optically isolated (each boiler)
- **Limits:** 120 VAC, optically isolated (each boiler)
- **Boiler Lockout:** 120 VAC, optically isolated (each boiler)
- **Domestic HW Priority:** 120 VAC, optically isolated

**Outputs**
- **Modulation:** Isolated 4-20 mADC or 0-135 ohm (each boiler)
- **Boiler Start:** Dry contact, 8 FLA, ½ HP, 120 VAC (each boiler)
- **Domestic HW Circulation Pump:** Dry contact, 8 FLA, ½ HP, 120 VAC

### Ordering Information

Specify Chief Dispatcher Catalog Number:

- **Boiler Quantity:** 2 to 10
- **Analog Output Type:** 4-20 mADC - I
  - 0-135 ohm - P

**Optional Features**

<table>
<thead>
<tr>
<th>Feature Description</th>
<th>Catalog Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Building Automation System (BAS)</td>
<td>JC-CDHWxxxx-BAS</td>
</tr>
<tr>
<td>Condensing Boiler Logic</td>
<td>JC-CDHWxxxx-C</td>
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</table>

**Order Sensors Separately (Quantity as Required)**

<table>
<thead>
<tr>
<th>Sensor Description</th>
<th>Catalog Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hot Water Thermistor Temperature Sensor 0° to 300° F, 4½&quot; depth</td>
<td>70610</td>
</tr>
<tr>
<td>Thermowell, SS, 4½&quot; x ½&quot; NPT</td>
<td>70610W</td>
</tr>
<tr>
<td>Outside Air Thermistor Temperature Sensor with weather-proof cover</td>
<td>70612</td>
</tr>
</tbody>
</table>
1. Application
Supply a fully integrated boiler control system to coordinate the operation of two (select up to ten) fully modulating hot water boilers in order to maintain the Hot Water Supply (HWS) temperature at setpoint. The control system shall be microprocessor-based and suitable for wall mounting.

2. Boiler Modulation
The control system shall incorporate a HWS header temperature PID control scheme. Boilers shall be modulated in "Unison" (all at the same firing rate). Modulation signals shall be 4-20 mADC or 0-135 ohm (as required by the boiler) and shall be electrically isolated channel-channel and channel-ground.

3. Hot Water Supply (HWS) Temperature Setpoint
When the HWS Temperature control loop is in the "automatic" mode, the control system shall establish the HWS temperature setpoint based on the time of day, day of the week and the outside air temperature. When in "manual" mode the operator may set the HWS temperature via a front panel display. All temperatures and time/date data must be field adjustable through "fill-in-the-blanks" style displays. Alternately, the control system shall accept a 4-20 mADC outdoor air temperature reset setpoint signal from an external Building Automation System (BAS).

4. Boiler Sequence
The control system shall utilize both HWS temperature and boiler firing rate percent to start and stop the boilers and shall minimize the total number of boilers in operation. The controller shall start and stop boilers when the HWS temperature is outside the adjustable temperature limit for longer than the adjustable time delay. In order to minimize header temperature deviations, the control system shall start and stop the next boiler when the "lead" boiler is at an adjustable firing rate limit for longer than the adjustable time delay. The control system shall monitor both boiler lockout and limit circuits to automatically skip over those boilers that are powered down for maintenance, tripped or otherwise will not start. The lead boiler shall either automatically rotate on a time of day, day of week (or month) schedule, or shall be manually selected by the operator. The boiler shall be run at low fire for warm-up for a preset low fire hold time. The base load ramp rate shall be field adjustable. The Control System shall reduce the firing rate to a minimum before stopping a boiler to prevent accumulation of fuel in the furnace.

5. Operator Controls, Trends, Indications and Alarms
The control system shall include a 16 line x 40 character (or greater) LCD display for boiler sequence control and status, alarm and event summaries, and setup menus for easy operation, tuning and troubleshooting. Alarms, events and operator actions shall be logged with Time/Date stamp and English language description.

6. Reliability
Include hardwired backup stations to permit manual operation of the plant should the control system require service. Manual operation must be possible when the microprocessor is not functioning. Hardwired "Hand-Off-Auto" control switches must be wired directly into every boiler and pump Start/Stop circuit. Each 4-20 mADC or 0-135 ohm modulating control output must include a hardwired manual backup station with Auto/Manual switch, output control knob and output level indicator (bargraph, analog meter or digital display).

7. Communication
The Control System shall have the ability of simultaneously communicating to a Data Acquisition System (DAS), Building Automation System (BAS) or Building Management System (BMS) via RS485 Modbus protocol and to a Personal Computer. The individual boiler limits, lockout, start/stop, warm standby, and firing rate status shall be readable. Header setpoint, plant firing rate, boiler quantity called to start, boiler selected as lead and all setup parameters shall be easily read and written.

8. Quality Assurance
The control system shall be manufactured and labeled in accordance with UL508 requirements (CSA C22.2 #14 for use in Canada). Inspection and labeling shall be supervised by UL or other OSHA approved Nationally Recognized Test Lab (NRTL). The control system shall be a Preferred Instruments, Danbury, CT, Model JC-CDHW-x-P (‘x’ = boiler quantity from 2 to 10; "-P" for 0-135 ohm; "-I" for 4-20 mA).
Application
The Chief Dispatcher Model JC-CDHWF optimizes hot water system performance and helps extend Cast Iron Sectional, Finned-Tube, Firebox or Flexible Tube boiler life.

2 to 10 Fully Modulating Boilers
Hot Water Supply (HWS) header temperature is maintained using accurate PID control. Multiple boilers are modulated in “Unison” (all at the same firing rate) to ensure even heat is delivered evenly. Lag boilers are brought up to the “unison” firing rate using a predetermined ramp rate to meet the heating load with minimum overshoot. When desired, the operator may set the “unison” firing rate manually.

Outdoor Reset
Energy is saved by lowering the Hot Water Supply (HWS) temperature setpoint as the outside air temperature increases. Operating cost is reduced during warmer days. When desired, the operator may set the HWS setpoint manually.

Simplified Design
The installation is reduced by monitoring only the fuel valve instead of the normal limits and lockout. Outdoor reset or BAS setpoint as well as how many boilers are installed is field selectable without reprogramming the unit.
CHIEF DISPATCHER MODEL JC-CDHWF
Condensing Hot Water Boilers Modulating Lead/Lag Controller

Time of Day / Week Setback
This feature is used in heating applications to save energy by lowering the Hot Water Supply (HWS) temperature setpoint during times when the heating requirement is reduced, such as at night or on weekends and holidays.

Domestic Hot Water Priority (2 to 9 boiler systems)
A temperature switch (thermostat) contact closure input will override the “outdoor reset” and “setback portion” of the program and force the HWS temperature setpoint to a domestic hot water setpoint. A relay output is available to start a domestic hot water pump if required.

Condensing Boiler Logic
Condensing boiler logic takes full advantage of the condensing boiler design by maximizing the number of boilers running near low fire to increase efficiency.

Header Pump Control
Header circulating pumps are controlled to ensure a continuous flow of water through the heating system. Pumps are controlled for handling the plant, and a tripped pump is automatically replaced with a standby unit. The lead pump can be rotated manually or automatically.
CHIEF DISPATCHER MODEL JC-CDHWF
Condensing Hot Water Boilers Modulating Lead/Lag Controller

**Specifications**

**Panel Details**
- Controller: PWC
- Case Size: 19¼" H X 18" W X 8½" D
- Enclosure Type: Wall mounted, Weight: 55 lbs.

**Inputs**
- Hot Water Temperature: 0° to 300° F, Thermistor
- Outdoor Air Temperature: Thermistor
- BAS Reset Setpoint: 4-20 mADC
- BAS Boiler Disable: 120 VAC, optically isolated (each boiler)
- Fuel: 120 VAC, optically isolated (each boiler)
- Domestic HW Priority: 120 VAC, optically isolated

**Outputs**
- Modulation: Isolated 4-20 mADC or 0-135 ohm (each boiler)
- Boiler Start: Dry contact, 8 FLA, ½ HP, 120 VAC (each boiler)
- Domestic HW Circulation Pump: Dry contact, 8 FLA, ½ HP, 120 VAC

**Ordering Information**

Specify Chief Dispatcher Catalog Number:

- Boiler Quantity
- Analog Output Type: 4-20 mADC - 1, 0-135 ohm - P
- Condensing Header Pump

**Optional Features**

<table>
<thead>
<tr>
<th>Header Pump Control</th>
<th>Catalog Number</th>
</tr>
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<tbody>
<tr>
<td>JC-CDHWFxxx-H</td>
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</table>

**Order Sensors Separately**

<table>
<thead>
<tr>
<th>(Quantity as Required)</th>
<th>Catalog Number</th>
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<tbody>
<tr>
<td>Hot Water Thermistor Temperature Sensor 0° to 300° F, 4½&quot; depth</td>
<td>70610</td>
</tr>
<tr>
<td>Thermowell, SS, 4½&quot; x ½&quot; NPT</td>
<td>70610W</td>
</tr>
<tr>
<td>Outside Air Thermistor Temperature Sensor with weatherproof cover</td>
<td>70612</td>
</tr>
</tbody>
</table>
1. Application
Supply a fully integrated boiler control system to coordinate the operation of two (select up to ten) fully modulating, condensing hot water boilers and header secondary water circulating pumps in order to maintain the Hot Water Supply (HWS) temperature at setpoint. The control system shall be microprocessor-based and suitable for wall mounting.

2. Boiler Modulation
The control system shall incorporate a HWS header temperature PID control scheme. Boilers shall be modulated in "Unison" (all at the same firing rate). Modulation signals shall be 4-20 mA mADC or 0-135 ohm (as required by the boiler) and shall be electrically isolated channel-channel and channel-ground.

3. Hot Water Supply (HWS) Temperature Setpoint
When the HWS Temperature control loop is in the “automatic” mode, the control system shall establish the HWS temperature setpoint based on the time of day, day of the week and the outside air temperature. When in “manual” mode the operator may set the HWS temperature via a front panel display. All temperatures and time/date data must be field adjustable through “fill-in-the-blanks” style displays. Alternately, the control system shall accept a 4-20 mA mADC outdoor air temperature reset setpoint signal from an external Building Automation System (BAS).

4. Boiler Sequence
The control system shall use both HWS temperature and boiler firing rate percent to start and stop the boilers, minimizing the total number of boilers in operation. The controller shall start and stop boilers when the HWS temperature is outside the adjustable temperature limit for longer than the adjustable time delay. To minimize header temperature deviations, the control system shall start and stop the next boiler when the "lead" boiler is at an adjustable firing rate limit for longer than the adjustable time delay. The control system shall monitor boiler fuel valve circuits to automatically skip over those boilers that are powered down for maintenance, tripped or otherwise will not start. The lead boiler shall either automatically rotate on a time of day, day of week (or month) schedule, or shall be manually selected by the operator. The boiler shall be run at low fire for warm-up for a preset low fire hold time. The base load ramp rate shall be field adjustable. The control system shall reduce the firing rate to a minimum before stopping a boiler to prevent accumulation of fuel in the furnace.

5. Operator Controls, Trends, Indications and Alarms
The control system shall include a 16 line x 40 character (or greater) LCD display for boiler sequence control and status, alarm and event summaries, and setup menus for easy operation, tuning and troubleshooting. Alarms, events, and operator actions shall be logged with Time/Date stamp and English language description.

6. Reliability
Include hardwired backup stations to permit manual operation of the plant if the control system require service. Manual operation must be possible when the microprocessor is not functioning. Hardwired "Hand-Off-Auto" control switches must be wired directly into every boiler and pump Start/Stop circuit. Each 4-20 mA mADC or 0-135 ohm modulating control output must include a hardwired manual backup switch with Auto/Manual switch, output control knob and output level indicator (bargraph, analog meter or digital display).

7. Communication
The Control System shall have the ability of simultaneously communicating to a Data Acquisition System (DAS), Building Automation System (BAS) or Building Management System (BMS) via RS485 Modbus protocol and to a Personal Computer. The individual boiler limits, lockout, start/stop, warm standby, and firing rate status shall be read. Header setpoint, plant firing rate, boiler quantity called to start, boiler selected as lead and all setup parameters shall be readable and writable.

8. Quality Assurance
The control system shall be manufactured and labeled in accordance with UL508 requirements (CSA C22.2 #14 for use in Canada). Inspection and labeling shall be supervised by UL or other OSHA approved Nationally Recognized Test Lab (NRTL). The control system shall be a Preferred Instruments, Danbury, CT, Model JC-CDHW F-C-H-x-P (‘x’ = boiler quantity from 2 to 10; "-P" for 0-135 ohm; "-I" for 4-20 mA).
CHIEF DISPATCHER MODEL JC-CDHWBP
Hot Water Boilers with Boiler Pumps Modulating Lead/Lag Controller

Application
The Chief Dispatcher Model JC-CDHWBP optimizes hot water system performance and helps extend Cast Iron Sectional, Finned-Tube, Firebox or Flexible Tube boiler life. Boiler pump sequencing ensures accurate temperature sensing, and boiler cool down.

2 to 7 Fully Modulating Boilers
Hot Water Supply (HWS) header temperature is maintained using accurate PID control. Multiple boilers are modulated in “Unison” (all at the same firing rate) to ensure even heat delivery. Lag boilers are brought up to the “Unison” firing rate using a predetermined Ramp Rate to meet the heating load with minimum overshoot. The operator may set the “Unison” firing rate manually.

Boiler Pump Sequencing
In line, boiler pump sequencing keeps the lead boiler pump running (therefore water flowing past the header sensor) to ensure accurate header temperature sensing and provides pump shutdown delay for boiler cool down. Dedicated boiler outlet valves (relay output to open) can be controlled instead of dedicated boiler pump.

Outdoor Reset
Energy is saved by decreasing the Hot Water Supply (HWS) temperature setpoint as the outside air temperature increases. Operating cost is reduced during warmer days. The operator may set the HWS setpoint manually.

Time of Day / Week Setback
This feature is used in heating applications to save energy by lowering the Hot Water Supply (HWS) temperature setpoint during times when the heating requirement is reduced, such as nights, weekends, and holidays.

Domestic Hot Water Priority
A temperature switch (thermostat) contact closure input will override the Outdoor Reset and Setback portion of the program and force the HWS temperature setpoint to a Domestic Hot Water Setpoint. A relay output is available to start a domestic hot water pump if required.

Condensing Boiler Logic (option “-C”)
Condensing boiler logic uses the condensing boiler design to maximize the number of boilers running near low fire to maximize efficiency.
CHIEF DISPATCHER MODEL JC-CDHWBP
Hot Water Boilers with Boiler Pumps Modulating Lead/Lag Controller

Specifications
Panel Details
Controller: PWC
Case Size: 19¾" H X 18" W X 8½" D
Enclosure Type: Wall mounted, Weight: 55 lbs.

Inputs
Hot Water
Temperature: 0° to 300° F, Thermistor
Outdoor Air
Temperature: Thermistor (non “BAS” version)
BAS Reset Setpoint: 4-20 mADC (“-BAS” version)
BAS Boiler Disable: 120 VAC, optically isolated (each boiler)
Limits: 120 VAC, optically isolated (each boiler)
Boiler Lockout: 120 VAC, optically isolated (each boiler)
Domestic HW Priority: 120 VAC, optically isolated

Outputs
Modulation: Isolated 4-20 mADC or 0-135 ohm (each boiler)
Boiler Start: Dry contact, 8 FLA, ½ HP, 120 VAC (each boiler)
Pump Start: Dry contact, 8 FLA, ½ HP, 120 VAC (each boiler)
Domestic HW Circulation Pump: Dry contact, 8 FLA, ½ HP, 120 VAC

Ordering Information
Specify Chief Dispatcher Catalog Number:

Boiler Quantity
Analog Output Type 4-20 mADC - P
                  0-135 ohm - P

Optional Features
Catalog Number
Building Automation System (BAS) add “-BAS” suffix
Condensing Boiler Logic add “-C” suffix

Order Sensors Separately (Quantity as Required)
Catalog Number
Hot Water Thermistor Temperature Sensor 0° to 300° F, 4½" depth 70610
Thermowell, SS, 4½" x ½" NPT 70610W
Outside Air Thermistor Temperature Sensor with weatherproof cover 70612
1. Application
Supply a fully integrated boiler control system to coordinate the operation of two (select up to seven) fully modulating hot water boilers and boiler primary water circulating pumps in order to maintain the Hot Water Supply (HWS) temperature at setpoint. The control system shall be microprocessor-based and suitable for wall mounting.

2. Boiler Modulation
The control system shall incorporate a HWS header temperature PID control scheme. Boilers shall be modulated in “Unison” (all at the same firing rate). Modulation signals shall be 4-20 mADC or 0-135 ohm (as required by the boiler) and shall be electrically isolated channel-channel and channel-ground.

3. Hot Water Supply (HWS) Temperature Setpoint
When the HWS Temperature control loop is in the “automatic” mode, the control system shall establish the HWS temperature setpoint based on the time of day, day of the week and the outside air temperature. When in “manual” mode the operator may set the HWS temperature via a front panel display. All temperatures and time/date displays shall be field adjustable through “fill-in-the-blanks” style displays. Alternately, the control system shall accept a 4-20 mADC outdoor air temperature reset setpoint signal from an external Building Automation System (BAS).

4. Boiler Sequence
The control system shall utilize both HWS temperature and boiler firing rate percent to start and stop the boilers and shall minimize the total number of boilers in operation. The controller shall start and stop boilers when the HWS temperature is outside the adjustable temperature limit for longer than the adjustable time delay. In order to minimize header temperature deviations, the control system shall start and stop the next boiler when the “lead” boiler is at an adjustable firing rate limit for longer than the adjustable time delay. The control system shall monitor both boiler lockout and limit circuits to automatically skip over those boilers that are powered down for maintenance, tripped or otherwise will not start. The lead boiler shall either automatically rotate on a time of day, day of week (or month) schedule, or shall be manually selected by the operator. The boiler shall be run at low fire for warm-up for a preset low fire hold time. The base load ramp rate shall be field adjustable. The control system shall reduce the firing rate to a minimum before stopping a boiler to prevent accumulation of fuel in the furnace.

5. Boiler Pump Sequence
Include independently operated primary water pump control to allow boiler warm-up to the return water temperature before the boilers start, continue water flow for an adjustable cool down period after the boiler has stopped, and ensure water is always moving past the header temperature sensor even after the last boiler has been stopped. The pump shall immediately stop if any trips occur during pre-purge, pilot, or main flame trial for ignition.

6. Operator Controls, Trends, Indications and Alarms
The control system shall include a 16 line x 40 character (or greater) LCD display for boiler sequence control and status, alarm and event summaries, and setup menus for easy operation, tuning and troubleshooting. Alarms, events and operator actions shall be logged with time/date stamp and English language description.

7. Reliability
Include hardwired backup stations to permit manual operation of the plant should the control system require service. Manual operation must be possible when the microprocessor is not functioning. Hardwired “hand-off-auto” control switches must be wired directly into every boiler and pump start/stop circuit. Each 4-20 mADC or 0-135 ohm modulating control output must include a hardwired manual backup station with auto/manual switch, output control knob and output level indicator ( bargraph, analog meter or digital display).

8. Communication
The control system shall have the ability of simultaneously communicating to a Data Acquisition System (DAS), Building Automation System (BAS) or Building Management System (BMS) via RS485 Modbus protocol and to a Personal Computer. The individual boiler limits, lockout, start/stop, warm standby, and firing rate status shall be readable. Header setpoint, plant firing rate, boiler quantity called to start, boiler selected as lead and all setup parameters shall be readable and writable.

9. Quality Assurance
The control system shall be manufactured and labeled in accordance with UL508 requirements (CSA C22.2 #14 for use in Canada). Inspection and labeling shall be supervised by UL or other OSHA approved Nationally Recognized Test Lab (NRTL). The control system shall be a Preferred Instruments, Danbury, CT, Model JC-CDHWBP-x-P (’x’ = boiler quantity from 2 to 7; ‘-P’ for 0-135 ohm; ‘-I’ for 4-20 mA).
Application
The Chief Dispatcher Model JC-CDHWHP optimizes hot water system performance, and helps extend Cast Iron Sectional, Finned-Tube, Fire Box or Flexible Tube boiler life. Header pump sequencing ensures accurate temperature sensing and a failed pump is replaced with a backup pump.

2 To 5 Modulating Boilers
Hot Water Supply (HWS) header temperature is maintained using accurate PID control. Multiple boilers are modulated in “unison” (all at the same firing rate) to ensure even heat delivery. Lag boilers are brought up to the “unison” firing rate using a predetermined ramp rate to meet the heating load with minimum overshoot. When desired, the operator may set the “unison” firing rate manually.

Header Pump Sequencing
Header pump sequencing keeps the lead boiler pump running (therefore water flowing past the header sensor) to ensure accurate header temperature sensing and provides pump shutdown delay for boiler cool down. Additionally, a failed pump is automatically replaced with a backup pump.

Outdoor Reset
Energy is saved by lowering the Hot Water Supply (HWS) temperature setpoint as the outside air temperature increases. Operating cost is reduced during warmer days. When desired, the operator may set the HWS setpoint manually.

Time Of Day / Week Setback
This feature is used in heating applications to save energy by lowering the Hot Water Supply (HWS) temperature setpoint during times when the heating requirement is reduced, such as at nights, weekends, and holidays.

Domestic Hot Water Priority
A temperature switch (thermostat) contact closure input will override the “outdoor reset” and “setback” portion of the program and force the HWS temperature setpoint to a “domestic hot water setpoint.” A relay output is available to start a domestic hot water pump if required.

Condensing Boiler Logic (Option “-C”)
Condensing boiler logic takes full advantage of the condensing boiler design by maximizing the number of boilers running near low fire to maximize efficiency.
CHIEF DISPATCHER MODEL JC-CDHWHP
Hot Water Boilers with Header Pumps Modulating Lead/Lag Controller

Specifications
Panel Details
Controller: PWC
Case Size: 19¼" H X 18" W X 8½" D
Enclosure Type: Wall mounted, Weight: 55 lbs.

Inputs
Hot Water Header: 0º to 300º F, Thermistor
Outdoor Air: Thermistor (non "-BAS" version)
BAS Reset Setpoint: 4-20 mADC ("-BAS" version)
BAS Boiler Disable: 120 VAC, optically isolated
Limits: 120 VAC, optically isolated (each boiler)
Boiler Lockout: 120 VAC, optically isolated (each boiler)
Pump Flow Proven: 120 VAC, optically isolated (each boiler)
Domestic HW Priority: 120 VAC, optically isolated

Outputs
Modulation: Isolated 4-20 mADC or 0-135 ohm (each boiler)
Boiler Start: Dry Contact, 8 FLA, ½ HP, 120 VAC (each boiler)
Pump Start: Dry Contact, 8 FLA, ½ HP, 120 VAC (each boiler)
Valve Open: Dry Contact, 8 FLA, ½ HP, 120 VAC (each boiler)
Domestic HW Circulation Pump: Dry Contact, 8 FLA, ½ HP, 120 VAC

Ordering Information
Specify Chief Dispatcher Catalog Number:
- JC-CDHWHP - 2 - P - 2

Boiler Quantity
- 2 to 5

Analog Output Type
- 4-20 mADC - I
- 0-135 ohm - P

Header Pump Quantity
- 2 to 3

Optional Features
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Order Sensors Separately
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<td>Thermowell, SS, 4.5&quot; x ½ NPT</td>
<td>70610W</td>
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<tr>
<td>Outside Air Thermistor Temperature Sensor with weatherproof cover</td>
<td>70612</td>
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1. Application
Supply a fully integrated boiler control system to coordinate the operation of two (select up to five) fully modulating hot water boilers, two (select up to three) header primary water circulating pumps and boiler water flow control valves in order to maintain the Hot Water Supply (HWS) temperature at setpoint. The control system shall be microprocessor-based and suitable for wall mounting.

2. Boiler Modulation
The control system shall incorporate a HWS header temperature PID control scheme. Boilers shall be modulated in “unison” (all at the same firing rate). Modulation signals shall be 4-20mADC or 0-135 ohm (as required by the boiler) and shall be electrically isolated channel-channel and channel-ground.

3. Hot Water Supply (HWS) Temperature Setpoint
When the HWS Temperature control loop is in the “automatic” mode, the control system shall establish the HWS temperature setpoint based on the time of day, day of the week and the outside air temperature. When in “manual” mode the operator may set the HWS temperature via a front panel display. All temperatures and time/date data must be field adjustable through “fill-in-the-blanks” style displays. Alternately, the control system shall accept a 4-20 mADC outdoor air temperature reset setpoint signal from an external Building Automation System (BAS).

4. Boiler Sequence
The control system shall utilize both HWS temperature and boiler firing rate percent to start and stop the boilers and shall minimize the total number of boilers in operation. The controller shall start and stop boilers when the HWS temperature is outside the adjustable temperature limit for longer than the adjustable time delay. In order to minimize header temperature deviations the control system shall start and stop the next boiler when the “lead” boiler is at an adjustable firing rate limit for longer than the adjustable time delay. The control system shall monitor both boiler lockout and limit circuits to automatically skip over those boilers that are powered down for maintenance, tripped or otherwise will not start. The lead boiler shall either automatically rotate on a time of day, day of week (or month) schedule, or shall be manually selected by the operator. The boiler shall be run at low fire for warm-up for a preset low fire hold time. The base load ramp rate shall be field adjustable. The control system shall reduce the firing rate to a minimum before stopping a boiler to prevent accumulation of fuel in the furnace.

5. Header Pump Sequence
Provide main header primary water pump control to improve fired equipment availability. Start the quantity of header pumps as required for the number of boilers in operation. The control system shall monitor pump outlet flow switch status to automatically start a standby pump when a command to start the pump fails to produce flow. System must keep at least one pump running to ensure water is always moving past the header temperature sensor even after the last boiler has been stopped.

6. Boiler Water Flow Control Valve Sequence
Provide boiler water flow valve control to prevent water from flowing through off-line boilers (and lowering the HWS temperature); continue water flow for an adjustable cool down period after the boiler has stopped, and ensure water is always moving past the header temperature sensor even after the last boiler has been stopped. The valve shall be immediately closed if any trips occur during pre-purge, pilot, or main flame trial for ignition.

7. Operator Controls, Trends, Indications and Alarms
The control system shall include a 16 line x 40 character (or greater) LCD display for boiler sequence control and status, alarm and event summaries, and setup menus for easy operation, tuning and troubleshooting. Alarms, events and operator actions shall be logged with time/date stamp and English language description.

8. Reliability
Include hardwired backup stations to permit manual operation of the plant should the control system require service. Manual operation must be possible when the microprocessor is not functioning. Hardwired “Hand-Off-Auto” control switches must be wired directly into every boiler, pump, and valve start/stop circuit. Each 4-20 mADC or 0-135 ohm modulating control output must include a hardwired manual backup station with auto/manual switch, output control knob and output level indicator ( bargraph, analog meter or digital display).

9. Communication
The control system shall have the ability of simultaneously communicating to a Data Acquisition System (DAS), Building Automation System (BAS) or Building Management System (BMS) via RS485 Modbus protocol and to a personal computer. The individual boiler limits, lockout, start/stop, warm standby, and firing rate status shall be readable. Header setpoint, plant firing rate, boiler quantity called to start, boiler selected as lead and all setup parameters shall be easily read and written.

10. Quality Assurance
The control system shall be manufactured and labeled in accordance with UL508 requirements (CSA C22.2 #14 for use in Canada). Inspection and labeling shall be supervised by UL or other OSHA approved Nationally Recognized Test Lab (NRTL). The control system shall be a Preferred Instruments, Danbury, CT, Model JC-CDHWHP-x-P-y (“x” = boiler quantity from 2 to 5; “-P” for 0-135 ohm; “-I” for 4-20 mA; “y” = pump quantity from 2 to 3).
CHIEF DISPATCHER MODEL JC-CDHWTS
Hot Water Boilers with Thermal Shock Protection Modulating Lead/Lag Controller

Application
The Chief Dispatcher Model JC-CDHWTS will optimize hot water system performance and help extend boiler life. Blend valves are used to allow off-line boiler warm-up and prevent thermal shock.

2 To 4 Modulating Boilers
Hot Water Supply (HWS) header temperature is maintained using accurate PID control. Multiple boilers are modulated in “unison” (all at the same firing rate) to ensure even heat delivery. Lag boilers are brought up to the “unison” firing rate using a predetermined ramp rate to meet the heating load with minimum overshoot. The operator may set the “unison” firing rate manually. Each boiler has an individual boiler outlet temperature sensor. If any boiler approaches its high temperature shutdown limit, it will cut back firing rate individually to prevent a boiler trip.

Boiler Pump Sequencing
In line boiler pump sequencing keeps the lead boiler pump running (water flows past the header sensor) to ensure accurate header temperature sensing and provides pump shutdown delay for boiler cool down.

Thermal Shock Protection
Individual boiler outlet 3-way recirculating valves are automatically positioned based on the boiler start sequence, boiler outlet and return water temperatures. If the boiler return water temperature drops below a low temperature setpoint, the valve opens to allow hot boiler outlet water to blend with cold return water temperature. The valve slowly repositions toward 0% recirculation after return water rises above setpoint. When a boiler is called to operate, the 3-way valve is set to 95% recirculation. After the boiler starts and the outlet temperature is close to supply temperature setpoint, the valve slowly repositions toward 0% recirculation.

Outdoor Reset
Energy is saved by lowering the Hot Water Supply (HWS) temperature setpoint as the outdoor air temperature increases. Operating cost is reduced during warmer days. The operator may set the HWS setpoint manually.

Time Of Day/Week Setback
This feature is used in heating applications to save energy by lowering the Hot Water Supply (HWS) temperature setpoint during times when the heating requirement is reduced, such as at night or on weekends and holidays.

Domestic Hot Water Priority
A temperature switch (thermostat) contact closure input will override the “outdoor reset” and “setback” portion of the program and force the HWS temperature setpoint to a domestic hot water setpoint. A relay output is available to start a domestic hot water pump if required.

Condensing Boiler Logic (Option “C”)
Condensing boiler logic takes full advantage of the condensing boiler design by maximizing the number of boilers running near low fire to maximize efficiency.
**CHIEF DISPATCHER MODEL JC-CDHWHTSP**

Hot Water Boilers with Thermal Shock Protection Modulating Lead/Lag Controller

### Specifications

**Panel Details**
- Controller: PWC
- Case Size: 19¼" H X 18" W X 8½" D
- Enclosure Type: Wall mounted, Weight: 55 lbs.

**Inputs**
- Hot Water Temperature: 0° to 300° F, Thermistor
- Outlet Water: Thermistor (each boiler)
- Return Water: Thermistor (each boiler)
- Outdoor Air: Thermistor (non "-BAS" version)
- BAS Reset Setpoint: 4-20 mADC ("-BAS" version)
- BAS, Boiler Disable: 120 VAC, optically isolated
- Limits: 120 VAC, optically isolated (each boiler)
- Boiler Lockout: 120 VAC, optically isolated (each boiler)
- Domestic HW Priority: 120 VAC, optically isolated

**Outputs**
- Boiler Modulation: Isolated: 4-20 mADC or 0-135 ohm (each boiler)
- Balancing Valve: Isolated: 4-20 mADC (each boiler)
- Boiler Start: Dry contact, 8 FLA, ½ HP, 120 VAC (each boiler)
- Pump Start: Dry contact, 8 FLA, ½ HP, 120 VAC (each boiler)
- Domestic HW Circulation Pump: Dry contact, 8 FLA, ½ HP, 120 VAC

### Ordering Information

Specify Chief Dispatcher Catalog Number:

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<th>Boiler Quantity</th>
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**Optional Features**

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**Order Sensors Separately**

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<tr>
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<td>70610W</td>
</tr>
<tr>
<td>Outside Air Thermistor Temp. Sensor with weatherproof cover</td>
<td>70612</td>
</tr>
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</table>
**CHIEF DISPATCHER MODEL JC-CDHWTS**

**Suggested Specifications**

1. **Application**
   Supply a fully integrated boiler hot water control system to coordinate the operation of two (select up to four) fully modulating hot water boilers, boiler water circulating pumps and boiler water flow control valves to maintain Hot Water Supply (HWS) temperature at setpoint and provide thermal shock protection. The control system shall be microprocessor-based and suitable for wall mounting.

2. **Boiler Modulation**
   The control system shall incorporate a "cascade with cutback" HWS temperature PID control scheme. The HWS temperature shall be compared with a setpoint to establish a target boiler firing rate. If an individual boiler outlet temperature exceeds a pre-set maximum setpoint, that boiler’s firing rate shall be automatically cutback by a PID loop to prevent a high temperature trip. Boilers shall be modulated in “unison” (all at the same firing rate). Modulation signals shall be 4-20 mADC or 0-135 ohm (as required by the boiler) and shall be electrically isolated channel-channel and channel-ground.

3. **Hot Water Supply (HWS) Temperature Setpoint**
   When the HWS Temperature control loop is in the “automatic” mode, the control system shall establish the HWS temperature setpoint based on the time of day, day of the week and the outside air temperature. When in “manual” mode the operator may set the HWS temperature via a front panel display. All temperatures and time/date data must be field adjustable through “fill-in-the-blanks” style displays. Alternately, the control system shall accept a 4-20 mADC outdoor air temperature reset setpoint signal from an external Building Automation System (BAS).

4. **Boiler Sequence**
   The control system shall use both HWS temperature and boiler firing rate percent to start and stop the boilers, minimizing the total number of boilers in operation. The controller shall start and stop boilers when the HWS temperature is outside the adjustable temperature limit for longer than the adjustable time delay. In order to minimize header temperature deviations, the control system shall start and stop the next boiler when the “lead” boiler is at an adjustable firing rate limit for longer than the adjustable time delay. The control system shall monitor both boiler lockout and limit circuits to automatically skip over boilers that are powered down for maintenance, tripped or otherwise will not start. The lead boiler shall either automatically rotate on a time of day, day of week (or month) schedule, or shall be manually selected by the operator. The boiler shall be run at low fire for warm-up for a preset low fire hold time. The control system shall reduce the firing rate to a minimum before stopping a boiler to prevent accumulation of fuel in the furnace.

5. **Boiler Pump Sequence**
   Include independently operated primary water pump control. System must keep at least one pump running to ensure water is always moving past the header temperature sensor.

6. **Boiler Water Flow Control Valve Sequence**
   Provide control for an electric actuator, with slow opening (2 minute), flow balancing, two valve assembly for each boiler. The valve assembly shall link a boiler outlet valve and boiler water recirculation valve so that they operate as a single unit. The valves shall be arranged so that as one valve closes, the other valve opens, ensuring a continuous flow of water through the boiler. The assembly shall accept a single 4-20 mADC signal to position both valves. This valve shall prevent water from flowing through off-line boilers (and lowering the HWS temperature), allow boiler warm-up to return water temperature before the boiler starts, continue water flow for an adjustable cool down period after the boiler has stopped, and ensure water is always moving past the header temperature sensor even after the last boiler has been stopped. Slowly jog open the valve over a 10-minute period (adjustable) to prevent boiler thermal shocking. If the boiler return water temperature is 50° F (adjustable) below the boiler outlet water temperature, the valve shall slowly jog closed, causing boiler outlet water to blend with the excessively cold return water. When the return water temperature returns to an acceptable range, the boiler outlet valve shall slowly jog open.

7. **Operator Controls, Trends, Indications and Alarms**
   The control system shall include an 16 line x 40 character (or greater) LCD display for boiler sequence control and status, alarm and event summaries, and setup menus for easy operation, tuning and troubleshooting. Alarms, events and operator actions shall be logged with time/date stamp and English language description.

8. **Reliability**
   Include hardwired backup stations to permit manual operation of the plant should the control system require service. Manual operation must be possible when the microprocessor is not functioning. Hardwired “hand-off-auto” control switches must be wired directly into every boiler and pump start/stop circuit. Each 4-20 mADC or 0-135 ohm modulating control output must include a hardwired manual backup station with auto/manual switch, output control knob and output level indicator ( bargraph, analog meter or digital display).

9. **Communication**
   The control system shall have the ability of simultaneously communicating to a Data Acquisition System (DAS), Building Automation System (BAS) or Building Management System (BMS) via RS485 Modbus protocol and to a personal computer. The individual boiler limits, lockout, start/stop, warm standby, and firing rate status shall be readable. Header setpoint, plant firing rate, boiler quantity called to start, boiler selected as lead and all setup parameters shall be readable and writable.

10. **Quality Assurance**
    The control system shall be manufactured and labeled in accordance with UL508 requirements (CSA C22.2 #14 for use in Canada). Inspection and labeling shall be supervised by UL or other OSHA approved Nationally Recognized Test Lab (NRTL). The control system shall be a Preferred Instruments, Danbury, CT, Model JC-CDHWTS-x-P (‘x’ = boiler quantity from 2 to 4; “-P” for 0-135 ohm; “-I” for 4-20 mADC).