Packaged Boiler Control Sequences

System Overview

The boiler water system serves the space heating needs of the entire building, which is achieved through reheat coils in every terminal box. There are two atmospherically vented packaged boilers which work lead / lag: one boiler when outside air temperatures are less than 65F and both boilers under 45F (adjustable). The boilers work to maintain a constant temperature output (currently 170F), delivery to a 3-way mixing valve which mixes return water to maintain a hot water loop temperature setpoint. Each boiler has two burners and 2 stages of fire per burner. There are three levels of capacity: 1) both beds low fire, 2) one bed high and one low, 3) both beds high fire.

The water is delivered by two constant speed pumps, one for each boiler. Upon failure of the lead pump or boiler, the lag will start. Most coils have 2-way valves. There are a few that have 3-way valves to allow constant speed on the pumps. Each boiler has a small blend pump that circulates water through the boiler whenever the boiler is enabled.

The boiler has packaged controls that regulate the temperature of water it is supplying to the 3-way valve, prior to mixing. Those sequences are listed in Part I, below. The building automation system (BAS) enables the boiler, controls the temperature of the supply loop through a 3-way mixing valve and performs boiler lead/lag control and hot water temperature reset. Those sequences are listed in Part II, below.

Seasonal Settings

It is expected that the boilers will be shut off during summer. During the swing seasons, if the boiler will be enabled, the firing rate control should be set as low as possible. According to Proctor Sales who supplied the boiler, condensation can occur and be a potential problem if the Firing Rate Control setting is below 160F. If the control is ever raised above 170F during winter, it should be lowered back to 160F during spring and fall, to minimize energy use. The loop temperature (via the BAS) should be kept as low as possible and is automatically changed via a reset strategy.

Part I. Packaged Boiler Controls

Once the boiler is enabled, it tries to maintain the temperature of the output, prior to the mixing valve, at the boiler Operating Control Setpoint, in the following manner.

1. When the heating water system is enabled, via the OSA temperature setpoint (initially 65F) in the BAS, the lead boiler comes on with both burners at the high firing rate.

2. Once the water temperature climbs to the low limit setpoint of the Firing Rate Control (initially at 150F), one burner bed drops to low fire (less gas pressure). The low limit setpoint is the main dog on the low limit dial.

3. If the temperature continues to climb to the high limit setpoint of the firing rate control (initially at 160F), the other burner bed drops to low fire.

4. If the temperature continues to rise to the Operating Control setpoint (initially set at 170F), the boiler cycles OFF.

5. Upon cooling, when the temperature lowers to the Operating Control Setpoint minus the differential of 10F the boiler starts at low fire on both beds.

6. If the temperature continues to drop to the high limit of the Firing Rate Control setting minus a fixed 10F differential, one burner bed goes to high fire.

7. If the temperature continues to drop to the lower setting (via the differential dog) of the Low Firing Rate Control setpoint, the other burner goes to high fire.

Setting recommendations: 1) Set the Operating Control Setpoint. 2) Set the High Limit of the Firing Rate Control 10F to 15F lower than the Operating Control Setpoint. 3) Set the main dog of the Low Limit of the Firing Rate Control 10-15F lower than the High Limit (of the Firing Rate Control), 4) Set the differential dog of the Low Limit of the Firing Rate Control to 5-15F below the Low Limit. 5) Set the High Limit Safety to 30F above the Operating Control Setpoint.

Boiler Safeties

8. Loss of power will shut burners OFF.

9. Low water level sensed via the water low limit control will shut burners OFF (manual reset required).

10. If the operating control fails or the sensor is bad, and the water temperature goes to 200F, the safety high limit shuts the burner off. Manual reset is required.

11. In all of the above three cases, the BAS will be sent an alarm.

12. If the electronic ignition tries to light the pilot and a flame is not sensed, the main gas valve will not open.

Sensors. The high limit safety, the Operating Control and the Firing Rate Control all have their own sensors.

Part II. Building Automation System Controlled Boiler Sequences

13. When the outside air temperature (OSAT) is less than the OSAT setpoint, initially at 65F (adjustable), the lead boiler and its integral blend pump and its associated heating water pump will start. Whenever a boiler is enabled, its associated HW pump shall run and the lag boiler will be isolated by a automatic valve. Boilers are not scheduled by time.

14. The lag boiler isolation valve will open, lag boiler and associated pumps will start when the OSAT is less than 45F (adjustable).

15. Via pump status monitoring, after the boiler system has been enabled and the lead pump ON status has not been established within 30 seconds, the lead pump shall stop, the lag pump shall be started and an alarm generated.

16. Via boiler status monitoring, after the boiler system has been enabled and the lead boiler ON status has not been established within 30 seconds, the lead boiler shall stop, lead boiler isolation valve close, lag boiler isolation valve open and the lag boiler shall be started and an alarm generated.

17. During unoccupied periods, during night low limit operation, the boiler will cycle ON and OFF with the air handlers to maintain the NLL setpoint.

Hot Water Mixing Valve Control

18. The 3-way mixing valve in the hot water supply is modulated to mix return water with boiler supplied hot water to maintain a hot water supply temperature based on the OSAT, according to the following proportional reset schedule:

OSAT	HWST
23F	180F
70F	140F