

■ Boiler System Assessment Guidelines

General Boiler System Assessment Procedure

1. Acquire copies of mechanical drawings (determine boiler system layout).
2. Determine type of boilers: open draft, forced draft, water tube, fire tube, condensing, etc.
3. Collect boiler name plate data and sketch out the system configuration (including pumping system).
4. Acquire a copy of the boiler engineering specifications.
5. Take screen shots of the boiler system through the direct digital control (DDC) system.
6. Specifically record control sequences and setpoint temperatures.

Note: The following retro-commissioning information was taken directly from PECEI's functional testing guide (www.peci.org/ftguide/) and modified for this energy assessment training.

The performance of a boiler and the hot water system is acceptable if it meets the design intent and specified operating sequence. Attention to the following actions during the commissioning process can result in significant improvements in system operation and energy efficiency:

➤ Actuation and sequencing

- Verify that automatic isolation valves are installed and operate correctly, if applicable. Automatic isolation valves are typically installed when multiple boilers are connected to a common supply header. Boilers with dedicated pumps generally do not have automatic isolation valves. When an individual boiler is not operating, the isolation valve should be closed to prevent water from circulating through the unit. This configuration reduces pumping energy and prevents dilution of the hot water temperature by blending unheated water flowing through the non-operational boilers with hot water coming from the operating unit(s).
- Verify proper boiler staging under normal operation, as well as under all failure and emergency operating modes, especially if multiple units are installed that are unequal in size. Close coordination between boiler staging and actual load minimizes energy usage. For example, it is beneficial to use a small boiler with good turn-down efficiency to meet low loads and to enable a larger boiler only when the load surpasses the heating capacity of the smaller boiler. When this occurs, the small boiler will be sequenced off until load exceeds the large boiler capacity, then both boilers would operate to meet the load.
- Verify that the boilers and primary/feed water pumps stage up and down per the sequence of operations under all operating modes.
- Verify that the time delay between boiler start/stop commands works as designed. To remove residual heat from the boiler, the primary/feed water pump operation time delay should operate as designed after the boiler is commanded OFF.
- Verify that the automatic isolation valve(s) associated with the respective equipment opens fully upon start-up and closes fully upon shutdown after the specified time delay has expired.

➤ **Setpoints and reset controls**

- Verify that the system operates and maintains its hot water supply temperature setpoint under all operating modes, including automatic, manual, and failure/emergency modes.
- Verify proper coordination between individual setpoints and reset strategies. For example, the hot water temperature reset and air handling unit discharge air temperature reset control strategies should be compatible. Without coordination between hot water temperature reset and discharge air temperature reset, the air handler may be trying to make hotter air than is possible with the hot water supply temperature. This situation would result in boilers being staged ON even though there is no load on the system, wasting a significant amount of energy.
- Verify that the control algorithms generate the proper water temperature setpoint based on the reset parameters specified in the sequence of operations.
- Verify that the reset parameters are optimized for the system. In addition, ensure the reset control strategy does not result in a return water temperature from the building loads, which can cause the flue gasses to condense in noncondensing boiler systems.
- Verify that the O₂ trim controls, if applicable for a specific project, operate to ensure that excess oxygen in flue gas is maintained at setpoint. If O₂ trim controls are not installed, review flue gas report and verify the boiler was tuned at high-fire and at least one intermediate part-load operating point.

Control accuracy and stability

- Verify that all control loops stabilize within a reasonable amount of time (typically 2 to 5 minutes) after a significant load change such as start-up or automatic/manual recovery from shutdown. Some projects may require full-load capacity and part-load turndown performance testing. Tests should be performed when the loads generated can be dissipated adequately. Verify the boiler meets the manufacturer's stated part load performance under actual operating conditions.

Final boiler system testing can be best achieved through trending under normal operation.