FUNCTIONAL PERFORMANCE TEST

Heating Hot Water

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<th>Sequence of Operation Testing</th>
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Sequence of Operation: The building hot water system comes into operation whenever an air handler is on and one of its VAVs is calling for heat. Once turned on, the hot water system will operate for a minimum of 60 minutes. The value of the hot water setpoint is calculated from the outside air, going from a minimum of 100°F to a maximum of 180°F. Once in operation, the lead hot water pump will maintain a differential pressure at the most distant reheat valve. If the signal to the lead hot water pump is 100% for five minutes, the lag pump should start and ramp up to help achieve the DP setpoint. If the signal to the lag pump starts below 40% for ten minutes, it is turned off. If the lead hot water pump fails when operating by itself, it is locked out and the lag pump turns on and becomes the lead. Under normal circumstances, Pumps 1 and 2 exchange lead status twice a month. When the hot water system comes on, the steam valves on the heat exchanger modulate to maintain the heating hot water setpoint. The smaller valve acts as the trim valve: when the signal to it is 100% for a minute, the larger valve opens slowly at an adjustable ramp to increase the volume of steam. When the smaller valve goes closed for a minute, the larger valve is closed at an adjustable, but more rapid ramp. The steam valves only operate when the hot water flow switch is on and there is a call for the hot water system.

1. **HW Pump On-Off Operation**
   
   **ACTION:** Command any AH’s MAXVAVHWV point to 100%.
   
   **EXPECTED RESULTS:** The hot water system starts if any VAV in the building has a fully open hot water valve. When the system starts, a hot water pump comes on. If both points above are turned off, the lead hot water pump will not shut down until it has run for at least an hour.

2. **HW Pump VFD Modulation**
   
   **ACTION:** Change the setpoint of building HW DP to go above or below measured building DP.
   
   **EXPECTED RESULTS:** As the setpoint is raised above the DP setpoint, the fan speed should ramp up. As the setpoint is dropped below the DP setpoint, the fan speed will drop. If the DP matches the DP setpoint, the pump speed should remain stable.

3. **HW Setpoint Calculation**
   
   **ACTION:** Change the value of the OAT virtual point.
   
   **EXPECTED RESULTS:** The chilled water setpoint should range between 100°F and 180°F.

4. **HW Steam Valve Operation**
   
   **ACTION:** Change the HW reset value to be greater than the hot water supply going to the building.
   
   **EXPECTED RESULTS:** If the HW pump is off, the valve should stay shut. If the reset value is above the hot water supply, the 1/3 valve should open. If the reset value is commanded below the hot water supply, then the 1/3 valve should close. If the reset value is near or at the value of the hot water supply, the 1/3 valve should remain in its position. The 2/3 valve opens slowly when 1/3
valve is fully open for 30 seconds. The 2/3 valve closes slowly when 1/3 valve is closed. When 1/3 valve is operating at mid-range, the 2/3 valve does not move.

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5. **HWP Lead/Lag**

**ACTION:** Command actual lead pump speed (i.e., MATH.HW.CHWP1.SPEED) to half speed. Command the HWP.SPEED point to 100% simulating the need for additional capacity. After second pump starts, command HWP.SPEED to 40% simulating the over capacity of pumping.

**EXPECTED RESULTS:** After 5 minutes of HWP.SPEED at 100%, lag pump comes on and goes to 100%. Commanding HWP.SPEED to 40% will drop the lag pump speed to 40%. Ten minutes later the 2nd pump will shut off, leaving the lead pump on.

**REMARKS:**