

SEQUENCE OF OPERATIONS FOR HVAC CONTROLS

1. GENERAL

- .1 The control sequences contain a general description of the intent of the operation of the systems to be controlled. The Contractor shall review individual systems to ensure equipment and life safety interlocks are not overridden.
- .2 The relationships between the points, systems and building are described in the control sequences.
- .3 Review with the Contract Administrator during the Shop Drawing stage to finalise the control sequences for each system.
- .4 All temperature setpoints mentioned below are initial setup values and shall be adjustable for future requirements.

2. PRODUCTS

- .1 Not Applicable

3. EXECUTION

- .1 Provide data base for all hardware points listed for system operation to meet specification operating sequences.

4. CONTROL SEQUENCES

4.1 Indirect Water Heating System (IWH-1 & IWH-2)

- .1 The major components of this system are:
 - .1 Indirect water heaters, IWH-1 & IWH-2
 - .2 Motorized open/close 2-way control valve (MCV-IWH)
- .2 IWH-1 & IWH-2 each have an onboard aquastat that will close a circuit at 5°C (9°F) below the set point and opens when the setpoint is reached. When either of the aquastat circuits are closed (call for heat), the BMS will signal boiler B-1 to go into DHW priority to start heating the loop to 160°F. When the boiler loop has reached 130°F, the BMS will open the 2-way valve to the indirect water heaters to start making DHW. When the aquastat circuit is open (heating is satisfied), the 2-way valve will close and boiler B-1 to resume the normal reset temperature.
- .3 The aquastat set point shall be initially set at 54°C (130°F).

4.2 Existing Heat Exchanger (HX-1) System

- .1 The intent of this control sequence is to inject the higher temperature water of the new boiler B-1 high temperature heating loop (runs from 100°F to 160°F) into the existing high temperature heating loop (runs from 100°F to 140°F). This will allow the existing HX-1 to provide more heat to the MUA pre-heat coil.

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- .2 The major components of this system are:
 - .1 Existing high temperature heating loop consisting of pump P-8, heat exchanger HX-1 and a temperature transmitter.
 - .2 Motorized open/close 2-way control valve (MCV-HX-1)
- .3 The 2-way motorized control valve shall open when:
 - .1 the outside air temperature is less than -5°C (23°F) and,
 - .2 the new boiler B-1 high temperature heating loop is hotter than the existing high temperature heating loop.
- .4 Readjust existing glycol loop outdoor reset schedule to:

O/A Temperature	GLS
-30°C (-22°F) or less	48.9°C (120°F)
10°C (50°F) or higher	26.7°C (80°F)

4.3 High Temperature Heating Loop (B-1)

- .1 The major components of this system are:
 - .1 Condensing boiler B-1
 - .2 Circulator pump P-5 VFD
 - .3 Motorized modulating 3-way control valve (MCV-B-1)
- .2 Boiler controls are provided by the boiler Manufacturer. Provide tie-in points to BAS, as indicated on the Points Schedule.
- .3 Provide all safety or operational interlocks to boiler control panels as required.
- .4 The water supply temperature of the High Temperature Heating Loop will be based on a normal outdoor reset schedule as follows:

O/A Temperature	HWS
-30°C (-22°F) or less	71.1°C (160°F)
10°C (50°F) or higher	37.8°C (100°F)

- .5 The water supply temperature of the boiler shall be temporarily reset to a DHW priority temperature of 71.1°C (160°F) when IWH-1/IWH-2 2-way valve is fully open. The water

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supply temperature shall return to the normal outdoor reset schedule when IWH-1/IWH-2 2-way valve is fully closed.

- .6 Boiler shall be locked out by safety features such as Low water cut-out, low flow condition at flow switch, fire alarm activation or opening of the Emergency Boiler disconnect switch at the entry to the mechanical room.
- .7 Circulator pump P-5 shall be controlled by B-1 via P-5 VFD.
- .8 The motorized 3-way valve shall normally divert 100% flow away from IWH-1/IWH-2 and HX-1. When either one of the two motorized 2-way valves for IWH-1 and HX-1 are open (i.e. calling for flow), the 3-way valve shall divert the flow as follows:
 - .1 When the motorized 2-way valve for IWH-1/IWH-2 is open, the 3-way valve shall divert 20% of the flow to IWH-1/IWH-2.
 - .2 When the motorized 2-way valve for HX-1 is open, the 3-way valve shall divert 30% of the flow to HX-1.
 - .3 When both of the two motorized 2-way valves for IWH-1/IWH-2 and HX-1 are open, the 3-way valve shall divert 50% of the flow to IWH-1/IWH-2 and HX-1.

4.4 Low Temperature Heating Loop (B-2)

- .1 The major components of this system are:
 - .1 Condensing boiler B-2
 - .2 Circulator pump P-6 VFD
 - .3 Motorized modulating 3-way control valve (MCV-B-2)
- .2 Boiler controls are provided by the boiler Manufacturer. Provide tie-in points to BAS, as indicated on the Points Schedule.
- .3 Provide all safety or operational interlocks to boiler control panels as required.
- .4 The water supply temperature of the Low Temperature Heating Loop will be based on a normal outdoor reset schedule as follows:

O/A Temperature	HWS
-30°C (-22°F) or less	48.9°C (130°F)
10°C (50°F) or higher	37.8°C (100°F)

- .5 Boiler shall be turned off when the outdoor air temperature is 18°C or higher or from May 1st to August 31st.

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- .6 Boiler shall be locked out by safety features such as Low water cut-out, low flow condition at flow switch, fire alarm activation or opening of the Emergency Boiler disconnect switch at the entry to the mechanical room.
- .7 Circulator pump P-6 shall be controlled by B-2 via P-6 VFD.
- .8 The motorized 3-way valve shall normally divert 100% flow away from the existing building loop. The existing building loop temperature, reading taken from a new temperature transmitter in main-floor men's washroom shall be maintained at 90°F set-point during the heating season. When the temperature reading is more than 1°C (1.8°F) off the setpoint the 3-way valve will be modulated up or down in 10% increments with 1 minute (field adjustable) delays between each increment to maintain set-point.

4.5 Building Loop Booster Pump (P-14)

- .1 The major components of this system are:
 - .1 Booster pump P-14
 - .2 Motorized open/close 3-way control valve (MCV-P-14)
- .2 Booster pump P-14 normally runs continuously with ability to be shut down remotely via BMS.
- .3 The motorized 3-way valve will automatically divert flow 100% through the fluid cooler in summer mode (OAT $\geq 10^{\circ}\text{C}$) or 100% past the fluid cooler in winter mode (OAT $< 10^{\circ}\text{C}$).

4.6 Existing Pumps P-1 & P-2

- .1 Pumps P-1 & P-2 is an existing standalone system that currently injects HWS from the old B-1 and B-2 boilers into the building loop. An adjustable thermostat located on the main floor mechanical room and a temperature transmitter controls the two pumps and a 2-way valve.
- .2 Revise system to be controlled via BMS.
 - .1 Remove existing thermostat, temperature transmitter and control wiring.
 - .2 Change the operation of P-1 and P-2 so that they are normally off and the 2-way valve is closed.
 - .3 When the B-2 3-way valve has reached 100% and the building loop temperature is $< 90^{\circ}\text{F}$, the BMS will open the 2-way valve and turn on both P-1 and P-2. When the B-2 3-way valve has dropped to 80% or less, P-1 and P-2 will turn off and the 2-way valve will close.

4.7 Basement Electrical Room Temperature Transmitter

- .1 The major components of this system are:
 - .1 Temperature Transmitter

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- .2 The new temperature transmitter will monitor the room temperature through the BMS. An alarm will be generated if the room exceeds 40°C (104°F).

END OF SECTION