

SEQUENCE OF OPERATION

**GENERAL:** BAS shall fully control the hot water blending system and equipment and provide monitoring and diagnostic information for management purposes.

**DIFFERENTIAL PRESSURE REGULATING:** The central heating plant maintains differential pressure throughout the distribution system. Each building connection is exposed to a variable degree of differential pressure fluctuation based on the distance between the central heating plant and the most hydraulically remote portion of the distribution system (refer to hydraulic model). If the differential pressure fluctuation for a building is high, a mechanical differential pressure regulating valve shall be provided to limit the differential pressure across the temperature control valve and improve controllability. The differential pressure regulator setpoint shall be estimated by the engineer for selection in association with the control valve design Cv, but final setpoint shall be determined by the balancer and reported to owner in turnover package. The differential pressure regulator is shown as a separate device for buildings with multiple temperature control zones. For a small building with a single temperature control zone, it is also acceptable to integrate the differential pressure regulation with the control valve as a pressure-independent control valve.

**HEATING ENABLE:** Heating shall be enabled by the operator at the operator interface via a graphic icon OR when non-critical heating requests exceed 20% (adj), with a 50% cycle differential. For example if heating enable setpoint is 20%, then heating disable setpoint shall be 10% of all available requests OR when any single critical heating request is active (as determined by design engineer). Once enabled, heating shall remain enabled for at least one hour.

**VARIABLE SPEED & HW PUMPS (P-1 & P-2):** BAS shall control the pumps as follows:  
 1. START/STOP: BAS shall command the operation of the lead pump and it shall run continuously whenever heating is enabled.  
 2. PROOF: BAS shall prove pump operation and use the status indication to accumulate runtime. Upon failure of the lead pump, BAS shall energize the lag pump and enunciate a level 1 alarm.  
 3. VFD CONTROL: Whenever heating is enabled, BAS shall control the output of the active pump VFDs to maintain the HW remote differential pressure (RDP) setpoint (determined by balancer; initially 10 PSID). On start and stop, the VFD shall ramp to speed and slow down within adjustable acceleration and deceleration limits.

**PRESSURE OPTIMIZATION:** The remote differential pressure setpoint shall be re-set incrementally between minimum and maximum setpoints (determined by the balancer) every 10 minutes (adj) to maintain the most open hot water valve at 95%.

**HW BYPASS VALVE:** BAS shall modulate the position of the valve as required to maintain each HW DPT at no more than 2 psid above the HW DPT set point when only one pump is running and has been at minimum speed for 2 minutes.

**FIN TUBE HW PUMPS (P-3 & P-4):** BAS shall control the pumps as follows:  
 1. START/STOP: BAS shall command the operation of the lead pump and it shall run continuously whenever heating is enabled.  
 2. PROOF: BAS shall prove pump operation and use the status indication to accumulate runtime. Upon failure of the lead pump, BAS shall energize the lag pump and enunciate a level 1 alarm.

**HW TEMPERATURE CONTROL:** BAS shall reset the blended HW temperature supply setpoint based on outdoor air temperature and heating requests with all values being adjustable. The initial setpoint shall be reset from 130°F at or above 60°F or below 15°F. As the total percentage of heating requests rises from 0 to 100% the initial reset set point shall be increased by an additional 0 to 10°F with a maximum set point of 160°F (adj.). Once the hot water system has been enabled for at least 30 minutes (adj.) the BAS shall enunciate a level 3 alarm whenever the hot water supply temperature is more than 2°F (adj.) below setpoint for more than 10 minutes (adj.) continuously. A HW temperature regulating valve shall be provided in series downstream of the HW control valve to prevent exceeding building temperature limits in the event of a valve, control, power, or other failure of the temperature control system. The HW temperature regulating valve setpoint shall be 5°F higher than the highest scheduled HW reset temperature, but never greater than 165°F. A temperature switch shall be provided in the HW supply piping with a setpoint 2°F lower than the HW temperature regulating valve setpoint to enunciate a level 3 alarm when the temperature control system has failed and the temperature regulating valve is acting to limit HW supply temperature to the building piping.

**FIN TUBE TEMPERATURE CONTROL:** BAS shall reset the fin tube HW temperature supply setpoint based on outdoor air temperature with all values being adjustable. The setpoint shall be reset from 100°F at or above 60°F or below 0°F. BAS shall modulate the 2-way re-circulation valve to maintain the fin tube hot water supply temperature setpoint.

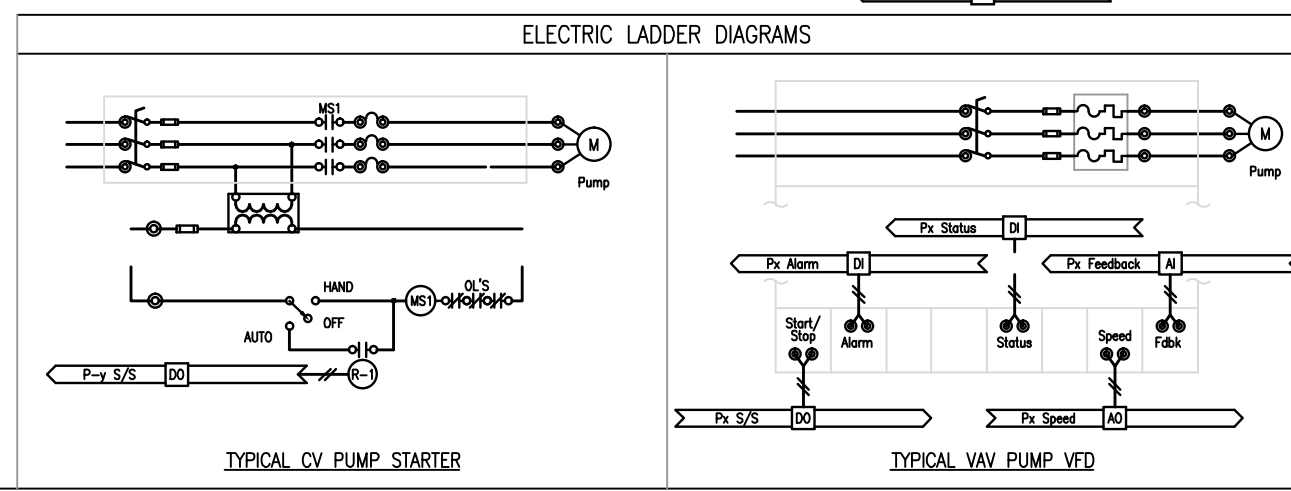
**WYE STRAINER MONITORING:** Wye strainers shall be provided with differential pressure manifold and transmitter to monitor pressure drop (indication of clogging). When switch detects high differential pressure of 5 psid (adj.) across the wye strainer, a non-critical alarm shall be enunciated to notify operator that strainer blowdown or cleaning is required.

**DOMESTIC HOT WATER HEATER:** Domestic hot water supply temperature setpoint shall be locally configured to 140°F. Provide hardwired inputs from domestic hot water heater control panel to BAS for monitoring and indication of domestic hot water supply temperature setpoint, domestic hot water heater status, and domestic hot water heater alarm.

- NOTES**
1. Locate remote differential pressure sensor at most remote HW coil, as directed. Install transmitter and bypass assembly no higher than 6 feet AFF.
  2. Provide communications interface to the control system for diagnostic point information.
  3. Provide BACnet interface to the control system for diagnostic point information. VSD rate of change (Acceleration/Deceleration) shall be programmed in to the VSD controller and not rely on BAS logic. Meter to be owner furnished contractor installed per UVA FDG.
  4. Provide BACnet interface to the control system for diagnostic point information: flow rate, supply and return water temperature, and inlet, intermediate, and outlet pressure.
  5. Check valve prevents excess distribution flow.
  6. Critical buildings shall include double-block and bypass valve assembly at PDRV and PDC.
  7. Meter to be owner furnished contractor installed per UVA FDG.

**BILL OF MATERIALS**

DESIG	QTY	MODEL NO.	DESCRIPTION
TMV-1	1		Thermostatic Mixing Valve
V-1/8	8		Manual Isolation Valve
PDRV	1		Pressure Differential Regulating Valve
TRV-1	1		Temperature Regulating Valve
HLTS-1	1		Temp Switch, Temp Sensor, Well
TS-1/8,10	5		Temp Transmitter, Temp Sensor, Well
PT-1,2,3,4	4		Static Pressure Transmitter
DP-1,2,3	3		Differential Pressure Transmitter
CT-1,2	2		Current Transformer
V-2,3	2		Control Valve
PICV-1	1		Pressure Independent Control Valve
FT-1,2	2		Flow Meter



CONTROL SCHEMATIC

TYPICAL CV PUMP STARTER

TYPICAL VAV PUMP VFD

UNIVERSITY of VIRGINIA  
FACILITIES MANAGEMENT

HVAC CONTROLS STANDARDS

Eng	-
Drawn	-
Chkd	-
Updated	06/28/2018
Updated By	-
Job No.	-
Scale	N/A
Proj Code	-

STANDARD

BUILDING HOT WATER SYSTEM (SCHEMATIC)

22 OF 30 SHEET NUMBER

C-3.1a

DWG NUMBER