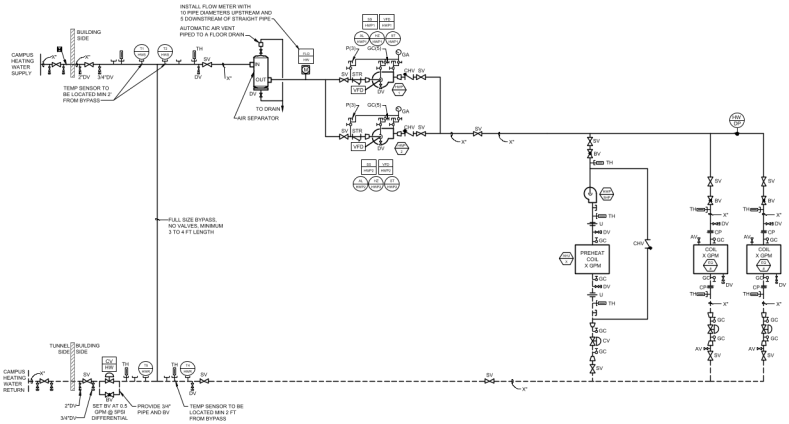

NON-PLANT HEATING WATER FLOW DIAGRAM

SCALE: NONE

GENERAL NOTE:

ALL SERVICE VALVES AND CONTROL VALVES TO BE LINE SIZE UNLESS SHOWN WITH REDUCER AND EXPANDER FITTINGS OR NOTED OTHERWISE.

NON-PLANT BUILDING - HEATING HOT WATER POINTS LIST

POINT DESCRIPTION					STARTUP TREND		SERVICE TREND		FIELD DEVICE DESCRIPTION	NOTES
TYPE	NAME	DESCRIPTION	SEMANTIC TAGS	UNITS	FREQ	ARCHIVE	FREQ	ARCHIVE	INSTRUMENT TYPE	
GLOBAL POINTS (TO BE MAPPED TO OTHER CONTROLLERS)										
AI	OA_T	OUTSIDE AIR TEMPERATURE	OUTSIDE_AIR, TEMP, SENSOR	°F,1	-	-	-	-	OUTDOOR AIR TEMPERATURE SENSOR	
AI	OA_H	OUTSIDE AIR RELATIVE HUMIDITY	OUTSIDE_AIR, HUMIDITY, SENSOR	% RH,1	-	-	-	-	GENERAL PURPOSE OUTSIDE RELATIVE HUMIDITY SENSOR	
AV	OA_DWP	OUTSIDE AIR DEW POINT REFERENCE	OUTSIDE_AIR, HUMIDITY, SENSOR, REF	°F,1	-	-	-	-	SOFTWARE (VIRTUAL) POINT	CALCULATED FROM OA-T AND OA-H
AV	OA_WB	OUTSIDE AIR WET BULB REFERENCE	OUTSIDE_AIR, HUMIDITY, SENSOR, REF	°F,1	-	-	-	-	SOFTWARE (VIRTUAL) POINT	CALCULATED FROM OA-T AND OA-H
HOT WATER SYSTEM POINTS										
AI	TSHWR	HW RETURN TO CAMPUS LOOP HEADER TEMPERATURE	HEATING, WATER, LEAVING, TEMP, SENSOR	°F,1	1 MIN	30 MIN	15 MIN	1 WEEK	INSERTION ELEMENT FLUID TEMPERATURE SENSOR	
AI	THWS	HW SUPPLY LOOP HEADER TEMPERATURE	HEATING, WATER, ENTERING, TEMP, SENSOR	°F,1	1 MIN	30 MIN	15 MIN	1 WEEK	INSERTION ELEMENT FLUID TEMPERATURE SENSOR	
AI	THWR	HW RETURN FROM BUILDING LOOP TEMPERATURE	HEATING, WATER, LEAVING, TEMP, SENSOR	°F,1	1 MIN	30 MIN	15 MIN	1 WEEK	INSERTION ELEMENT FLUID TEMPERATURE SENSOR	
AI	T2HWS	HW SUPPLY TO BUILDING LOOP TEMPERATURE	HEATING, WATER, ENTERING, TEMP, SENSOR	°F,1	1 MIN	30 MIN	15 MIN	1 WEEK	INSERTION ELEMENT FLUID TEMPERATURE SENSOR	
AI	HW_DP	HEATING WATER LOOP DIFFERENTIAL PRESSURE	CHILLED, WATER, PUMP, PRESSURE	PSI,1	1 MIN	30 MIN	15 MIN	1 WEEK	HYDRONIC DIFFERENTIAL PRESSURE TRANSMITTER	PIPED FROM SUPPLY TO RETURN TO GET SYSTEM DP
AO	VFD_HWP1	HEATING WATER PUMP 1 SPEED COMMAND	HEATING, WATER, PUMP, SPEED, CMD	%,0	1 MIN	30 MIN	15 MIN	1 WEEK	HARDWIRED POINT TO CONTROLLED DEVICE	4-10 mA/2-10 VDC, COORD. WITH VFD
AO	VFD_HWP2	HEATING WATER PUMP 2 SPEED COMMAND	HEATING, WATER, PUMP, SPEED, CMD	%,0	1 MIN	30 MIN	15 MIN	1 WEEK	HARDWIRED POINT TO CONTROLLED DEVICE	4-10 mA/2-10 VDC, COORD. WITH VFD
AO	CV_HW	HEATING WATER BY-PASS VALVE COMMAND	HEATING, WATER, VALVE, CMD	%,0	1 MIN	30 MIN	15 MIN	1 WEEK	HARDWIRED POINT TO CONTROLLED DEVICE	
AV	HZ_HWP1	HEATING WATER PUMP 1 SPEED FEEDBACK	HEATING, WATER, PUMP, FREQ, SENSOR	HZ,0	1 MIN	30 MIN	15 MIN	1 WEEK	NETWORK INTERFACE TO CONTROLLED DEVICE	
AV	HZ_HWP2	HEATING WATER PUMP 2 SPEED FEEDBACK	HEATING, WATER, PUMP, FREQ, SENSOR	HZ,0	1 MIN	30 MIN	15 MIN	1 WEEK	NETWORK INTERFACE TO CONTROLLED DEVICE	
AV	FLO_HW	HEATING WATER LOOP FLOW	HEATING, WATER, FLOW, SENSOR	GPM,0	1 MIN	30 MIN	15 MIN	1 WEEK	STRAP-ON ULTRASONIC FLUID FLOW MEASUREMENT	INTEGRATE VIA BACNET
AV	NEG_TOT	FLOW METER NEGATIVE TOTALIZER	N/A	GAL,0	1 MIN	30 MIN	15 MIN	1 WEEK	NETWORK INTERFACE TO CONTROLLED DEVICE	INTEGRATE VIA BACNET
AV	POS_TOT	FLOW METER POSITIVE TOTALIZER	N/A	GAL,0	1 MIN	30 MIN	15 MIN	1 WEEK	NETWORK INTERFACE TO CONTROLLED DEVICE	INTEGRATE VIA BACNET
AV	SIG_STR	FLOW METER SIGNAL STRENGTH	N/A	A,0	1 MIN	30 MIN	15 MIN	1 WEEK	NETWORK INTERFACE TO CONTROLLED DEVICE	INTEGRATE VIA BACNET
BV	RES_TOT	FLOW METER TOTALIZER RESET	N/A	OFF / ON					NETWORK INTERFACE TO CONTROLLED DEVICE	INTEGRATE VIA BACNET
BV	AL_HWP1	HEATING WATER PUMP 1 VFD ALARM	N/A	NORM / ALARM	1 MIN	30 MIN	15 MIN	1 WEEK	NETWORK INTERFACE TO CONTROLLED DEVICE	INTEGRATE VIA BACNET
BV	AL_HWP2	HEATING WATER PUMP 2 VFD ALARM	N/A	NORM / ALARM	1 MIN	30 MIN	15 MIN	1 WEEK	NETWORK INTERFACE TO CONTROLLED DEVICE	INTEGRATE VIA BACNET
BI	ST_HWP1	HEATING WATER PUMP 1 STATUS	HEATING, WATER, PUMP, RUN, SENSOR	OFF / ON	1 MIN	30 MIN	15 MIN	1 WEEK	FIXED TRIP CURRENT SWITCH	
BI	ST_HWP2	HEATING WATER PUMP 2 STATUS	HEATING, WATER, PUMP, RUN, SENSOR	OFF / ON	1 MIN	30 MIN	15 MIN	1 WEEK	FIXED TRIP CURRENT SWITCH	
BO	SS_HWP1	HEATING WATER PUMP 1 ENABLE	HEATING, WATER, PUMP, RUN, CMD	OFF / ON	1 MIN	30 MIN	15 MIN	1 WEEK	DRY CONTACT / RELAY	
BO	SS_HWP2	HEATING WATER PUMP 2 ENABLE	HEATING, WATER, PUMP, RUN, CMD	OFF / ON	1 MIN	30 MIN	15 MIN	1 WEEK	DRY CONTACT / RELAY	

BI BINARY INPUT
BO BINARY OUTPUT
BV BINARY VIRTUAL POINT
AI ANALOG INPUT
AO ANALOG OUTPUT
AV ANALOG VIRTUAL POINT
HW HARD WIRED INTERLOCK/SAFETY
COS CHANGE OF STATE

GENERAL NOTES
1. FOR ANALOG POINTS, UNITS COLUMN HAS TWO COMPONENTS. FIRST VALUE INDICATES ENGINEERING UNITS FOR POINT. SECOND VALUE IS NUMBER OF DECIMAL PLACES TO DISPLAY.
2. FOR BINARY POINTS, UNITS COLUMN LISTS "OFF" AND "ON" STATE LABELS FOR POINT.

UPDATED: 2021

PROJECT STANDARDS
Missouri University of Science & Technology
S & T Project #RCXXXXXX

401 West 16th Street
Rolla, MO

PROJECT ENGINEER
LICENSE #

HEATING WATER FLOW DIAGRAM

M5.5

Revision Schedule

SEQUENCE OF OPERATION (SOO) - HEATING WATER BYPASS FLOW CONTROL AT NON-PLANT BUILDING ON CAMPUS HEATING WATER LOOP

A. Overview: This system consists of a heating water (HW) bypass flow control valve and (4) Platinum RTD temperature sensors. HW is pumped with one or more building pumps to the building (tertiary) HW loads. An appropriately sized bypass leg decouples the secondary and tertiary HW systems. The bypass flow control valve controls the amount of HW that is imported from the loop (secondary) to the building (tertiary) such that the loop (secondary) side HW delta-T is maximized.

B. PID Loop Definitions: The following PID loop shall be provided at the system device controller:

PID Loop #2 (Tertiary Heating Water Bypass Flow Control)

PID Loop Description		Point Name	Units	Point Description
1.	PID Input Point Name:	FLOWINP2	%	Bypass Recirculation Flowrate Error as Percentage of Loop Flowrate
2.	PID Set-Point:	0	%	Percent Error
3.	PID Output Point Name:	BYPVLVCMD2	%	Output Range from 0 to 100
4.	PID Loop Action:	Direct Acting		
5.	PID Loop Reset:	See Section C for PID Enable and Output Bias		

C. Software & Hardware Point Definitions: **LCT Programming** is required at a higher-level controller and shall be remotely accessible for commissioning purposes.

Point Number	Point Name	Point Description and Formula
1.	SYSX T1MINUST2	Common secondary HW supply temperature minus tertiary HW supply temperature
		T1MINUST2 = MAX {0, (MIN (T1HWS, T2LOW) – T2HWS)}
2.	SYSX T2MINUST4	Tertiary HW supply temperature minus tertiary HW return temperature
		T2MINUST4 = MAX {1.0, (T2HWS – T4HWR)}
3.	SYSX T4MINUST5	Tertiary HW return temperature minus secondary HW return temperature

		IF T1MINUST2 > 0.25 THEN
		T4MINUST5 = 0
		ELSE
		IF T1MINUST2 < 0.05 THEN
		T4MINUST5 = MIN {0, (T4HWR – T5HWR)}
		ENDIF

4.	SYSX FLOWINP2	Building re-circulated bypass flow error percentage
		FLOWINP2 = MIN [100, MAX (5, HWBYPVLV) * {(T1MINUST2 / T2MINUST4) + (T4MINUST5 / T2MINUST4) – C2 / 100}]
5.	SYSX OATMIN2	Minimum Outdoor Air Dry-Bulb Temperature for Span Block, deg F (User Adjustable)
		OATMIN2 = 30

6.	SYSX OATMAX2	Maximum Outdoor Air Dry-Bulb Temperature for Span Block, deg F (User Adjustable)
		OATMAX2 = 60
7.	SYSX T2LOW	Minimum Acceptable Tertiary HW Supply Temperature, deg F (User Adjustable)
		T2LOW = CAMPUS_HWSP – OFFSET2
8.	SYSX CHIGH2	Highest Re-circulated HW Building Flow as % of Design Building Flow for Span Block (User Adjustable)
		CHIGH2 = 2
9.	SYSX CLOW2	Lowest Re-circulated Building HW Flow as % of Design Building Flow for Span Block
		CLOW2 = 1
10.	SYSX C2	Desired Re-circulated Building HW Flow % calculated using span block
		C2 = Output from SPAN Block [OATAVG, OATMIN2, CLOW2, OATMAX2, CHIGH2]
11.	SYSX OAT	Outdoor Air Temperature, deg F
		OAT = Mapped from Weather Station
12.	SYSX OARH	Outdoor Air Relative Humidity, %
		OARH = Mapped from Weather Station
13.	SYSX OAWB	Outdoor Air Wet Bulb Temperature, deg F
		Calculated Outdoor Air Wet Bulb based on OAT and OARH
14.	SYSX OATAVG	Time Averaged Outdoor Air Temperature, deg F
		Calculate average value of OAT over 108 consecutive scans
15.	SYSX OFFSET2	Offset to Minimum Acceptable Tertiary HW Supply Temperature, deg F
		OFFSET2 = Output from SPAN Block [OATAVG, OATMIN2, 1, OATMAX2, 2]
16.	SYSX BYPVMIN2	Minimum PID Output Value (User Adjustable)
		BYPVMIN2 = 10
17.	SYSX BYPVMAX2	Maximum PID Output Value (User Adjustable)
		BYPVMAX2 = 100
18.	SYSX PB2	Proportional Band Term – Mapped to Device Controller with PID Loop #2
		PB2 = 800
19.	SYSX IT2	Integral Term – Mapped to Device Controller with the PID Loop #2
		IT2 = 48 sec
20.	SYSX STARTVAL2	PID Output when Enabled
		STARTVAL2 = 30
21.	SYSX STOPVAL2	PID #2 Output when Disabled
		STOPVAL2 = BYPVMIN2
22.	SYSX PID2ENABLE	PID #2 Enable and Disable Criteria
		If all tertiary HW pumps are disabled, as confirmed by run status, for 60 seconds continuously, then PID2ENABLE = FALSE else PID2ENABLE = TRUE
23.	SYSX HWBYPVLV	Tertiary HW Bypass Flow Control Valve % Open Command. Command Mapped to Device Controller
		HWBYPVLV = BYPVLVCMD2 * PID2ENABLE