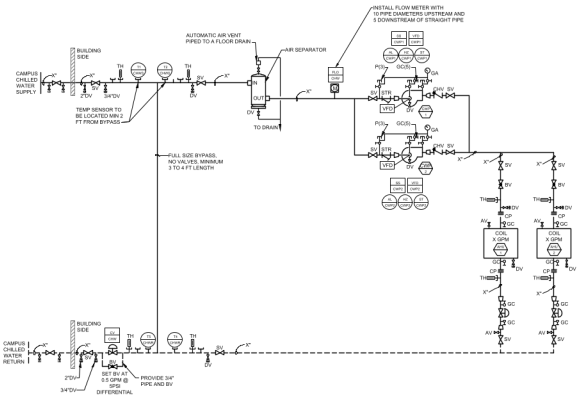

NON-PLANT CHILLED WATER FLOW DIAGRAM

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 CHILLED WATER POINTS LIST

POINT DESCRIPTION					START/UP 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 UNIT CONTROLLER)										
AV	OA-T	OUTSIDE AIR TEMPERATURE REFERENCE	OUTSIDE_AIR_TEMP_SENSOR_REF	°F,1	-	-	-	-	BAS POINT MAPPED TO CONTROLLER	
AV	OA-H	OUTSIDE AIR RELATIVE HUMIDITY REFERENCE	OUTSIDE_AIR_HUMIDITY_SENSOR_REF	% RH,1	-	-	-	-	BAS POINT MAPPED TO CONTROLLER	
AV	OA-DWP	OUTSIDE AIR DEW POINT REFERENCE	OUTSIDE_AIR_DEWPOINT_SENSOR_REF	°F,1	-	-	-	-	BAS POINT MAPPED TO CONTROLLER	
CHILLED WATER SYSTEM POINTS										
AI	TS-CHWR	CHW RETURN TO CAMPUS LOOP HEADER TEMPERATURE	CHILLED_WATER_LEAVING_TEMP_SENSOR	°F,1	1 MIN	30 MIN	15 MIN	1 WEEK	INSERTION ELEMENT FLUID TEMPERATURE SENSOR	
AI	T1-CHWS	CHW SUPPLY LOOP HEADER TEMPERATURE	CHILLED_WATER_ENTERING_TEMP_SENSOR	°F,1	1 MIN	30 MIN	15 MIN	1 WEEK	INSERTION ELEMENT FLUID TEMPERATURE SENSOR	
AI	T4-CHWR	CHW RETURN FROM BUILDING LOOP TEMPERATURE	CHILLED_WATER_LEAVING_TEMP_SENSOR	°F,1	1 MIN	30 MIN	15 MIN	1 WEEK	INSERTION ELEMENT FLUID TEMPERATURE SENSOR	
AI	T2-CHWS	CHW SUPPLY TO BUILDING LOOP TEMPERATURE	CHILLED_WATER_ENTERING_TEMP_SENSOR	°F,1	1 MIN	30 MIN	15 MIN	1 WEEK	INSERTION ELEMENT FLUID TEMPERATURE SENSOR	
AI	CW-DP	CHILLED 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
AO	VFD-CWP1	CHILLED WATER PUMP 1 SPEED COMMAND	CHILLED_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-CWP2	CHILLED WATER PUMP 2 SPEED COMMAND	CHILLED_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-CHW	CHILLED WATER BY-PASS VALVE COMMAND	CHILLED_WATER_VALVE_CMD	% ,0	1 MIN	30 MIN	15 MIN	1 WEEK	HARDWIRED POINT TO CONTROLLED DEVICE	
AV	HZ-CWP1	CHILLED WATER PUMP 1 SPEED FEEDBACK	CHILLED_WATER_PUMP_FREQ_SENSOR	HZ ,0	1 MIN	30 MIN	15 MIN	1 WEEK	NETWORK INTERFACE TO CONTROLLED DEVICE	
AV	HZ-CWP2	CHILLED WATER PUMP 2 SPEED FEEDBACK	CHILLED_WATER_PUMP_FREQ_SENSOR	HZ ,0	1 MIN	30 MIN	15 MIN	1 WEEK	NETWORK INTERFACE TO CONTROLLED DEVICE	
AV	FLO-CHW	CHILLED WATER LOOP FLOW	CHILLED_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-CWP1	CHILLED 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-CWP2	CHILLED WATER PUMP 2 VFD ALARM	N/A	NORM / ALARM	1 MIN	30 MIN	15 MIN	1 WEEK	NETWORK INTERFACE TO CONTROLLED DEVICE	
BV	AL-CWP3	CHILLED WATER PUMP 1 ALARM	N/A	NORM / ALARM	1 MIN	30 MIN	15 MIN	1 WEEK	NETWORK INTERFACE TO CONTROLLED DEVICE	
BI	ST-CWP1	CHILLED WATER PUMP 1 STATUS	CHILLED_WATER_PUMP_RUN_SENSOR	OFF / ON	1 MIN	30 MIN	15 MIN	1 WEEK	FIXED TRIP CURRENT SWITCH	
BI	ST-CWP2	CHILLED WATER PUMP 2 STATUS	CHILLED_WATER_PUMP_RUN_SENSOR	OFF / ON	1 MIN	30 MIN	15 MIN	1 WEEK	FIXED TRIP CURRENT SWITCH	
BO	SS-CWP1	CHILLED WATER PUMP 1 START/STOP	CHILLED_WATER_PUMP_RUN_CMD	OFF / ON	1 MIN	30 MIN	15 MIN	1 WEEK	DRY CONTACT / RELAY	
BO	SS-CWP2	CHILLED WATER PUMP 2 START/STOP	CHILLED_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.

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

CHILLED WATER FLOW DIAGRAM

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

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

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

PID Loop #1 (Tertiary Chilled Water Bypass Flow Control)

PID Loop Description		Point Name	Units	Point Description
1.	PID Input Point Name:	FLOWINP1	%	Bypass Recirculation Flowrate Error as Percentage of Secondary Flowrate
2.	PID Set-Point:	0	%	Percent Error
3.	PID Output Point Name:	BYPVLVCMD1	%	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 OAWBMIN1	Minimum Outdoor Air Wet Bulb Temperature for Span Block, deg F (User Adjustable)
		OAWBMIN1 = 30
2.	SYSX OAWBMAX1	Maximum Outdoor Air Wet Bulb Temperature for Span Block, deg F (User Adjustable)
		OAWBMAX1 = 60
3.	SYSX T2HIGH	Maximum Acceptable Tertiary CHW Supply Temperature, deg F (User Adjustable)
		T2HIGH = CAMPUS_CHWSP + OFFSET1
4.	SYSX OFFSET1	Winter Offset to Maximum Acceptable Tertiary CHW Supply Temperature, deg F
		OFFSET1 = Output from SPAN Block [OAWBAVG, OAWBMIN1, 2, OAWBMAX1, 1]
5.	SYSX CHIGH1	Highest Re-circulated CHW Tertiary Flow as % of Design Tertiary Flow for Span Block (User Adjustable)
		CHIGH1 = 2 (Value is dependent on building properties)
6.	SYSX CLOW1	Lowest Re-circulated Tertiary CHW Flow as % of Design Tertiary Flow for Span Block (User Adjustable)
		CLOW1 = 1 (Value is dependent on building properties)
7.	SYSX C1	Desired Re-circulated Tertiary CHW Flow % calculated using span block
		C1 = Output from SPAN Block [OAWBAVG, OAWBMIN1, CHIGH1, OAWBMAX1, CLOW1]

8.	SYSX OAT	Outdoor Air Temperature, deg F
		OAT = Mapped from Campus Weather Station, deg F
9.	SYSX OARH	Outdoor Air Relative Humidity, %
		OARH = Mapped from Campus Weather Station
10.	SYSX OAWB	Outdoor Air Wet Bulb Temperature, deg F
		Calculated Outdoor Air Wet Bulb based on OAT and OARH
11.	SYSX OAWBAVG	Time Averaged Outdoor Air Wet Bulb Temperature, deg F
		Calculate average value of OAWB over 108 consecutive scans
12.	SYSX BYPVMIN1	Minimum PID Output Value (User Adjustable)
		BYPVMIN1 = 10
13.	SYSX BYPVMAX1	Maximum PID Output Value (User Adjustable)
		BYPVMAX1 = 100
14.	SYSX PB1	Proportional Band Term – Mapped to Device Controller with Bypass Flow Control PID Loop (User Adjustable)
		PB1 = 800
15.	SYSX IT1	Integral Term – Mapped to Device Controller with Bypass Flow Control PID Loop (User Adjustable)
		IT1 = 48 sec
16.	SYSX STARTVAL1	PID Output Value when PID loop goes from Disabled to Enabled State (User Adjustable)
		STARTVAL1 = 30
17.	SYSX STOPVAL1	PID Output Value when PID loop goes from Enabled to Disabled State (User Adjustable)
		STOPVAL1 = BYPVMIN1
18.	SYSX PID1ENABLE	PID Loop Enable and Disable Criteria
		If all tertiary CHW pumps are disabled, as confirmed by run status, for 60 seconds continuously, then PID1ENABLE = FALSE else PID1ENABLE = TRUE
19.	SYSX T2MINUST1	Common tertiary CHW supply temperature minus secondary CHW supply temperature
		T2MINUST1 = MAX {0, (T2CHWS – MAX (T1CHWS, T2HIGH))}
20.	SYSX T4MINUST2	Tertiary CHW return temperature minus tertiary CHW supply temperature
		T4MINUST2 = MAX {2, (T4CHWR – T2CHWS)}
21.	SYSX T5MINUST4	Secondary CHW return temperature minus tertiary CHW return temperature

		IF T2MINUST1 > 0.25 THEN
		T5MINUST4 = 0
		ELSE
		IF T2MINUST1 < 0.05 THEN
		T5MINUST4 = MIN {0, (T5CHWR – T4CHWR)}
		ENDIF

22.	SYSX FLOWINP1	Tertiary re-circulated bypass flow error percentage
		FLOWINP1 = MIN [100, MAX (5, CHWBYPVLV) * {(T2MINUST1 / T4MINUST2) + (T5MINUST4 / T4MINUST2) – (C1 / 100)}]
23.	SYSX CHWBYPVLV	Tertiary CHW Bypass Flow Control Valve % Open Command. Command Mapped to Device Controller
		CHWBYPVLV = BYPVLVCMD1 * PID1ENABLE