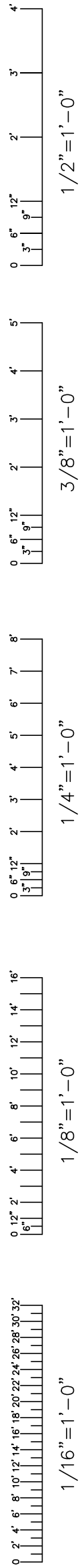
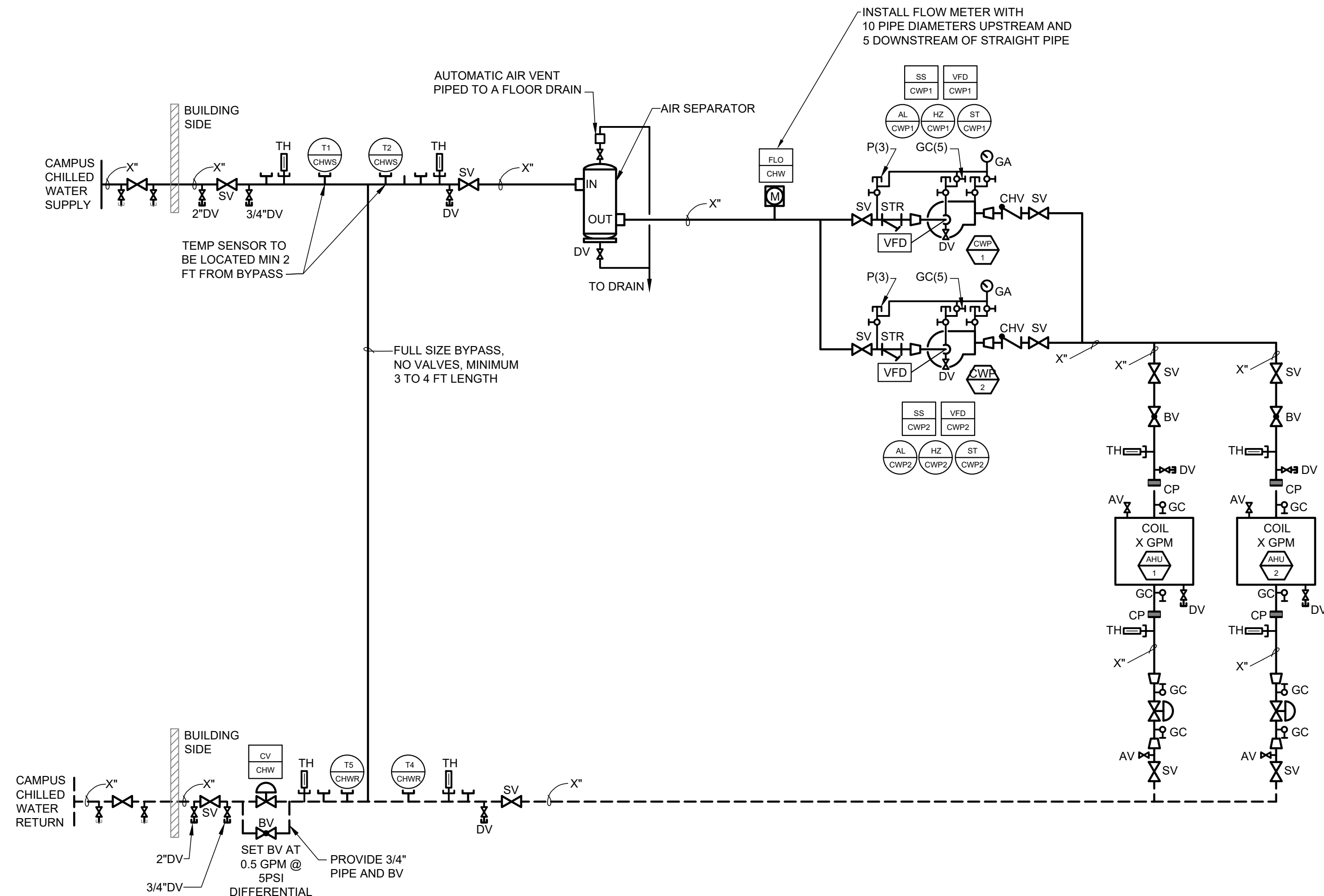


File: S:\071143.000 MS&T GEOTHERMAL SYSTEM DESIGN DETAIL\03 MECHANICAL\M5-X - 071143.000 Saved: 2025-3-18 10:22 By: DReynolds



F
E
D
C
B
A



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										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 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	T5-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							
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.																
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															

UPDATED: 3/1/2024

UPDATED: 3/18

SHEET IS PLOTTED TO SCALE IF ADJACENT LINE MEASURES 1 INCH

PRELIMINARY
NOT FOR CONSTRUCTION

PROJECT STATUS: XXXXXXXXXX

DATE: xx/xx/xxxx
PROJECT #: xxxxxx
DRAWN BY: xxx
CHECKED BY: xxx

CHILLED WATER
FLOW DIAGRAM

M5.3

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PROJECT ENGINEER
LICENSE #

REVISONS	NO	DATE	DESCRIPTION				

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

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Rolla, MO

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MEP Engineers:
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Missouri State Certificate of
Authority #000087

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) $T2HIGH = \text{CAMPUS_CHWSP} + \text{OFFSET1}$
4.	SYSX OFFSET1	Winter Offset to Maximum Acceptable Tertiary CHW Supply Temperature, deg F $\text{OFFSET1} = \text{Output from SPAN Block [OAWBAVG, OAWBMIN1, 2, OAWBMAX1, 1]}$
5.	SYSX CHIGH1	Highest Re-circulated CHW Tertiary Flow as % of Design Tertiary Flow for Span Block (User Adjustable) $\text{CHIGH1} = 2$ (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) $\text{CLOW1} = 1$ (Value is dependent on building properties)
7.	SYSX C1	Desired Re-circulated Tertiary CHW Flow % calculated using span block $\text{C1} = \text{Output from SPAN Block [OAWBAVG, OAWBMIN1, CHIGH1, OAWBMAX1, CLOW1]}$

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
		$T2MINUST1 = \text{MAX} \{0, (T2CHWS - \text{MAX} (T1CHWS, T2HIGH))\}$
20.	SYSX T4MINUST2	Tertiary CHW return temperature minus tertiary CHW supply temperature
		$T4MINUST2 = \text{MAX} \{2, (T4CHWR - T2CHWS)\}$
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
		$\text{FLOWINP1} = \text{MIN} [100, \text{MAX} (5, \text{CHWBYPVLV}) * \{(T2MINUST1 / T4MINUST2) + (T5MINUST4 / T4MINUST2) - (C1 / 100)\}]$
23.	SYSX CHWBYPVLV	Tertiary CHW Bypass Flow Control Valve % Open Command.
		Command Mapped to Device Controller $\text{CHWBYPVLV} = \text{BYPVLVCMD1} * \text{PID1ENABLE}$