University of Delaware

Design & Construction Technical Guidelines

Division 23 MECHANICAL

23 21 25_CHW DISTRICT INTERCONNECTION

To insure operational stability, reliability, and energy efficiency of the central campus chilled water (CHW) plants and district, the following guidance is provided. The two drawings provided in Attachment A illustrate the principles of operation to be adhered to when designing a new building, or a significant building renovation, with an interconnection to the central campus CHW District. Additionally, as described in Section 23 00 00: 1) There are to be no 3-way valves or open bypasses on any CHW system equipment connected to the CWH District. 2) Process cooling water loops in buildings are to be separated from the District via an appropriately designed heat exchanger.

The information provided in this document is technical guidance on the principles of operation of the Central Campus CHW district for operational stability, reliability and energy efficiency. The designer of record on the specific project is responsible the development of the project specific engineering/drawings/documentation related to this guidance.

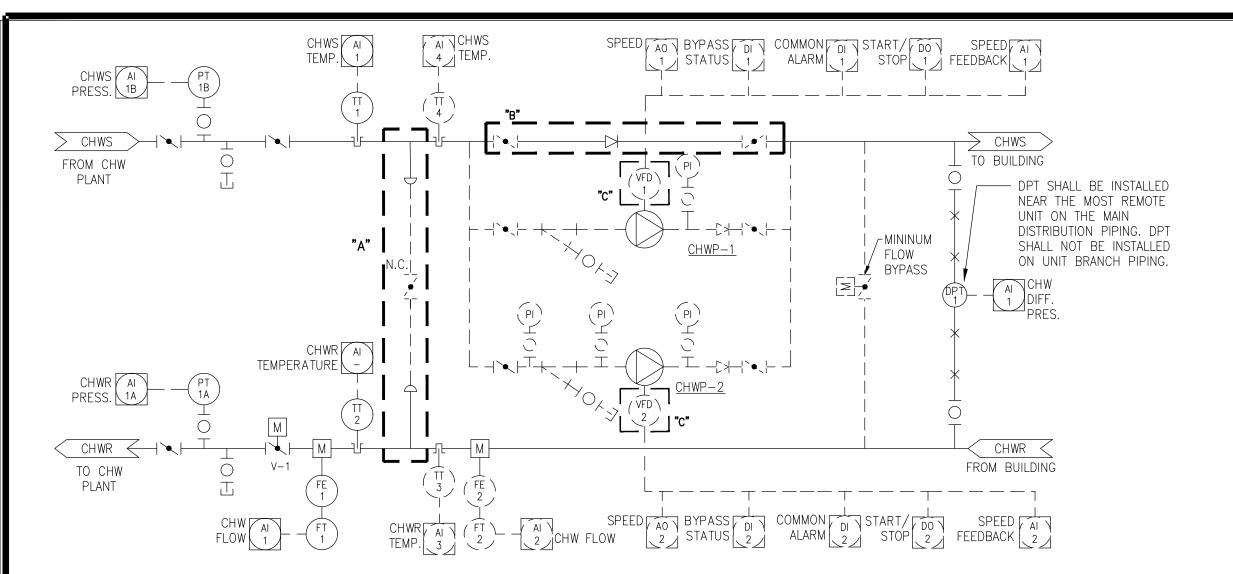
END OF SECTION

University of Delaware

Design & Construction Technical Guidelines

Division 23 MECHANICAL

ATTACHMENT A



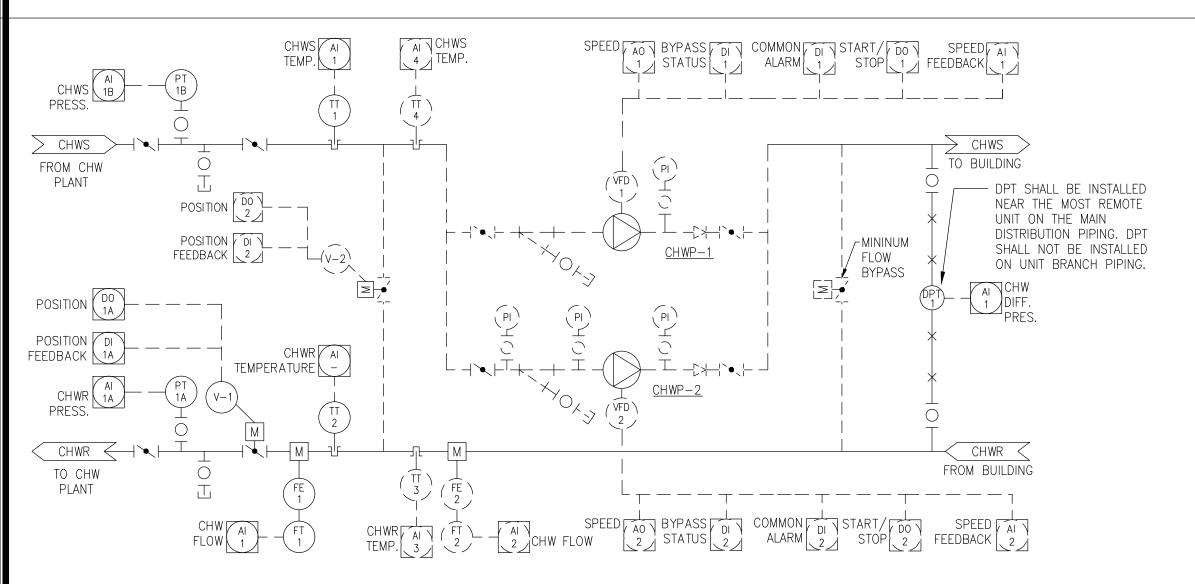
BUILDING PIPING WITH VFD PUMPS AND BYPASS - INSIDE LOOP

CONFIGURATIONS:

- A. THE FOLLOWING ACTIONS WILL BE TAKEN WITH THE EXISTING DECOUPLER.
- 1. IF BUILDING CHILLED WATER SHUTDOWN IS REQUIRED FOR OTHER WORK ASSOCIATED WITH THIS SCOPE, REMOVE DECOUPLER PIPING AND CAP. 2. IF THE DECOUPLER DOES NOT HAVE A MANUAL OR AUTOMATIC ISOLATION VALVE, REMOVE DECOUPLER PIPING AND CAP.
- 3. IF THERE IS NO CHW SHUTDOWN/DRAIN-DOWN REQUIRED AND THERE IS A MANUAL OR AUTOMATIC ISOLATION VALVE IN THE DECOUPLER, CLOSE MANUAL VALVE OR REMOVE ACTUATOR OF AUTOMATIC VALVE AND CLOSE
- B. CHILLED WATER PUMPS BYPASS SHALL BE INSTALLED IF NOT ALREADY EXISTING. IF THE EXISTING BYPASS DOES NOT INCLUDE THE CHECK AND ISOLATION VALVE
- AS SHOWN, ANY MISSING VALVES SHALL BE INSTALLED.
- C. VFDs SHALL BE INSTALLED ON CHILLED WATER PUMPS IF NOT ALREADY EXISTING.

SEQUENCE OF OPERATIONS:

- 1. CHWP-1/2 SHALL RUN IN LEAD LAG ARRANGEMENT. THE PUMPS SHALL MODULATE TO MAINTAIN THE DP SET-POINT PRESSURE OF 10 PSID (ADJ) AT DPT-1. THE PUMPS SHALL AUTO-ROTATE LEAD/LAG EVERY 200 HOURS OF OPERATION. IF THE LEAD PUMP SPEED REACHES 85% THE LAG PUMP SHALL START AND
- RUN IN UNISON OFF THE SAME PID LOOP. WITH BOTH PUMPS RUNNING THE LAG PUMP SHALL TURN OFF IF THE SPEED DROPS TO 55%. 1.1. IF PUMPS ARE AT MINIMUM SPEED AND DP AT <u>DPT-1</u> GOES 3 PSID ABOVE THE DP SET-POINT FOR 5 MINUTES, PUMPS SHALL TURN OFF.
- 1.2. IF PUMPS ARE OFF V-1 SHALL MODULATED TO MAINTAIN DP SETPOINT. 1.3. IF PUMPS ARE OFF AND DP AT DPT-1 IS 1 PSID BELOW THE SETPOINT FOR 5 MINUTES, PUMP SHALL ENGAGE AT MINIMUM SPEED.
- 2. IF BUILDING HAS AN EXISTING MINIMUM FLOW BYPASS AND IF ANY PUMPS ARE RUNNING, MIN FLOW BYPASS SHALL MODULATE VIA DIRECT ACTING PID LOOP TO
- MAINTAIN A DP SET-POINT OF 15PSID ABOVE THE CONTROL SETPOINT. 3. THE CHW RETURN VALVE V-1 SHALL CLOSE IF THE OAT DROPS BELOW 35 °F (ADJ) UNLESS THE BUILDING REQUIRES YEAR-ROUND COOLING FOR PROCESS.



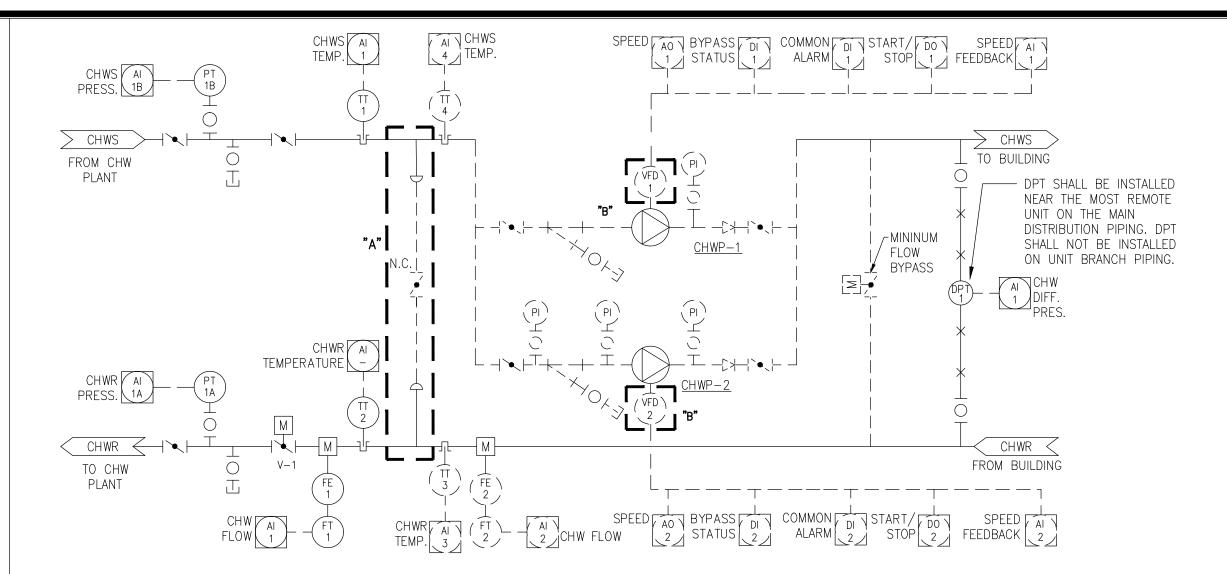
BUILDING PIPING WITH DECOUPLER

<u>CONFIGURATION:</u>

A. REGARDLESS OF HYDRAULIC LOOPS, BUILDINGS WITH THREE WAY VALVES ON AHUS AND FCUS SHALL MAINTAIN DECOUPLER OPERATION.

SEQUENCE OF OPERATIONS:

- 1. THE CHW RETURN VALVE V-1 SHALL MODULATE TO MAINTAIN BUILDING RETURN TEMPERATURE T-3 PER EQUATION T-3 = T-4 + X. DECOUPLER VALVE V-2 SHALL BE NORMALLY OPEN. 1.1. X SHALL BE RESET BETWEEN 1 AND 10 BASED ON CHW VALVE POSITION.
- 1.2. IF THE MOST OPEN CHW VALVE IS LESS THAN 90%, X SHALL BE INCREMENTED BY 1. IF THE MOST OPEN VALVE IS GREATER THAN 90% X SHALL BE DECREMENTED BY 1. THIS LOOP
- 1.3. IF X = 1 AND BUILDING \underline{DT} , CALCULATED PER EQUATION $\underline{DT} = \underline{TT-3} \underline{TT-4}$, IS GREATER THAN 8°F THEN $\underline{V-2}$ SHALL CLOSE AND PUMPS SHALL OPERATE PER SEQUENCE SHOWN IN 3. IF PUMP IS AT MINIMUM SPEED FOR MORE THAN 15 MIN THE PUMP SHALL TURN OFF. IF THE DP DROPS BELOW 2 PSID BELOW SET-POINT THE PUMP SHALL BE ENERGIZED IMMEDIATELY. IF PUMPS ARE OFF AND DP PRESSURE AT <u>DPT-1</u> IS GREATER THAN SET-POINT BY 5 PSID (ADJ), <u>V-1</u> SHALL MODULATE TO MAINTAIN DP SET-POINT BY +5 PSI. IF THE BUILDING DT DROPS BELOW 5°F THE SYSTEM SHALL REVERT BACK TO THIS SEQUENCE.
- 2. THE CHW RETURN VALVE V-1 SHALL CLOSE IF THE OAT DROPS BELOW 35 °F (ADJ) AND CHW PUMPS ARE OFF UNLESS THERE IS A PROCESS LOAD IN THE BUILDING (VALVE MUST OPEN
- 3. CHWP-1/2 SHALL RUN IN LEAD LAG ARRANGEMENT. THE PUMPS SHALL MODULATE TO MAINTAIN THE DP SET-POINT PRESSURE AT DPT-1. THE PUMPS SHALL AUTO-ROTATE LEAD/LAG EVERY 200 HOURS OF OPERATION. IF THE LEAD PUMP SPEED REACHES 85% THE LAG PUMP SHALL START AND RUN IN UNISON OFF THE SAME PID LOOP. WITH BOTH PUMPS RUNNING THE LAG PUMP
- SHALL TURN OFF IF THE SPEED DROPS TO 55%. 4. IF BUILDING HAS AN EXISTING MINIMUM FLOW BYPASS AND ANY PUMPS ARE RUNNING, BYPASS SHALL MODULATE VIA DIRECT ACTING PID LOOP TO MAINTAIN A DP SET-POINT OF 15PSID ABOVE
- THE CONTROL SETPOINT.



BUILDING PIPING WITH VFD PUMPS AND NO BYPASS - INSIDE LOOP 2

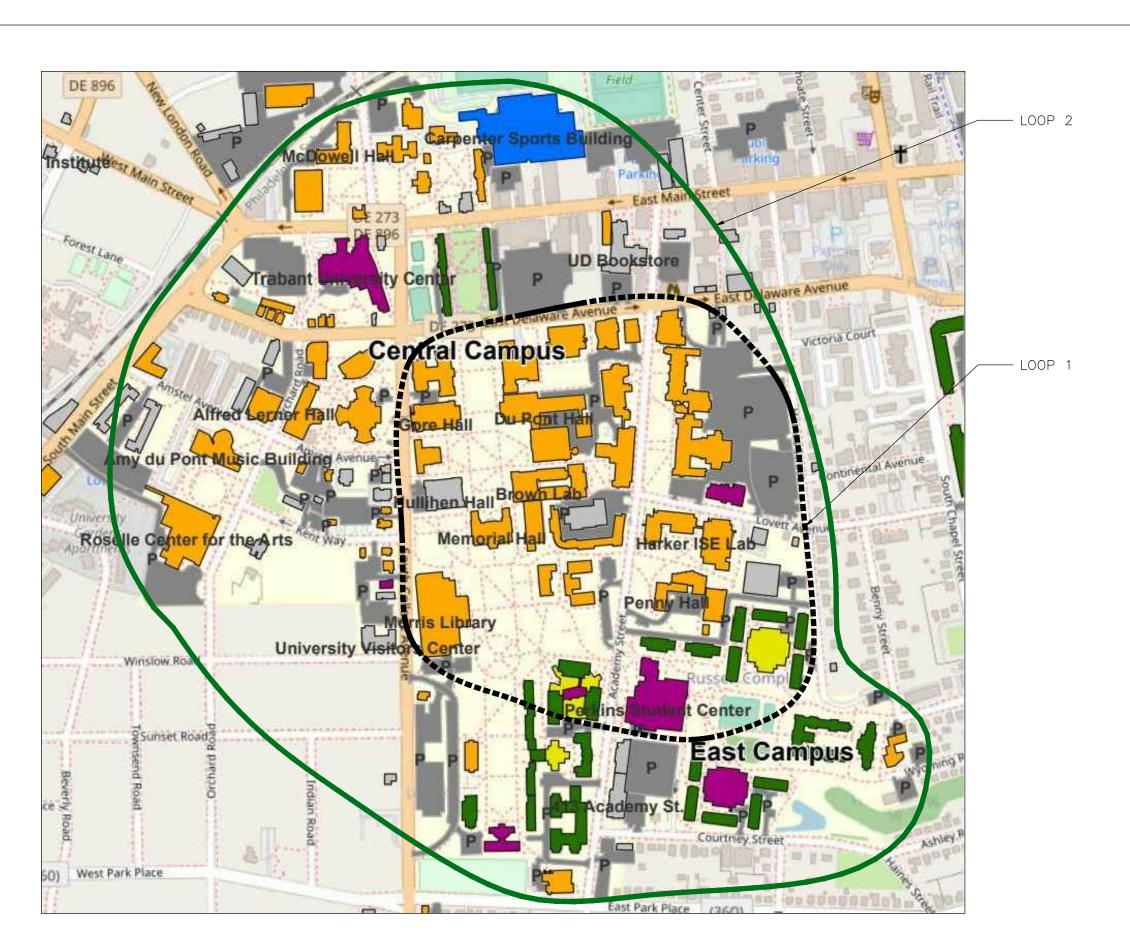
CONFIGURATIONS:

- A. THE FOLLOWING ACTIONS WILL BE TAKEN WITH THE EXISTING DECOUPLER
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- 3. IF THERE IS NO CHW SHUTDOWN/DRAIN-DOWN REQUIRED AND THERE IS A MANUAL OR AUTOMATIC ISOLATION VALVE IN THE DECOUPLER, CLOSE MANUAL VALVE OR
- REMOVE ACTUATOR OF AUTOMATIC VALVE AND CLOSE. B. VFDs SHALL BE INSTALLED ON CHILLED WATER PUMPS IF NOT ALREADY EXISTING.

SEQUENCE OF OPERATIONS:

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3. THE CHW RETURN VALVE V-1 SHALL CLOSE IF THE OAT DROPS BELOW 35 °F (ADJ) UNLESS THE BUILDING REQUIRES YEAR-ROUND COOLING FOR PROCESS.





HYDRAULIC LOOPS FOR CENTRAL CAMPUS PLANTS

NOT TO SCALE



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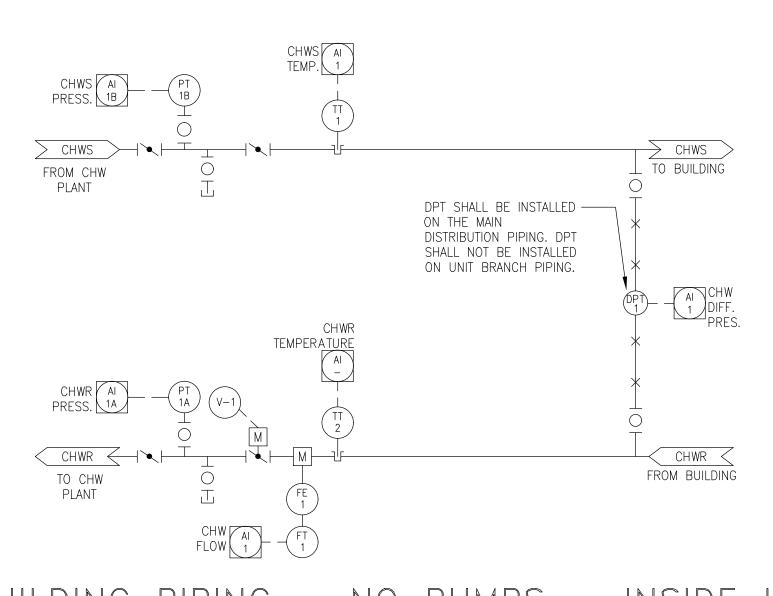
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NO	DATE	DESCRIPTION
0	7.2.19	ISSUED FOR OWNER'S REVIEW
1	8.6.19	ISSUED FOR OWNER'S REVIEW
2	8.28.19	ISSUED FOR DESIGN
3	11.18.19	ISSUED FOR DESIGN

CHW DISTRICT OPTIMIZATION PROGRAM

CHW DISTRICT INTERCONNECTION STANDARD -**EXISTING BUILDING**

PROJECT: CHW DISTRICT OPTIMIZATION
DATE : 06.27.2019
DRAWN: RN
CHECKED: TS
UD WORK ORDER #: 572963

M-101



BUILDING PIPING - NO PUMPS - INSIDE LOOP 1

CONFIGURATION:

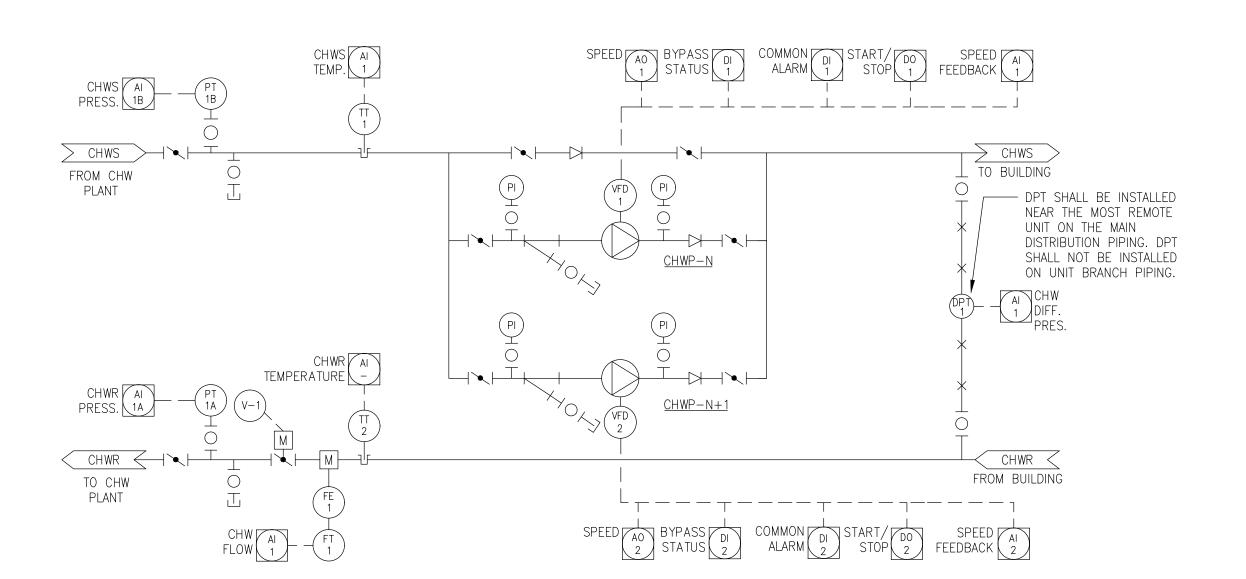
A. NO PUMPS SHALL BE INSTALLED IN THE BUILDING.

SEQUENCE OF OPERATIONS:

- 1. THE CHW RETURN VALVE $\underline{ extsf{V}-1}$ SHALL MODULATE TO MAINTAIN THE DP SET-POINT PRESSURE AT $\underline{ extsf{DPT}-1}$.
- 2. THE CHW RETURN VALVE V-1 SHALL CLOSE IF THE OAT DROPS BELOW 35 °F (ADJ) UNLESS THE BUILDING NEEDS YEAR ROUND COOLING.

DESIGN NOTES:

1. BUILDING SHALL BE DESIGNED TO FUNCTION WITH 30 FT OF DIFFERENTIAL PRESSURE HEAD AVAILABLE AT BUILDING WALL.



BUILDING PIPING - VFD PUMPS AND BYPASS - OUTSIDE LOOP 1

CONFIGURATIONS:

- A. BUILDING PUMPS SHALL HAVE VFDs.
- B. BYPASS WITH ISOLATION AND CHECK VALVES SHALL BE PROVIDED ACROSS THE PUMPS.

SEQUENCE OF OPERATIONS:

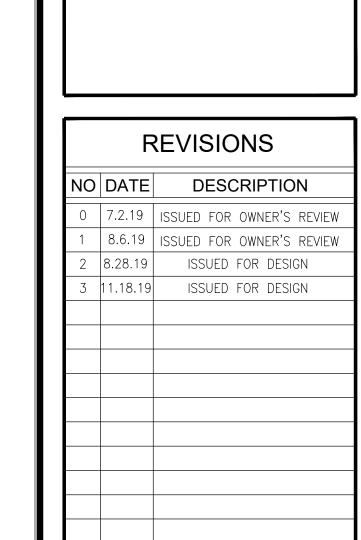
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 1.1. IF PUMPS ARE AT MINIMUM SPEED AND DP PRESSURE AT <u>DPT-1</u> GOES 3 PSID ABOVE THE DP SET-POINT FOR 5 MINUTES, PUMPS SHALL TURN OFF.

 1.2. IF PUMPS ARE OFF <u>V-1</u> SHALL MODULATED TO MAINTAIN DP SETPOINT.

 1.3. IF PUMPS ARE OFF AND DP PRESSURE AT <u>DPT-1</u> IS 1 PSID BELOW THE SETPOINT FOR 5 MINUTES, PUMP SHALL ENGAGE AT MINIMUM SPEED.
- 2. IF BUILDING HAS AN EXISTING MINIMUM FLOW BYPASS AND IF ANY PUMPS ARE RUNNING, MIN FLOW BYPASS SHALL MODULATE VIA DIRECT ACTING PID LOOP TO MAINTAIN A DP SET-POINT OF 15PSID ABOVE THE CONTROL SETPOINT.

3. THE CHW RETURN VALVE V-1 SHALL CLOSE IF THE OAT DROPS BELOW 35 °F (ADJ) UNLESS THE BUILDING REQUIRES YEAR-ROUND COOLING FOR PROCESS.



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CHW DISTRICT OPTIMIZATION PROGRAM

CHW DISTRICT
INTERCONNECTION
STANDARD NEW BUILDING

PROJECT: CHW DISTRICT OPTIMIZATION

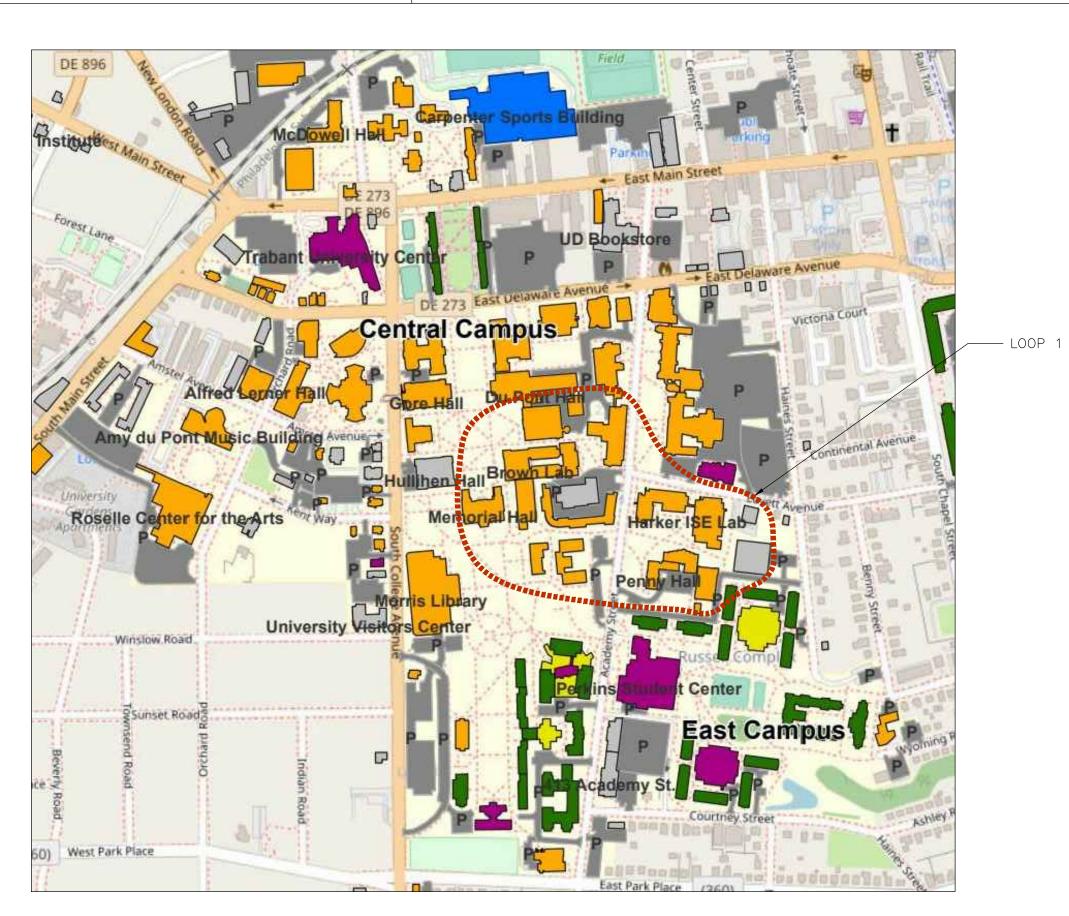
DATE: 06.27.2019

DRAWN: RN

CHECKED: TS

UD WORK ORDER #: 572963

M-102



HYDRAULIC LOOP FOR CENTRAL CAMPUS PLANTS

NOT TO SCALE

	FLOW N	/IETER			RNISHE	D AND INST			OLS CONTR	ACTOR	R) 	POWE	R
TAG	TYPE	MAKE	MODEL NUMBER	TRANSDUCER LOCATION	FIFE SIZE	TEMPERATURE	PIPE MATERIAL	WETTED MATERIAL	ENCLOSURE	OUTPUT	ACCURACY	V/PH/HZ	W
			1.01.102.1	20 0.111011	INCHES	°F						V/F11/MZ	L VV
FM-X	INSERTION MAGMETER	ONICON	F3500	CHW RETURN	•	42-95	STEEL	316 SS	NEM A TYPE 4X	4-20 mA	1% FLOW READING	24VDC	-
NOTES : 1. MAINTAIN MINIMUM	1 STRAIGHT RU	N PER M A	NUFACTUR	ER'S RECOMME	NDATION.								

	TEMPERATURE TRANSMITTERS SCHEDULE (ADD ALTERNATE - FURNISHED AND INSTALLED BY CONTROLS CONTRACTOR)													
TAG	SERVICE	SENSOR TYPE	MAKE	M ODEL NUM BER	OUTPUT	EXCITATION	NUMBER OF WIRES	ACCURACY	RANGE	MAX OPERATING TEMPERATURE	MAX OPERATING PRESSURE	CONNECTION TYPE(S)	CONSTRUCTION	OPTIONS
TT-X	CHWS/R	IMMERSON RTD	KELE	ST-W85	4-20 mA	24 VDC	-	+/- 0.27°F	-40°F TO 221°F	80°F	150 PSIG	THERM OWELL	SS WETTED PARTS	CALIBRATION CERT
NOTES	; :	,			_									

1. ALL THERMOWELLS TO BE FILLED WITH THERM AL CONDUCTIVE GREASE

1. REFER TO BUILDING DRAWINGS FOR SIZE AND FLOWS.

1. UNIT TO BE ANCHORED ON THE EXISTING FRAMES

1. ALL DRIVE COMPONENTS TO BE INSTALLED IN ONE COMPLETE UL508 ENCLOSURE

				VAL	VE ACTUAT	TOR SCHEDU	JLE (FURN	NISHED	AND INS	STALLED I	BY CONTRO	DLS CO	NTRACTO	OR)	
	PROCESS DATA ACTUATOR DATA												į		
TAG	SERVICE					MAX DESIGN	CLOSE-OFF	TYPE	POWER	MOUNTING	ACTION / FAIL	CONTROL	ENCLOSURE	MAKE/MODEL	ACCESSORIES
	SERVICE	MAX MIN AVERAGE PRESSURE (PSIG) TEM		TEMPERATURE (F)	PRESSURE (PSI)		(VAC/PH/HZ)	MOUNTING	POSITION	SIGNAL	ENCLUSURE				
	CHW	-	1	-	150	100	100	ELECTRIC	24VAC	INTEGRAL TO VALVE	MODULATING / LAST	0-10V	NEMA 2X	BELIMO/ CCV	
NOTES:															

1. FOR OUTSIDE AIR UNITS EQUIPPED WITH FREEZE STATS, VALVES SHALL BE FAIL SAFE SPRING RETURN NORMALLY CLOSED.

										11) (E)		CON 17		(C.D.)			
						SCHEDULE (FURNISHE	ED AND INS	I ALLED B	Y MEC	CHANICAL			OR)			
					PROCESS DATA							VAL	VE DATA				
TAG	SERVICE]	FLOW (GPM)	MAX DESIGN	MAX DESIGN	CLOSE-OFF	ТҮРЕ	SIZE	BODY	ANSI PRESSURE	LEAK			MATERIAL		M AKE/MODEL
	SERVICE	MAX	MIN	AVERAGE	PRESSURE (PSIG)	TEMPERATURE (F)	PRESSURE (PSI)	11112	SIZE	DOD 1	CLASS	CLASS	BODY	STEM/DISC	PACK/SEAT	SPRING/TRIM/BALL	WARE/WODEL
-	CHW	-	-	-	150	100	100	RESILIENT SEATED BUTTERFLY	>= 6"	150# LUGGED	150		CI	316SS	EPDM	-	ABZ/397
-	CHW	-	-	-	150	100	100	FLANGED THREE PIECE, FULL PORT BALL VALVE	2-1/2" - 4"	125#	150		BRONZE	-	TEFLON	SS	NIBCO
-	CHW	-	-	-	150	100	100	TWO PIECE, FULL PORT BALL VALVE	< 2"	125#	150		BRONZE	-	TEFLON	SS	APOLLO/70-150
-	CHW	-	-	-	150	100	100	GLOBE SILENT CHECK VALVE	-	125#	125		CS	SS	VITON	SS	TITAN/ CV51-CS
NOTES:																	

	INSTRUMI	ENTATION A	ND CONTE	ROL SENSOR	S SCHEDU	JLE (FUR	NISHED A	ND INST	ALLED B	Y CONTROL	S CONTRA	CTOR, TAP	S AND VALVE	ES INSTALLED	BY MECHANCAL)
TAG	SERVICE	SENSOR TYPE	MAKE	M ODEL NUMBER	OUTPUT	EXCITATION	NUMBER OF WIRES	ACCURACY	OPERATING RANGE	MAX OPERATING TEMPERATURE	MAX OPERATING PRESSURE	CONNECTION TYPE(S)	CONSTRUCTION	OPTIONS	ACCESSORIES
DPT-1	CHW HEADER	DIFF PRESSURE	SCHNEIDER ELECTRIC	EPW 2104	4-20 mA	24 VDC	2	+/- 1 % FS	0-100 PSID	100°F	150 PSIG	(2) 1/8" NPT (F)	SS WETTED PARTS	CALIBRATION CERTIFICATE	3-WAY COPLANAR MANIFOLD, MOUNTING BRACKET

					MOT	OK SCH	EDULE (F	UKNISE	IED AND IN	STALLED	BY UD MOTOR VEN	DOK)							
											MOTOR DATA								
TAG	USE	MAKE	MODEL		SYNCHRONOUS	MAYSUD	INSULATION	NIEMA		SERVICE	MATE	RIAL		UNIT ELEC	TRIC DATA	EFFIC	IENCY		
TAG	USL	WAKL	WODEL	HP	SPEED	WAX SLII	CLASS	NEM A DESIGN	DUTY	FACTOR ON	SHAFT	FRAME	BEARING	V/PH/HZ	MAX FLA	NEM A	NOM.	MIN.	ENCLOSUR
					RPM	%	02.155	DESIGN		VFD	SHAFI	TRAME	DEARING	V/1 11/11Z	AMPS	INDIVIA	%	%	
P-1	CHILLED WATER PUMP	USMOTORS	AS APPLICABLE	-	1,775	1.2	F	В	CONTINUOUS DUTY	1.15	HEAT TREATED AND STRESS RELIEVED CARBON STEEL	ROLLED STEEL	GROUNDEED REGREASABLE STEEL BALL	460/3/60	-	PREMIUM	91.0	89.0	ODP
P-2	CHILLED WATER PUMP	CHILLED WATER US MOTORS AS AP	AS APPLICABLE	-	1,775	1.2	F	В	CONTINUOUS DUTY	1.15	HEAT TREATED AND STRESS RELIEVED CARBON STEEL	ROLLED STEEL	GROUNDEED REGREASABLE STEEL BALL	460/3/60	-	PREMIUM	91.0	89.0	ODP

										7741						NID DICTAL	IIDD		ENDOD)									
	1		Γ				Ī		T	V AJ	RIABLE FF			SCHEDULE (FUR	KNISHED A	IND INSTAI	LLED B	3Y VFD VI	T	 		T	T	T	<u> </u>	т	Г	<i>!</i>
ON SEDVICE	TVDE	MAKE	MODEL NUMBER		EEE X	ъпла (MAX Current	OUTPUT CURRENT		DANCE	A CCLIP A CV			OUTDUT DESOLUTION	VOLTAGE	SHORT CIRCUIT	DRIVE	HEAT DISSIPATION	AIRFLOW REQUIREMENT	COMMUNICATION	DVDACC	ENCLOSURE	HARMONIC	REACTOR IMPEDANCE	EMI/RMI	PROTECTION	DISCONNIECT	WEIGHT
ON SERVICE	1 TFE	WAKE	MODEL NUMBER	HP	Err.		AMPS	AMPS	FT	HZ DIO			ANALOG	HZ	RANGE	RATING	AMPS	BTUH	CFM	COMMUNICATION	DIFASS	ENCLOSURE	PERFORM ANCE	MIN	FILTERS	FROTECTION	DISCONNECT	LBS
P-1		ABB	ACH550	-	98%	80/3/60	-	-	-	10 - 500 0	.10% 1.00%	0.1 HZ	1% OF MAX FREG	Q 0.01	+30% TO -35%	100,000 SCCR	-			BACNET - VFD, BYPASS, & AUX I/O	2 CONTACTOR W/ NEC RATED SERVICE SWITCH	NEMA 1	6 PULSE WITH DUAL DC CHOKES	5%		INTEGRAL CIRCUIT BREAKER	YES	
P-2		ABB	ACH550	-	98%	80/3/60	-	-	-	10 - 500 0	.10% 1.00%	0.1 HZ	1% OF MAX FREG	Q 0.01	+30% TO -35%	100,000 SCCR	_			BACNET - VFD,	2 CONTACTOR W/ NEC	NEMA 1	6 PULSE WITH DUAL DC CHOKES	5%		INTEGRAL CIRCUIT	YES	
'I	P-1	P-1	 	P-1 ABB ACH550	P-1 ABB ACH550 -	P-1 ABB ACH550 - 98% 43	Note	SERVICE	FION SERVICE TYPE MAKE MODEL NUMBER SIZE EFF. V/PH/HZ CURRENT CURRENT HP AMPS AMPS P-1 ABB ACH550 - 98% 480/3/60	SERVICE TYPE MAKE MODEL NUMBER SIZE EFF. V/PH/HZ CURRENT CURRENT FROM MOTOR HP - 98% 480/3/60	SERVICE TYPE MAKE MODEL NUMBER $\begin{array}{c ccccccccccccccccccccccccccccccccccc$	$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	SERVICE TYPE MAKE MODEL NUMBER MOTOR SIZE EFF. V/PH/HZ CURRENT CURRENT CURRENT FROM MOTOR ANGE ACCURACY SETTING AMPS AMPS FT HZ DIGITAL ANALOG DIGITAL P-1 ABB ACH550 - 98% 480/3/60 10 - 500 0.10% 1.00% 0.1 HZ	HOTOR SERVICE TYPE MAKE MODEL NUMBER SIZE EFF. WHILE LEFT. WIPH/HZ CURRENT CURRENT CURRENT CURRENT CURRENT CURRENT FROM MOTOR RANGE ACCURACY SETTING RESOLUTION AMPS AMPS FT HZ DIGITAL ANALOG DIGITAL ANALOG DIGITAL ANALOG COMPANY FROM MOTOR RANGE ACCURACY SETTING RESOLUTION AMPS AMPS FT HZ DIGITAL ANALOG DIGITAL ANALOG COMPANY FROM MOTOR RANGE ACCURACY SETTING RESOLUTION AMPS AMPS FT HZ DIGITAL ANALOG DIGITAL ANALOG COMPANY FROM MOTOR RANGE ACCURACY SETTING RESOLUTION AMPS AMPS FT HZ DIGITAL ANALOG COMPANY FROM MOTOR RANGE ACCURACY SETTING RESOLUTION AMPS AMPS FT HZ DIGITAL ANALOG COMPANY FROM MOTOR RANGE ACCURACY SETTING RESOLUTION AMPS AMPS FT HZ DIGITAL ANALOG COMPANY FROM MOTOR RANGE ACCURACY SETTING RESOLUTION AMPS AMPS FT HZ DIGITAL ANALOG COMPANY FROM MOTOR RANGE ACCURACY SETTING RESOLUTION AMPS AMPS FT HZ DIGITAL ANALOG COMPANY FROM MOTOR RANGE ACCURACY SETTING RESOLUTION AMPS AMPS FT HZ DIGITAL ANALOG COMPANY FROM MOTOR RANGE ACCURACY SETTING RESOLUTION AMPS AMPS FT HZ DIGITAL ANALOG COMPANY FROM MOTOR RANGE ACCURACY SETTING RESOLUTION AMPS AMPS FT HZ DIGITAL ANALOG COMPANY FROM MOTOR RANGE ACCURACY SETTING RESOLUTION AMPS AMPS FT HZ DIGITAL ANALOG COMPANY FROM MOTOR RANGE ACCURACY SETTING RESOLUTION AMPS AMPS AMPS FT HZ DIGITAL ANALOG COMPANY FROM MOTOR RANGE ACCURACY SETTING RESOLUTION AMPS AMPS AMPS AMPS AMPS AMPS AMPS AMPS	SERVICE TYPE MAKE MODEL NUMBER SIZE EFF. V/PH/HZ CURRENT CURRENT CURRENT CURRENT FROM MOTOR AMPS AMPS FT HZ DIGITAL ANALOG DIG	SERVICE TYPE MAKE MODEL NUMBER MODEL NUMBER $\frac{1}{SIZE}$ EFF. $\frac{1}{V/PH/HZ}$ $\frac{MAX}{CURRENT}$ $\frac{OUTPUT}{CURRENT}$ $\frac{DISTANCE}{FROM MOTOR}$ $\frac{1}{RANGE}$	SERVICE TYPE MAKE MODEL NUMBER $\left(\begin{array}{c} MOTOR \\ SIZE \\ HP \end{array}\right)$ $\left(\begin{array}{c} MOTOR \\ SIZE \\ HP \end{array}\right)$ $\left(\begin{array}{c} FFF. \\ V/PH/HZ \\ EFF. \\ HP \end{array}\right)$ $\left(\begin{array}{c} MAX \\ CURRENT \\ CURRENT \\ AMPS \end{array}\right)$ $\left(\begin{array}{c} DISTANCE \\ FROM MOTOR \\ FRANGE \\ ANALOG \\ DIGITAL \\ DI$	$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	SERVICE TYPE MAKE MODEL NUMBER SIZE FF . $V/PH/HZ$ FF . $V/$	$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	$\begin{array}{c c c c c c c c c c c c c c c c c c c $	$\begin{array}{cccccccccccccccccccccccccccccccccccc$	$\begin{array}{c c c c c c c c c c c c c c c c c c c $	$\begin{array}{c c c c c c c c c c c c c c c c c c c $	$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	

DIVERSITY OF ELAWARE.

347 W. 36TH ST. SUITE 204
NEW YORK, NY 10018

TEL: (212) 671-2420
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	F	REVISIONS
NO	DATE	DESCRIPTION
0	7.19.19	ISSUED FOR OWNER'S REVIEW
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CHW DISTRICT OPTIMIZATION PROGRAM

CHW DISTRICT INTERCONNECTION STANDARD -SCHEDULES

PROJECT: CHW DISTRICT OPTIMIZATION

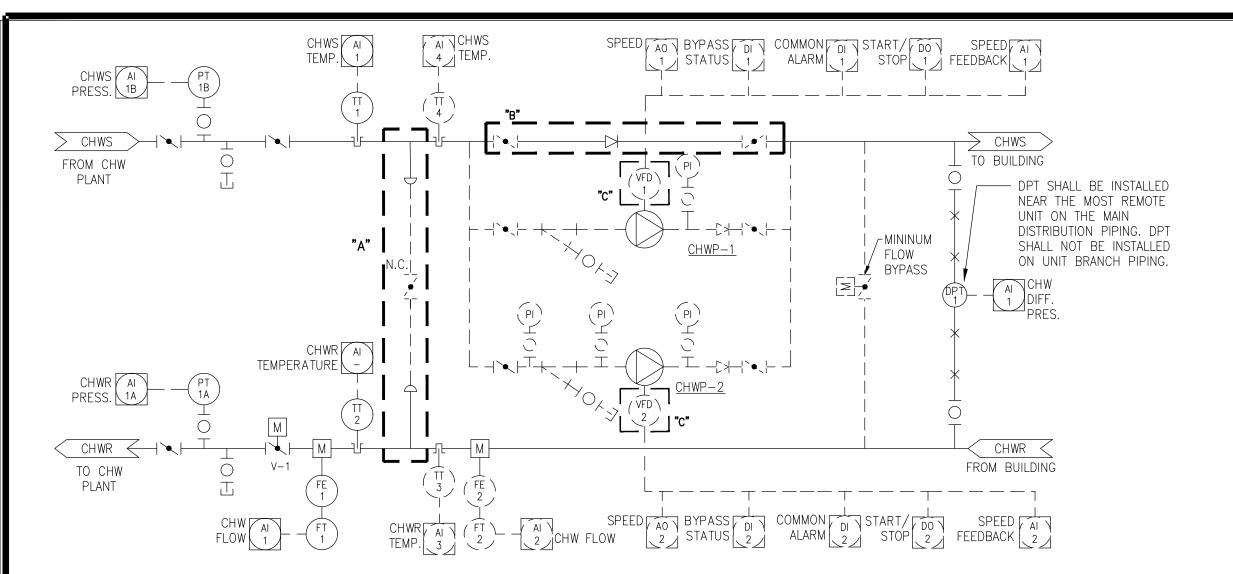
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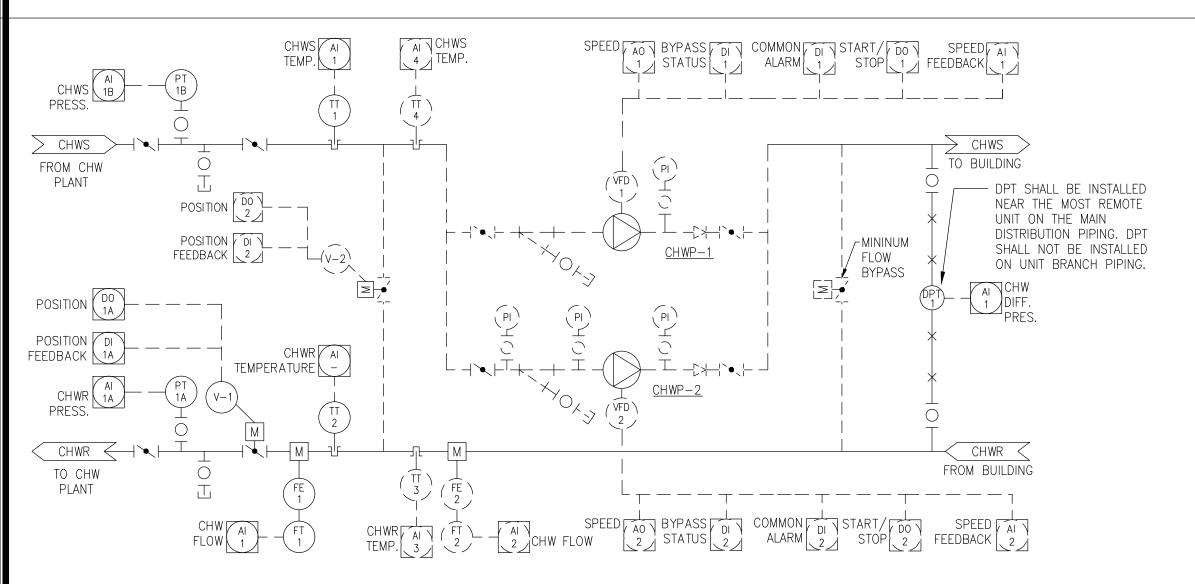
BUILDING PIPING WITH VFD PUMPS AND BYPASS - INSIDE LOOP

CONFIGURATIONS:

- A. THE FOLLOWING ACTIONS WILL BE TAKEN WITH THE EXISTING DECOUPLER.
- 1. IF BUILDING CHILLED WATER SHUTDOWN IS REQUIRED FOR OTHER WORK ASSOCIATED WITH THIS SCOPE, REMOVE DECOUPLER PIPING AND CAP. 2. IF THE DECOUPLER DOES NOT HAVE A MANUAL OR AUTOMATIC ISOLATION VALVE, REMOVE DECOUPLER PIPING AND CAP.
- 3. IF THERE IS NO CHW SHUTDOWN/DRAIN-DOWN REQUIRED AND THERE IS A MANUAL OR AUTOMATIC ISOLATION VALVE IN THE DECOUPLER, CLOSE MANUAL VALVE OR REMOVE ACTUATOR OF AUTOMATIC VALVE AND CLOSE
- B. CHILLED WATER PUMPS BYPASS SHALL BE INSTALLED IF NOT ALREADY EXISTING. IF THE EXISTING BYPASS DOES NOT INCLUDE THE CHECK AND ISOLATION VALVE
- AS SHOWN, ANY MISSING VALVES SHALL BE INSTALLED.
- C. VFDs SHALL BE INSTALLED ON CHILLED WATER PUMPS IF NOT ALREADY EXISTING.

SEQUENCE OF OPERATIONS:

- 1. CHWP-1/2 SHALL RUN IN LEAD LAG ARRANGEMENT. THE PUMPS SHALL MODULATE TO MAINTAIN THE DP SET-POINT PRESSURE OF 10 PSID (ADJ) AT DPT-1. THE PUMPS SHALL AUTO-ROTATE LEAD/LAG EVERY 200 HOURS OF OPERATION. IF THE LEAD PUMP SPEED REACHES 85% THE LAG PUMP SHALL START AND
- RUN IN UNISON OFF THE SAME PID LOOP. WITH BOTH PUMPS RUNNING THE LAG PUMP SHALL TURN OFF IF THE SPEED DROPS TO 55%. 1.1. IF PUMPS ARE AT MINIMUM SPEED AND DP AT <u>DPT-1</u> GOES 3 PSID ABOVE THE DP SET-POINT FOR 5 MINUTES, PUMPS SHALL TURN OFF.
- 1.2. IF PUMPS ARE OFF V-1 SHALL MODULATED TO MAINTAIN DP SETPOINT. 1.3. IF PUMPS ARE OFF AND DP AT DPT-1 IS 1 PSID BELOW THE SETPOINT FOR 5 MINUTES, PUMP SHALL ENGAGE AT MINIMUM SPEED.
- 2. IF BUILDING HAS AN EXISTING MINIMUM FLOW BYPASS AND IF ANY PUMPS ARE RUNNING, MIN FLOW BYPASS SHALL MODULATE VIA DIRECT ACTING PID LOOP TO
- MAINTAIN A DP SET-POINT OF 15PSID ABOVE THE CONTROL SETPOINT. 3. THE CHW RETURN VALVE V-1 SHALL CLOSE IF THE OAT DROPS BELOW 35 °F (ADJ) UNLESS THE BUILDING REQUIRES YEAR-ROUND COOLING FOR PROCESS.



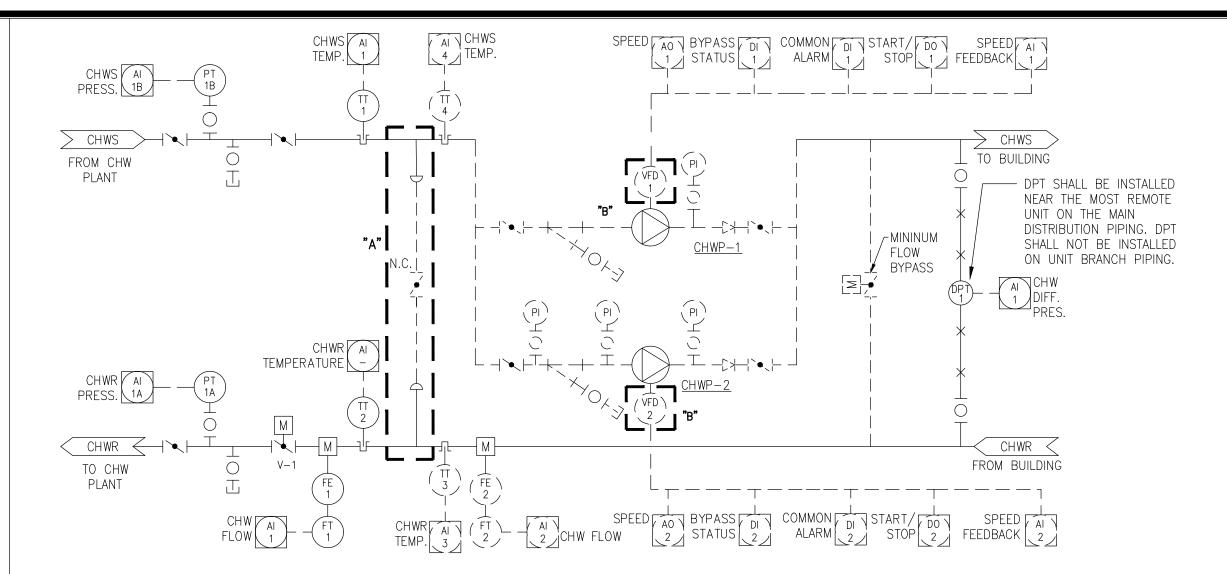
BUILDING PIPING WITH DECOUPLER

<u>CONFIGURATION:</u>

A. REGARDLESS OF HYDRAULIC LOOPS, BUILDINGS WITH THREE WAY VALVES ON AHUS AND FCUS SHALL MAINTAIN DECOUPLER OPERATION.

SEQUENCE OF OPERATIONS:

- 1. THE CHW RETURN VALVE V-1 SHALL MODULATE TO MAINTAIN BUILDING RETURN TEMPERATURE T-3 PER EQUATION T-3 = T-4 + X. DECOUPLER VALVE V-2 SHALL BE NORMALLY OPEN. 1.1. X SHALL BE RESET BETWEEN 1 AND 10 BASED ON CHW VALVE POSITION.
- 1.2. IF THE MOST OPEN CHW VALVE IS LESS THAN 90%, X SHALL BE INCREMENTED BY 1. IF THE MOST OPEN VALVE IS GREATER THAN 90% X SHALL BE DECREMENTED BY 1. THIS LOOP
- 1.3. IF X = 1 AND BUILDING \underline{DT} , CALCULATED PER EQUATION $\underline{DT} = \underline{TT-3} \underline{TT-4}$, IS GREATER THAN 8°F THEN $\underline{V-2}$ SHALL CLOSE AND PUMPS SHALL OPERATE PER SEQUENCE SHOWN IN 3. IF PUMP IS AT MINIMUM SPEED FOR MORE THAN 15 MIN THE PUMP SHALL TURN OFF. IF THE DP DROPS BELOW 2 PSID BELOW SET-POINT THE PUMP SHALL BE ENERGIZED IMMEDIATELY. IF PUMPS ARE OFF AND DP PRESSURE AT <u>DPT-1</u> IS GREATER THAN SET-POINT BY 5 PSID (ADJ), <u>V-1</u> SHALL MODULATE TO MAINTAIN DP SET-POINT BY +5 PSI. IF THE BUILDING DT DROPS BELOW 5°F THE SYSTEM SHALL REVERT BACK TO THIS SEQUENCE.
- 2. THE CHW RETURN VALVE V-1 SHALL CLOSE IF THE OAT DROPS BELOW 35 °F (ADJ) AND CHW PUMPS ARE OFF UNLESS THERE IS A PROCESS LOAD IN THE BUILDING (VALVE MUST OPEN
- 3. CHWP-1/2 SHALL RUN IN LEAD LAG ARRANGEMENT. THE PUMPS SHALL MODULATE TO MAINTAIN THE DP SET-POINT PRESSURE AT DPT-1. THE PUMPS SHALL AUTO-ROTATE LEAD/LAG EVERY 200 HOURS OF OPERATION. IF THE LEAD PUMP SPEED REACHES 85% THE LAG PUMP SHALL START AND RUN IN UNISON OFF THE SAME PID LOOP. WITH BOTH PUMPS RUNNING THE LAG PUMP
- SHALL TURN OFF IF THE SPEED DROPS TO 55%. 4. IF BUILDING HAS AN EXISTING MINIMUM FLOW BYPASS AND ANY PUMPS ARE RUNNING, BYPASS SHALL MODULATE VIA DIRECT ACTING PID LOOP TO MAINTAIN A DP SET-POINT OF 15PSID ABOVE
- THE CONTROL SETPOINT.



BUILDING PIPING WITH VFD PUMPS AND NO BYPASS - INSIDE LOOP 2

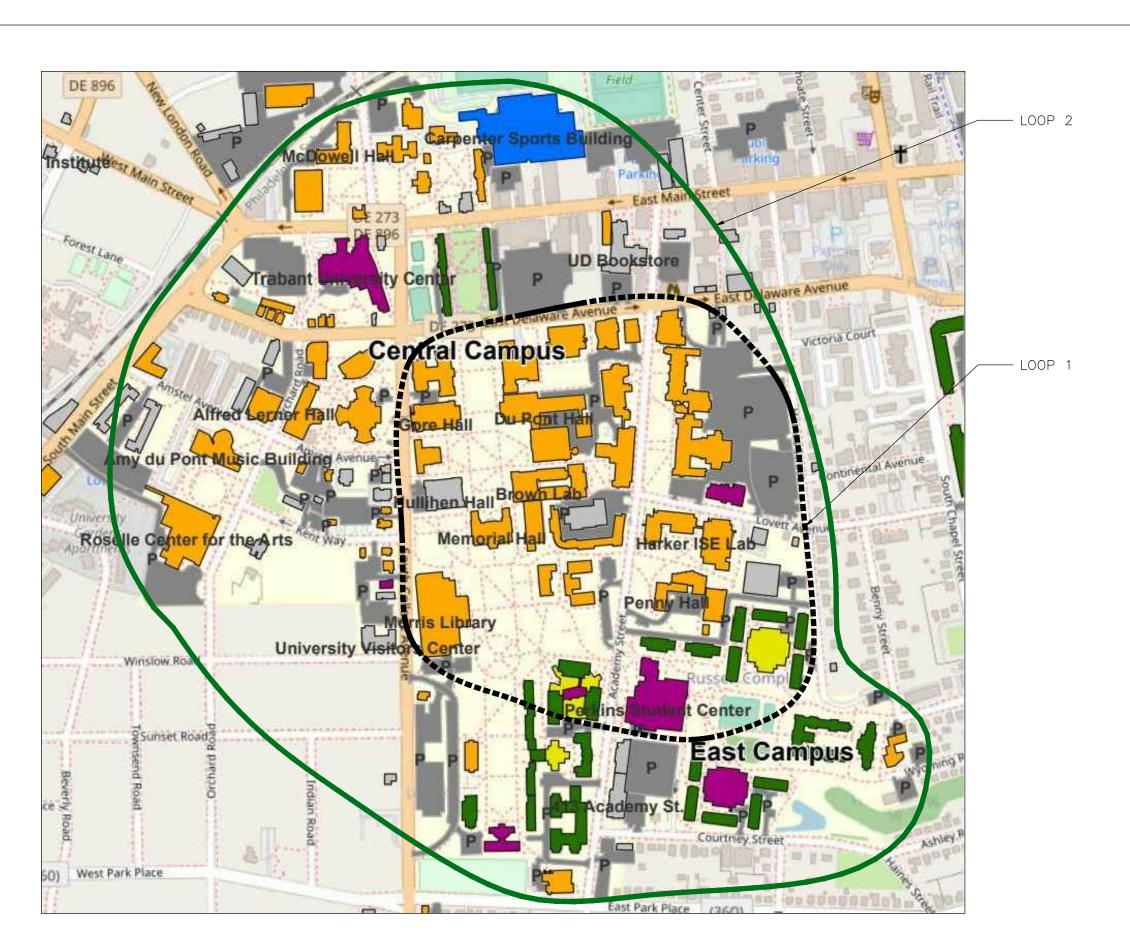
CONFIGURATIONS:

- A. THE FOLLOWING ACTIONS WILL BE TAKEN WITH THE EXISTING DECOUPLER
- 1. IF BUILDING CHILLED WATER SHUTDOWN IS REQUIRED FOR OTHER WORK ASSOCIATED WITH THIS SCOPE, REMOVE DECOUPLER PIPING AND CAP. 2. IF THE DECOUPLER DOES NOT HAVE A MANUAL OR AUTOMATIC ISOLATION VALVE, REMOVE DECOUPLER PIPING AND CAP.
- 3. IF THERE IS NO CHW SHUTDOWN/DRAIN-DOWN REQUIRED AND THERE IS A MANUAL OR AUTOMATIC ISOLATION VALVE IN THE DECOUPLER, CLOSE MANUAL VALVE OR
- REMOVE ACTUATOR OF AUTOMATIC VALVE AND CLOSE. B. VFDs SHALL BE INSTALLED ON CHILLED WATER PUMPS IF NOT ALREADY EXISTING.

SEQUENCE OF OPERATIONS:

- 1. CHWP-1/2 SHALL RUN IN LEAD LAG ARRANGEMENT. THE PUMPS SHALL MODULATE TO MAINTAIN THE DP SET-POINT PRESSURE OF 10 PSID (ADJ) AT DPT-1. THE PUMPS SHALL AUTO-ROTATE LEAD/LAG EVERY 200 HOURS OF OPERATION. IF THE LEAD PUMP SPEED REACHES 85% THE LAG PUMP SHALL START AND RUN IN
- UNISON OFF THE SAME PID LOOP. WITH BOTH PUMPS RUNNING THE LAG PUMP SHALL TURN OFF IF THE SPEED DROPS TO 55%. 1.1. IF PUMPS ARE AT MINIMUM SPEED AND DP AT <u>DPT-1</u> GOES 3 PSID ABOVE THE DP SET-POINT FOR 5 MINUTES, PUMPS SHALL TURN OFF.
- 1.2. IF PUMPS ARE OFF V-1 SHALL MODULATED TO MAINTAIN DP SETPOINT.
- 1.3. IF PUMPS ARE OFF AND DP AT <u>DPT-1</u> IS 1 PSID BELOW THE SETPOINT FOR 5 MINUTES, PUMP SHALL ENGAGE AT MINIMUM SPEED.
- 2. IF BUILDING HAS AN EXISTING MINIMUM FLOW BYPASS AND IF ANY PUMPS ARE RUNNING, MIN FLOW BYPASS SHALL MODULATE VIA DIRECT ACTING PID LOOP TO MAINTAIN A DP SET-POINT OF 15PSID ABOVE THE CONTROL SETPOINT.

3. THE CHW RETURN VALVE V-1 SHALL CLOSE IF THE OAT DROPS BELOW 35 °F (ADJ) UNLESS THE BUILDING REQUIRES YEAR-ROUND COOLING FOR PROCESS.





HYDRAULIC LOOPS FOR CENTRAL CAMPUS PLANTS

NOT TO SCALE



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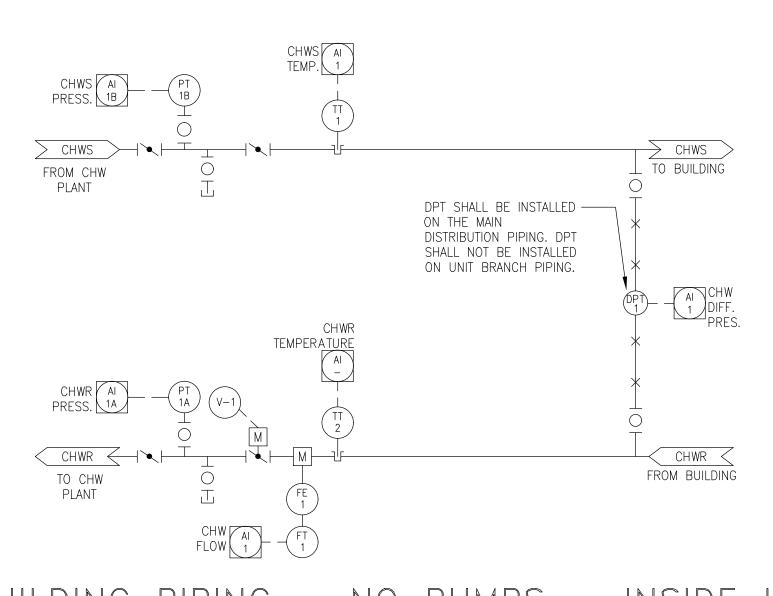
	F	REVISIONS
NO	DATE	DESCRIPTION
0	7.2.19	ISSUED FOR OWNER'S REVIEW
1	8.6.19	ISSUED FOR OWNER'S REVIEW
2	8.28.19	ISSUED FOR DESIGN
3	11.18.19	ISSUED FOR DESIGN

CHW DISTRICT OPTIMIZATION PROGRAM

CHW DISTRICT INTERCONNECTION STANDARD -**EXISTING BUILDING**

PROJECT: CHW DISTRICT OPTIMIZATION
DATE : 06.27.2019
DRAWN: RN
CHECKED: TS
UD WORK ORDER #: 572963

M-101



BUILDING PIPING - NO PUMPS - INSIDE LOOP 1

CONFIGURATION:

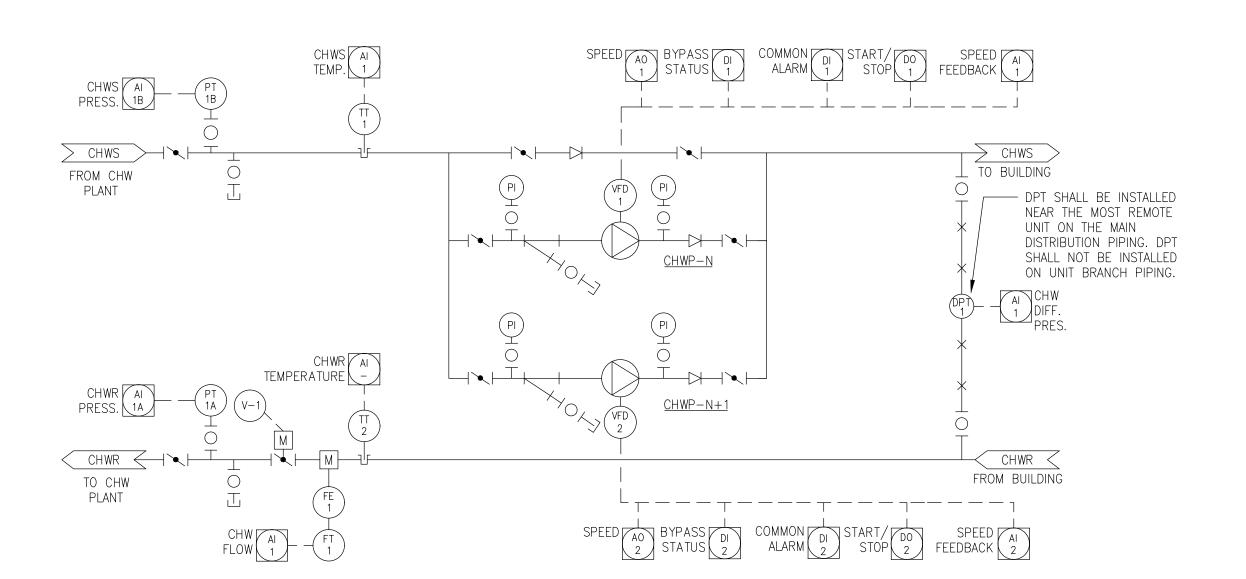
A. NO PUMPS SHALL BE INSTALLED IN THE BUILDING.

SEQUENCE OF OPERATIONS:

- 1. THE CHW RETURN VALVE $\underline{ extsf{V}-1}$ SHALL MODULATE TO MAINTAIN THE DP SET-POINT PRESSURE AT $\underline{ extsf{DPT}-1}$.
- 2. THE CHW RETURN VALVE V-1 SHALL CLOSE IF THE OAT DROPS BELOW 35 °F (ADJ) UNLESS THE BUILDING NEEDS YEAR ROUND COOLING.

DESIGN NOTES:

1. BUILDING SHALL BE DESIGNED TO FUNCTION WITH 30 FT OF DIFFERENTIAL PRESSURE HEAD AVAILABLE AT BUILDING WALL.



BUILDING PIPING - VFD PUMPS AND BYPASS - OUTSIDE LOOP 1

CONFIGURATIONS:

- A. BUILDING PUMPS SHALL HAVE VFDs.
- B. BYPASS WITH ISOLATION AND CHECK VALVES SHALL BE PROVIDED ACROSS THE PUMPS.

SEQUENCE OF OPERATIONS:

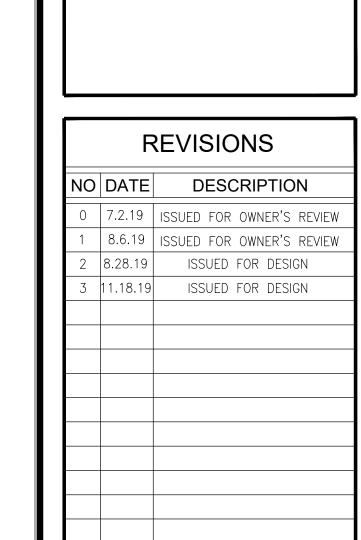
- 1. <u>CHWP-1/2</u> SHALL RUN IN LEAD LAG ARRANGEMENT. THE PUMPS SHALL MODULATE TO MAINTAIN THE DP SET-POINT PRESSURE OF 10 PSID (ADJ) AT <u>DPT-1</u>. THE PUMPS SHALL AUTO-ROTATE LEAD/LAG EVERY 200 HOURS OF OPERATION. IF THE LEAD PUMP SPEED REACHES 85% THE LAG PUMP SHALL START AND RUN IN UNISON OFF THE SAME PID LOOP. WITH BOTH PUMPS RUNNING THE LAG PUMP SHALL TURN OFF IF THE SPEED DROPS TO 55%.

 1.1. IF PUMPS ARE AT MINIMUM SPEED AND DP PRESSURE AT <u>DPT-1</u> GOES 3 PSID ABOVE THE DP SET-POINT FOR 5 MINUTES, PUMPS SHALL TURN OFF.

 1.2. IF PUMPS ARE OFF <u>V-1</u> SHALL MODULATED TO MAINTAIN DP SETPOINT.

 1.3. IF PUMPS ARE OFF AND DP PRESSURE AT <u>DPT-1</u> IS 1 PSID BELOW THE SETPOINT FOR 5 MINUTES, PUMP SHALL ENGAGE AT MINIMUM SPEED.
- 2. IF BUILDING HAS AN EXISTING MINIMUM FLOW BYPASS AND IF ANY PUMPS ARE RUNNING, MIN FLOW BYPASS SHALL MODULATE VIA DIRECT ACTING PID LOOP TO MAINTAIN A DP SET-POINT OF 15PSID ABOVE THE CONTROL SETPOINT.

3. THE CHW RETURN VALVE V-1 SHALL CLOSE IF THE OAT DROPS BELOW 35 °F (ADJ) UNLESS THE BUILDING REQUIRES YEAR-ROUND COOLING FOR PROCESS.



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CHW DISTRICT OPTIMIZATION PROGRAM

CHW DISTRICT
INTERCONNECTION
STANDARD NEW BUILDING

PROJECT: CHW DISTRICT OPTIMIZATION

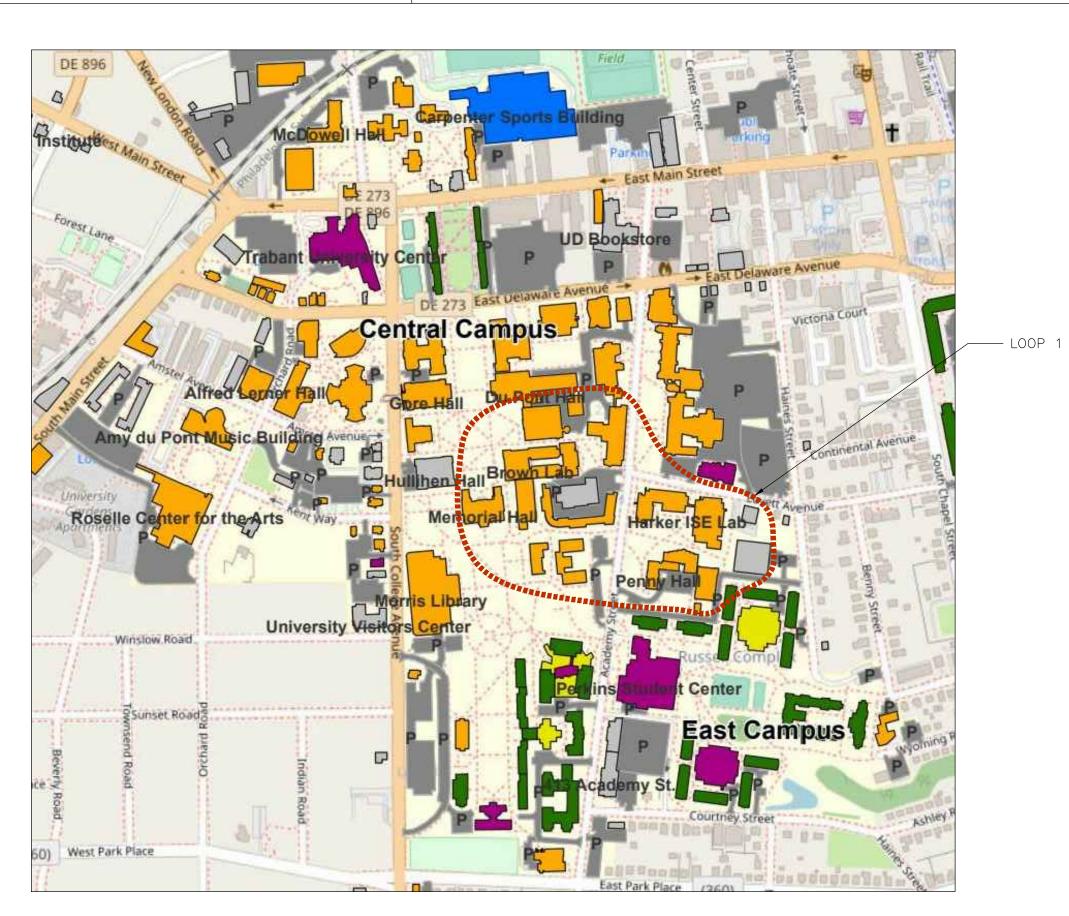
DATE: 06.27.2019

DRAWN: RN

CHECKED: TS

UD WORK ORDER #: 572963

M-102



HYDRAULIC LOOP FOR CENTRAL CAMPUS PLANTS

NOT TO SCALE