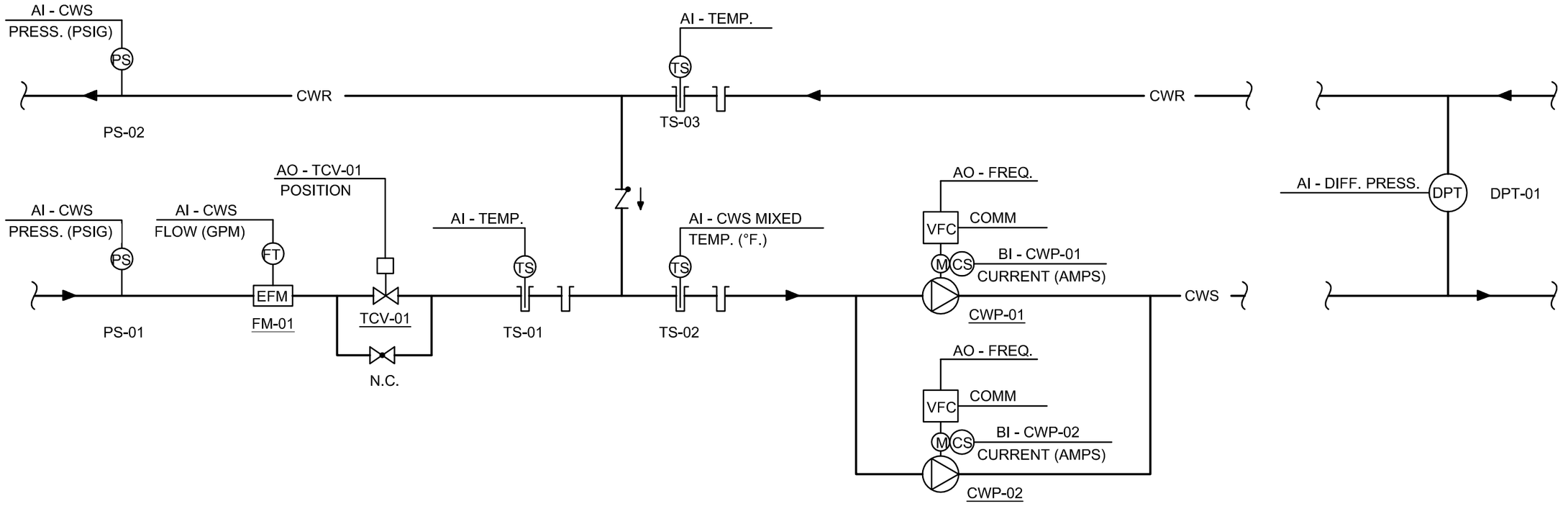
APPENDIX B

Campus Loop Connection Details

Last Updated 10/12/2018



SEQUENCE OF OPERATION: TERTIARY CHILLED WATER SYSTEM

THE TERTIARY CHILLED WATER SYSTEM SHALL BE CONTROLLED BY LOCAL EMCS OPERATOR COMMAND AT THE BUILDING DDC CONTROLLER OR LOCAL DDC CONTROLLER, OR BY EMCS SOFTWARE. WHEN TERTIARY CHILLED WATER SYSTEM IS COMMANDED ON , TERTIARY CHILLED WATER PUMP CWP-01 SHALL BE ENABLED. IN AUTOMATIC MODE PUMP SHALL START AND RUN BASED ON A CALL FOR COOLING IN THE AREAS SERVED BY THE CHILLED WATER SYSTEM.

WHEN PUMP IS RUNNING , DIFFERENTIAL PRESSURE TRANSMITTER DPT-01 SHALL MODULATE PUMP SPEED TO MAINTAIN PRESSURE SETPOINT. IF PUMP CWP-01 FAILS TO RUN WHEN CALLED TO OPERATE, PUMP CWP-02 SHALL START AND RUN. PUMP OPERATION SHALL BE VERIFIED BY CURRENT SENSORS AND DIFFERENTIAL PRESSURE TRANSMITTERS.

WHEN TERTIARY CHILLED WATER PUMP IS RUNNING, TEMPERATURE CONTROL VALVE TCV-01 SHALL MODULATE TO MAINTAIN TEMPERATURE SETPOINT OF TERTIARY CHILLED WATER SUPPLY AT TEMPERATURE TRANSMITTER TS-02. TEMPERATURE SENSORS TS-01 AND TS-03 SHALL MONITOR THE TEMPERATURE DOWNSTREAM OF CONTROL VALVE TCV-01 AND OF THE TERTIARY CHILLED WATER RETURN RESPECTIVELY. FLOW METER FM-01 SHALL MEASURE THE FLOW RATE OF CHILLED WATER FROM THE CAMPUS CHILLED WATER DISTRIBUTION SYSTEM. PRESSURE SENSOR PS-01 SHALL MONITOR PRESSURE OF TERTIARY CHILLED WATER SUPPLY FROM CAMPUS SYSTEM.

IN INOCCUPIED MODE, BOTH CHILLED WATER PUMPS SHALL BE DISABLED.

UPON PROOF OF RUN STATUS OF EITHER TERTIARY CHILLED WATER PUMPS, THE TEMPERATURE CONTROL VALVE TCV-01 SHALL BE MODULATED AS REQUIRED TO MAINTAIN THE BUILDING CHILLED WATER SETPOINT AT TEMPERATURE SENSOR TS-02. THE BUILDING CHILLED WATER SUPPLY TEMPERATURE SETPOINT FOR THE TERTIARY LOOP SHALL BE RESET FROM A MINIMUM OF 42F AT AN OUTSIDE AIR TEMPERATURE OF 70F AND ABOVE (ADJ.) TO A MAXIMUM OF 48F (ADJ.) AT AN OUTSIDE AIR TEMPERATURE OF 50F (ADJ.) OR BELOW.

ON LOSS OF PROOF OF RUN STATUS OF BOTH TERTIARY CHILLED WATER PUMPS CWP-01 AND CWP-02, THE TEMPERATURE CONTROL VALVE TCV-01 SHALL BE CLOSED.

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OKLAHOMA STATE UNIVERSITY
ENGINEERING STANDARDS
MECHANICAL CONTROL STANDARD

DRAWN BY: C. SPENCER
CHECKED BY:
APPROVED BY:
DATE: 03-15-2018
PROJECT #:
SCALE: NTS

SEQUENCE OF
OPERATIONS
OSU E.S. STANDARDS

SHEET NUMBER
1

EQUIPMENT INPUT/OUTPUT SUMMARY

POINT NAME	BO			BI				AI								AO			PROGRAMS							
	ENABLE / DISABLE	OPEN / CLOSE		STATUS	POSITION	PULSE - TOTALIZING	FLOW STATUS	KW / KWH	FREQUENCY	VOLTS / AMPS	PRESSURE	TEMPERATURE	FLOW	LEVEL	TIME	ELECTRIC	RESET		HI LIMIT ALARM	LOW LIMIT ALARM	ABNORMAL OFF	RUN TIME TOTAL				GRAGHIC
TERTIARY CHILLED WATER PUMP CWP-01	●																									●
CWP-01 VFC STATUS				●																	●	●				●
CWP-01 VFC FAULT				●																						●
CWP-01 VFC HAND-OFF-AUTO				●																						●
CWP-01 VFC SPEED									●							●										●
CWP-01 VFC FREQUENCY									●										●	●						●
CWP-01 VFC ALARM				●																						●
CWP-01 VOLTAGE EACH PHASE										●									●	●						●
CWP-01 CURRENT EACH PHASE										●									●	●						●
CWP-01 POWER									●										●	●						●
CWP-01 POWER FACTOR				●																●						●
CWP-01 VFC ACCELERATION TIME															●		●									●
CWP-01 VFC DECELERATION TIME															●		●									●
CWP-01 STATUS. DPT-01	●										●								●	●						●
TERTIARY CHILLED WATER PUMP CWP-02	●																									●
CWP-02 VFC STATUS				●																	●	●				●
CWP-02 VFC FAULT				●																						●
CWP-02 VFC HAND-OFF-AUTO				●																						●
CWP-02 VFC SPEED									●							●										●
CWP-02 VFC FREQUENCY									●										●	●						●
CWP-02 VFC ALARM				●																						●
CWP-02 VOLTAGE EACH PHASE										●									●	●						●
CWP-02 CURRENT EACH PHASE										●									●	●						●
CWP-02 POWER									●										●	●						●
CWP-02 POWER FACTOR				●																●						●
CWP-02 VFC ACCELERATION TIME															●		●									●
CWP-02 VFC DECELERATION TIME															●		●									●
CWP-02 STATUS. DPT-01	●										●								●	●						●
TERTIARY CHS WATER TEMP FROM CAMPUS, TS-01												●							●	●						●
TERTIARY CHS/MIXED WATER TEMP, TS-02												●							●	●						●
TERTIARY CHR WATER TEMP, TS-03												●							●	●						●
TERTIARY CHILLED WATER SUPPLY FLOW, FM-01													●						●	●						●
TERTIARY CHILLED WATER SUPPLY PRESSURE, PS-01											●								●							●
TERTIARY CHILLED WATER SUPPLY PRESSURE, PS-02											●								●							●

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OKLAHOMA STATE UNIVERSITY
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MECHANICAL CONTROL STANDARD

DRAWN BY: C.SPENCER
CHECKED BY:
APPROVED BY:
DATE: 03-15-2018
PROJECT #:
SCALE: NTS

CONTROLS TABLE

OSU E.S. STANDARDS

SHEET NUMBER
2

DESIGN GUIDELINES FOR TERTIARY PUMP SETUP

1 - THE DIFFERENTIAL PRESSURE SENSOR MUST BE INSTALLED AS NEAR AS POSSIBLE TO THE FURTHEST LOAD IN THE BUILDING. .

2 - THE DIFFERENTIAL PRESSURE SETPOINT MUST BE CONFIRMED BY PRESSURE READINGS AT THE PROPOSED INSTALLATION LOCATION OF THE DIFFERENTIAL PRESSURE SENSOR. ALL VALVES DOWNSTREAM SHALL BE OPEN AT 100% BEFORE PRESSURE READINGS ARE TAKEN.

3 - A SECOND DIFFERENTIAL PRESSURE SENSOR SHALL BE INSTALLED ACROSS A LARGE LOAD FOR WHICH PROPER FLOW MUST BE MAINTAINED.

4 - HYDRAULIC BRIDGE PIPING SHALL BE OVERSIZED BY ONE STANDARD PIPE DIAMETER OVER SUPPLY AND RETURN PIPING SIZE, IN ORDER TO LIMIT PRESSURE DROP ACROSS BRIDGE.

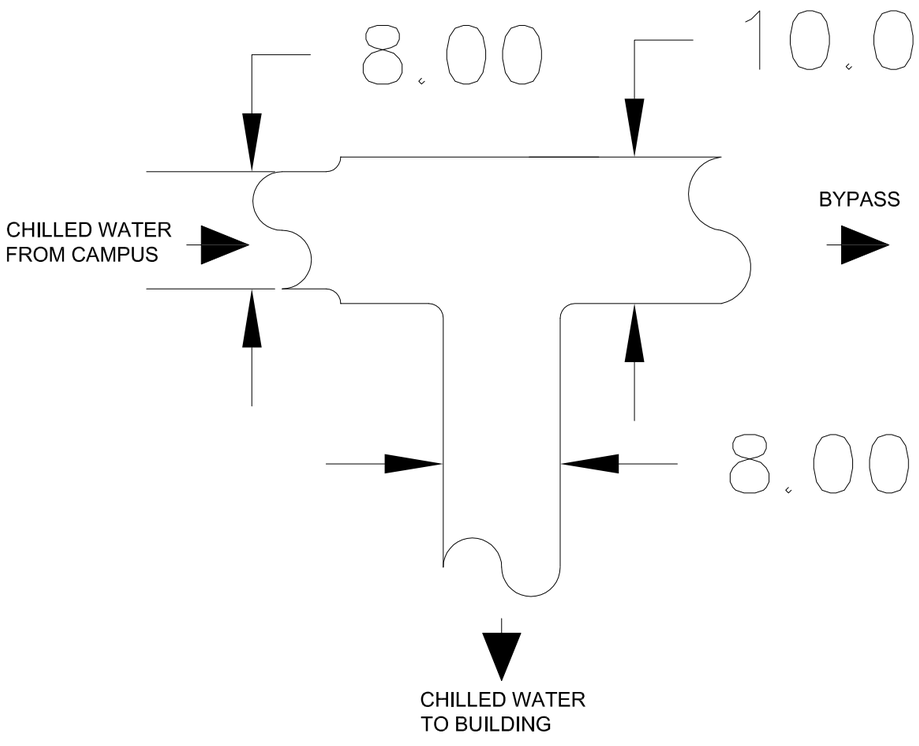
5 - HYDRAULIC BRIDGE LENGTH SHOULD BE MAXIMIZED. IT SHALL BE NO LESS THAN TWO (2) PIPE DIAMETERS AND NO MORE THAN TEN (10) PIPE DIAMETERS IN LENGTH (REF. SUPPLY AND RETURN PIPING).

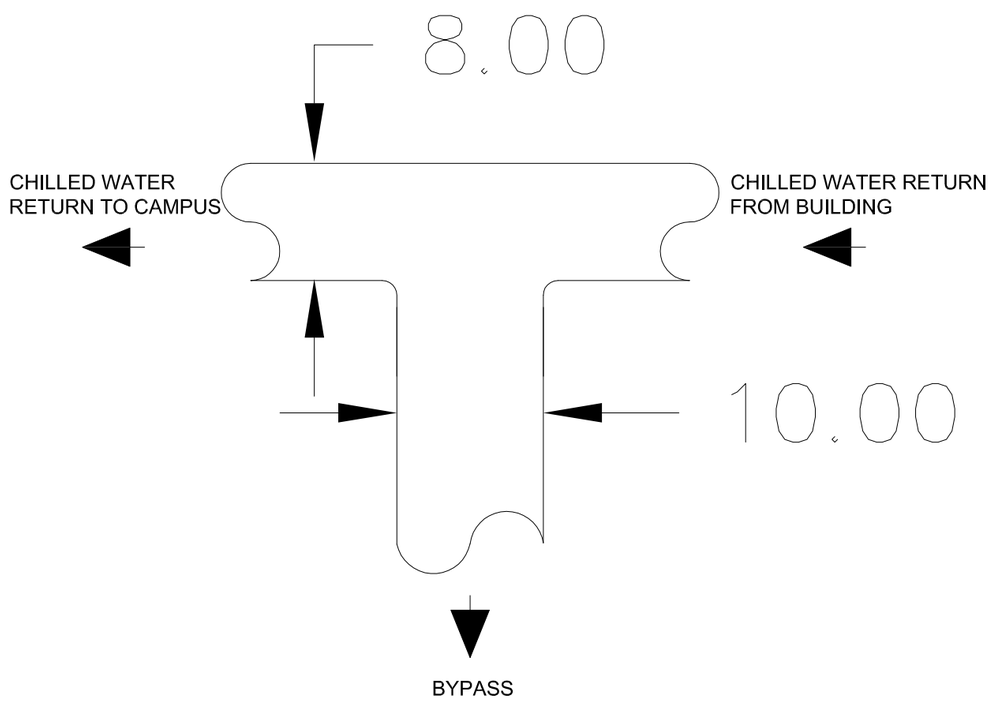
6 - CHECK VALVE IN BRIDGE MUST OF THE NON-SLAM TYPE, AND BE ORIENTED TO PERMIT FLOW FROM RETURN TO SUPPLY.

7 - HYDRAULIC BRIDGE MUST BE DESIGNED TO AVOID A BULL HEAD CONFIGURATION (SEE BELOW FOR EXAMPLES). DESIGN MUST BE REVIEWED BY OSU ENERGY SERVICES.

8 - FOLLOW MANUFACTURER'S RECOMMENDATIONS FOR REQUIRED STRAIGHT PIPE LENGTHS UPSTREAM AND DOWNSTREAM OF THE FLOW METER.

9 - ALL THREADOLETS TO BE $\frac{3}{4}$" FNPT





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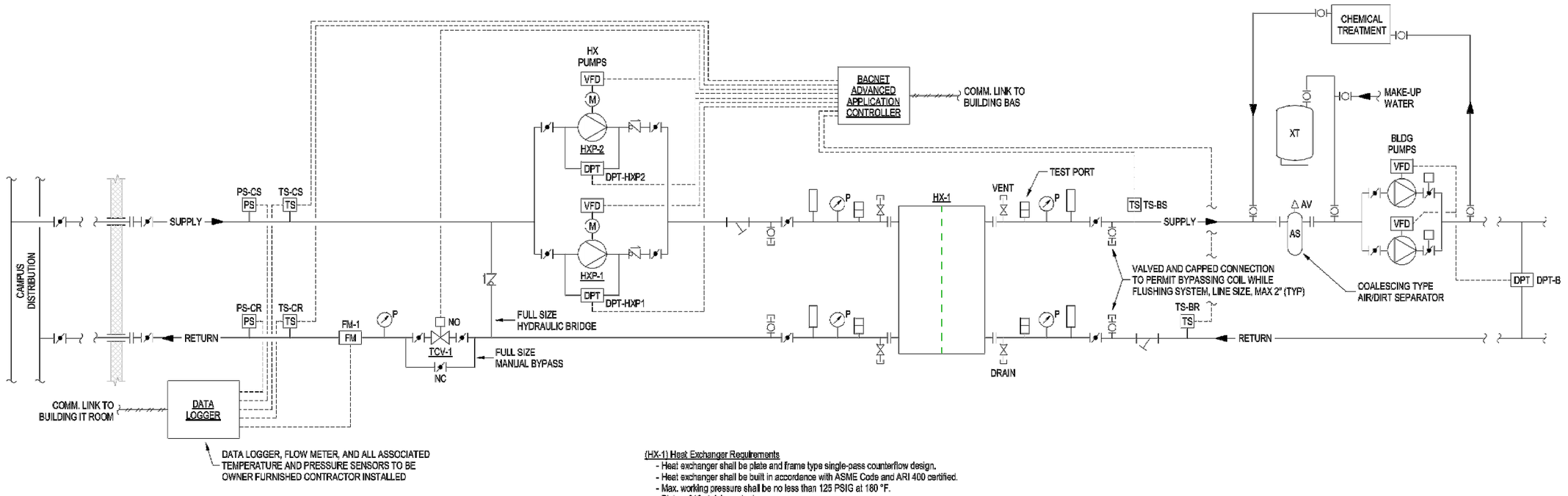
OKLAHOMA STATE UNIVERSITY
ENGINEERING STANDARDS
MECHANICAL CONTROL STANDARD

DRAWN BY:	C. SPENCER
CHECKED BY:	
APPROVED BY:	
DATE:	03-15-2018
PROJECT #:	
SCALE:	NTS

DESIGN GUIDELINES

OSU E.S. STANDARDS

SHEET NUMBER
3



(HX-1) Heat Exchanger Requirements
- Heat exchanger shall be plate and frame type single-pass counterflow design.
- Heat exchanger shall be built in accordance with ASME Code and ARI 400 certified.
- Max. working pressure shall be no less than 125 PSIG at 180 °F.
- Plates: 316 stainless steel.
- Gaskets: One-piece construction with double gasket barrier at the port region. Area isolated by double gasket shall be vented to atmosphere with visible leak detection ports. Mechanically-fixed gaskets of material approved for use with design fluids and temperatures. Glued gaskets not acceptable.
- Units with 2-1/2" or larger connections shall have studded ports to mate with raised face ANSI flanges. Units with 2" and smaller connections shall have carbon steel threaded NPT connections.
- Heat exchanger shall be selected using campus water temperatures of 180 °F HWS and 160 °F HWR and shall be sized to minimize pressure drop.
- If heat exchanger is used to generate domestic hot water, heat exchanger shall have double-wall construction and the building side of the above diagram shall be modified accordingly.

(HXP-1,2) Heat Exchanger Pump Requirements
- Pumps shall be vertical inline type.
- Pumps shall be provided with minimum 18-pulse variable speed drive.
- Pumps shall be be selected as 100% redundant, with each pump being individually capable of delivering the full design flow at a duty head sized to account for the head loss from the point of connection at the campus heating water supply main, through all piping and components, and back to the campus heating water return main.
- Pumps shall be provided with differential pressure sensor with integral transmitter manufactured by Veris Industries or approved equal. Sensor span and zero shall be adjustable. Electronics housing shall be NEMA 4. Sensor shall have integral LCD display with range appropriate for application. Accuracy shall be 1% of full scale.
- Pumps shall be provided with suction guide with removable strainer. Include 10-mesh or better start-up strainer and final stainless steel strainer.

(TCV-1) Temperature Control Valve Requirements
- Control valve shall be a pressure independent control valve (PICV) which includes an integral regulator valve that maintains the differential pressure across a flow control valve. Provide valves with factory installed pressure/temperature measurement ports to measure the pressure drop to determine the valve flow rate.
- PICV must accurately control the flow from 0-100 percent full rated flow regardless of changes in the piping pressure and not vary the flow more than plus or minus 5 percent at any given flow control valve position when the PICV differential pressure lies between the manufacturer's stated minimum and maximum. Rated minimum differential pressure for steady flow must not exceed 5 PSIG across the PICV.
- PICV shall have an FCI 70-2 Class 4 shut-off rating for all sizes and shall maintain proportional/linear flow coil characteristics.
- Provide either globe or ball type valve.
- PICV shall incorporate control, balancing, and flow limiting functions.
- Provide valves with a flow tag listing full rated flow and minimum required pressure drop.

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CAMPUS HOT WATER PIPING DETAIL

DATE	ISSUE
7/23/18	

DRAWN BY: RRB
CHECKED BY: HS
APPROVED BY: HS
DATE: 7/23/18
PROJECT CP18-1061
SCALE: NONE
SHEET NUMBER