SEQUENCE OF OPERATION GUIDELINE

CHILLED WATER PUMPING

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NOTES:

1. THIS SEQUENCE IS INTENDED TO PROVIDE THE DESIGN PROFESSIONAL WITH A BASIC GUIDELINE OF MINIMUM REQUIREMENTS FOR A TYPICAL BUILDING CHILLED WATER PUMPING SYSTEM. THIS SEQUENCE SHALL BE CAREFULLY REVIEWED AND EDITED WITH RESPECT TO APPLICATION-SPECIFIC PROJECT REQUIREMENTS AND PROPOSED MODIFICATIONS SHALL BE REVIEWED WITH FSU STAFF.

2. THE INTENT IS FOR THIS SEQUENCE TO BE INCLUDED IN THE CONTRACT DRAWINGS.

3. THE PUMP CONTROL SEQUENCE HAS BEEN WRITTEN TO ACCOMODATE A TWO PUMP DESIGN. TWO DIFFERENT PUMP CONTROL SEQUENCES ARE SHOWN TO ACCOUNT FOR BOTH THE 100% REDUNDANT CONDITION AND THE CONDITION IN WHICH EACH PUMP IS SIZED FOR 50% OF THE TOTAL LOAD. SELECT THE APPROPRIATE SEQUENCE ACCORDING TO THE SPECIFIC APPLICATION.

4. REFERENCE STANDARD CONTROL DIAGRAM IC-8.

CHILLED WATER PUMPING

PROVIDE THE FOLLOWING FOR CHILLED WATER PUMPING SYSTEMS.

1. APPROPRIATE TEMPERATURE, FLOW AND PRESSURE SENSORS.
2. BTU METERS
3. DIFFERENTIAL PRESSURE SENSORS FOR PUMP CONTROL
4. CONTROL VALVES
5. SYSTEM ENABLE/DISABLE SHALL BE DETERMINED BY BUILDING OCCUPANCY SCHEDULE AND AHU STATUS.

ENABLE MODE

1. THE BAS SHALL ENABLE THE CHILLED WATER PUMPING SYSTEM WHEN ANY AHU IS PROVEN ON.
2. ONCE THE SYSTEM IS ENABLED, THE PUMP BYPASS VALVE SEQUENCE SHALL BE THE PRIMARY MEANS OF CONTROLLING DIFFERENTIAL PRESSURE.
3. IN THE EVENT THE MAIN BUILDING RETURN CONTROL VALVE REMAINS AT 100% AND THE REMOTE DIFFERENTIAL PRESSURE IS 2 PSID (ADJ) BELOW THE *C*ALCULATED SETPOINT FOR MORE THAN 15 MINUTES (ADJ), CLOSE THE BYPASS VALVE, OPEN THE MAIN BUILDING RETURN CONTROL VALVE TO 100%, AND ENABLE THE PUMP CONTROL SEQUENCE. THIS IS AN INDICATION THAT THE

PLANT PRESSURE IS NO LONGER SUFFICIENT TO SATISFY THE BUILDING CHILLED WATER DEMAND.

4. VERIFY PUMPS ARE RUNNING BY WAY OF PUMP STATUS AND WATER FLOW METER.
5. UPON VERIFICATION THAT PUMP(S) ARE ON AND WATER IS FLOWING, ENABLE THE PUMP CONTROL SEQUENCE
6. MONITOR PUMP COMMAND AND IF THE % SPEED DROPS TO MINIMUM SPEED FOR A SINGLE PUMP FOR MORE THAN 15 MINUTES (ADJ), SHUTDOWN THE PUMPING SYSTEM AND RE-ESTABLISH PUMP BYPASS VALVE CONTROL SEQUENCE.

BYPASS VALVE CONTROL

1. ONCE ENABLED, OPEN THE BYPASS VALVE AND MODULATE THE MAN BUILDING RETURN VALVE TO MAINTAIN CALCULATED DIFFERENTIAL PRESSURE SETPOINT.
2. OPEN THE RETURN VALVE ON A DROP IN DIFFERENTIAL PRESSURE AND CLOSE THE RETURN VALVE ON A RISE IN DIFFERENTIAL PRESSURE.

PUMP CONTROL (LEAD/LAG EACH PUMP SIZED AT 50%)

1. ONCE ENABLED THE PUMP SPEED SHALL BE MODULATED TO MAINTAIN THE CALCULATED DIFFERENTIAL SETPOINT.
2. SOFTWARE LEAD/LAG FUNCTION SHALL ALLOW EITHER OF THE CHILLED WATER PUMPS TO ACT AS THE LEAD PUMP.
3. DIFFERENTIAL PRESSURE CONTROL. THE OBJECTIVE IS TO ALWAYS HAVE ONE COOLING CONTROL VALVE 80% OPEN SO THE PUMPS OPERATE AT THE LOWEST SPEED AND PRESSURE POSSIBLE TO SATISFY THE CURRENT LOAD. EVERY 5 MINUTES THE COOLING VALVES SHALL BE POLLED. WHEN THE MOST OPEN HEATING VALVE IS MORE THAN 80% OPEN, THE BAS SHALL RESET THE DIFFERENTIAL PRESSURE SETPOINT UP BY .50 PSID (ADJ). WHEN ALL COOLING CONTROL VALVES ARE 60% (ADJ) OR BELOW, THE BAS SHALL RESET THE DIFFERENTIAL PRESSURE SETPOINT DOWN BY .25 PSID.
4. THE REMOTE DP SETPOINT SHALL BE MAINTAINED BETWEEN MAXIMUM AND MINIMUM PRESSURES. THE MAXIMUM PRESSURE LIMIT IS THE PRESSURE REQUIRED TO PROVIDE FULL FLOW TO ALL COOLING CONTROL VALVES SIMULTANEOUSLY (PER TAB). THE MINIMUM PRESSURE LIMIT IS THE PRESSURE CORRELATING TO THE LOWEST SPEED THE PUMP MOTOR IS ALLOWED TO BE OPERATED AT (PER MOTOR MANUF. AND TAB). MAXIMUM PRESSURE LIMIT:_____PSI. MININUM PRESSURE LIMIT:_____PSI. THE VFD INTERNAL SETTINGS WILL ALLOW THE VFD TO RUN THE PUMPS TO THEIR MINIMUMS.
5. WHEN TWO REMOTE DIFFERENTIAL PRESSURE SENSORS ARE USED, CONTROL TO THE SENSOR THAT IS FARTHEST FROM SETPOINT.
6. PUMP STAGING: WITH ONE PUMP RUNNING, WHEN THE PUMP COMMAND REACHES 100% AND THE DIFFERENTIAL PRESSURE DROPS MORE THAN 2 PSI BELOW THE SETPOINT FOR 10 MINUTES (ALL ADJUSTABLE), START THE LAG PUMP. BOTH PUMPS SHALL CONVERGE AND RUN IN PARALLEL TO MAINTAIN THE DIFFERENTIAL PRESSURE SETPOINT AND THE REMOTE DP SETPOINTS.
7. DURING REDUCING LOAD AS THE DP INCREASES: WHEN THE TWO PUMPS DROP BELOW 20% FOR 10 MINUTES (ADJUSTABLE), THE LAG PUMP SHUTS OFF AND THE LEAD PUMP RESUMES CONTROL.

1. ALARM ON PUMP FAILURE DETECTED VIA CURRENT SENSING SWITCH. UPON FAILURE OF THE LEAD PUMP, THE LAG PUMP SHALL START AUTOMATICALLY. THE BAS SHALL MAINTAIN A START COMMAND AT THE LEAD PUMP AND RESUME CONTROL WITH THE LEAD PUMP UPON CONFIRMATION THAT THE LEAD PUMP HAS RETURNED TO NORMAL OPERATION. THE LAG PUMP SHALL BE DISABLED IF THE LOAD ONLY REQUIRES A SINGLE PUMP TO RUN..
8. LEAD PUMP DESIGNATION SHALL BE ROTATED WEEKLY (ADJ) IN ACCORDANCE WITH THE BAS SCHEDULE.

PUMP CONTROL (PRIMARY/STANDBY EACH PUMP SIZED AT 100%)

2. ONCE ENALBLED THE PUMP SPEED SHALL BE MODULATED TO MAINTAIN THE CALCULATED DIFFERENTIAL SETPOINT.
3. SOFTWARE PRIMARY/STANDBY FUNCTION SHALL ALLOW EITHER OF THE CHILLED WATER PUMPS TO ACT AS THE PRIMARY PUMP.
4. DIFFERENTIAL PRESSURE CONTROL. THE OBJECTIVE IS TO ALWAYS HAVE ONE HEATING CONTROL VALVE 80% OPEN SO THE PUMP OPERATES AT THE LOWEST SPEED AND PRESSURE POSSIBLE TO SATISFY THE CURRENT LOAD. EVERY 5 MINUTES THE HEATING VALVES SHALL BE POLLED. WHEN THE MOST OPEN HEATING VALVE IS MORE THAN 80% OPEN, THE BAS SHALL RESET THE DIFFERENTIAL PRESSURE SETPOINT UP BY .50 PSID (ADJ). WHEN ALL HEATING CONTROL VALVES ARE 60% (ADJ) OR BELOW, THE BAS SHALL RESET THE DIFFERENTIAL PRESSURE SETPOINT DOWN BY .25 PSID.
5. THE REMOTE DP SETPOINT SHALL BE MAINTAINED BETWEEN MAXIMUM AND MINIMUM PRESSURES. THE MAXIMUM PRESSURE LIMIT IS THE PRESSURE REQUIRED TO PROVIDE FULL FLOW TO ALL HEATING CONTROL VALVES SIMULTANEOUSLY (PER TAB). THE MINIMUM PRESSURE LIMIT IS THE PRESSURE CORRELATING TO THE LOWEST SPEED THE PUMP MOTOR IS ALLOWED TO BE OPERATED AT (PER MOTOR MANUF. AND TAB). MAXIMUM PRESSURE LIMIT:_____PSI.   MININUM PRESSURE LIMIT:_____PSI. THE VFD INTERNAL SETTINGS WILL ALLOW THE VFD TO RUN THE PUMP TO ITS MINIMUM.
6. WHEN TWO REMOTE DIFFERENTIAL PRESSURE SENSORS ARE USED, CONTROL TO THE SENSOR THAT IS FARTHEST FROM SETPOINT.
7. ALARM ON PRIMARY PUMP FAILURE DETECTED VIA CURRENT SENSING SWITCH. UPON FAILURE OF THE PRIMARY PUMP, THE STANDBY PUMP SHALL START AUTOMATICALLY. THE BAS SHALL MAINTAIN A START COMMAND AT THE PRIMARY PUMP AND RESUME CONTROL WITH THE PRIMARY PUMP UPON CONFIRMATION THAT THE LEAD PUMP HAS RETURNED TO NORMAL OPERATION. THE STANDBY PUMP SHALL BE DISABLED ONCE THE PRIMARY PUMP RESTARTS.
8. LEAD PUMP DESIGNATION SHALL BE ROTATED WEEKLY (ADJ) IN ACCORDANCE WITH THE BAS SCHEDULE.

CHILLED WATER - BUILDING PUMPING TYPE: IC-8			POINT TYPE		ALARM CONDITION			INTEGRATED POINT	NOTES
SHORT NAME	POINT DESCRIPTION	UNITS	ANALOG	DIGITAL	EQUIP ALARM	HIGH LIMIT	LOW LIMIT		
bbb_CHWP1_SS	CHILLED WATER PUMP-1 START/STOP	ON/OFF		X	X				
bbb_CHWP1_S	CHILLED WATER PUMP-1 STATUS	ON/OFF		X	X				
bbb_CHWP1_VFD	CHILLED WATER PUMP-1 VFD	%	X						
bbb_CHWP2_SS	CHILLED WATER PUMP-2 START/STOP	ON/OFF		X	X				
bbb_CHWP2_S	CHILLED WATER PUMP-2 STATUS	ON/OFF		X	X				
bbb_CHWP2_VFD	CHILLED WATER PUMP-2 VFD	%	X						
bbb_BLGD_CHWS	BUILDING ENTERING CHILL WATER SUPPLY	DEG F	X			X	X		
bbb_BLDG_CHWR	BUILDING EXITING CHILL WATER RETURN	DEG F	X						
bbb_BLDG_DP	CAMPUS CHILLED WATER DIFFERENTIAL PRESSURE	PSID	X						
bbb_BLDG_DP1	BUILDING CHILLED WATER DIFFERENTIAL PRESSURE-1	PSID	X						
bbb_BLDG_DP2	BUILDING CHILLED WATER DIFFERENTIAL PRESSURE-2	PSID	X						
bbb_CHWS_V	CAMPUS CHILLED WATER SUPPLY ISOLATION VALVE	OPN/CLO		X	X				
bbb_CHWS_VS	CAMPUS CHILLED WATER SUPPLY ISOLATION VALVE STATUS	OPN/CLO		X	X				
bbb_CHWR_V	CAMPUS CHILLED WATER RETURN ISOLATION VALVE	OPN/CLO		X	X				
bbb_CHWR_VS	CAMPUS CHILLED WATER RETURN ISOLATION VALVE STATUS	OPN/CLO		X	X				
bbb_CHWS_BYPV	CAMPUS CHILLED WATER SUPPLY BYPASS VALVE	OPN/CLO		X	X				
bbb_CHWS_BYPVS	CAMPUS CHILLED WATER SUPPLY BYPASS VALVE STATUS	OPN/CLO		X	X				
bbb_CHWP1_HZ	CHILLED WATER PUMP-1 VFD HERTZ	HZ	X					X	
bbb_CHWP1_KW	CHILLED WATER PUMP-1VFD KW DEMAND	KW	X					X	
bbb_CHWP1_A	CHILLED WATER PUMP-1 VFD ALARM	KW		X	X			X	
bbb_CHWP2_HZ	CHILLED WATER PUMP-2 VFD HERTZ	HZ	X					X	
bbb_CHWP2_KW	CHILLED WATER PUMP-2VFD KW DEMAND	KW	X					X	
bbb_CHWP2_A	CHILLED WATER PUMP-2 VFD ALARM	KW		X	X			X	
bbb_BLDG_CHWS	BUILDING ENTERING CHILL WATER SUPPLY	DEG F	X					X	
bbb_BLDG_CHWR	BUILDING EXITING CHILL WATER RETURN	DEG F	X					X	
bbb_BLDG_CHWDP	BUILDING CHILL WATER DIFFERENTIAL PRESSURE	PSID	X			X	X	X	
bbb_BLDG_FLW	BUILDING CHILL WATER FLOW	GPM	X			X	X	X	