



UCF

**Utilities and
Energy Services**

UNIVERSITY OF CENTRAL FLORIDA

UES Energy Services

October 16, 2020

Re: UCF Division 23 Standard Chilled Water Tertiary Pump System Controls

CAMPUS CHILLED WATER (CHW) SYSTEM

BUILDING LOOP:

CHILLED WATER PUMP SYSTEM – RUN CONDITIONS:

THE CHILLED WATER PUMPS SHALL BE ENABLED TO RUN UPON REQUEST FOR COOLING:

- START THE LEAD BUILDING CHILLED WATER PUMP AT MINIMUM SPEED (15% ADJ.)
- VERIFY PUMP STATUS
- CLOSE THE TERTIARY PUMP BYPASS 2-WAY VALVE
- OPEN THE 2-WAY ISOLATION VALVE FOR THE LEAD PUMP
- VERIFY 2-WAY ISOLATION VALVE FOR THE LEAD PUMP IS “NOT CLOSED”
 - IF VALVE DOES NOT OPEN AFTER 60 SEC (ADJ.), INITIATE LEAD PUMP VALVE FAILURE ALARM, LEAD PUMP FAILURE ALARM AND FOLLOW THE LEAD / LAG PUMP FAILURE SEQUENCES BELOW

TO PREVENT SHORT CYCLING, THE CHILLED WATER PUMP SYSTEM SHALL RUN FOR A MINIMUM 15 MIN (ADJ.) AND BE OFF FOR A MINIMUM 10 MIN (ADJ.)

CHILLED WATER PUMP LEAD / LAG OPERATION:

THE TWO CHILLED WATER PUMPS SHALL OPERATE IN A LEAD / LAG FASHION

- THE LEAD PUMP SHALL RUN FIRST
- ON FAILURE OF THE LEAD PUMP OR FAILURE OF LEAD PUMP ISOLATION VALVE TO BE “NOT CLOSED”, 60 SEC (ADJ.), THE PUMP SHALL INITIATE A PUMP FAILURE ALARM AND THE LAG PUMP SHALL RUN AND BECOME THE LEAD PUMP (FOLLOW THE ABOVE SEQUENCE FOR CHILLED WATER PUMP RUN CONDITIONS)
- RUNTIME SHALL BE MEASURED BY PUMP VFD AMPS INDICATING RUN STATUS.
- THE DESIGNATED LEAD PUMP SHALL ROTATE UPON ONE OF THE FOLLOWING CONDITIONS (USER SELECTABLE):
 - MANUALLY THROUGH A SOFTWARE SWITCH
 - WEEKLY (WEDNESDAY ADJ.)
- IF THE LEAD PUMP IS IN ALARM:
 - THE ALARM SHALL REMAIN ACTIVE UNTIL THE NEXT SCHEDULED PUMP ROTATION
 - THE ALARM / LOCKOUT OF THE FAILED PUMP SHALL BE RELEASED

- THE SPECIFIED PUMP ROTATION SEQUENCE SHALL BE INITIATED
- SHOULD THE PUMP PRODUCE AN ALARM AGAIN THE PUMP WILL BE LOCKED OUT OF SERVICE AND THE LAG PUMP STARTED AS NOTED ABOVE UNTIL THE NEXT SCHEDULED PUMP ROTATION

CHILLED WATER DIFFERENTIAL PRESSURE CONTROL:

THE CONTROLLER SHALL MEASURE CHILLED WATER DIFFERENTIAL PRESSURE AND MODULATE THE CHILLED WATER PUMP VFD TO MAINTAIN ITS CHILLED WATER DIFFERENTIAL PRESSURE SETPOINT VIA REVERSE-ACTING PID.

- THE PID LOOP SHALL BE TUNED SUCH THAT THE PUMP SPEED COMMAND DOES NOT EXCEED 1HZ PER SECOND VFD SPEED RESPONSE.
- THE PUMP VFD'S SHALL BE PROGRAMMED TO RAMP NO GREATER THAN 1HZ PER SECOND.
 - THIS IS TO ALLOW FOR THE DRIVE TO KEEP UP WITH THE PID LOOP SPEED COMMAND AND MAINTAIN CONTROL LOOP STABILITY.
- THE PID LOOP SHALL RECALCULATE AND MODULATE THE PUMP SPEED CONTROL OUTPUT EVERY ONE (1) SECOND

THE FOLLOWING SETPOINTS ARE RECOMMENDED VALUES. ALL SETPOINTS SHALL BE FIELD ADJUSTED DURING THE COMMISSIONING PERIOD TO MEET THE REQUIREMENTS OF ACTUAL FIELD CONDITIONS

- THE CONTROLLER SHALL STAGE LEAD CHILLED WATER PUMP ON / OFF AND MODULATE PUMP SPEED TO MAINTAIN THE BUILDING CHILLED WATER DIFFERENTIAL PRESSURE OF 10 PSIG (ADJ.)
 - THE LEAD PUMP VFD MINIMUM SPEED SHALL NOT DROP BELOW 15% (ADJ.) WHEN MODULATING
- ON DROPPING CHILLED WATER DIFFERENTIAL PRESSURE BELOW THE BUILDING DP SETPOINT, THE LEAD PUMP VFD SHALL INCREASE SPEED TO REACH SETPOINT (ADJ.)
- ON RISING CHILLED WATER DIFFERENTIAL PRESSURE ABOVE THE BUILDING DP SETPOINT, THE LEAD PUMP VFD SHALL DECREASE SPEED TO REACH SETPOINT
- LEAD PUMP STAGING ON AND OFF IS PER THE CAMPUS LOOP DIFFERENTIAL PRESSURE CONTROL SEQUENCE NOTED BELOW

CHILLED WATER PUMP DIFFERENTIAL PRESSURE RESET (CHWP – DPR):

THE CHWP – DPR SETPOINT SHALL BE RESET BASED UPON THE POSITION OF THE AHU CHW VALVES WITH A GOAL OF REDUCING THE DIFFERENTIAL PRESSURE UNTIL AT LEAST ONE VALVE IS NEARLY WIDE OPEN

- THE INITIAL CHWP – DPR SETPOINT UPON START-UP SHALL RAMP UP TO THE TEST AND BALANCE SPECIFIED BUILDING CHILLED WATER DIFFERENTIAL PRESSURE (ADJ.)
- IF ALL VALVES ARE LESS THAN 70% (ADJ.) OPEN FOR 5 MINUTES (ADJ.), THE BUILDING CHILLED WATER DIFFERENTIAL PRESSURE SETPOINT SHALL INCREMENTALLY (0.5 PSI ADJ.) RESET DOWN EVERY 5 MINUTES (ADJ.) UNTIL MINIMUM SETPOINT IS REACHED
- AS ONE (ADJ.) OR MORE VALVES ARE GREATER THAN 85% (ADJ.) OPEN, THE BUILDING CHILLED WATER DIFFERENTIAL PRESSURE SETPOINT SHALL INCREMENTALLY (1.0 PSI ADJ.) RESET UP EVERY 2 MINUTES (ADJ.) UNTIL MAXIMUM SETPOINT IS REACHED.

CAMPUS LOOP DIFFERENTIAL PRESSURE (DP) CONTROL:

THE CAMPUS CHILLED WATER DP SHALL BE MONITORED BY THE BAS:

- IF THE CAMPUS CHILLED WATER DP VALUE IS GREATER THAN THE BUILDING LOOP DP SETPOINT PLUS 3 PSIG (ADJ.), THE LEAD PUMP SPEED CMD IS AT MINIMUM AND THE BUILDING LOOP DP IS BEING MAINTAINED FOR 10 MIN (ADJ.):
 - CLOSE THE LEAD PUMP 2-WAY ISOLATION VALVE
 - OPEN TERTIARY PUMP BYPASS 2-WAY VALVE
 - VERIFY TERTIARY PUMP BYPASS 2-WAY VALVE IS “NOT CLOSED”
 - IF THE TERTIARY PUMP BYPASS VALVE FAILS TO OPEN, INITIATE THE BYPASS VALVE ALARM AND LOCK OUT THE CAMPUS CHILLED WATER CONTROL SEQUENCE
 - TURN OFF THE LEAD BUILDING CHILLED WATER PUMP
 - VERIFY LEAD CHILLED WATER PUMP HAS PROVEN OFF
- IF THE AVAILABLE CAMPUS DP IS LESS THAN BUILDING LOOP SETPOINT OR THE BUILDING LOOP DP IS NOT BEING MAINTAINED FOR 60 SEC (ADJ.):
 - START THE CHILLED WATER PUMP SYSTEM – RUN CONDITIONS SEQUENCE NOTED PREVIOUSLY

CAMPUS DELTA T 3-WAY VALVE:

THE CAMPUS DELTA T 3-WAY VALVE SHALL MAINTAIN ACCEPTABLE CAMPUS CHILLED WATER RETURN TEMPERATURES. THE 3-WAY VALVE SHALL MAINTAIN BUILDING DELTA TEMPERATURE SETPOINT (16°F ADJ.) OR THE ORIGINAL BUILDING DESIGN DELTA T

- CAMPUS DELTA T CONTROL SHALL BE ACTIVE WHEN:
 - ALL CONTROLLING SPACE RH READINGS ARE LESS THAN THE SPACE RH SETPOINTS
 - ALL AHU DISCHARGE TEMPERATURES SETPOINTS ARE ACHIEVED
- CAMPUS DELTA T CONTROL SHALL BE DEACTIVATED WHEN:
 - CONTROLLING SPACE RH SETPOINTS ARE EXCEEDED BY 5% (ADJ.) OR ANY AHU CANNOT MEET THE DISCHARGE AIR SETPOINT FOR 15 MIN (ADJ.)

DIRECT DIGITAL CONTROL (DDC) POINTS SCHEDULE													
CAMPUS CHILLED WATER (CHW) SYSTEM					HARDWARE POINTS		SOFTWARE POINTS (BACNET VALUE / TREND / SETPOINT / ALARM)						
DRAWING TAG	POINT DESCRIPTION	ANALOG INPUT	ANALOG OUTPUT	BINARY INPUT	BINARY OUTPUT	TREND INTERVAL	SETPOINT / ALARM CONDITION (ALL SHOWN VALUES ARE ADJ)	UNITS	ALARM MESSAGE WITH TYP 5 MIN (ADJ.) ENTRY & EXIT DELAY TIMER	ALARM LEVEL 1 [HIGH] / 2 [MEDIUM] / 3 [LOW]	EMAIL ALARM	LOG ALARM	
		AI	AO	BI	BO								
	NORMAL OPERATION MODE												
	CAMPUS CHILLED WATER SUPPLY PRESSURE	AI				15 MIN	< TBD	PSIG	LOW CAMPUS CHILLED WATER SUPPLY PRESSURE	3		X	
	CAMPUS CHILLED WATER SUPPLY TEMPERATURE	AI				15 MIN	>52	DEG F	HIGH CAMPUS CHILLED WATER SUPPLY TEMPERATURE	3		X	
	CAMPUS CHILLED WATER RETURN TEMPERATURE	AI				15 MIN		DEG F					
	CAMPUS CHILLED WATER DIFFERENTIAL PRESSURE	AI				15 MIN	TBD	PSIG					
	CAMPUS DELTA T 3-WAY VALVE COMMAND		AO			15 MIN		% OPEN					
	CAMPUS DELTA T 3-WAY VALVE FEEDBACK	AI				15 MIN	AI ≠ AO	% OPEN	3-WAY VALVE FAILURE (COMMAND NOT EQUAL TO FEEDBACK)	2	X	X	
	BTU FLOW METER	AI											
	CHILLED WATER PUMP 1 VFD HAND ON-OFF-AUTO SWITCH REFERENCE			BI		COV	ON / OFF	ON / OFF / AUTO	CHILLED WATER PUMP 1 VFD MANUAL OVERRIDE	3		X	
	CHILLED WATER PUMP 1 VFD START/STOP COMMAND				BO	COV		ON / OFF					
	CHILLED WATER PUMP 1 VFD FAULT			BI		COV	ON	ON / OFF	CHILLED WATER PUMP 1 VFD FAULT	2	X	X	
	CHILLED WATER PUMP 1 VFD SPEED COMMAND		AO			15 MIN		% SPEED					
	CHILLED WATER PUMP 1 VFD SPEED FEEDBACK	AI				15 MIN	AI ≠ AO	% SPEED	VFD 1 SPEED FAILURE (COMMAND NOT EQUAL TO FEEDBACK)	2	X	X	
	CHILLED WATER PUMP 2 VFD HAND ON-OFF-AUTO SWITCH REFERENCE			BI		COV	ON / OFF	ON / OFF / AUTO	CHILLED WATER PUMP 2 VFD MANUAL OVERRIDE	3	X	X	
	CHILLED WATER PUMP 2 VFD START/STOP COMMAND				BO	COV		ON / OFF					
	CHILLED WATER PUMP 2 VFD FAULT			BI		COV	ON	ON / OFF	CHILLED WATER PUMP 2 VFD FAULT	2	X	X	
	CHILLED WATER PUMP 2 VFD SPEED COMMAND		AO			15 MIN		% SPEED					
	CHILLED WATER PUMP 2 VFD SPEED FEEDBACK	AI				15 MIN	AI ≠ AO	% SPEED	VFD 2 SPEED FAILURE (COMMAND NOT EQUAL TO FEEDBACK)	2	X	X	
	BLDG PUMP ENTERING CHILLED WATER SUPPLY TEMPERATURE	AI						DEG F					
	BLDG CHILLED WATER SUPPLY TEMPERATURE	AI						DEG F					
	BLDG CHILLED WATER RETURN TEMPERATURE	AI						DEG F					
	BUILDING CHILLED WATER DIFFERENTIAL PRESSURE	AI				15 MIN	<10 >25	PSIG	LOW BUILDING CHILLED WATER SUPPLY PRESSURE HIGH BUILDING CHILLED WATER SUPPLY PRESSURE	2	X	X	
	TERTIARY BYPASS VALVE COMMAND		AO			15 MIN		% OPEN					
	TERTIARY BYPASS VALVE FEEDBACK	AI				15 MIN	AI ≠ AO	% OPEN	VALVE FAILURE (COMMAND NOT EQUAL TO FEEDBACK)	2	X	X	
	CHILLED WATER PUMP 1 ISOLATION VALVE COMMAND		AO			15 MIN		% OPEN					
	CHILLED WATER PUMP 1 ISOLATION VALVE FEEDBACK	AI				15 MIN	AI ≠ AO	% OPEN	VALVE FAILURE (COMMAND NOT EQUAL TO FEEDBACK)	2	X	X	
	CHILLED WATER PUMP 2 ISOLATION VALVE COMMAND		AO			15 MIN		% OPEN					
	CHILLED WATER PUMP 2 ISOLATION VALVE FEEDBACK	AI				15 MIN	AI ≠ AO	% OPEN	VALVE FAILURE (COMMAND NOT EQUAL TO FEEDBACK)	2	X	X	

CHILLED WATER TERTIARY PUMP SYSTEM

