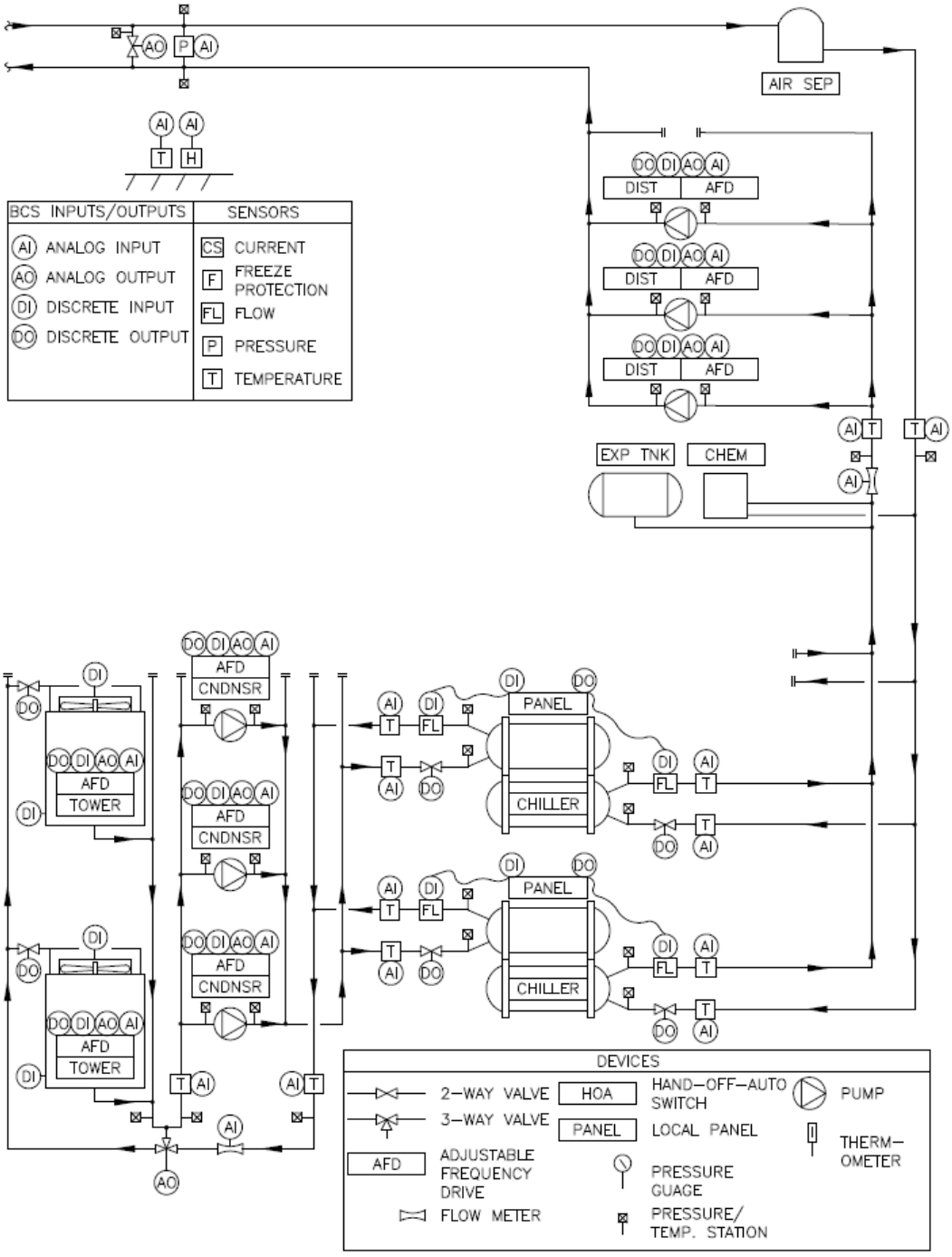
CHILLED WATER PLANT – WATER-COOLED – BYPASS CHILLED WATER DISTRIBUTION

1. INTRODUCTION

This sample functional performance test (FPT) procedure is for a hypothetical water-cooled chilled water plant with bypass chilled water distribution.

The following system diagram is intended to communicate information about this hypothetical system and is not required to be included as part of any FPT.



2. NOTABLE SYSTEM FEATURES

The purpose of this section is to identify notable system features to facilitate an understanding of system operation.

Notable system features include:

a. Each chiller is selected to meet 50-percent of system requirements yielding no redundant chiller.

b. Each chilled water distribution pump is selected to meet 100-percent of a single chiller's requirements yielding one redundant pump.

c. Each cooling tower is selected to meet 100-percent of a single chiller's requirements yielding no redundant cooling tower.

d. Each condenser water pump is selected to meet 100-percent of a single chiller's requirements yielding one redundant pump.

e. Terminal equipment is selected such that system net temperature change is always greater than chiller evaporator temperature change ensuring system chilled water demand never exceeds that allowed by active chillers.

f. Cooling tower optimization control algorithm maintains lowest allowable condenser water temperature to minimize chiller energy usage.

g. Condenser water pumping control algorithm maintains minimum flow equivalent to the maximum flow required by either the number of chillers with open condenser valves and flow required by the number of active condenser water pumps:
Min Flow = Max((Open Cond Valves)(Flow / Chiller),(Active Pumps)(Flow / Pump))

h. Distribution pumping optimization control algorithm resets pump speed based on valve position of terminal equipment to minimize distribution pump energy usage.

i. Chilled water bypass control algorithm maintains minimum flow equivalent to the maximum flow required by either the number of chillers with open evaporator valves and flow required by the number of active distribution pumps:
Min Flow = Max((Open Evap Valves)(Flow / Chiller),(Active Pumps)(Flow / Pump))

j. Cooling tower bypass control algorithm maintains condenser water supply temperature by diverting flow around towers during low load conditions.

k. Plant activation, multiple chiller operation, single cooling tower operation, and multiple cooling tower operation control algorithms inherently include duty status rotation for all equipment by setting next active equipment equivalent to the inactive equipment with shortest runtime.

l. Plant deactivation operation mode includes Operator options to not set or to set plant deactivation parameters for stable chiller operation based on plant and connected load characteristics.
   - Deactivation option one allows setting minimum running load current of last enabled chiller and period required to disable next inactive chiller circuit / to deactivate plant, and / or
   - Deactivation option two allows setting minimum system load and period required to disable next inactive chiller circuit / to deactivate plant

m. Plant activation operation mode includes Operator options to not set or to set staged plant activation parameters for stable chiller operation based on plant and connected load characteristics.
   - Stage one activation allows setting minimum number of system terminal equipment control valves commanded from their 0-percent open position and period required to enable next active distribution pump, and
   - Stage two activation allows setting minimum system flow rate and period required to enable next active chiller circuit

n. Multiple chiller operation mode includes Operator options to not set or to set parameters to enable next active chiller circuit and to disable next inactive chiller circuit for maximized plant efficiency based on plant characteristics.
   - Activation option one allows setting minimum running load current of last enabled chiller and period required to enable next active chiller circuit, and / or
   - Activation option two allows setting minimum system load and period required to enable next active chiller circuit
   - Deactivation option one allows setting minimum running load current of last enabled chiller and period required to disable next inactive chiller circuit, and / or
   - Deactivation option two allows setting minimum system load and period required to disable next inactive chiller circuit

o. Multiple chiller operation mode includes calculation of actual load based on supply water setpoint temperature, chiller loop return water actual temperature, and chiller loop actual flow to maintain an accurate load calculation during transition time during manufacturer’s initial load limiting initiated when next active chiller’s evaporator isolation valve is commanded to its 100-percent open position.

p. Low chilled water return temperature alarm condition includes visual indication of net system temperature change being significantly less than design thus negatively impacting central plant efficiency.

3. CONCLUSIONS AND RECOMMENDATIONS

The purpose of this section is to identify conclusions and recommendations based on control system feature observations, point-to-point observations, actuator observations, and system operation observations.

It is concluded that this system [does / does not perform] in accordance with contract requirements.

It is recommended that this system [be / not be] accepted by the government.

The following system control enhancements are recommended:

4. TEST CONDITIONS

The purpose of this section is to identify conditions occurring at time of testing.

Test date: _____
Test begin time: _____
Test end time: _____
Test begin outside air temp: _____
Test end outside air temp: _____

5. EQUIPMENT IDENTIFICATION

The purpose of this section is to identify equipment included in this system.

Chiller: _____
Chiller: _____
Cooling tower: _____
Cooling tower: _____
Distribution pump: _____
Distribution pump: _____
Distribution pump: _____
Condenser water pump: _____
Condenser water pump: _____
Condenser water pump: _____

6. ATTENDEES

The purpose of this section is to identify persons present during system functional performance testing.

ATTENDEES			
REPRESENTING	**NAME**	**COMPANY**	**TELEPHONE NUMBER**
Mechanical Commissioning Specialist:			
Owner's Representative:			
Mechanical Contractor:			
Controls Contractor:			
Test & Balance Contractor:			

7. CONTROL SYSTEM FEATURE OBSERVATIONS

The purpose of this section is to identify control system features including control point description, imbedded / visible type, adjustable / monitoring type, actual value, setpoint value / alarm range.

Abbreviations used in the matrix below include:

a. Unit:

Unit of measure for control point.

b. Imbedded / Visible:

I - Imbedded such that control point is not observable by Operator.

V - Visible such that control point is observable by Operator.

c. Type:

A1 - Both setpoint and minimum / maximum alarm or alarm range are adjustable by Operator.

A2 - Only minimum / maximum alarm or alarm range is adjustable by Operator.

A3 - Only setpoint is adjustable by Operator.

M - Control point is visible, but not adjustable by Operator.

d. Value / Status:

As-found imbedded or visible value or status of control point observed prior to control point(s) manipulation.

A - Status of control point is in alarm.

N - Status of control point is normal operation.

e. Setpt / Alarm Range:

Alarm Min - Alarm activated when actual value is equal to or less than alarm activation setpoint.

Setpt - Setpoint.

Alarm Max - Alarm activated when actual value is equal to or greater than alarm activation setpoint.

CONTROL SYSTEM FEATURES								
POINT DESCRIPTION	UNIT	VISIBLE / IMBEDDED	TYPE	VALUE / STATUS	SETPT / ALARM			NOTES
					ALARM MIN	SETPT	ALARM MAX	
Chiller (___):								
Status					-	-	-	
Percent output					-	-	-	
Evaporator entering temp					-	-	-	
Evaporator leaving temp					-	-		
Evaporator flow					-	-	-	
Evaporator valve position	% Open				-	-	-	
Condenser Entering temp					-	-	-	
Condenser leaving temp					-	-	-	
Condenser flow					-	-	-	
Condenser valve position	% Open				-	-	-	
Chiller (___):								
Status					-	-	-	
Percent output					-	-	-	
Evaporator entering temp					-	-	-	
Evaporator leaving temp					-	-		
Evaporator flow					-	-	-	
Evaporator valve position	% Open				-	-	-	
Condenser entering temp					-	-	-	
Condenser leaving temp					-	-	-	
Condenser flow					-	-	-	
Condenser valve position	% Open				-	-	-	
Cooling tower (___):								
Status					-	-	-	
Speed					-	-	-	
Fan vibration					-	-	-	
Basin heater					-	-	-	
Cooling tower (___):								
Status					-	-	-	
Speed					-	-	-	
Fan vibration					-	-	-	
Basin heater					-	-	-	

CONTROL SYSTEM FEATURES								
POINT DESCRIPTION	UNIT	VISIBLE / IMBEDDED	TYPE	VALUE / STATUS	SETPT / ALARM			NOTES
					ALARM MIN	SETPT	ALARM MAX	
Distribution pump (___):								
Status					-	-	-	
Speed					-	-	-	
Distribution pump (___):								
Status					-	-	-	
Speed					-	-	-	
Distribution pump (___):								
Status					-	-	-	
Speed					-	-	-	
Condenser water pump (___):								
Status					-	-	-	
Speed					-	-	-	
Condenser water pump (___):								
Status					-	-	-	
Speed					-	-	-	
Condenser water pump (___):								
Status					-	-	-	
Speed					-	-	-	
Chiller loop:								
Supply temp								
Return temp						-	-	
Flow					-			
Chilled water bypass:								
Valve position	% Open				-	-	-	
Valve setpoint					-		-	
Condenser water loop:								
Supply temp								
Return temp					-	-	-	
Flow					-	-	-	
Valve position	% Open				-	-	-	
Valve setpoint								
Facility:								
Outside dry-bulb temp					-	-	-	
Outside relative humidity					-	-	-	

8. POINT-TO-POINT OBSERVATIONS

The purpose of this section is to identify system meters and sensors have been calibrated.

Abbreviations used in the matrix below include:

a. Display:

As-found imbedded or visible value of control point documented at Operator workstation at same time measurement or observation occurred and prior to control point(s) manipulation.

Value / status is recorded for both locations when control point is displayed locally at equipment Operator workstation.

b. Measured / Observed:

As-found imbedded or visible value of control point measured or observed at same time documentation of value at Operator workstation occurred and prior to control point(s) manipulation.

POINT-TO-POINT			
POINT DESCRIPTION	**DISPLAY (LOCAL / CONTROL SYSTEM)**	**MEASURED / OBSERVED**	**NOTES**
Chiller (___):			
Evaporator Entering temp			
Evaporator Leaving temp			
Evaporator flow	/		
Condenser Entering temp			
Condenser Leaving temp			
Condenser flow	/		
Chiller (___):			
Evaporator Entering temp			
Evaporator Leaving temp			
Evaporator flow	/		
Condenser Entering temp			
Condenser Leaving temp			
Condenser flow	/		
Chiller loop:			
Supply temp			
Return temp			
Flow	/		
System loop:			
Supply temp			
Return temp			
Flow	/		
Facility:			
Outside dry-bulb temp			
Outside relative humidity			

9. ACTUATOR AND MOTOR OBSERVATIONS

The purpose of this section is to identify actuator responses to commands from the control system.

Abbreviations used in the matrix below include:

a. Type:

A - Actuator / controlled device is controlled by an analog control signal.

D - Actuator / controlled device is controlled by a discrete (binary) control signal.

b. Maximum Command:

Control system command resulting in actuator moving controlled device to its full open position with maximum / full flow across device.

c. Minimum Command:

Control system command resulting in actuator moving controlled device to its full closed position with minimum / no flow across device.

d. Signal:

Output from control system measured in units of 0 to 100 percent, 0 to 10 volts, etc.

e. Position:

Position of controlled device (not actuator) physically observed that corresponds to control system signal observed in units of 0-percent open (minimum / no flow across device) and 100-percent open (maximum / full flow across device).

ACTUATORS AND MOTORS						
ACTUATOR DESCRIPTION	**TYPE**	**MAXIMUM COMMAND**		**MINIMUM COMMAND**		**NOTES**
		SIGNAL	**POSITION / SPEED**	**SIGNAL**	**POSITION / SPEED**	
Chiller (___):						
Evaporator isolation valve						
Condenser isolation valve						
Chiller (___):						
Evaporator isolation valve						
Condenser isolation valve						
Cooling tower (___) isolation valve						
Cooling tower (___) isolation valve						
Chilled water bypass valve						
Cooling tower bypass valve						

ACTUATORS AND MOTORS						
ACTUATOR DESCRIPTION	TYPE	MAXIMUM COMMAND		MINIMUM COMMAND		NOTES
		SIGNAL	POSITION / SPEED	SIGNAL	POSITION / SPEED	
Distribution pump (___) speed						
Distribution pump (___) speed						
Distribution pump (___) speed						
Condenser water pump (___) speed						
Condenser water pump (___) speed						
Condenser water pump (___) speed						

10. VARIABLE FREQUENCY DRIVE OBSERVATIONS

The purpose of this section is to identify characteristics of variable frequency drives (VFD's).

Procedure for obtaining characteristics included:

a. Procedure for documenting maximum motor speed allowed by VFD included:
   - Record served motor's nameplate full load current
   - Confirm / manually set VFD's maximum allowed speed of 60 Hz
   - Manually set VFD hand-off-auto switch to "hand" position
   - Manually set VFD to maximum allowed speed of 60 Hz
   - Record served motor's running load current at motor conductors

b. Procedure for documenting minimum safe motor speed allowed by VFD included:
   - Manually set VFD speed to 24 Hz
   - Repeatedly decreased VFD speed by 3 Hz and recorded served motor's running load amperes until running load amperes increases
   - Set VFD's minimum allowed speed equivalent to speed at which running load amperes increased plus 3 Hz
   - Manually set VFD speed to VFD's minimum allowed speed
   - Record served motor's running load amperes at motor conductors

VARIABLE FREQUENCY DRIVE INFORMATION														
PARAMETER DESCRIPTION	**SERVED EQUIPMENT**													
Data for maximum motor speed allowed by VFD:														
Motor nameplate full load current														
VFD maximum allowed speed (Hz)														
Running load current with VFD at 60 Hz														
Data for minimum safe motor speed allowed by VFD:														
Current at 24 Hz														
Current at 21 Hz														
Current at 18 Hz														
Current at 15 Hz														
Current at 12 Hz														
Current at 9 Hz														
Current at 6 Hz														
Minimum allowed speed (Hz)														
Current at minimum allowed speed (Amps)														

11. SYSTEM OPERATION OBSERVATIONS

The purpose of this section is to document results from system-based testing of responses for each control algorithm, operation mode, and alarm condition resulting from manipulated control point(s).

Testing is sequentially grouped based on similar functions to maximize testing efficiency and is categorized as follows:

a. As-found conditions.
b. Control algorithms.
c. Operation modes.
d. Alarm conditions.

Control algorithms initiated by operation modes are tested prior to testing operation modes.
Operation modes initiated by alarm conditions are tested prior to testing alarm conditions.

Because point-to-point and actuator observations were physically made, system responses are observed from Operator workstation unless indicated otherwise.

Some equipment / component responses may be combined in a single test.

The following control algorithm testing is provided in the matrix below:

a. Cooling tower optimization.
b. Distribution pumping.
c. Condenser water pumping.
d. Chilled water bypass.
e. Distribution pumping optimization.
f. Cooling tower bypass.

The following operation mode testing is provided in the matrix below:

a. Plant deactivation.
b. Plant activation.
c. Single chiller.
d. Single cooling tower.
e. Multiple chiller.
f. Multiple cooling tower.

The following alarm condition testing is provided in the matrix below:

a. High chilled water supply temperature.
b. Low chilled water supply temperature.
c. Low chilled water return temperature.
d. High condenser water temperature.
e. Low condenser water temperature.
f. High chilled water flow.
g. Chiller evaporator temperature.
h. Chiller general fault.
i. Cooling tower general fault.
j. Cooling tower failure type one.
k. Distribution pump general fault.
l. Distribution pump failure type one.
m. Condenser water pump general fault.
n. Condenser water pump failure type one.
o. Chiller failure.
p. Cooling tower failure type two.
q. Distribution pump failure type two.
r. Condenser water pump failure type two.
s. Chiller opposite status.
t. Cooling tower opposite status.
u. Distribution pump opposite status.
v. Condenser water pump opposite status.

Abbreviations used in the matrix below include:

a. Test Method:
   Manipulated parameter(s) necessary to produce expected system response.
b. Expected Response:
   Anticipated system reaction to manipulated parameter(s).
c. Comments:
   Commissioning specialist’s issues related to observations.
d. Pass / Fail:
   P - Expected response is observed without issues of concern.
   F - Expected response is not observed resulting in noted issues of concern.
e. Miscellaneous:
   CS - Control signal.

SYSTEM OPERATION				
STEP	**TEST METHOD**	**EXPECTED RESPONSE**	**COMMENTS**	**PASS/ FAIL**
As-Found Conditions				
01	To observe as-found conditions: • Confirm system is activated • Record observations in expected response /comments columns prior to manipulating parameters	Chiller (___):		
02		Status: _____		
03		% Output: _____		
04		Ent evap temp: _____		
05		Lve evap temp: _____		
06		Evap valve pos: _____		
07		Ent cond temp: _____		
08		Ent cond temp: _____		
09		Cond valve pos: _____		
10		Chiller (___):		
11		Status: _____		
12		% Output: _____		
13		Ent evap temp: _____		
14		Lve evap temp: _____		
15		Evap valve pos: _____		
16		Ent cond temp: _____		
17		Ent cond temp: _____		
18		Cond valve pos: _____		
19		Cooling tower (___):		
20		Status: _____		
21		Fan speed: _____		
22		Ent temp: _____		
23		Lve temp: _____		
24		Valve pos: _____		
25		Cooling tower (___):		
26		Status: _____		
27		Fan speed: _____		
28		Ent temp: _____		
29		Lve temp: _____		
30		Valve pos: _____		
31		Distribution pump (___):		
32		Status: _____		
33		Speed: _____		
34		Distribution pump (___):		
35		Status: _____		
36		Speed: _____		
37		Distribution pump (___):		
38		Status: _____		
39		Speed: _____		

SYSTEM OPERATION				
STEP	**TEST METHOD**	**EXPECTED RESPONSE**	**COMMENTS**	**PASS/ FAIL**
40		Condenser water pump (___):		
41		Status: _____		
42		Speed: _____		
43		Condenser water pump (___):		
44		Status: _____		
45		Speed: _____		
46		Condenser water pump (___):		
47		Status: _____		
48		Speed: _____		
49		Chiller loop:		
50		Supply temp: _____		
51		Return temp: _____		
52		Flow: _____		
53		System loop:		
54		Supply temp: _____		
55		Return temp: _____		
56		Flow: _____		
57		Chilled water bypass:		
58		Valve position: _____		
59		Condenser water loop:		
60		Supply temp: _____		
61		Return temp: _____		
62		Flow: _____		
63		Valve position: _____		
64		Facility:		
65		Temperature: _____		
66		Humidity: _____		

SYSTEM OPERATION				
STEP	**TEST METHOD**	**EXPECTED RESPONSE**	**COMMENTS**	**PASS/ FAIL**
Cooling Tower Optimization Control Algorithm Design Control Sequence: Upon detection of this algorithm having been activated, the control system shall: • Continuously calculate outside wet-bulb temperature • Continuously set condenser supply water setpoint temperature equivalent to outside air actual wet-bulb temperature plus five degrees • Monitor outside dry-bulb temperature and relative humidity • Monitor condenser water supply temperature • Initiate cooling tower optimization response upon detection of outside air wet-bulb temperature being greater than response setpoint temperature of 65.0 °F • Command active cooling tower fans toward their maximum allowed motor speed upon detection of condenser water actual temperature being greater than setpoint temperature and condenser water supply actual temperature being greater than response setpoint temperature of 65.0 °F • Command active cooling tower fans toward their minimum allowed motor speed upon detection of condenser water actual temperature being less than setpoint temperature • Cancel cooling tower optimization action upon detection of outside air wet-bulb temperature being equal to or less than response setpoint temperature of 65.0 °F • Re-initiate action upon detection of outside air wet-bulb temperature being greater than response setpoint temperature of 65.0 °F				
67	To prepare for system response: • Confirm / override calculated outside wet-bulb temperature to significantly greater than response setpoint temperature	Condenser supply water setpoint temperature set	CS of _____	
68		Cooling tower optimization response initiated	CS of _____	
69		Outside dry-bulb temperature monitored	CS of _____	
70		Outside relative humidity monitored		
71	To observe system response to deficient capacity: • Override condenser water setpoint temperature to slightly greater than actual temperature	Active cooling tower fans commanded towards their maximum allowed motor speed	CS of _____	

SYSTEM OPERATION				
STEP	**TEST METHOD**	**EXPECTED RESPONSE**	**COMMENTS**	**PASS/ FAIL**
72	To observe system response to excessive capacity: • Override condenser water setpoint temperature to slightly less than actual temperature	Active cooling tower fans commanded towards their minimum allowed motor speed	CS of _____	
73	To observe system response to outside air wet-bulb temperature being equal to or less than response setpoint: • Override response setpoint temperature to significantly greater than condenser water actual temperature	Cooling tower optimization response cancelled		
74	Release all overrides	System returns to pre-test conditions		

SYSTEM OPERATION				
STEP	**TEST METHOD**	**EXPECTED RESPONSE**	**COMMENTS**	**PASS/ FAIL**
Distribution Pumping Control Algorithm Design Control Sequence: Upon detection of this algorithm having been activated, the control system shall: • Set setpoint pressure equivalent to 15 psid when distribution pumping optimization control algorithm is inactive and that set by distribution pumping optimization control algorithm when it is active • Continuously set distribution pump disable setpoint flow equivalent to 90-percent of capacity of enabled distribution pumps minus one distribution pump • Continuously set next active distribution pump equivalent to the inactive distribution pump with shortest runtime • Continuously set next inactive distribution pump equivalent to the active distribution pump with longest runtime • Monitor pressure sensor located is system loop • Command enabled distribution pump(s) toward their maximum allowed motor speed upon detection of actual pressure being less than setpoint • Enable next active distribution pump upon detection of enabled distribution pumps having been commanded to their maximum allowed motor speed and actual pressure being less than setpoint for a two-minute period • Enabled distribution pumps equally share load • Command enabled distribution pump(s) toward their minimum allowed motor speed upon detection of actual pressure being greater than setpoint • Disable next inactive distribution pump upon detection of chilled water actual flow being equal to or less than distribution pump disable setpoint flow for a two-minute period				
75	To prepare for system response: • Deactivate distribution pumping optimization • Observe system status	Setpoint pressure set	CS of _____	
76		Distribution pump disable setpoint flow set	CS of _____	
77		Next active distribution pump set	CS of _____	
78		Next inactive distribution pump set	CS of _____	
79		Pressure sensor monitored	CS of _____	

SYSTEM OPERATION				
STEP	**TEST METHOD**	**EXPECTED RESPONSE**	**COMMENTS**	**PASS/ FAIL**
80	To observe system response to deficient capacity: • Override setpoint pressure to slightly greater than actual pressure	Enabled distribution pump(s) commanded towards their maximum allowed motor speed	CS of _____	
81	To observe system response to continued deficient capacity: • Override setpoint pressure to significantly greater than actual pressure	Two-minute period passes without control system action		
82		Next active distribution pump enabled	CS of _____	
83		Enabled distribution pump drives indicate nominally equivalent output	CS of _____	
84	To observe system response to excessive capacity: • Override setpoint pressure to slightly less than actual pressure	Enabled distribution pumps commanded towards their minimum allowed motor speed	CS of _____	
85	To observe system response to continued excessive capacity: • Override set load to significantly less than set distribution pump disable setpoint flow	Two-minute period passes without control system action		
86		Next inactive distribution pump disabled	CS of _____	
87	Release all overrides	System returns to pre-test conditions		

SYSTEM OPERATION				
STEP	**TEST METHOD**	**EXPECTED RESPONSE**	**COMMENTS**	**PASS/ FAIL**
Condenser Water Pumping Control Algorithm Design Control Sequence: Upon detection of this algorithm having been activated, the control system shall: • Continuously set condenser water setpoint flow equivalent to the maximum of the product of the number of active chillers with their isolation valves commanded to their 100-percent open position and 750 gpm and the product of the number of active condenser water pumps and 25-percent of pump maximum flow • Reset condenser water setpoint flow for one additional chiller upon detection of next active chiller's condenser isolation valve having been commanded to its 100-percent open position • Reset condenser water setpoint flow for one less chiller upon detection of next inactive chiller's condenser isolation valve having been commanded to its 0-percent open position for a two-minute period • Continuously set condenser water pump disable setpoint flow equivalent to 90-percent of capacity of enabled condenser water pumps minus one condenser water pump • Continuously set next active condenser water pump equivalent to the inactive condenser water pump with shortest runtime • Continuously set next inactive condenser water pump equivalent to the active condenser water pump with longest runtime • Monitor flow meter located in condenser water loop water • Command enabled condenser water pump(s) toward their maximum allowed motor speed upon detection of actual condenser water flow being less than setpoint • Enable next active condenser water pump upon detection of enabled condenser water pumps having been commanded to their maximum allowed motor speed and actual flow being less than setpoint • Enabled condenser water pumps equally share load • Command enabled condenser water pump(s) toward their minimum allowed motor speed upon detection of actual condenser water flow being greater than setpoint • Disable next inactive condenser water pump upon detection of condenser water actual flow being equal to or less than distribution pump disable setpoint flow for a two-minute period			
88	To prepare for system response: • Observe system status	Condenser water pump setpoint flow set	CS of _____	
89		Condenser water pump disable setpoint flow set	CS of _____	
90		Next active condenser water pump set	CS of _____	
91		Next inactive condenser water pump set	CS of _____	

SYSTEM OPERATION				
STEP	**TEST METHOD**	**EXPECTED RESPONSE**	**COMMENTS**	**PASS/ FAIL**
92		Condenser water loop water flow meter monitored	CS of _____	
93	To observe system response to deficient capacity: • Override setpoint flow to slightly greater than actual flow	Enabled condenser water pump(s) commanded towards their maximum allowed motor speed	CS of _____	
94	To observe system response to continued deficient capacity: • Initiate increased number of active chillers	Condenser water setpoint flow reset	CS of _____	
95		Enabled condenser water pump(s) commanded towards their maximum allowed motor speed	CS of _____	
96		Enabled condenser water pump drives indicate nominally equivalent output	CS of _____	
97		Next active chiller circuit enabled	CS of _____	
98	To observe system response to excessive capacity: • Override setpoint flow to slightly less than actual flow	Enabled condenser water pumps commanded towards their minimum allowed motor speed	CS of _____	
99	Release setpoint flow override	System returns to pre-test conditions		
100	To observe system response to continued excessive capacity: • Initiate decreased number of active chillers	Next inactive chiller circuit disabled	CS of _____	
101		Two-minute period passes without control system action		
102		Condenser water setpoint flow reset	CS of _____	
103		Next inactive distribution pump disabled	CS of _____	
104	Release all overrides	System returns to pre-test conditions		

SYSTEM OPERATION				
STEP	**TEST METHOD**	**EXPECTED RESPONSE**	**COMMENTS**	**PASS/ FAIL**
Chilled Water Bypass Control Algorithm Design Control Sequence: Upon detection of this algorithm having been activated, the control system shall: • Set bypass water setpoint flow equivalent to the maximum of the product of chillers with evaporator valves commanded to their 100-percent open position and 180 gpm and the product of the number of active distribution pumps and 25-percent of pump maximum flow • Reset bypass water setpoint flow for one additional chiller upon detection of next active chiller being enabled • Reset bypass water setpoint flow for one less chiller two minutes after disabling next inactive chiller • Monitor water flow meter located in chiller loop • Command chilled water bypass valve towards its 100-percent open position upon detection of actual flow being less than setpoint • Command chilled water bypass valve towards its 0-percent open position upon detection of actual flow being greater than setpoint				
105	To prepare for system response: • Initiate minimum load to maintain single chiller at minimum allowable stable output • Observe system status	Chilled water bypass setpoint flow set	CS of _____	
106		Water flow meter monitored	CS of _____	
107	To observe system response to deficient flow: • Override setpoint water flow to slightly greater than actual flow	Chilled water bypass valve commanded towards its 100-percent open position	CS of _____	
108	To observe system response to excessive flow: • Override setpoint water flow to slightly less than actual flow	Chilled water bypass valve commanded towards its 0-percent open position	CS of _____	
109	To observe system response to increased number of active chillers: • Initiate increased number of active chillers	Bypass water setpoint flow reset	CS of _____	
110		Enabled distribution pumps commanded towards their maximum allowed motor speed	CS of _____	
111		Next active chiller circuit enabled	CS of _____	

SYSTEM OPERATION				
STEP	**TEST METHOD**	**EXPECTED RESPONSE**	**COMMENTS**	**PASS/ FAIL**
112	To observe system response to decreased number of active chillers: • Initiate decreased number of active chillers	Next inactive chiller circuit disabled	CS of _____	
113		Two-minute period passes without control system action		
114		Bypass water setpoint flow reset	CS of _____	
115	Release all overrides	System returns to pre-test conditions		
Distribution Pumping Optimization Control Algorithm Design Control Sequence: Upon detection of this algorithm having been activated, the control system shall: • Monitor each terminal equipment's control valve position • Command enabled pump(s) toward their maximum allowed motor speed upon detection of any control valve having been commanded to greater than its 95-percent open position • Command enabled pump(s) toward their minimum allowed motor speed upon detection of no control valve having been commanded to greater than its 80-percent open position and no control valve having been commanded to greater than its 95-percent open position				
116	To prepare for system response: • Observe system status	Each terminal equipment's control valve position monitored	CS of _____	
117	To observe system response to deficient pressure: • Override one control valve to its 97-percent open position	Enabled pump(s) commanded towards their maximum allowed motor speed	CS of _____	
118	To observe system response to excessive pressure: • Override all control valves to their 50-percent open position	Enabled pump(s) commanded towards their minimum allowed motor speed	CS of _____	
119	Release all overrides	System returns to pre-test conditions		

SYSTEM OPERATION				
STEP	**TEST METHOD**	**EXPECTED RESPONSE**	**COMMENTS**	**PASS/ FAIL**
Cooling Tower Bypass Control Algorithm Design Control Sequence: Upon detection of this algorithm having been activated, the control system shall: • Monitor condenser water supply temperature • Command bypass valve towards its 100-percent open position (more / full tower flow) upon detection of actual temperature being equal to or greater than setpoint of 65.0 °F • Command bypass valve towards its 0-percent open position (less / no tower flow) upon detection of actual temperature being less than setpoint of 65.0 °F				
120	To prepare for system response: • Initiate minimum load to maintain single chiller at minimum allowable stable output • Take no action until system has stabilized • Observe system status	Condenser water supply temperature sensor monitored	CS of _____	
121		System stabilized		
122	To observe system response to deficient capacity: • Override setpoint temperature to slightly greater than actual temperature	Bypass valve commanded towards its 100-percent open position (more / full tower flow)	CS of _____	
123	To observe system response to excessive capacity: • Override setpoint temperature to slightly less than actual temperature	Bypass valve commanded towards its 0-percent open position (less / no tower flow)	CS of _____	
124	Release all overrides	System returns to pre-test conditions		

SYSTEM OPERATION				
STEP	**TEST METHOD**	**EXPECTED RESPONSE**	**COMMENTS**	**PASS/ FAIL**
Plant Deactivation Operation Mode Design Control Sequence: Upon detection of completion of plant activation operation mode and only one chiller being active, the control system shall: • Set next inactive chiller circuit disable / plant deactivation setpoints equivalent to: – Operator option one: Minimum running load current of last enabled chiller and disable period, and / or – Operator option two: Minimum system load and disable period, or – No Operator input default: All terminal equipment control valves having been commanded to their 0-percent open position for a five-minute disable period • Disable next inactive chiller circuit upon detection of Operator option one and / or option two disable parameter(s) having occurred and disable period(s) having passed • Disable next inactive chiller circuit upon detection of no Operator option one or option two inputs, default disable parameter having occurred, and disable period having passed • Take no action for a two-minute period • Disable all distribution pumps • Deactivate distribution pumping control algorithm • Deactivate distribution pumping optimization control algorithm • Disable all condenser water pumps • Deactivate condenser water pumping control algorithm • Command all chiller evaporator isolation valves to their 0-percent open position • Command all chiller condenser isolation valves to their 0-percent open position • Disable all cooling towers • Command all cooling tower isolation valves to their 0-percent open position • Deactivate cooling tower optimization control algorithm • Deactivate chilled water bypass control algorithm • Deactivate cooling tower bypass control algorithm			
125	To prepare for system response: • Set Operator option one next inactive chiller circuit disable / plant deactivation setpoint and set disable period • Observe system status • Release Operator inputs • Set Operator option two next inactive chiller circuit disable / plant	Operator option one for next inactive chiller circuit disable / plant deactivation setpoint set	CS of _____	
126		Operator option one for next inactive chiller circuit disable / plant deactivation period set	CS of _____	
127		Operator option two for next inactive chiller circuit disable / plant deactivation setpoint set	CS of _____	
128		Operator option two for next inactive chiller circuit disable / plant deactivation period set	CS of _____	

SYSTEM OPERATION				
STEP	**TEST METHOD**	**EXPECTED RESPONSE**	**COMMENTS**	**PASS/ FAIL**
129	deactivation setpoint and set disable period • Observe system status • Release Operator inputs • Observe system status	No Operator input default for next inactive chiller circuit disable / plant deactivation setpoint set	CS of _____	
130		No Operator input default for next inactive chiller circuit disable / plant deactivation period set	CS of _____	
131	To observe system response: • Override all terminal equipment control valves to their 0-percent open position	Five-minute period passes without control system action		
132		All chillers disabled	CS of _____	
133		Two-minute period passes without control system action		
134		All distribution pumps disabled	CS of _____	
135		Distribution pumping control algorithm deactivated	CS of _____	
136		Distribution pumping optimization control algorithm deactivated	CS of _____	
137		All condenser water pumps disabled	CS of _____	
138		Condenser water pumping control algorithm deactivated	CS of _____	
139		All chiller evaporator isolation valves commanded to their 0-percent open position	CS of _____	
140		All chiller condenser isolation valves commanded to their 0-percent open position	CS of _____	
141		All cooling towers disabled	CS of _____	
142		All cooling tower isolation valves commanded to their 0-percent open position	CS of _____	

SYSTEM OPERATION				
STEP	**TEST METHOD**	**EXPECTED RESPONSE**	**COMMENTS**	**PASS/ FAIL**
143		Cooling tower optimization control algorithm deactivated	CS of _____	
144		Chilled water bypass control algorithm deactivated	CS of _____	
145		Cooling tower bypass control algorithm deactivated	CS of _____	

SYSTEM OPERATION				
STEP	**TEST METHOD**	**EXPECTED RESPONSE**	**COMMENTS**	**PASS/ FAIL**
Plant Activation Operation Mode Design Control Sequence: Upon detection of no chiller being active, the control system shall: • Set stage one next active distribution pump enable setpoints equivalent to: – Operator option: Minimum number of system control valves commanded from their 0-percent open position and enable period, or – No Operator input default: Any single system control valve having been commanded from its 0-percent open position for a 15-minute enable period • Set stage two next active chiller circuit enable setpoints equivalent to: – Operator option: Minimum system flow and enable period, or – No Operator input default: 15-Percent of maximum system flow for a 15-minute enable period • Continuously set next active distribution pump equivalent to the inactive distribution pump with shortest runtime • Continuously set next active chiller circuit equivalent to the inactive chiller with shortest runtime • Continuously set next active condenser water pump equivalent to the inactive condenser water pump with shortest runtime • Monitor chilled water flow meter located in chiller loop • Command next active chiller's evaporator isolation valve to its 100-percent open position upon detection of stage one parameter having occurred and stage one enable period having passed • Enable next active distribution pump • Activate distribution pumping control algorithm • Activate distribution pumping optimization control algorithm • Activate chilled water bypass control algorithm • Command next active chiller's condenser isolation valve to its 100-percent open position upon detection of stage two activation parameter having occurred and stage two activation period having passed • Command next active tower's isolation valve to its 100-percent open position • Enable next active condenser water pump • Activate condenser water pumping control algorithm • Enable next active chiller • Enable next active cooling tower • Activate cooling tower optimization control algorithm • Activate cooling tower bypass control algorithm			
146	To prepare for system response: • Set Operator stage one next active distribution pump enable setpoint and set enable period • Observe system status • Release Operator	Operator stage one for next active distribution pump enable setpoint set	CS of _____	
147		Operator stage one for next active distribution pump enable period set	CS of _____	
148		No Operator input default for next active distribution pump enable setpoint set	CS of _____	

SYSTEM OPERATION				
STEP	**TEST METHOD**	**EXPECTED RESPONSE**	**COMMENTS**	**PASS/ FAIL**
149	inputs • Observe system status • Set Operator stage two next active chiller circuit enable setpoint and set enable period • Observe system status • Release Operator inputs • Observe system status	No Operator input default for next active distribution pump activation period set	CS of _____	
150		Operator stage two for next active chiller circuit enable setpoint set	CS of _____	
151		Operator stage two for next active chiller circuit enable period set	CS of _____	
152		No Operator input default for next active chiller circuit enable setpoint set	CS of _____	
153		No Operator input default for next active chiller circuit enable period set	CS of _____	
154		Next active distribution pump set	CS of _____	
155		Next active chiller set	CS of _____	
156		Next active condenser water pump set	CS of _____	
157		Chilled water flow monitored	CS of _____	
158	To observe system response: • Override one terminal equipment control valve to its 100-percent open position	15-Minute stage one enable period passes without control system action		
159		Next active chiller's evaporator isolation valve commanded to its 100-percent open position	CS of _____	
160		Next active distribution pump enabled	CS of _____	
161		Distribution pumping control algorithm activated	CS of _____	
162		Distribution pumping optimization control algorithm activated	CS of _____	
163		Chilled water bypass control algorithm activated	CS of _____	

SYSTEM OPERATION				
STEP	**TEST METHOD**	**EXPECTED RESPONSE**	**COMMENTS**	**PASS/ FAIL**
164		System loop chilled water flow measured	CS of _____	
165		Five-minute stage two enable period passes without control system action		
166		Next active chiller's condenser isolation valve commanded to its 100-percent open position	CS of _____	
167		Next active cooling tower's isolation valve commanded to its 100-percent open position	CS of _____	
168		Next active condenser water pump enabled	CS of _____	
169		Condenser water pumping control algorithm activated	CS of _____	
170		Next active chiller enabled	CS of _____	
171		Next active cooling tower enabled	CS of _____	
172		Cooling tower optimization control algorithm activated	CS of _____	
173		Cooling tower bypass control algorithm activated	CS of _____	
Single Chiller Operation Mode Design Control Sequence: Upon detection of completion of plant activation operation mode, the control system shall: • Monitor chilled water supply temperature sensor located in chiller loop • Forward supply water setpoint temperature of 44.0 °F to all chiller control panels • Enabled chiller output matches load				
174	To prepare for system response: • Observe system status	Chilled water supply temperature monitored	CS of _____	
175		Supply water setpoint temperature forwarded to all chiller control panels	CS of _____	

SYSTEM OPERATION				
STEP	**TEST METHOD**	**EXPECTED RESPONSE**	**COMMENTS**	**PASS/ FAIL**
176	To observe system response to deficient capacity: • Override supply water setpoint temperature to slightly less than actual temperature	Enabled chiller control panel indicates increased output	CS of _____	
177	To observe system response to excessive capacity: • Override supply water setpoint temperature to slightly greater than actual temperature	Enabled chiller control panel indicates decreased output	CS of _____	
Single Cooling Tower Operation Mode Design Control Sequence: Upon detection of completion of plant activation operation mode, the control system shall: • Set condenser supply water setpoint temperature equivalent to 65.0 °F when cooling tower optimization control algorithm is inactive and that set by cooling tower optimization control algorithm when active • Set cooling tower fan disable setpoint temperature equivalent to 64.0 °F • Monitor condenser water supply temperature sensor located in condenser supply water piping • Enable cooling tower fan upon detection of condenser supply water actual temperature being greater than cooling tower fan disable setpoint temperature for a two-minute period • Command enabled cooling tower fan towards its maximum allowed motor speed upon detection of condenser supply water actual temperature being greater than setpoint • Command enabled cooling tower fan towards its minimum allowed motor speed upon detection of condenser supply water actual temperature being less than setpoint • Disable cooling tower fan upon detection of fan having been commanded to its minimum allowed motor speed and condenser supply water actual temperature being equal to or less than cooling tower fan disable setpoint temperature for a two-minute period				
178	To prepare for system response: • Initiate minimum load to maintain single chiller at minimum allowable stable output • Override cooling tower fan disable setpoint temperature to slightly greater than actual temperature	Condenser supply water setpoint temperature set	CS of _____	
179		Cooling tower fan disable setpoint temperature set	CS of _____	
180		Condenser water supply temperature monitored	CS of _____	
181		Single chiller active status initiated	CS of _____	

SYSTEM OPERATION				
STEP	**TEST METHOD**	**EXPECTED RESPONSE**	**COMMENTS**	**PASS/ FAIL**
182	• Take no action until system has stabilized • Observe system status	Single cooling tower active status initiated	CS of _____	
183		Cooling tower fan disabled	CS of _____	
184		System stabilized		
185	To observe system response to deficient capacity:	Two-minute period passes without control system action		
186	• Release cooling tower fan disable setpoint temperature override	Cooling tower fan enabled	CS of _____	
187	To observe system response to continued deficient capacity: • Confirm / override supply water setpoint temperature to slightly less than actual temperature	Enabled cooling tower fan commanded towards its maximum allowed motor speed	CS of _____	
188	To observe system response to excessive capacity: • Override supply water setpoint temperature to slightly less than actual temperature	Enabled cooling tower fan commanded towards its minimum allowed motor speed	CS of _____	
189	To observe system response to continued excessive capacity:	Two-minute period passes without control system action		
190	• Override cooling tower fan disable setpoint temperature to slightly greater than actual temperature	Cooling tower fan disabled	CS of _____	
191	Release all overrides	System returns to pre-test conditions		

SYSTEM OPERATION				
STEP	**TEST METHOD**	**EXPECTED RESPONSE**	**COMMENTS**	**PASS/ FAIL**
Multiple Chiller Operation Mode Design Control Sequence: Upon detection of completion of plant activation operation mode, the control system shall: • Set next active chiller circuit enable setpoints equivalent to: – Operator option one: Minimum running load current of last enabled chiller and enable period, and / or – Operator option two: Minimum system load and enable period, or – No Operator input default: Actual chilled water supply temperature being equal to or greater than two degrees above setpoint temperature for a five-minute enable period • Set next inactive chiller circuit disable setpoints equivalent to: – Operator option one: Minimum running load current of last enabled chiller and disable period, and / or – Operator option two: Minimum system load and disable period, or – No Operator input default: System actual load being equal to or less than 90-percent of capacity of enabled chillers minus capacity of one chiller for a five-minute disable period • Continuously calculate actual load based on supply water setpoint temperature and input from chiller loop's return water temperature sensor and chiller loop's water flow meter • Continuously set next active chiller circuit equivalent to the inactive chiller with shortest runtime		• Continuously set next inactive chiller circuit equivalent to the active chiller with longest runtime • Monitor chiller water supply water temperature sensor located in chilled loop • Forward supply water setpoint temperature of 44.0 °F to all chiller control panels • Command next active chiller's evaporator and condenser isolation valves to their 100-percent open position upon detection of Operator option one and / or option two enable parameter(s) having occurred and enable period(s) having passed • Command next active chiller's evaporator and condenser isolation valves to their 100-percent open position upon detection of no Operator option one or option two inputs and default enable parameter having occurred and enable period having passed • Enable next active chiller • Enabled chillers equally share load • Disable next inactive chiller upon detection of Operator option one and / or option two disable parameter(s) having occurred and disable period(s) having passed • Disable next inactive chiller upon detection of no Operator option one or option two inputs, default disable parameter having occurred, and disable period having passed • Take no action for a two-minute period • Command next inactive chiller's evaporator isolation valve to its 0-percent open position • Command next inactive chiller's condenser isolation valve to its 0-percent open position	

SYSTEM OPERATION				
STEP	**TEST METHOD**	**EXPECTED RESPONSE**	**COMMENTS**	**PASS/ FAIL**
192	To prepare for system response: • Set Operator option one next active chiller circuit enable setpoint and set enable period • Observe system status • Release Operator inputs • Set Operator option two next active chiller circuit enable setpoint and set enable period • Observe system status • Release Operator inputs • Observe system status • Set Operator option one next inactive chiller circuit disable setpoint and set disable period • Observe system status • Release Operator inputs • Set Operator option two next inactive chiller circuit disable setpoint and set disable period • Observe system status • Release Operator inputs • Observe system status	Operator option one for next active chiller circuit enable setpoint set	CS of _____	
193		Operator option one for next active chiller circuit enable period set	CS of _____	
194		Operator option two for next active chiller circuit enable setpoint set	CS of _____	
195		Operator option two for next active chiller circuit enable period set	CS of _____	
196		No Operator input default for next active chiller circuit enable setpoint set	CS of _____	
197		No Operator input default for next active chiller circuit enable period set	CS of _____	
198		Operator option one for next inactive chiller circuit disable setpoint set	CS of _____	
199		Operator option one for next inactive chiller circuit disable period set	CS of _____	
200		Operator option two for next inactive chiller circuit disable setpoint set	CS of _____	
201		Operator option two for next inactive chiller circuit disable period set	CS of _____	
202		No Operator input default for next inactive chiller circuit disable setpoint set	CS of _____	
203		No Operator input default for next inactive chiller circuit disable period set	CS of _____	
204		Chilled water supply temperature monitored	CS of _____	
205		Load calculated	CS of _____	

SYSTEM OPERATION				
STEP	**TEST METHOD**	**EXPECTED RESPONSE**	**COMMENTS**	**PASS/ FAIL**
206		Supply water setpoint temperature forwarded to all chiller control panels	CS of _____	
207	To observe system response to deficient capacity: • Override supply water setpoint temperature to significantly less than actual temperature	Five-minute period passes without control system action		
208		Next active chiller's evaporator isolation valve commanded to its 100-percent open position	CS of _____	
209		Next active chiller's condenser isolation valve commanded to its 100-percent open position	CS of _____	
210		Next active chiller enabled	CS of _____	
211		Enabled chiller control panels indicate nominally equivalent increased output	CS of _____	
212	To observe system response to continued excessive capacity: • Override calculated load to significantly less than set chiller circuit disable setpoint load	Enabled chiller control panels indicate nominally equivalent decreased output	CS of _____	
213		Five-minute period passes without control system action		
214		Next inactive chiller disabled	CS of _____	
215		Two-minute period passes without control system action		
216		Next inactive chiller chiller's evaporator isolation valve commanded to its 0-percent open position	CS of _____	
217		Next inactive chiller chiller's condenser isolation valve commanded to its 0-percent open position	CS of _____	
218	Release all overrides	System returns to pre-test conditions		

SYSTEM OPERATION				
STEP	**TEST METHOD**	**EXPECTED RESPONSE**	**COMMENTS**	**PASS/ FAIL**
Multiple Cooling Tower Operation Mode Design Control Sequence: Upon detection of completion of plant activation operation mode, the control system shall: • Set condenser supply water setpoint temperature equivalent to 65.0 °F when cooling tower optimization control algorithm is inactive and that set by cooling tower optimization control algorithm when active • Continuously set next active cooling tower circuit equivalent to the inactive cooling tower with shortest runtime • Continuously set next inactive cooling tower circuit equivalent to the active cooling tower with longest runtime • Monitor condenser water supply temperature sensor located in condenser supply water piping • Command enabled cooling tower fans toward their maximum allowed motor speed upon detection of condenser supply water actual temperature being greater than setpoint of 65.0 °F • Enable next active cooling tower circuit upon detection of enabled cooling tower fan(s) having been commanded to maximum allowed motor speed and condenser supply water actual temperature being greater than setpoint of 65.0 °F for a two-minute period • Command next active cooling tower's isolation valve to its 100-percent open position • Enable next active cooling tower • Enabled cooling towers equally share load • Command enabled cooling tower fans toward their minimum allowed motor speed upon detection of condenser supply water actual temperature being less than setpoint of 65.0 °F • Disable next inactive cooling tower circuit upon detection of cooling tower fans having been commanded to their minimum allowed motor speed and condenser supply water actual temperature being less than setpoint of 65.0 °F for a two-minute period • Disable next inactive cooling tower • Command next inactive cooling tower's isolation valve to its 0-percent open position			
219	To prepare for system response: • Observe system status	Condenser supply water setpoint temperature set	CS of _____	
220		Next active cooling tower circuit set	CS of _____	
221		Next inactive cooling tower circuit set	CS of _____	
222		Condenser water supply temperature monitored	CS of _____	

SYSTEM OPERATION				
STEP	**TEST METHOD**	**EXPECTED RESPONSE**	**COMMENTS**	**PASS/ FAIL**
223	To observe system response to deficient capacity: • Override supply water setpoint temperature to slightly less than actual temperature	Enabled cooling tower fan(s) commanded to their maximum allowed motor speed	CS of _____	
224	To observe system response to continued deficient capacity: • Override supply water setpoint temperature to significantly less than actual temperature	Two-minute period passes without control system action		
225		Next active cooling tower's isolation valve commanded to its 100-percent open position	CS of _____	
226		Next active cooling tower enabled	CS of _____	
227		Enabled cooling tower fan drives indicate nominally equivalent output	CS of _____	
228	To observe system response to excessive capacity: • Override supply water setpoint temperature to slightly greater than actual temperature	Enabled cooling tower fans commanded towards their minimum allowed motor speed	CS of _____	
229	To observe system response to continued excessive capacity: • Initiate minimum load to maintain single chiller at minimum allowable stable output • Override supply water setpoint temperature to significantly greater than actual temperature	Enabled cooling tower fans commanded to their minimum allowed motor speed	CS of _____	
230		Two-minute period passes without control system action		
231		Next inactive cooling tower disabled	CS of _____	
232		Next inactive cooling tower's isolation valve commanded to its 0-percent open position	CS of _____	
233	Release all overrides	System returns to pre-test conditions		

SYSTEM OPERATION				
STEP	**TEST METHOD**	**EXPECTED RESPONSE**	**COMMENTS**	**PASS/ FAIL**
High Chilled Water Supply Temperature Alarm Condition Design Control Sequence: Upon detection of initiation of plant activation operation mode, the control system shall: • Set high chilled water alarm setpoint temperature equivalent to control setpoint plus 10.0 °F • Continuously set next active chiller circuit equivalent to the inactive chiller with shortest runtime • Monitor chilled water supply temperature sensor located in chiller loop supply • Take no action during chiller manufacturer's load limiting at chiller start-up • Initiate audible and visual alarms at Operator workstation upon detection of actual supply water temperature being equal to or greater than alarm setpoint temperature for a 15-mintue period • Maintain enabled chiller statuses • Enable next active chiller circuit				
234	To prepare for system response: • Observe system status	Alarm setpoint temperature set	CS of _____	
235		Next active chiller circuit set	CS of _____	
236		Chilled water supply temperature monitored	CS of _____	
237	To observe system response: • Override high supply water alarm setpoint temperature to significantly less than actual temperature	15-minute period passes without control system action		
238		Audible and visual alarms initiated at Operator workstation		
239		Enabled chiller statuses maintained	CS of _____	
240		Next active chiller circuit enabled	CS of _____	
241	Release all overrides	System returns to pre-test conditions		

SYSTEM OPERATION				
STEP	**TEST METHOD**	**EXPECTED RESPONSE**	**COMMENTS**	**PASS/ FAIL**
Low Chilled Water Supply Temperature Alarm Condition Design Control Sequence: Upon detection of initiation of plant activation operation mode, the control system shall: • Set low chilled water alarm setpoint temperature equivalent to control setpoint minus 10.0 °F • Monitor chilled water supply temperature sensor located in chiller loop supply • Initiate audible and visual alarms at Operator workstation upon detection of actual supply water temperature being equal to or less than alarm setpoint temperature for a 15-mintue period • Maintain chiller statuses				
242	To prepare for system response: • Observe system status	Alarm setpoint temperature set	CS of _____	
243	To observe system response: • Override low supply water alarm setpoint temperature to significantly greater than actual temperature	15-minute period passes without control system action		
244		Audible and visual alarms initiated at Operator workstation		
245		Chiller statuses maintained	CS of _____	
246	Release all overrides	System returns to pre-test conditions		
Low Chilled Water Return Temperature Alarm Condition Design Control Sequence: Upon detection of receiving enable command, the control system shall: • Set chilled water return low limit alarm setpoint temperature equivalent to control setpoint minus 6.0 °F • Monitor chilled water return temperature sensor located in chiller loop return • Take no action during chiller manufacturer’s load limiting at chiller start-up • Initiate audible alarm at Operator workstation upon detection of actual return water temperature being equal to or greater than alarm setpoint temperature for a 15-mintue period • Maintain enabled chiller statuses				
247	To observe system response to excessive heating: • Override chilled water return low limit alarm setpoint temperature to significantly greater than actual temperature	15-Minute period passes without control system action		
248		Visual alarm initiated at Operator workstation		
249		Enabled chiller statuses maintained	CS of _____	

SYSTEM OPERATION				
STEP	**TEST METHOD**	**EXPECTED RESPONSE**	**COMMENTS**	**PASS/ FAIL**
250	Release all overrides	System returns to pre-test conditions		
High Condenser Water Temperature Alarm Condition Design Control Sequence: Upon detection of initiation of plant activation operation mode, the control system shall: • Set stage one alarm setpoint temperature equivalent to control setpoint plus 10.0 °F • Set stage two alarm setpoint temperature equivalent to control setpoint plus 20.0 °F • Continuously set next active cooling tower circuit equivalent to the inactive cooling tower with shortest runtime • Monitor condenser water supply temperature sensor located in condenser water supply • Initiate visual alarm at Operator workstation and maintain cooling tower statuses upon detection of condenser water temperature being equal to or greater than stage one alarm setpoint temperature • Initiate audible and visual alarms at Operator workstation, maintain enabled cooling tower statuses, and enable next active cooling tower circuit upon detection of condenser water temperature being equal to or greater than stage two alarm setpoint temperature				
251	To prepare for system response: • Observe system status	Stage one alarm setpoint temperature set	CS of _____	
252		Stage two alarm setpoint temperature set	CS of _____	
253		Next active cooling tower circuit set	CS of _____	
254		Condenser water supply temperature monitored	CS of _____	
255	To observe system response to stage one alarm: • Override stage one alarm setpoint temperature to slightly less than actual temperature	Visual alarm initiated at Operator workstation		
256		Cooling tower statuses maintained		
257	To observe system response to stage two alarm: • Override stage two alarm setpoint temperature to	Audible and visual alarms initiated at Operator workstation		
258		Enabled cooling tower statuses maintained	CS of _____	

SYSTEM OPERATION				
STEP	**TEST METHOD**	**EXPECTED RESPONSE**	**COMMENTS**	**PASS/ FAIL**
259	significantly less than actual temperature	Next active cooling tower circuit enabled	CS of _____	
260	Release all overrides	System returns to pre-test conditions		
Low Condenser Water Temperature Alarm Condition Design Control Sequence: Upon detection of initiation of plant activation operation mode, the control system shall: • Set low condenser water alarm setpoint temperature equivalent to control setpoint minus 10.0 °F • Monitor condenser water supply temperature sensor located in condenser water supply • Initiate visual alarm at Operator workstation upon detection of actual supply water temperature being equal to or less than alarm setpoint temperature • Maintain cooling tower statuses				
261	To prepare for system response: • Observe system status	Alarm setpoint temperature set	CS of _____	
262		Condenser water supply temperature monitored	CS of _____	
263	To observe system response: • Override low supply water alarm setpoint temperature to significantly greater than actual temperature	Visual alarm initiated at Operator workstation		
264		Cooling tower statuses maintained	CS of _____	
265	Release all overrides	System returns to pre-test conditions		

SYSTEM OPERATION				
STEP	**TEST METHOD**	**EXPECTED RESPONSE**	**COMMENTS**	**PASS/ FAIL**
High Chilled Water Flow Alarm Condition Design Control Sequence: Upon detection of initiation of plant activation operation mode, the control system shall: • Continuously set high chilled water alarm setpoint flow equivalent to the product of the number of active chillers and 600 gpm • Continuously set next active chiller circuit equivalent to the inactive chiller with shortest runtime • Monitor water flow meter located in chiller loop • Initiate audible and visual alarms at Operator workstation upon detection of actual chiller loop water flow being equal to or greater than alarm setpoint flow • Enable next active chiller circuit				
266	To prepare for system response: • Initiate single chiller operation mode • Observe system status	High chilled water alarm setpoint flow set	CS of _____	
267		Chiller loop water flow monitored	CS of _____	
268		Single chiller operation mode initiated	CS of _____	
269	To observe system response to excessive system flow: • Override all terminal equipment control valves to their 100-percent open position	Audible and visual alarms initiated at Operator workstation		
270		Next active chiller circuit enabled	CS of _____	
271	Release all overrides	System returns to pre-test conditions		

SYSTEM OPERATION				
STEP	**TEST METHOD**	**EXPECTED RESPONSE**	**COMMENTS**	**PASS/ FAIL**
Chiller (___) Evaporator Temperature Alarm Condition Design Control Sequence: Upon detection of initiation of plant activation operation mode, the control system shall: • Set chiller evaporator high limit alarm setpoint temperature equivalent to supply water setpoint temperature plus 5.0 °F • Monitor chiller supply water temperature sensor located in chiller evaporator outlet • Take no action during chiller manufacturer's load limiting at chiller start-up • Initiate audible and visual alarms at Operator workstation upon detection of actual supply water temperature being equal to or greater than alarm setpoint temperature for a 15-mintue period • Maintain enabled chiller statuses				
272	To observe system response to excessive heating: • Override evaporator high limit alarm setpoint temperature to significantly less than actual temperature	15-Minute period passes without control system action		
273		Audible alarm initiated at Operator workstation		
274		Enabled chiller statuses maintained	CS of _____	
275	Release all overrides	System returns to pre-test conditions		
Chiller (___) Evaporator Temperature Alarm Condition				
276	To observe system response to excessive heating: • Override evaporator high limit alarm setpoint temperature to significantly less than actual temperature	Five-minute period passes without control system action		
277		Audible and visual alarms initiated at Operator workstation		
278		Enabled chiller statuses maintained	CS of _____	
279	Release all overrides	System returns to pre-test conditions		
Chiller (___) General Fault Alarm Condition Design Control Sequence: Upon detection of initiation of plant activation operation mode and chiller general fault alarm, the control system shall: • Initiate visual alarm at Operator workstation • Maintain system active status				
280	To observe system response:	Visual alarm initiated at Operator workstation		

SYSTEM OPERATION				
STEP	**TEST METHOD**	**EXPECTED RESPONSE**	**COMMENTS**	**PASS/ FAIL**
281	• Initiate chiller fault at chiller's control panel	System status maintained	CS of _____	
282	Release all overrides	System returns to pre-test conditions		
Chiller (___) General Fault Alarm Condition				
283	To observe system response: • Initiate chiller fault at chiller's control panel	Visual alarm initiated at Operator workstation		
284		System status maintained	CS of _____	
285	Release all overrides	System returns to pre-test conditions		
Cooling Tower (___) General Fault Alarm Condition				
286	To observe system response: • Initiate general fault at adjustable frequency drive	Visual alarm initiated at Operator workstation		
287		System status maintained	CS of _____	
288	Release all overrides	System returns to pre-test conditions		
Cooling Tower (___) General Fault Alarm Condition				
289	To observe system response: • Initiate general fault at adjustable frequency drive	Visual alarm initiated at Operator workstation		
290		System status maintained	CS of _____	
291	Release all overrides	System returns to pre-test conditions		

SYSTEM OPERATION				
STEP	**TEST METHOD**	**EXPECTED RESPONSE**	**COMMENTS**	**PASS/ FAIL**
Cooling Tower (___) Failure Type One Alarm Condition Design Control Sequence: Upon detection of initiation of plant activation operation mode and a cooling tower failure alarm status without all towers being active, the control system shall: • Continuously set next active cooling tower circuit equivalent to the inactive cooling tower with shortest runtime • Initiate audible and visual alarms at Operator workstation • Disable failed cooling tower • Command failed cooling tower's isolation valve to its 0-percent open position • Command next active cooling tower's isolation valve to its 100-percent open position • Enable next active cooling tower • Maintain chiller statuses • Maintain distribution pump statuses • Maintain condenser water pump statuses				
292	To prepare for system response: • Observe system status	Next active cooling tower circuit set	CS of _____	
293		Confirm at least one cooling tower's status is inactive	CS of _____	
294	To observe system response: • Manually turn cooling tower's disconnect switch to off position	Audible and visual alarms initiated at Operator workstation		
295		Failed cooling tower disabled	CS of _____	
296		Failed cooling tower's isolation valve commanded to its 0-percent open position	CS of _____	
297		Next active cooling tower's isolation valve commanded to its 100-percent open position	CS of _____	
298		Next active cooling tower enabled	CS of _____	
299		Chiller statuses maintained	CS of _____	
300		Distribution pump statuses maintained	CS of _____	
301		Condenser water pump statuses maintained	CS of _____	

SYSTEM OPERATION				
STEP	**TEST METHOD**	**EXPECTED RESPONSE**	**COMMENTS**	**PASS/ FAIL**
302	Release all overrides	System returns to pre-test conditions		
Cooling Tower (___) Failure Type One Alarm Condition				
303	To observe system response: • Manually turn cooling tower's disconnect switch to off position	Audible and visual alarms initiated at Operator workstation		
304		Failed cooling tower disabled	CS of _____	
305		Failed cooling tower's isolation valve commanded to its 0-percent open position	CS of _____	
306		Next active cooling tower's isolation valve commanded to its 100-percent open position	CS of _____	
307		Next active cooling tower enabled	CS of _____	
308		Chiller statuses maintained	CS of _____	
309		Distribution pump statuses maintained	CS of _____	
310		Condenser water pump statuses maintained	CS of _____	
311	Release all overrides	System returns to pre-test conditions		
Distribution Pump (___) General Fault Alarm Condition Design Control Sequence: Upon detection of initiation of plant activation operation mode and distribution pump general fault alarm, the control system shall: • Initiate visual alarm at Operator workstation • Maintain system active status				
312	To observe system response: • Initiate general fault at adjustable frequency drive	Visual alarm initiated at Operator workstation		
313		System status maintained	CS of _____	
314	Release all overrides	System returns to pre-test conditions		

SYSTEM OPERATION				
STEP	**TEST METHOD**	**EXPECTED RESPONSE**	**COMMENTS**	**PASS/ FAIL**
Distribution Pump (___) General Fault Alarm Condition				
315	To observe system response: • Initiate general fault at adjustable frequency drive	Visual alarm initiated at Operator workstation		
316		System status maintained	CS of _____	
317	Release all overrides	System returns to pre-test conditions		
Distribution Pump (___) General Fault Alarm Condition				
318	To observe system response: • Initiate general fault at adjustable frequency drive	Visual alarm initiated at Operator workstation		
319		System status maintained	CS of _____	
320	Release all overrides	System returns to pre-test conditions		
Distribution Pump (___) Failure Type One Alarm Condition Design Control Sequence: Upon detection of initiation of plant activation operation mode and distribution pump failure alarm status with more than one distribution pump being active, the control system shall: • Continuously set next active distribution pump equivalent to the inactive distribution pump with shortest runtime • Initiate audible and visual alarms at Operator workstation • Disable failed distribution pump • Enable next active distribution pump				
321	To prepare for system response: • Observe system status	Next active distribution pump set	CS of _____	
322	To observe system response: • Manually turn distribution pump's disconnect switch to off position	Audible and visual alarms initiated at Operator workstation		
323		Filed distribution pump disabled	CS of _____	
324		Next active distribution pump enabled	CS of _____	
325	Release all overrides	System returns to pre-test conditions		

SYSTEM OPERATION				
STEP	**TEST METHOD**	**EXPECTED RESPONSE**	**COMMENTS**	**PASS/ FAIL**
Distribution Pump (___) Failure Type One Alarm Condition				
326	To observe system response: • Manually turn distribution pump's disconnect switch to off position	Audible and visual alarms initiated at Operator workstation		
327		Filed distribution pump disabled	CS of _____	
328		Next active distribution pump enabled	CS of _____	
329	Release all overrides	System returns to pre-test conditions		
Distribution Pump (___) Failure Type One Alarm Condition				
330	To observe system response: • Manually turn distribution pump's disconnect switch to off position	Audible and visual alarms initiated at Operator workstation		
331		Filed distribution pump disabled	CS of _____	
332		Next active distribution pump enabled	CS of _____	
333	Release all overrides	System returns to pre-test conditions		
Condenser Water Pump (___) General Fault Alarm Condition Design Control Sequence: Upon detection of initiation of plant activation operation mode and distribution pump general fault alarm, the control system shall: • Initiate visual alarm at Operator workstation • Maintain system active status				
334	To observe system response: • Initiate general fault at adjustable frequency drive	Visual alarm initiated at Operator workstation		
335		System status maintained	CS of _____	
336	Release all overrides	System returns to pre-test conditions		
Condenser Water Pump (___) General Fault Alarm Condition				
337	To observe system response:	Visual alarm initiated at Operator workstation		

SYSTEM OPERATION				
STEP	**TEST METHOD**	**EXPECTED RESPONSE**	**COMMENTS**	**PASS/ FAIL**
338	• Initiate general fault at adjustable frequency drive	System status maintained	CS of _____	
339	Release all overrides	System returns to pre-test conditions		
Condenser Water Pump (___) General Fault Alarm Condition				
340	To observe system response: • Initiate general fault at adjustable frequency drive	Visual alarm initiated at Operator workstation		
341		System status maintained	CS of _____	
342	Release all overrides	System returns to pre-test conditions		
Condenser Water Pump (___) Failure Type One Alarm Condition Design Control Sequence: Upon detection of initiation of plant activation operation mode and condenser water pump failure alarm status with more than one condenser water pump being active, the control system shall: • Continuously set next active condenser water pump equivalent to the inactive distribution pump with shortest runtime • Initiate audible and visual alarms at Operator workstation • Disable failed condenser water pump • Enable next active condenser water pump				
343	To prepare for system response: • Observe system status	Next active condenser water pump set	CS of _____	
344	To observe system response: • Manually turn distribution pump's disconnect switch to off position	Audible and visual alarms initiated at Operator workstation		
345		Filed condenser water pump disabled	CS of _____	
346		Next active condenser water pump enabled	CS of _____	
347	Release all overrides	System returns to pre-test conditions		
Condenser Water Pump (___) Failure Type One Alarm Condition				
348	To observe system response:	Audible and visual alarms initiated at Operator workstation		

SYSTEM OPERATION				
STEP	**TEST METHOD**	**EXPECTED RESPONSE**	**COMMENTS**	**PASS/ FAIL**
349	• Manually turn distribution pump's disconnect switch to off position	Filed condenser water pump disabled	CS of _____	
350		Next active condenser water pump enabled	CS of _____	
351	Release all overrides	System returns to pre-test conditions		
Chiller (___) Failure Alarm Condition Design Control Sequence: Upon detection of initiation of plant activation operation mode and a chiller failure alarm status, the control system shall: • Continuously set next active chiller circuit equivalent to the inactive chiller with shortest runtime • Initiate audible and visual alarms at Operator workstation • Disable failed chiller • Enable next active chiller circuit • Maintain cooling tower statuses • Maintain distribution pump statuses • Maintain condenser water pump statuses				
352	To prepare for system response: • Observe system status	Next active chiller circuit set	CS of _____	
353	To observe system response: • Manually turn chiller's disconnect switch to off position	Audible and visual alarms initiated at Operator workstation		
354		Failed chiller disabled	CS of _____	
355		Next active chiller circuit enabled	CS of _____	
356		Cooling tower statuses maintained	CS of _____	
357		Distribution pump statuses maintained	CS of _____	
358		Condenser water pump statuses maintained	CS of _____	
359	Release all overrides	System returns to pre-test conditions		

SYSTEM OPERATION				
STEP	**TEST METHOD**	**EXPECTED RESPONSE**	**COMMENTS**	**PASS/ FAIL**
Cooling Tower (___) Failure Type Two Alarm Condition Design Control Sequence: Upon detection of initiation of plant activation operation mode and a cooling tower failure alarm status with all towers being active, the control system shall: • Continuously set next inactive chiller circuit equivalent to the active chiller with longest runtime • Continuously set next inactive condenser water pump equivalent to the active condenser water pump with longest runtime • Initiate audible and visual alarms at Operator workstation • Disable failed cooling tower • Command failed cooling tower's isolation valve to its 0-percent open position • Disable next inactive chiller circuit • Disable next inactive condenser water pump				
360	To prepare for system response: • Observe system status • Initiate all cooling towers to active status	Next inactive chiller circuit set	CS of _____	
361		Next inactive condenser water pump set	CS of _____	
362		Confirm all cooling tower's status are active	CS of _____	
363	To observe system response: • Manually turn cooling tower's disconnect switch to off position	Audible and visual alarms initiated at Operator workstation		
364		Failed cooling tower disabled	CS of _____	
365		Failed cooling tower's isolation valve commanded to its 0-percent open position	CS of _____	
366		Next inactive chiller circuit disabled	CS of _____	
367		Next inactive condenser water pump disabled	CS of _____	
368	Release all overrides	System returns to pre-test conditions		

SYSTEM OPERATION				
STEP	**TEST METHOD**	**EXPECTED RESPONSE**	**COMMENTS**	**PASS/ FAIL**
Distribution Pump (___) Failure Type Two Alarm Condition Design Control Sequence: Upon detection of initiation of plant activation operation mode and a distribution pump failure alarm status with one distribution pump being active, the control system shall: • Initiate audible and visual alarms at Operator workstation • Disable failed distribution pump • Initiate plant deactivation operation mode • Initiate plant activation operation mode				
369	To observe system response: • Manually turn distribution pump's disconnect switch to off position	Audible and visual alarms initiated at Operator workstation		
370		Failed distribution pump disabled	CS of _____	
371		Plant deactivation operation mode initiated	CS of _____	
372		Plant activation operation mode initiated	CS of _____	
373	Release all overrides	System returns to pre-test conditions		
Condenser Water Pump (___) Failure Type Two Alarm Condition Design Control Sequence: Upon detection of initiation of plant activation operation mode and a condenser water pump failure alarm status with one condenser water pump being active, the control system shall: • Initiate audible and visual alarms at Operator workstation • Disable failed condenser water pump • Initiate plant deactivation operation mode • Initiate plant activation operation mode				
374	To observe system response: • Manually turn condenser water pump's disconnect switch to off position	Audible and visual alarms initiated at Operator workstation		
375		Failed condenser water pump disabled	CS of _____	
376		Plant deactivation operation mode initiated	CS of _____	
377		Plant activation operation mode initiated	CS of _____	
378	Release all overrides	System returns to pre-test conditions		

SYSTEM OPERATION				
STEP	**TEST METHOD**	**EXPECTED RESPONSE**	**COMMENTS**	**PASS/ FAIL**
Chiller (___) Opposite Status Alarm Condition Design Control Sequence: Upon detection of initiation of plant activation operation mode and status being opposite command, the control system shall: • Initiate audible and visual alarms at Operator workstation • Maintain system active status				
379	To observe system response to equipment off status:	Audible and visual alarms initiated at Operator workstation		
380	• Override system to inactive status • Manually set chiller to “off” at chiller control panel • Enable chiller at control system	Equipment and system status maintained	CS of _____	
381	To observe system response to equipment on status:	Audible and visual alarms initiated at Operator workstation		
382	• Maintain system inactive status • Manually set chiller to “on” at chiller control panel • Disable chiller at control system	Equipment and system status maintained	CS of _____	
383	Release selected overrides	Selected components return to pre-test conditions		
Chiller (___) Opposite Status Alarm Condition				
384	To observe system response to equipment off status:	Audible and visual alarms initiated at Operator workstation		
385	• Maintain system inactive status • Manually set chiller to “off” at chiller control panel • Enable chiller at control system	Equipment and system status maintained	CS of _____	
386	To observe system response to equipment on status:	Audible and visual alarms initiated at Operator workstation		

SYSTEM OPERATION				
STEP	**TEST METHOD**	**EXPECTED RESPONSE**	**COMMENTS**	**PASS/ FAIL**
387	• Maintain system inactive status • Manually set chiller to “on” at chiller control panel • Disable chiller at control system	Equipment and system status maintained	CS of _____	
388	Release selected overrides	Selected components return to pre-test conditions		
Cooling Tower (___) Opposite Status Alarm Condition Design Control Sequence: Upon detection of initiation of plant activation operation mode and status being opposite command, the control system shall: • Initiate audible and visual alarms at Operator workstation • Maintain system active status				
389	To observe system response to equipment off status:	Audible and visual alarms initiated at Operator workstation		
390	• Maintain system inactive status • Manually set hand-off-auto switch at adjustable frequency drive to “off” position	Equipment and system status maintained	CS of _____	
391	To observe system response to equipment on status:	Audible and visual alarms initiated at Operator workstation		
392	• Maintain system inactive status • Manually set hand-off-auto switch at adjustable frequency drive to “on” position	Equipment and system status maintained	CS of _____	
393	Release selected overrides	Selected components return to pre-test conditions		
Cooling Tower (___) Opposite Status Alarm Condition				
394	To observe system response to equipment off status:	Audible and visual alarms initiated at Operator workstation		

SYSTEM OPERATION				
STEP	**TEST METHOD**	**EXPECTED RESPONSE**	**COMMENTS**	**PASS/ FAIL**
395	• Maintain system inactive status • Manually set hand-off-auto switch at adjustable frequency drive to “off” position	Equipment and system status maintained	CS of _____	
396	To observe system response to equipment on status:	Audible and visual alarms initiated at Operator workstation		
397	• Maintain system inactive status • Manually set hand-off-auto switch at adjustable frequency drive to “on” position	Equipment and system status maintained	CS of _____	
398	Release selected overrides	Selected components return to pre-test conditions		
Distribution Pump (___) Opposite Status Alarm Condition Design Control Sequence: Upon detection of initiation of plant activation operation mode and status being opposite command, the control system shall: • Initiate audible and visual alarms at Operator workstation • Maintain system active status				
399	To observe system response to equipment off status:	Audible and visual alarms initiated at Operator workstation		
400	• Maintain system inactive status • Manually set hand-off-auto switch at adjustable frequency drive to “off” position	Equipment and system status maintained	CS of _____	
401	To observe system response to equipment on status:	Audible and visual alarms initiated at Operator workstation		
402	• Maintain system inactive status • Manually set hand-off-auto switch at adjustable frequency drive to “on” position	Equipment and system status maintained	CS of _____	
403	Release selected overrides	Selected components return to pre-test conditions		

SYSTEM OPERATION				
STEP	**TEST METHOD**	**EXPECTED RESPONSE**	**COMMENTS**	**PASS/ FAIL**
Distribution Pump (___) Opposite Status Alarm Condition				
404	To observe system response to equipment off status:	Audible and visual alarms initiated at Operator workstation		
405	• Maintain system inactive status • Manually set hand-off-auto switch at adjustable frequency drive to “off” position	Equipment and system status maintained	CS of _____	
406	To observe system response to equipment on status:	Audible and visual alarms initiated at Operator workstation		
407	• Maintain system inactive status • Manually set hand-off-auto switch at adjustable frequency drive to “on” position	Equipment and system status maintained	CS of _____	
408	Release selected overrides	Selected components return to pre-test conditions		
Distribution Pump (___) Opposite Status Alarm Condition				
409	To observe system response to equipment off status:	Audible and visual alarms initiated at Operator workstation		
410	• Maintain system inactive status • Manually set hand-off-auto switch at adjustable frequency drive to “off” position	Equipment and system status maintained	CS of _____	
411	To observe system response to equipment on status:	Audible and visual alarms initiated at Operator workstation		
412	• Maintain system inactive status • Manually set hand-off-auto switch at adjustable frequency drive to “on” position	Equipment and system status maintained	CS of _____	
413	Release selected overrides	Selected components return to pre-test conditions		

SYSTEM OPERATION				
STEP	**TEST METHOD**	**EXPECTED RESPONSE**	**COMMENTS**	**PASS/ FAIL**
Condenser Water Pump (___) Opposite Status Alarm Condition Design Control Sequence: Upon detection of initiation of plant activation operation mode and status being opposite command, the control system shall: • Initiate audible and visual alarms at Operator workstation • Maintain system active status				
414	To observe system response to equipment off status:	Audible and visual alarms initiated at Operator workstation		
415	• Maintain system inactive status • Manually set hand-off-auto switch at adjustable frequency drive to “off” position	Equipment and system status maintained	CS of _____	
416	To observe system response to equipment on status:	Audible and visual alarms initiated at Operator workstation		
417	• Maintain system inactive status • Manually set hand-off-auto switch at adjustable frequency drive to “on” position	Equipment and system status maintained	CS of _____	
418	Release selected overrides	Selected components return to pre-test conditions		
Condenser Water Pump (___) Opposite Status Alarm Condition				
419	To observe system response to equipment off status:	Audible and visual alarms initiated at Operator workstation		
420	• Maintain system inactive status • Manually set hand-off-auto switch at adjustable frequency drive to “off” position	Equipment and system status maintained	CS of _____	
421	To observe system response to equipment on status:	Audible and visual alarms initiated at Operator workstation		
422	• Maintain system inactive status • Manually set hand-off-auto switch at adjustable frequency drive to “on” position	Equipment and system status maintained	CS of _____	

SYSTEM OPERATION				
STEP	**TEST METHOD**	**EXPECTED RESPONSE**	**COMMENTS**	**PASS/ FAIL**
423	Release selected overrides	Selected components return to pre-test conditions		
Condenser Water Pump (___) Opposite Status Alarm Condition				
424	To observe system response to equipment off status:	Audible and visual alarms initiated at Operator workstation		
425	• Maintain system inactive status • Manually set hand-off-auto switch at adjustable frequency drive to “off” position	Equipment and system status maintained	CS of _____	
426	To observe system response to equipment on status:	Audible and visual alarms initiated at Operator workstation		
427	• Maintain system inactive status • Manually set hand-off-auto switch at adjustable frequency drive to “on” position	Equipment and system status maintained	CS of _____	
428	Release all overrides	System returns to pre-test conditions		

-- End of Test --