012 -	Date	Type of Test	Function	Component	Device	Expected/Actual Results: / Remarks	Status
Condenser Water System							Condenser Water System

012 -	Date	Type of Test	Function	Component	Device	Expected/Actual Results: / Remarks	Status
Condenser Water System							Condenser Water System
0			0 - Test Goals	Test Targets			P / F / C / D

Test Description

-

TEST GOALS

1. To spot check system configuration and the location of critical sensing and control elements
2. To spot check prefunctional tests and start-up checks and verify documentation
3. To verify the completion of the manufacturer's factory start-ups where required
4. To spot check compliance with the manufacturer's installation and start-up requirements
5. To verify operation of the make up water valve and related alarms
6. To verify piping connections place no strain on the equipment as basin levels vary from empty to full.
7. To verify adequate water levels at start-up to prevent drawing a vortex at the cooling tower outlet and cavitation of the pumps.
8. To verify adequate basin capacity for drain-down when the system shuts down.
9. To verify self balancing nature intended by the piping design in terms of the distribution of condenser water and the maintenance of the operating level in the coolingTower basins
10. To verify hot basin water distribution in all operating modes
11. To verify proper interlocks with the water treatment system.
12. To verify proper operation of the water treatment equipment.
13. To verify non-overloading motors on the condenser water pumps and freedom from cavitation when the pumps run out their curves.
14. To verify coolingtower fan VFD minimum speeds and that the minimum speeds meet the requirements of the installed coolingTower manufacturer.
15. To verify coolin tower fan direction of rotation
16. To verify cooling tower fan speed modulation.
17. To verify lead/lag sequencing fo the condenser pumps and cooling tower fans.
18. To verify cooling tower isolation valve sequencing and related interlocks with theTower fan.
19. To verify integration with the emergency stop switch.
20. To verify cooling tower fan staging relative to chiller staging.
21. To identify the level of redundancy provided by operating one pump agaist the wide open system (bothtowers and chillers open for flow) and assess if the chillers have enough flexibility to operate at the below design flows provided in this mode.
22. To verify integrated operation of the condenser water system with the chilled water plant and the facility
23. To verify alarm functionality.

P=Pass, F=Fail, C=Could't, D=Didnt

012 -	Date	Type of Test	Function	Component	Device	Expected/Actual Results: / Remarks	Status
Condenser Water System							**Condenser Water System**

1 — 1 Preperation — 1 - Acceptance Criteria — Pass or Fail Criteria — P / F / C / D

Test Description -

ACCEPTANCE CRITERIA

The acceptance criteria for test targets 1 - 6, and 9 - 23 of this test sequence are as called out directly or implied by the project specifications and contract documents.

Test targets 7, 8, 21 is being assessed for information only purposes to provide operating data and identify operating limitations for the facility and have no specific acceptance critera assocaited with them.

Specific test critera will be called out for each test sequence at the approprate place in the test sequence.

2 — 1 Preperation — 2 - General Instructions — Test Overview — P / F / C / D

CA

Test Description -

GENERAL INSTRUCTIONS

1. Review the recommended test sequence to prior to testing.
2. Document all results as you proceed in the CACEA data base forms provided for the test.
3. Review all decisions to deviate from the procedure or recommended test sequence with other team members prior to making the change. Note any changes made for future reference.
4. If a test is suspended for any reason, go through the return to normal procedures to ensure that the system is left in a stable, known, satisfactory operating condition.

P=Pass, F=Fail, C=Could't, D=Didnt

012 -	Date	Type of Test	Function	Component	Device	Expected/Actual Results: / Remarks	Status
Condenser Water System							Condenser Water System
3		1 Preperation	3 - Test Equipment	Recommended Equipment			P / F / C / D

Test Description

-

TEST EQUIPMENT

The following test equipment is recommended for this test:

1. Standard hand tool kit.
2. Multimeter with amp measuring capability.
3. Temperature probe capable of measuring temperatures in a well.
4. Pressure gauges, a pressure transducer capable of interfacing with a Fluke meter, or a hydromanometer (preferred).
5. Ultrasonic flow meter (desirable but not mandatory)

012 -	Date	Type of Test	Function	Component	Device	Expected/Actual Results: / Remarks	Status
Condenser Water System							Condenser Water System
4		1 Preperation	4 - Prerequisites	Required to Test			P / F / C / D

Test Description

-

PREREQUISITES

The folllowing prerequisites should be completed or in place prior to this test.

1. Manufacturer's factory start-ups should be complete for the VFDs and the water treatment system. The equipment should be approved for operation by the factory including documenation of all settings and a signed off factory start-up report.
2. Contractor start-up and prefunctional testing of all components in the system with the exeption of the chillers should be complete and documented on the contractors start-up forms.
3. The chillers need to be capable of having condenser water flow through them but do not necessarily have to be fully operational for this test sequence.
4. Calibration and testing of all control components and control software associated with the cooling towers and condenser water pumps needs to be complete
5. The water treatment system needs to be functional and integrated with the control system.
6. The make up water system needs to be ready for operation, including verification of the back flow preventer and related approvals from the plumbing inspector.
7. The UCB facilities staff should be aware that the start-up is occuring and have been offered the opportunity to participate or witness it.
8. The system should be balanced with balance reports avaiablle for review and reference.
9. The EMCS Demonstration has been completed for the equipment associated with the condenser water system. (specification section 17010, paragraphs 3.05).

P=Pass, F=Fail, C=Could't, D=Didnt

012 -	Date	Type of Test	Function	Component	Device	Expected/Actual Results: / Remarks	Status
Condenser Water System							Condenser Water System
5		1 Preperation	5 - Precautions and Prep	Prior to Testing		*Contact -* *Position -* *Phone number -* *Contact -* *Position -* *Phone number -* *Contact -* *Position -* *Phone number -* *Contact -* *Position -* *Phone number -*	P / F / C / D

Test Description - -

PRECAUTIONS AND PREPERATION

1. Observe standard safety precautions associated with working around live electrical equipment, pressurized piping and duct systems, refrigerants, and rotating machinery.
2. Familiarize yourself with the evacuation paths from mechanical spaces in the event of a refrigerant alarm or major leak.
3. Observe the contractor and facilities lock-out/tag-out proceedures.
4. Coordinate all tests with the contracting team and UCB Facilities If possible obtain a set of radios that allow you to communicate directly with the contractor and UCB. If this is not possible obtain key cell phone numbers and note them on this form.
5. The factory start-up and setting of the VFDs may be critical for this equipment. For instance, if something dropped a fan off line and then restarted it while it was spinning down, the drive would be starting against a spinning motor, which can cause problems like broken belts and drive failures if braking settings, accelleration times, etc. have not been properly set. Similar problems can occur if airflow patterns around the buildng cause a fan to spin backwards and then the drive engages to start it.
6. The operation of the water treatment system is critical for releasing this system to service after the completion of functioanl testing. If water treatment is not proper, the chillers and towers can be fouled in a matter of days or weeks if the system remains in operation.
7. There are critical loads requireing chilled water in this facility in normal operation which include the dehumidification units and AH-A and AH-B. During start-up, the key critical loads are likely going to be the dehumidification units. Loss of chilled water to these units will cause them to shut down on a head pressure safety and disrupt their commissioning and start-up process. The thermal flywheel of the chilled water piping system will likely carry the dehumidification units through a short term (10 minutes or less) chiller shut down as long as flow is maintained. If a long term shut down is required for some reason,it should be coordinate carefully with the commissioning and start-up team before proceding.
8. Loss of chilled water flow will also disrupt any efforts being made to use the dehumidification units and AH-A and B to dry out the area they serve. A short term loss is likely not a significant impact. A long term loss could have an adverse impact on pulling the spaces down to operarting conditions and delay the commissioning and acceptance process. If a long term shut down is required for some reason,it should be coordinate carefully with the commissioning and start-up team before proceding.
9. When forcing system variables to simulate a condition and verify a response, bear in mind that multiple processes may be dependent upon the variable you are about to manipulate. Prior to manipulating it, verify that your manipulation will not upset some other process and cause problems in the facility. For instance, forcing the outdoor air temperature to 75 degrees F in a cold day to verify the reset schedule on a condenser water system may also shut down the heating water system. If it is below freezing this could lead to a frozen coil.

P=Pass, F=Fail, C=Could't, D=Didnt

012 -	Date	Type of Test	Function	Component	Device	Expected/Actual Results: / Remarks	Status
Condenser Water System							Condenser Water System
6		1 Preperation	6 - Reference Material	Useful Information			P / F / C / D

Test Description -

REFERENCES

All of these items have been loaded onto the project portal unless otherwise noted.

1. System diagram
2. Mechanical drawings, sheets M001, M206A, M401, M401, M501, and M704 (1, 35, 39 - 41, and 51 of the .pdf drawing set)
3. Spec section 15640 (cooling towers, page 207 of the spec .pdf file)
4. Spec section 15645 (water treatment, page 215 of the spec .pdf file)
5. Spec section 15130 (pumps, page 167 of the spec .pdf file)
6. Spec section 15051 (variable speed drives, page 49 of the spec .pdf file)
7. Spec section 15950 (testing and balancing, page 320 of the spec .pdf file)
8. Design intent document
9. Control sequences
10. Control shop drawings
11. Final approved control programming (draft only available pending approval as of 02-06-08)
12. Approved submittals (scheduled for delivery by 02-18-08)
13. O&M information (scheduled for delivery by 02-18-08)
14. Start-up reports and factory start-up forms (To be furnished prior to testing)
15. Pump curves (should be part of the approved shop drawings and O&M information)

012 -	Date	Type of Test	Function	Component	Device	Expected/Actual Results: / Remarks	Status
Condenser Water System							**Condenser Water System**
7		1 Preperation	7 - Return to Normal	Follow up steps			P / F / C / D

Test Description - -

RETURN TO NORMAL

1. Release all manual over-rides and external triggers, simlulated conditions, etc. to totally return the system to normal operation.
2. Completion of this test sets up testing for the chilled water system. Coordinate with the contractding team to determine the state that the system should be left in at the conclusion of testing.
3. Document all test results in CACEA and syncronize with the portal.
4. Create action items directed to McCarthy to address any contractual issues.
5. Create action items directed to UCB to address any non-contractual issues that have operational implications.

011 -	Date	Type of Test	Function	Component	Device	Expected/Actual Results: / Remarks	Status
Condenser Water System							**Condenser Water System**

8 :008 10:57:15 P / F / C / D

Test Description

PIPING SYSTEM VERIFICATION AND DOCUMENTATION

The following steps verify the system configuration and document critical details for the record or to ensure valid test results.

Document with a photograph the as balanced position of all throttling valves in the system and link the photos to this system with an information link. Verify that the balanced positions have been permanetly marked per spec requirements.

9 2008 9:53:43 Condenser Water Piping System P / F / C / D

Test Description - -

Field verify the FDE condenser water system diagram. Include verification of the exact location of all sensors relatives to tees in the piping system. For instance, a sensor located in the line leaving the tower basins after the point of connection to the first basin but ahead of the point of connection to the second basin is in the CW supply line, but will not read the correct temperature in all operating modes. The sensor needs to be in the condenser water supply line downstream of the point where all tower basins joint the line.

10 2008 9:49:39 Condenser Water Pump P / F / C / D

Test Description CWP-1 (South) -

For pumps not equipped with suction diffussers, verify that there are at least 5 pipe diameters of straight pipe between the suction flange and any elbows or tee branches leading to the pump.

P=Pass, F=Fail, C=Could't, D=Didnt

011 -	Date	Type of Test	Function	Component	Device	Expected/Actual Results: / Remarks	Status
Condenser Water System							**Condenser Water System**
11	2008 9:49:39		Condenser Water	Pump			P / F / C / D
	Test Description			CWP-2 (North)	-		
	For pumps not equipped with suction diffussers, verify that there are at least 5 pipe diameters of straight pipe between the suction flange and any elbows or tee branches leading to the pump.						
12	2008 10:34:27		Condenser Water	Pump			P / F / C / D
	Test Description			CWP-1 (South)	-		
	Select an item at random from the manufacturer's installation manual and verify that it has been implemented properly in the field. Document what you selected and its verification in the results field. Attach a photo if possible.						
13	2008 11:29:06		Condenser Water	Pump			P / F / C / D
	Test Description			CWP-2 (North)			
	Select an item at random from the manufacturer's installation manual and verify that it has been implemented properly in the field. Document what you selected and its verification in the results field. Attach a photo if possible.						
14	2008 10:23:1	Config Check	Condenser Water	Cooling Tower			P / F / C / D
	Test Description			CT-1 (South)	-		
	Select an item at random from the manufacturer's installation manual and verify that it has been implemented properly in the field. Document what you selected and its verification in the results field. Attach a photo if possible.						

P=Pass, F=Fail, C=Could't, D=Didnt

011 -	Date	Type of Test	Function	Component	Device	Expected/Actual Results: / Remarks	Status
Condenser Water System							**Condenser Water System**
15	2008 11:17:09		Condenser Water	Cooling Tower			P / F / C / D
	Test Description			CT-2 (North)			
	Select an item at random from the manufacturer's installation manual and verify that it has been implemented properly in the field. Document what you selected and its verification in the results field. Attach a photo if possible.						
16	2008 10:57:15		Condenser Water	Cooling Tower	Outlet Screen		P / F / C / D
	Test Description			CT-2 (North)	-		
	Verify by inspection that the tower inlet and outlet strainers are clean prior to testing the condenser water system. Iinclude a picture if possible. Also verify that the hot basin nozzels are clean and free of obstructions.						
17	2008 10:57:1	Config Check	Condenser Water	Cooling Tower	Outlet Screen		P / F / C / D
	Test Description			CT-1 (South)	-		
	Verify by inspection that the tower inlet and outlet strainers are clean prior to testing the condenser water system. Iinclude a picture if possible. Also verify that the hot basin nozzels are clean and free of obstructions.						
18	2008 9:53:43		Condenser Water	Control Valve			P / F / C / D
	Test Description			CH2 Isolation	-		
	Verify that the U.L. listing issue associated with Action Item 6 has been resolved.						

P=Pass, F=Fail, C=Could't, D=Didnt

011 -	Date	Type of Test	Function	Component	Device	Expected/Actual Results: / Remarks	Status
Condenser Water System							**Condenser Water System**
19	2008 9:53:4	UL Verification	Condenser Water	Control Valve			P / F / C / D
	Test Description			CH1 Isolation	-		
	Verify that the U.L. listing issue associated with Action Item 6 has been resolved.						
20	2008 9:49:3	Config Check	Condenser Water	Centrifugal Seperator			P / F / C / D
	Test Description			Future	-		
	Verify that the future side stream filter taps have been provided and are located in the proper spot.						
21	2008 9:49:39		Condenser Water	Pump			P / F / C / D
	Test Description			CWP-2 (North)	-		
	With CPW-1 in operation and both pumps valved into the system, verify that the check valve on CWP-2 is holding by observing the shaft and verifying that it is not rotating.						
22	/2008 8:26:5	Config Check	Condenser Water	Pump			P / F / C / D
	Test Description			CWP-1 (South)			
	With CPW-2 in operation and both pumps valved into the system, verify that the check valve on CWP-1 is holding by observing the shaft and verifying that it is not rotating.						

P=Pass, F=Fail, C=Could't, D=Didnt

010 -	Date	Type of Test	Function	Component	Device	Expected/Actual Results: / Remarks	Status
Condenser Water System							**Condenser Water System**

23 Condenser Water VSD P / F / C / D

Test Description CT-2 VFD

VSD VERIFICATION AND DOCUMENTATION

The following items document or verify critical items related to the coolign tower fan VFDs.

Select an item at random from the manufacturer's installation manual and verify that it has been implemented properly in the field. Document what you selected and its verification in the results field. Attach a photo if possible.

31 :008 11:29:06 Condenser Water VSD P / F / C / D

Test Description CT-1 VFD

Select an item at random from the manufacturer's installation manual and verify that it has been implemented properly in the field. Document what you selected and its verification in the results field. Attach a photo if possible.

P=Pass, F=Fail, C=Could't, D=Didnt

010 -	Date	Type of Test	Function	Component	Device	Expected/Actual Results: / Remarks	Status
Condenser Water System							**Condenser Water System**

32 Condenser Water VSD P / F / C / D

Test Description CT-2 VFD

Review the manufacturer's factory start-up report and verify that:

1. The drives are released for operation and that all programming settings have been documented.
2. The drives have been set up to accomdate an on-the-fly transfer from VFD to bypass or visa versa as well as engaging the drive against a free-wheeling fan. Usually this is part of the DC injection braking set up or equivalent function.
3. The drive enclosure heating and cooling system has been verified and set points adjusted to operate the cooling fan as necessary to control cabinet temperatures on a hot or sunny day and that the heaters will operate as necessary to prevent condensation in the cabinet on a cool, humid day.
4. The factory training requirements specified have been addressed (one of three options; 8 hours of training, interactive comuter based training, or professionally produced video training).

33 :008 11:29:06 Condenser Water VSD P / F / C / D

Test Description CT-1 VFD

Review the manufacturer's factory start-up report and verify that:

1. The drives are released for operation and that all programming settings have been documented.
2. The drives have been set up to accomdate an on-the-fly transfer from VFD to bypass or visa versa as well as engaging the drive against a free-wheeling fan. Usually this is part of the DC injection braking set up or equivalent function.
3. The drive enclosure heating and cooling system has been verified and set points adjusted to operate the cooling fan as necessary to control cabinet temperatures on a hot or sunny day and that the heaters will operate as necessary to prevent condensation in the cabinet on a cool, humid day.
4. The factory training requirements specified have been addressed (one of three options; 8 hours of training, interactive comuter based training, or professionally produced video training).

P=Pass, F=Fail, C=Could't, D=Didnt

010 -	Date	Type of Test	Function	Component	Device	Expected/Actual Results: / Remarks	Status
Condenser Water System							**Condenser Water System**
34	2008 11:29:06		Condenser Water	VSD		*Cooling tower manufacturer's minimum speed setting -* *Source -*	P / F / C / D
	Test Description			CT-1 VFD			
	Verify that the tower fan VSD minimum speed setting has been coordinated with the tower manufacturer's requirements for minimum speed. For gear box driven towers, this is realted to the lubrication system requiremetns and is usually something like no slower than 30% of full speed. For belt driven towers with the motor inside the tower where exposed to a hot and humid air stream, this requirement is usually related to motor cooling and is usually something like no slower than 20% of full speed. Document the manufacturer's requirement and its source.						
35			Condenser Water	VSD		*Cooling tower manufacturer's minimum speed setting -* *Source -*	P / F / C / D
	Test Description			CT-2 VFD			
	Verify that the tower fan VSD minimum speed setting has been coordinated with the tower manufacturer's requirements for minimum speed. For gear box driven towers, this is realted to the lubrication system requiremetns and is usually something like no slower than 30% of full speed. For belt driven towers with the motor inside the tower where exposed to a hot and humid air stream, this requirement is usually related to motor cooling and is usually something like no slower than 20% of full speed. Document the manufacturer's requirement and its source.						
36	2008 11:29:06		Condenser Water	VSD			P / F / C / D
	Test Description			CT-1 VFD			
	Verify that the minimum speed setting is stored as a single software point that is then downloaded to the drive via the network per Section 17000 – Energy Management and Control Systems 3.13 SEQUENCES OF OPERATION Paragraph A.7.						

P=Pass, F=Fail, C=Could't, D=Didnt

010 -	Date	Type of Test	Function	Component	Device	Expected/Actual Results: / Remarks	Status
Condenser Water System							**Condenser Water System**

37 Condenser Water VSD P / F / C / D

Test Description CT-2 VFD

Verify that the minimum speed setting is stored as a single software point that is then downloaded to the drive via the network per Section 17000 – Energy Management and Control Systems 3.13 SEQUENCES OF OPERATION Paragraph A.7.

38 2008 3:50:39 Condenser Water VSD P / F / C / D

Test Description CT-1 VFD

Verify with the drive supplier that the drive has been set up to tolerate what will happen if someone walks up to it and starts it against a motor that is free-wheeling in either direction. This could happen if someone had the drive in bypass with the motor running and then engaged the VFD with out waiting for the motor to spin to a stop or if wind had the fan spinning in either direction when a start command was sent to the drive. If the parameters are not set properly, damage can occur to the drive or the machinery or both. Typically the parameters that control this area called DC injection braking.

39 2008 3:57:21 Condenser Water VSD P / F / C / D

Test Description CT-2 VFD

Verify with the drive supplier that the drive has been set up to tolerate what will happen if someone walks up to it and starts it against a motor that is free-wheeling in either direction. This could happen if someone had the drive in bypass with the motor running and then engaged the VFD with out waiting for the motor to spin to a stop or if wind had the fan spinning in either direction when a start command was sent to the drive. If the parameters are not set properly, damage can occur to the drive or the machinery or both. Typically the parameters that control this area called DC injection braking.

010 -	Date	Type of Test	Function	Component	Device	Expected/Actual Results: / Remarks	Status
Condenser Water System							**Condenser Water System**

40 2008 4:05:48 Condenser Water VSD P / F / C / D

Test Description CT-1 VFD

Slowly ramp the tower fan up and back down through its entire speed range to verify that speeds that cause excessive vibration have been programmed to be jumped over as the drive modulates the fan.

For the purposes of this test, excessive vibration is defined as a resonate vibration that is created in any part of the tower or its supporting structure due to the operation of the tower fan at a critical speed.

Note any speeds where vibration is excessive in the remarks section and create an action item for the contractor to add them to the jumped speeds programmed into the drive.

41 2008 4:05:48 Condenser Water VSD P / F / C / D

Test Description CT-2 VFD

Slowly ramp the tower fan up and back down through its entire speed range to verify that speeds that cause excessive vibration have been programmed to be jumped over as the drive modulates the fan.

For the purposes of this test, excessive vibration is defined as a resonate vibration that is created in any part of the tower or its supporting structure due to the operation of the tower fan at a critical speed.

Note any speeds where vibration is excessive in the remarks section and create an action item for the contractor to add them to the jumped speeds programmed into the drive.

P=Pass, F=Fail, C=Could't, D=Didnt

010 -	Date	Type of Test	Function	Component	Device	Expected/Actual Results: / Remarks	Status
Condenser Water System							**Condenser Water System**

42 2008 4:05:48 Condenser Water VSD P / F / C / D

Test Description CT-1 VFD

Force the chiller load parameter to 30% (remember that the parameter may impact other processes) and verify that the condenser water supply temperature set point is reset to 55 degrees F.

43 2008 4:05:48 Condenser Water VSD P / F / C / D

Test Description CT-1 VFD

Force the chiller load parameter to 20% (remember that the parameter may impact other processes) and verify that the condenser water supply temperature set point remains at 55 degrees F. In other words, the low end of the reset schedule should be capped at 55 degrees F.

44 2008 4:05:48 Condenser Water VSD P / F / C / D

Test Description CT-1 VFD

Force the chiller load parameter to 80% (remember that the parameter may impact other processes) and verify that the condenser water supply temperature set point is reset to 67 degrees F.

P=Pass, F=Fail, C=Could't, D=Didnt

010 -	Date	Type of Test	Function	Component	Device	Expected/Actual Results: / Remarks	Status
Condenser Water System							**Condenser Water System**
45	2008 4:05:48		Condenser Water	VSD			P / F / C / D
	Test Description			CT-1 VFD			
	Force the chiller load parameter to 90% (remember that the parameter may impact other processes) and verify that the condenser water supply temperature set point remains at 67 degrees F. In other words, the low end of the reset schedule should be capped at 67 degrees F.						

009 -	Date	Type of Test	Function	Component	Device	Expected/Actual Results: / Remarks	Status
Condenser Water System							**Condenser Water System**

46 :008 10:24:35 Condenser Water Cooling Tower Overflow and Drain *Water depth relative to the bottom of the basin -* P / F / C / D

Test Description CT-1 (South) OF-1

MAKE UP AND LEVEL CONTROL SYSTEM FUNCTIONAL TESTS

The next series of tests will verify the make up and level control system.

With the basins full and the float valves satisfied, document the distance from the bottom of the basin to the surface of the water for future reference. Open both condensers amd tpwer cells up for flow and start both condenser water pumps while monitoring the sump outlets. Verify:

1. the pumps can come on line and achieve stable operation with out drawing a vortex at the tower outlet and entraining air into the supply line and that the pumps operate with out cavitating.
2. Air is vented or pushed through the piping and out to the tower basins. Of particular concern is the inverted trap created by the piping configuration as it rises from the discharge of the pumps, runs horizontally to the chillers, then drops to the inlet of the chillers. Assuming the check valves hold on the pumps, this inverted trap will be less of an issue once the piping system has been filled the first time. But, if the water drains from it for any reason (failed check valves, service operations that draing the pipng system, syphoning effects), then the air that is trapped in it must be vented or pushed through the chillers and out to the towers to be removed.

47 :008 11:03:51 Condenser Water Cooling Tower P / F / C / D

Test Description CT-1 (South)

Allow the make up valve to bring the basin water level back up to set point and close the valves. Shut down both pumps and verify that the water that drains down from the system does not cause the basins to overflow. If the basins over-flow, have the contractor re-adjust the basin level and retest.

P=Pass, F=Fail, C=Could't, D=Didnt

009 -	Date	Type of Test	Function	Component	Device	Expected/Actual Results: / Remarks	Status
Condenser Water System							**Condenser Water System**

48 ?008 11:03:51 Condenser Water Cooling Tower CT-1 (South)

Water depth relative to the bottom of the basin -
Bottom of the basin height above the supporting steel -

P / F / C / D

Test Description

With the pumps off, both tower cell sumps isolated from the piping system, the equaliation line open, and the float valves satisfied, perform the following steps.

1. Measure the level from the bottom of the basin to the water surface and document it if it has been adjusted from the original setting documented previously.
2. Measure the level from the bottom of the basin to the top of the supporting steel and document it.
3. Have the pipe fitter break the vic connection to the system side of the tower basin isolation valve on one basin and demonstrate that there is no strain on the basin connection. Close the joint back up when after verification.
4. Have the pipe fitter break the vic connection to the suction connection to one pump and demonstrate that there is no strain on the pump connection. Close the joint back up after verification.

49 ?008 11:03:51 Condenser Water Cooling Tower CT-1 (South)

Water depth relative to the bottom of the basin -

P / F / C / D

Test Description

Valve off the make-up water to CT-2. Crack open the drain valve and drop the water level to the point where the make up valve in CT-1 is just fully open and and perform the following steps.

1. Measure the level from the bottom of the basin to the water surface and document it.
2. Adjust the float valve in CT-2 so that it is just starting to open at this point.
3. Verify that no level alarms have been reported.
4. Open the make-up water valve to CT-2 to allow its float valve to work.

P=Pass, F=Fail, C=Could't, D=Didnt

009 -	Date	Type of Test	Function	Component	Device	Expected/Actual Results: / Remarks	Status
Condenser Water System							**Condenser Water System**

50 ?008 11:03:51 Condenser Water Cooling Tower *Water depth relative to the bottom of the basin -* P / F / C / D

Test Description CT-1 (South)

Further open the drain valve and drop the water level to the point where both make-up valves are fully open and perform the following steps.

1. Measure the level from the water surface to the bottom of the basin and document it.
2. Verify that no level alarms have been reported.

51 ?008 11:03:51 Condenser Water Cooling Tower *Low alarm water level relative to the bottom of the basin -* P / F / C / D

Test Description CT-1 (South)

Shut the drain valve and shut down the make-up water to the cooling tower.Set the AH-C discharge temperature to the supply chilled water temperature so that the chilled water valve is driven fully open and held there. Lower the water treatment system TDS set point below the current TDS level so that the bleed valve opens.

Crack the coolign tower drain valve back open to gradually drain the tower basin. Document the level at which a low level alarm is reported by measuring the distance from the bottom of the basin to the surface of the water. Start a stop watch when the alarm is generated.

Verify thee following:

1. The alarm generated is a level 2 alarm (critical equipment failure; see spec section 17000, page 54 of the .pdf file)
2. The bleed valve closes when the alarm comes in
3. The chilled water valve serving AH-C are slowly driven closed to shed non-essential loads.

P=Pass, F=Fail, C=Could't, D=Didnt

009 -	Date	Type of Test	Function	Component	Device	Expected/Actual Results: / Remarks	Status
Condenser Water System							**Condenser Water System**

52 2008 5:51:41 Condenser Water Cooling Tower P / F / C / D

Test Description CT-1 (South)

Monitor the make-up water flow meter and gradually open the make up valve until the make up rate is slightly above 10 gallons per minute. Verify the following.

1. The alarm is reset.
2. The bleed valve opens.
3. The AH-C chilled water valve is released to normal operation, which should cause it to drive wide open again.

53 2008 11:03:51 Condenser Water Cooling Tower *Bottom of the basin height above the supporting steel -* P / F / C / D

Test Description CT-1 (South)

Close the make-up valve and open the draing valve. With the basin fully drained perform the following steps.

1. Measure the level from the bottom of the basin to the top of the supporting steel and document it.
2. Have the pipe fitter break the vic connection to the system side of the tower basin isolation valve on one basin and demonstrate that there is no strain on the basin connection. Close the joint back up when after verification.
3. Have the pipe fitter break the vic connection to the suction connection to one pump and demonstrate that there is no strain on the pump connection. Close the joint back up after verification.

P=Pass, F=Fail, C=Could't, D=Didnt

009 -	Date	Type of Test	Function	Component	Device	Expected/Actual Results: / Remarks	Status
Condenser Water System							**Condenser Water System**
54	2008 11:03:51		Condenser Water	Cooling Tower CT-1 (South)		*Cooling tower make up flow rate with both float valves open -* *High alarm water level relative to the bottom of the basin -*	P / F / C / D

Test Description

Re-fill the basin and open up the tower outlets to connect the tower to the system. As the basins are filling, read the water meter in the make up line and document the flow rate with both valves open for use later. Manually hold the float valve open to allow the basin to fill above the float valve set point. Document the level at which a high basin level alarm is reported by measuring the distance between the bottom of the basin and the water surface. Verify that an alarm is reported before either tower basin over-flows.

P=Pass, F=Fail, C=Could't, D=Didnt

008 -	Date	Type of Test	Function	Component	Device	Expected/Actual Results: / Remarks	Status
Condenser Water System							**Condenser Water System**

55 2008 2:38:19 Condenser Water Cooling Tower CT-1 (South)

CWP-1 suction pressure -
CWP-1 discharge pressure -

P / F / C / D

Test Description

FLOW DISTSRIBUTION AND BALANCE FUNCTIONAL TESTS

The next several steps will spot check the CW system balance and assess the self balancing characteristics of the installed piping. (The design showed a self balancing arrangement but the installation did not follow the piping design).

Valve both tower basins back into the system. Drain the basin back down to the level where the CT-1 valve just start to open and then close it. Open the CT-1 isolation valve and close the CT-2 isolation valve. Open the CH-1 condenser isolation valve and close the CH-2 condenser isolation valve. Start CWP-1 and perform the following steps.

1. Observe basin water levels and verify that they stay with in the normal operating range established by the previous test and that a vortex is not pulled at the tower outlet connections.
2. Document the pump operating point using a single gauge for both readings.
3. Verify uniform distribution in the CT-1 hot basin and document with a photo if possible.
4. Open the CH-2 condenser isolation valve and close the CH-1 condenser isolation valve. Verify that this did not significantly impact the pump operating point.

56 2008 2:38:19 Condenser Water Cooling Tower CT-1 (South)

CWP-1 suction pressure -
CWP-1 discharge pressure -

P / F / C / D

Test Description

Open the CT-2 isolation valve and close the CT-1 isolation valve.

1. Continue monitoring the basin levels and outlets
2. Document the pump operating point using a single gauge for both readings.
3. Verify uniform distribution in the CT-2 hot basin and document with a photo if possible.
4. Cross check this operating point with the point documented in the previous step to assess the self balancing characteristics of the tower piping.

P=Pass, F=Fail, C=Could't, D=Didnt

008 -	Date	Type of Test	Function	Component	Device	Expected/Actual Results: / Remarks	Status
Condenser Water System						**Condenser Water System**	

57 2008 2:38:19 Condenser Water Cooling Tower CT-1 (South)

Test Description

Start CWP-2 and shut down CWP-1.

1. Continue monitoring the basin levels and outlets
2. Document the pump operating point using a single gauge for both readings and convert the operating point to flow using the pump curve.
3. Cross-check this flow with the value reported in the balance report and note any significant deviations (greater than 25%).
4. Cross check this flow with the flow documented in the previous step to assess the self balancing characteristics of the tower piping.

CWP-2 suction pressure -
CWP-2 discharge pressure -
CWP-2 differential pressure -
CWP-2 flow from the pump curve -
CWP-2 flow from the balance report -
Percent difference between balance report flow and tested flow -
Deviations above 25% require retesting by the TAB contractor per the spec.

P / F / C / D

58 2008 2:38:19 Condenser Water Cooling Tower CT-1 (South)

Test Description

Open the CT-1 isolation valve and close the CT-2 isolation valve.

1. Continue monitoring the basin levels and outlets
2. Document the pump operating point using a single gauge for both readings.
4. Cross check this flow with the flow documented in the previous step to assess the self balancing characteristics of the tower piping.

CWP-2 suction pressure -
CWP-2 discharge pressure -

P / F / C / D

P=Pass, F=Fail, C=Could't, D=Didnt

007 -	Date	Type of Test	Function	Component	Device	Expected/Actual Results: / Remarks	Status
Condenser Water System						**Condenser Water System**	

59	2008 2:38:19		Condenser Water	Cooling Tower CT-1 (South)	P / F / C / D

Test Description

SINGLE PUMP REDUNDANCY ASSESSMENT

The following steps will assess the level of reduncancy provided by operating one pump against a wide open system.

Open the CT-2 isolation valve with the CT-1 isolation valve open. Open the CH-1 condenser isolation valve with the CH-2 condenser isolation valve open.

1. Continue monitoring the basin levels and outlets
2. Document the pump amps and compare it to the nameplate to verify that the pump motor is a non-overloading selection.
3. Document the pump operating point using a single gauge for both readings and convert the operating point to flow using the pump curve.
4. Compare this flow to the design flow for two chillers and document the percentage of design flow provided by one pump with a wide open system.
5. Verify uniform distribution in the CT-1 and CT-2 hot basin and document with a photo if possible.

CWP-2 suction pressure -
CWP-2 discharge pressure -
CWP-2 differential pressure -
CWP-2 flow from the pump curve -
Required system flow at design with two chillers in operation -
Percentage of design flow -

P=Pass, F=Fail, C=Could't, D=Didnt

007 -	Date	Type of Test	Function	Component	Device	Expected/Actual Results: / Remarks	Status
Condenser Water System						**Condenser Water System**	

60 2008 2:38:19 Condenser Water Cooling Tower

Test Description CT-1 (South)

Start CWP-1 along with CWP-2 and operate both pumps against the wide open system.

1. Continue monitoring the basin levels and outlets
2. Document the operating point for both pumps using a single gauge for all readings and convert the operating point to flow using the pump curve.
3. Compare this flow to the balance report and to the design requirement and note any significant deviations (greater than 25%).
4. Verify uniform distribution in the CT-1 and CT-2 hot basin and document with a photo if possible.

CWP-1 suction pressure -
CWP-1 discharge pressure -
CWP-1 differential pressure -
CWP-1 flow from the pump curve -
CWP-1 flow from the balance report -
Percent difference between balance report flow and tested flow -
Deviations above 25% require retesting by the TAB contractor per the spec.

CWP-2 suction pressure -
CWP-2 discharge pressure -
CWP-2 differential pressure -
CWP-2 flow from the pump curve -
CWP-2 flow from the balance report -
Percent difference between balance report flow and tested flow -
Deviations above 25% require retesting by the TAB contractor per the spec.

Required system flow at design with two chillers in operation -
Total tested flow produced by CWP-1 and CWP-2 -
Percentage of design flow -

P / F / C / D

61 2008 2:38:19 Condenser Water Cooling Tower

Test Description CT-1 (South)

Shut down CWP-2 and keep CWP-1 in operation against the wide open system.

1. Continue monitoring the basin levels and outlets
2. Document the pump amps and compare it to the nameplate to verify that the pump motor is a non-overloading selection.
3. Document the pump operating point using a single gauge for both readings and convert the operating point to flow using the pump curve.
4. Compare this flow to the design flow for two chillers and document the percentage of design flow provided by one pump with a wide open system.

CWP-1 suction pressure -
CWP-1 discharge pressure -
CWP-1 differential pressure -
CWP-1 flow from the pump curve -
Required system flow at design with two chillers in operation -
Percentage of design flow -

P / F / C / D

P=Pass, F=Fail, C=Could't, D=Didnt

006 -	Date	Type of Test	Function	Component	Device	Expected/Actual Results: / Remarks	Status
Condenser Water System						**Condenser Water System**	

62 2008 3:43:27 Condenser Water Water Treatment

Test Description WT-1

WATER TREATMENT SYSTEM FUNCTIONAL TEST

The following steps will verify the water treatment system features.

EDITORIAL NOTE:

The exact method to be used to set up some of these modes will depend on what we find out when we finally get submittals and O&M information. So for now, I'm identifying what needs to be done and we can figure out the details later.

Obtain copies of the water treatment contractors desired process control parameters and document them in the results field. Initiate trends on all of these parameters and monitor them to ensure that the intended level of control is being provided.

TDS set point -
pH set point -
Maximum anticipated evaporation rate -
Maximum anticipated bleed-off rate -

P / F / C / D

63 2008 3:43:27 Condenser Water Water Treatment

Test Description WT-1

Contrast the fill rate noted earlier with both float valves open with the maximum evaporation rate and verify that matches or exceeds the maximum evaporation rate plus the maximum bleed-off rate.

P / F / C / D

006 -	Date	Type of Test	Function	Component	Device	Expected/Actual Results: / Remarks	Status
Condenser Water System						Condenser Water System	

64 2008 3:43:27 Condenser Water Water Treatment P / F / C / D

Test Description WT-1

Start both condenser water pumps. Simulate a TDS level above the high alarm limit (method to be determined). Verify the following:

1. A hard wired alarm is generated to the ALC system.
2. A local alarm is generated.
3. Power to the chemical feed pumps is shut down.
4. The blow-down valve opens.

65 2008 3:43:27 Condenser Water Water Treatment P / F / C / D

Test Description WT-1

Simlulate a low pH condition (corrosive) (method to be deterimend). Verify the following:

1. A network level alarm is generated to the ALC system.
2. A local alarm is generated.
3. Power to the chemical feed pumps is shut down.
4. The blow-down valve opens.
5. The bleed rate is at least twice the maximum calculated bleed rate required by the system.

66 2008 4:13:24 Condenser Water Water Treatment P / F / C / D

Test Description WT-1

Shut down one condenser pump and verify that nothing changes from the previous step.

P=Pass, F=Fail, C=Could't, D=Didnt

006 -	Date	Type of Test	Function	Component	Device	Expected/Actual Results: / Remarks	Status
Condenser Water System							**Condenser Water System**

67 2008 4:13:24 Condenser Water Water Treatment P / F / C / D

Test Description WT-1

Shut down the remaining condenser pump. Verify that the bleed valve closes.

68 2008 4:13:24 Condenser Water Water Treatment P / F / C / D

Test Description WT-1

Clear the low pH simluation and create a situation that would cause the injection pumps to run (method to be determined). Verify that the injection pumps will not start until CWP-1 is placed on line.

69 2008 4:13:24 Condenser Water Water Treatment P / F / C / D

Test Description WT-1

Shut down CWP-1 and verify that the injectino pumps shut back down.

70 2008 4:13:24 Condenser Water Water Treatment P / F / C / D

Test Description WT-1

Start CWP-2 and verify that the injection pumps start again.

P=Pass, F=Fail, C=Could't, D=Didnt

006 -	Date	Type of Test	Function	Component	Device	Expected/Actual Results: / Remarks	Status
Condenser Water System							**Condenser Water System**
71	2008 4:13:24		Condenser Water	Water Treatment			P / F / C / D
	Test Description			WT-1			
	Verify that all external mechanisms used to simulate out of tolerance water treatment levels have been removed and that the water treatment system is returned to normal operation.						

005 -	Date	Type of Test	Function	Component	Device	Expected/Actual Results: / Remarks	Status
Condenser Water System							**Condenser Water System**

72 2008 4:25:41 Condenser Water Emergency Stop Switch P / F / C / D

Test Description Chiller EMO

EMERGENCY SHUT DOWN FUNCTIONAL TEST

The following steps will verify the emergency shut down interface to the condenser system.

Start all condenser water pumps and cooling tower fans. Trigger the water treatment system so that the bleed valve is opened (method to be determined).

73 2008 4:25:41 Condenser Water Emergency Stop Switch P / F / C / D

Test Description Chiller EMO

Trip the emergency stop switch at the chiller room door. Verify the following:

1. CWP-1 and CWP-2 shut down.
2. CT-1 and CT-2 fans shut down.
3. The blow-down valve closes.

74 2008 4:25:41 Condenser Water Emergency Stop Switch P / F / C / D

Test Description Chiller EMO

Trigger a condition that should start the chemical feed pumps (method to be determined). Verify that the pumps do not start until the emergency switch is reset (assumes pumps restart when the switch is reset).

005 -	Date	Type of Test	Function	Component	Device	Expected/Actual Results: / Remarks	Status
Condenser Water System						**Condenser Water System**	

75 2008 4:25:41 Condenser Water Emergency Stop Switch Chiller EMO P / F / C / D

Test Description

Remove all triggers and simulations so that the watet treatment system returns to normal operation. Restart all condenser water pumps and cooling tower fans if they are not operating. Trigger the water treatment system so that the bleed valve is opened (method to be determined).

76 2008 4:25:41 Condenser Water Emergency Stop Switch Chiller EMO P / F / C / D

Test Description

Trip the refrigerant montior to simulate a refrigerant alarm. Verify the following:

1. CWP-1 and CWP-2 shut down.
2. CT-1 and CT-2 fans shut down.
3. The blow-down valve closes.

77 2008 4:25:41 Condenser Water Emergency Stop Switch Chiller EMO P / F / C / D

Test Description

Trigger a condition that should start the chemical feed pumps (method to be determined). Verify that the pumps do not start until the refrigerant monitor alarm is reset (assumes pumps restart when the switch is reset).

P=Pass, F=Fail, C=Could't, D=Didnt

005 -	Date	Type of Test	Function	Component	Device	Expected/Actual Results: / Remarks	Status
Condenser Water System							**Condenser Water System**

78 2008 4:25:41 Condenser Water Emergency Stop Switch Chiller EMO P / F / C / D

Test Description

Remove all triggers and simulations so that the watet treatment system returns to normal operation. Return the condenser pumps and cooling tower fans to the automatic operating mode and normal operation.

79 2008 4:25:41 Condenser Water Emergency Stop Switch Chiller EMO P / F / C / D

Test Description

Verify that all triggers simulating abnormal water treatment condtions have been removed and the water treatment system has been returned to normal operation.

80 2008 3:33:18 P / F / C / D

Test Description

Place both condenser water pumps in operation along with both cooling tower fans with flow over both towers. Trip the emergency stop switch and verify that both pumps and both fans are shut down and that the water treatment system is disabled.

P=Pass, F=Fail, C=Could't, D=Didnt

004 -	Date	Type of Test	Function	Component	Device	Expected/Actual Results: / Remarks	Status
Condenser Water System							**Condenser Water System**

81 Condenser Water VSD

CT-1 operating hours -
CT-2 operating hours -

P / F / C / D

Test Description CT-1 VFD

COOLING TOWER FAN AND ISOLATION VALVE LOGIC FUNCTIONAL TEST

If both tower fans have the same number of operating hours, operate a fan manually until one fan has accumulated more hours than the other. Once a difference in accumulated operating hours for the fans has been stablished, note the number of accumulated operating hours on each cooling tower fan.

82 Condenser Water VSD

P / F / C / D

Test Description CT-1 VFD

Manually force the cooling tower leaving water tempature set point to 45 degrees F to force any operating fan to its maximum speed.

Note for future reference that with one fan running, maximum speed will be 65%. With two fans running, it will be 100%. All operating fans should run at the same speed.

P=Pass, F=Fail, C=Could't, D=Didnt

004 -	Date	Type of Test	Function	Component	Device	Expected/Actual Results: / Remarks	Status
Condenser Water System							**Condenser Water System**

83 Condenser Water VSD P / F / C / D

CT-1 VFD

Test Description

If the chillers are not supposed to be operating, manually lock them out by turning their control switch off or locking and tagging them out. If the chillers are in operation, verify that a short term reduction to no chillers and then one chiller can be tolerated. Refer to the precautions regarding loss of chilled water flow for additional information.
After verifying that a loss of chilled water can be tolerated and how long it can be tolerated, shut down all condenser water pumps if they are operating and verify that the cooling tower fans shut down and that both cooling tower isolation valves close.

Note that for this step and those that follow, the condenser pumps should be started and stopped directly vs. by a chiller staging command to verify that the interlock is based on the pump operation not the chiller staging.

84 Condenser Water VSD P / F / C / D

CT-1 VFD

Test Description

Start one condenser water pump and verify that:

1. The cooling tower fan with the least number of accumulated operating hours is started as the lead fan and its associated isolation valve opens.
2. The fan ramps up to 65% and holds at that speed (maximum speed with one tower in operation).

004 -	Date	Type of Test	Function	Component	Device	Expected/Actual Results: / Remarks	Status
Condenser Water System							Condenser Water System

85 Condenser Water VSD P / F / C / D

Test Description CT-1 VFD

Via the staging points in the ALC graphics, change the fan that is currently operating as the lead fan to the lag fan and visa-versa. Verify that:

1. Tthe new lead fan starts and its isolation valve opens.
2. After the new lead fan is in operation with flow over its basin, the fan that was lead shuts down and its valve closes. In other words, verify that there is never a point when there are no fans running and no isolation valves open if someone were to change the fan lead-lag sequencing while the fans were operating.
3. The new lead fan ramps up to 65% speed and holds there.

86 Condenser Water VSD P / F / C / D

Test Description CT-1 VFD

Turn the fan that is operating off via the selector switch at the VFD to simulate a fan failure. Verify the following:

1. The lag fan is started and its associated isolation valve opens.
2. The isolation valve associated with the failed fan closes after the other cell isolation valve opens
3. A level 2 alarm is generated in 15 seconds or less (critical equipment failure; see spec section 17000, page 54 of the .pdf file)
4. The lag fan is set to be the lead fan.
5. The lead fan is set to be the lag fan.

Fan speeds should be capped at 65 %. If the chillers are in operation when you do this note what happens for future reference (i.e. safety trip, ride through the bump, etc.)

P=Pass, F=Fail, C=Could't, D=Didnt

004 -	Date	Type of Test	Function	Component	Device	Expected/Actual Results: / Remarks	Status
Condenser Water System							Condenser Water System

87 Condenser Water VSD P / F / C / D

Test Description CT-1 VFD

Return the fan that was turned off to service by placing the selector switch in the Hand position. Verify the following.

1. The fab re-starts and is made the lead fan.
2. The isolation valve associated with the fan opens.
3. A level 4 alarm is generated with-in 30 seconds (energy conservation monitor; see spec section 17000, page 54 of the .pdf file)
4. The fan that was operating becomes the lag fan and shuts down and its associated isolation valve closes after the other valve opens.

Fan speeds should be capped at 65%.

88 Condenser Water VSD P / F / C / D

Test Description CT-1 VFD

Start a second condenser water pump. Verify that the lag fan starts and that the speed of both fans increases to 100%. If the chillers are actually in operation note for future reference what happens when the staging command is issued.

89 Condenser Water VSD P / F / C / D

Test Description CT-1 VFD

Place the fan that was in Hand back in Auto. Acknowledge the level 4 alarm. If the fan that was in hand had fewer operating hours than the the other fan, verify that it is now selected as the lead fan.

Both fans should remain in operation at 100% speed and both isolation valves should remain open.

P=Pass, F=Fail, C=Could't, D=Didnt

004 -	Date	Type of Test	Function	Component	Device	Expected/Actual Results: / Remarks	Status
Condenser Water System							**Condenser Water System**

90 Condenser Water VSD P / F / C / D

Test Description CT-1 VFD

Place the current lag fan in Hand at the ALC controller output board. Verify the following.

1. The fan made the lead fan.
2. A level 4 alarm is generated with-in 30 seconds (energy conservation monitor; see spec section 17000, page 54 of the .pdf file)
3. The fan that was operating becomes the lag fan.

Both fans should remain in operation at 100% speed and both isolation valves should remain open.

91 Condenser Water VSD P / F / C / D

Test Description CT-1 VFD

Return to operating only 1 condenser water pump Verify that:

1. The lag pump fan down and that its isolation valve closes.
2. Fan speed is reduced to 65% and holds there.

If the chillers are in operation note for future reference what happens when the staging command is issued.

92 2008 1:30:31 P / F / C / D

Test Description

004 -	Date	Type of Test	Function	Component	Device	Expected/Actual Results: / Remarks	Status
Condenser Water System							**Condenser Water System**

93 Condenser Water VSD P / F / C / D

Test Description CT-1 VFD

Place the fan that was in Hand back in Auto. Acknowledge the level 4 alarm. If the fan that was in hand has fewer operating hours than the the other fan, verify that it is now selected as the lead fan. If it is the lag fan, verify that it shuts down and its associated isolation valve closes after the lead fan is started and its valve opens to ensure that there will not be a nuisance trip of the chillers if someone places something in hand and then returns it to auto.

94 Condenser Water VSD P / F / C / D

Test Description CT-1 VFD

Remove all over-rides and verify that everything has been returned to the Auto mode so the system can resume normal operation.

003 -	Date	Type of Test	Function	Component	Device	Expected/Actual Results: / Remarks	Status
Condenser Water System							**Condenser Water System**

95 2008 6:14:04 Condenser Water Pump

CWP-1 operating hours -
CWP-2 operating hours -

P / F / C / D

Test Description CWP-1 (South)

CONDENSER PUMP LOGIC FUNCTIONAL TEST

The following test steps will verify the logic that controls the condenser water pumps.

If both condenser pumps have the same number of operating hours, manipulate the chiller staging to operate one pump until it has more hours accumulated than the other. Once a difference in accumulated operating hours for the pumps has been stablished, note the number of accumulated operating hours on each condenser water pump.

96 2008 6:14:04 Condenser Water Pump

P / F / C / D

Test Description CWP-1 (South)

If the chillers are not supposed to be operating, manually lock them out by turning their control switch off or locking and tagging them out. If the chillers are in operation, verify that a short term reduction to no chillers and then one chiller can be tolerated. Refer to the precautions regarding loss of chilled water flow for additional information.
After verifying that a loss of chilled water can be tolerated and how long it can be tolerated, force a staging command for no chillers in the ALC system to shut down the chilled water plant. After the plant has shut down, force a staging command for one chiller in the ALC system. Verify that the pump with the least number of accumulated operating hours is started as the lead pump.

P=Pass, F=Fail, C=Could't, D=Didnt

003 -	Date	Type of Test	Function	Component	Device	Expected/Actual Results: / Remarks	Status
Condenser Water System							**Condenser Water System**

97 2008 6:14:04 Condenser Water Pump P / F / C / D

Test Description CWP-1 (South)

Via the staging points in the ALC graphics, change the pump that is current ly operating as the lead pump to the lag pump and visa-versa. Verify that the new lead pump starts and then, after the new lead pump is in operation, the pump that was lead shuts down. In other words, verify that there is never a point when there are no pumps running if someone were to change the pump lead-lag sequencing while the pumps were operating.

98 2008 6:14:04 Condenser Water Pump P / F / C / D

Test Description CWP-1 (South)

Turn the pump that is operating off via the selector switch at the starter to simulate a pump failure. Verify the following:

1. The lag pump is started.
2. A level 2 alarm is generated in 15 seconds or less (critical equipment failure; see spec section 17000, page 54 of the .pdf file)
3. The lag pump is set to be the lead pump.
4. The lead pump is set to be the lag pump.

If the chillers are in operation when you do this note what happens for future reference (i.e. safety trip, ride through the bump, etc.).

P=Pass, F=Fail, C=Could't, D=Didnt

003 -	Date	Type of Test	Function	Component	Device	Expected/Actual Results: / Remarks	Status
Condenser Water System							Condenser Water System

99 2008 6:14:04 Condenser Water Pump P / F / C / D

Test Description CWP-1 (South)

Return the pump that was turned off to service by placing the selector switch in the Hand position. Verify the following.

1. The pump re-starts and is made the lead pump.
2. A level 4 alarm is generated with-in 30 seconds (energy conservation monitor; see spec section 17000, page 54 of the .pdf file)
3. The pump that was operating becomes the lag pump and shuts down.

100 2008 6:14:04 Condenser Water Pump P / F / C / D

Test Description CWP-1 (South)

Force a staging command in the ALC system to bring the second chiller on line. Verify that the lag pump starts. If the chillers are in operation note for future reference what happens when the staging command is issued.

101 2008 6:14:04 Condenser Water Pump P / F / C / D

Test Description CWP-1 (South)

Place the pump that was in Hand back in Auto. Acknowledge the level 4 alarm. If the pump that was in hand had a fewer operating hours than the the other pump, verify that it is now selected as the lead pump.

P=Pass, F=Fail, C=Could't, D=Didnt

003 -	Date	Type of Test	Function	Component	Device	Expected/Actual Results: / Remarks	Status
Condenser Water System						**Condenser Water System**	

102 2008 6:14:04 Condenser Water Pump P / F / C / D

Test Description CWP-1 (South)

Place the current lag pump in Hand at the ALC controller output board. Verify the following.

1. The pump is made the lead pump.
2. A level 4 alarm is generated with-in 30 seconds (energy conservation monitor; see spec section 17000, page 54 of the .pdf file)
3. The pump that was lead becomes the lag pump.

103 2008 6:14:04 Condenser Water Pump P / F / C / D

Test Description CWP-1 (South)

Force a staging command in the ALC system to return to operating only one chiller. Verify that the lag pump shuts down. If the chillers are in operation note for future reference what happens when the staging command is issued.

104 2008 6:14:04 Condenser Water Pump P / F / C / D

Test Description CWP-1 (South)

Place the pump that was in Hand back in Auto. Acknowledge the level 4 alarm. If the pump that was in hand had a fewer operating hours than the the other pump, verify that it is now selected as the lead pump. If it is the lag pump, verify that it shuts down after the lead pump is started to ensure that there will not be a nuisance trip of the chillers if someone places something in hand and then returns it to auto.

P=Pass, F=Fail, C=Could't, D=Didnt

003 -	Date	Type of Test	Function	Component	Device	Expected/Actual Results: / Remarks	Status
Condenser Water System						**Condenser Water System**	
105	2008 6:14:04		Condenser Water	Pump			P / F / C / D
	Test Description			CWP-1 (South)			
	Remove all over-rides and verify that everything has been returned to the Auto mode so the system can resume normal operation.						

002 -	Date	Type of Test	Function	Component	Device	Expected/Actual Results: / Remarks	Status
Condenser Water System							**Condenser Water System**

110 /2008 9:30:36 Condenser Water VSD P / F / C / D

Test Description CT-1 VFD

VFD BYPASS, BRAKING, AND ON-THE-FLY ACROSS THE LINE TO VFD TRANSFER VERIFICATION

Review this test procedure with the VFD supplier and verify that their drives have been set up to tolerate an on-the-fly transfer from VFD operation to across the line operation and back.

CAUTION

Stand to one side of the drive enclosure and look away from the enclosure when throwing the switch from VFD to Bypass. If something does go wrong and the drive fails, you don't want to be standing in front of the enclosure and/or looking at it.

111 /2008 9:30:36 Condenser Water VSD P / F / C / D

Test Description CT-1 VFD

Command the drive to minimum speed. Once operation at minimum speed has been established transfer the drive from VFD to bypass and verify that the motor accellerates to full speed.

112 /2008 9:30:36 Condenser Water VSD P / F / C / D

Test Description CT-1 VFD

With the drive still commanded to minimum speed and the fan operating at full speed across the line, throw the drive from bypass to VFD. Verify that the drive smoothly transitions from across the line operation to variable speed operation with out failures or tripping out.

P=Pass, F=Fail, C=Could't, D=Didnt

002 -	Date	Type of Test	Function	Component	Device	Expected/Actual Results: / Remarks	Status
Condenser Water System							**Condenser Water System**

113 /2008 9:30:36 Condenser Water VSD P / F / C / D

Test Description CT-2 VFD

VFD BYPASS, BRAKING, AND ON-THE-FLY ACROSS THE LINE TO VFD TRANSFER VERIFICATION

Review this test procedure with the VFD supplier and verify that their drives have been set up to tolerate an on-the-fly transfer from VFD operation to across the line operation and back.

CAUTION

Stand to one side of the drive enclosure and look away from the enclosure when throwing the switch from VFD to Bypass. If something does go wrong and the drive fails, you don't want to be standing in front of the enclosure and/or looking at it.

114 /2008 9:30:36 Condenser Water VSD P / F / C / D

Test Description CT-2 VFD

Command the drive to minimum speed. Once operation at minimum speed has been established transfer the drive from VFD to bypass and verify that the motor accellerates to full speed.

115 /2008 9:30:36 Condenser Water VSD P / F / C / D

Test Description CT-2 VFD

With the drive still commanded to minimum speed and the fan operating at full speed across the line, throw the drive from bypass to VFD. Verify that the drive smoothly transitions from across the line operation to variable speed operation with out failures or tripping out.

P=Pass, F=Fail, C=Could't, D=Didnt

001 -	Date	Type of Test	Function	Component	Device	Expected/Actual Results: / Remarks	Status
Condenser Water System							Condenser Water System

116 :008 11:35:54 P / F / C / D

Test Description

INTEGRATED OPERATION VERIFICATION

Using trend analysis verify the integrated operation of the condenser water system with the chillers. Specifically verify:

1. Condenser pumps are staged appropriately with chillers. The number of pumps operating should equal the number of chillers operating.
2. The condenser water reset schedule follows the requirements of the specifications. A spreadsheet tool has been attached to the information link for the Condenser Water System node that will allow you to quickly calculate the desired set point based on the specified requirements and the current load conditoin. It also allows you to paste a days worth of 1 minute trend data into it, resulting in a graph of actual supply temperature vs. the calculated requirement. This will allow performance to be easily documented for any given day using trend data. It would be desirable to capture the reset schedule performance on a number of different days and load condtions as follows:
    a. Cool day, low load
    b. Cool day, heavy load
    c. Intermediate day, low load
    d. Intermediate day, heavy load
    e. Near design day, low load
    f. Near design day, heavy load
3. If the condenser water supply temperature drops below setpoint and the fans have been at minimum fan speed for 5 minutes, the fans should cycle off for at least 5 minutes and/ or until supply temperature rises above setpoint by 1°F.
4. The evaporator pump remains in operation for 30 seconds after all compressors are shut down as indicated by compressor kW or amps.
5. The condenser pump remains in operation for 30 seconds after all compressors are shut down as indicated by compressore kW or amps.
6. Verify that the chiller head pressure control system is working by trending the chiller head pressure. As of 02-08-08, it is not clear to me exactly how the head pressure control is supposed to be set up or coordinated with the condenser water set point control, so I am going to generate an action item to Taylor Engineering to find out what the intent was.

001 -	Date	Type of Test	Function	Component	Device	Expected/Actual Results: / Remarks	Status
Condenser Water System							Condenser Water System

117 /2008 1:08:12 P / F / C / D

Test Description

If this alarm does not occur naturally during the trend interval, verify for each pump:

1. That a maintenance interval alarm is generated when a pump has operated for more than 1500 hours
2. That the alarm is a Level 5 alarm (maintenance indication, notification)
3. That the interval counter is reset when the alarm is acknowledged.

118 /2008 1:08:12 P / F / C / D

Test Description

If this alarm does not occur naturally during the trend interval, verify for each pump:

1. A Level 2 alarm (significant equipment failure) is generated if a pump is commanded on and the status is off.
2. A Level 4 alarm (energy conseration monitor) is generated if a pump is commanded off but the status is on.

P=Pass, F=Fail, C=Could't, D=Didnt

001 -	Date	Type of Test	Function	Component	Device	Expected/Actual Results: / Remarks	Status
Condenser Water System							Condenser Water System

P=Pass, F=Fail, C=Could't, D=Didnt