|  |  |
| --- | --- |
| FT: | **23 64 00** |
| **ITEM:** | **Packaged Water Chillers** |
| **ID:** |  |
| **AREA SERVED:** |  |

Form Filled Out By:

|  |  |  |
| --- | --- | --- |
|  | **Name & Company** | **Date** |
| GC |  |  |
| MC |  |  |
| EC |  |  |
| BC |  |  |
| CC |  |  |
| OR |  |  |
| A/E |  |  |
| CA |  |  |

GC = General Contractor; MC = Mechanical Contractor; EC = Electrical Contractor; BC = Balancing Contractor; CC = Controls Contractor; OR = Owner Representative; A/E = Architect/Engineer; CA = Commissioning Agent

XX = No Initials Required

# TEST PREREQUISITES

The following items have been completed and the equipment is ready for Functional Testing.

Check if OK. Enter Outstanding Item Note number if deficient.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Item | **GC** | **MC** | **EC** | **BC** | **CC** | **OR** | **A/E** | **CA** |
| Unit startup completed | XX |  | XX | XX | XX |  |  |  |
| Start-up report submitted | XX |  | XX | XX | XX |  |  |  |
| Test and Balance (TAB) completed | XX |  | XX |  | XX |  |  |  |
| SOO programmed | XX |  | XX | XX |  |  |  |  |
| Prefuctional Checklist completed  | XX |  | XX | XX | XX |  |  |  |

# SENSOR CALIBRATION VERIFICATIONS

* Check a representative sample of sensors for calibration and adequate location.
* Test the packaged controls and BAS readings.
* Use the same test instruments as used for the original calibration, if possible.
* Verify that the sensor reading (via the permanent thermostat, gage, packaged control panel or building automation system (BAS)) compared to the test instrument-measured value is within the tolerances specified in the contract requirements. (\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_).
	+ "In calibration" means making a reading with a calibrated test instrument within 6 inches of the site sensor.
	+ For items out of calibration or adjustment, fix now if easy, via an offset in the BAS, calibration or replacement of sensor.

| **Sensor &****Location** | **LocationOK1** | **1st Gage / Pkg****& BAS Value** | **Test Inst****Value** | **Final Gage / Pkg****& BAS Value** | **Pass****Y/N?** |
| --- | --- | --- | --- | --- | --- |
|  |  | Pkg:BAS: |  | Pkg:BAS: |  |
|  |  | Pkg:BAS: |  | Pkg:BAS: |  |
|  |  | Pkg:BAS: |  | Pkg:BAS: |  |
|  |  | Pkg:BAS: |  | Pkg:BAS: |  |
|  |  | Pkg:BAS |  | Pkg:BAS |  |

1Sensor location is appropriate and away from causes of erratic operation.

# DEVICE CALIBRATION VERIFICATIONS

* Check a representative sample of actuators and devices for calibration and adequate operation.
	+ "In calibrationC" means observing a readout in the BAS and going to the actuator or controlled device and verifying that the BAS reading is correct.
	+ For items out of calibration or adjustment, fix now if easy, via an offset in the BAS, or a mechanical fix.

| **Device / Actuator &****Location** | **Procedure** | **1st BAS****Value** | **Site****Observation** | **Final BAS****Value** | **Pass****Y/N?** |
| --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  |
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# FUNCTIONAL PERFORMANCE VERIFICATIONS

**Demonstrate operation of equipment per Contract Documents including the following:**

1. Record of All Values for Current Setpoints (SP), Control Parameters, Limits, Delays, Lockouts, Schedules, Etc. Changed to Accommodate Testing:

| **Parameter** | **Pre-Test Values** | **Returned to Pre-Test Values √** |
| --- | --- | --- |
| Space temperature setpoint |  |  |
| Supply air temperature setpoint |  |  |
| Supply air reset schedule |  |  |
| Economizer change over setpoint |  |  |
| CHWS Set Point |  |  |
| CW Set Point |  |  |
| CHW differential pressure setpointAcross pump:Out in the system: |  |  |
| Chiller (Hand / Off / Auto) |  |  |
| Lead Chiller IDLag Chiller ID |  |  |
| Cooling Tower (Hand / Off / Auto) |  |  |
| Lead Cooling Tower IDLag Cooling Tower ID |  |  |
| Primary CHW Pumps (Hand / Off / Auto) |  |  |
| Lead Primary CHW PumpLag Primary CHW Pump |  |  |
| Secondary CHW Pumps (Hand / Off / Auto) |  |  |
| Lead Secondary CHW PumpLag Secondary CHW Pump |  |  |
| CW Pumps (Hand / Off / Auto) |  |  |
| Lead CW PumpLag CW Pump |  |  |
| Chiller demand limit |  |  |
| Safety overrides |  |  |
| Chiller flow switches (Normal / Jumped) |  |  |

1. The following testing requirements are in addition to and do not replace any testing requirements elsewhere in the Project Documents.

|  |
| --- |
| The following is a step by step test to verify the system follows the design sequence of operation. The test procedure column indicates what adjustments are needed for testing. Each step is either pass or fail. |
| **Step** | **Test Procedure** |  |  | **Pass/Fail** |
| **Functional Test** |
| 1 | **Chiller System Startup and Staging** |   |
| 2 | Verify lead chiller startup and staging ON sequence |   |
| 3 | Verify lead primary pump staging ON operation  |   |
| 4 | Verify lead secondary pump staging ON operation |   |
| 5 | Verify lead cooling tower startup and staging ON sequence |   |
| 6 | Verify lead condenser pump staging ON operation |   |
| 7 | Verify lead chiller staging OFF sequence |  |
| 8 | Verify lead primary pump staging OFF operation  |  |
| 9 | Verify lead secondary pump staging OFF operation |  |
| 10  | Verify lead cooling tower staging OFF sequence |  |
| 11 | Verify lead condenser pump staging OFF operation |  |
| 12 | Verify lead / lag chiller operation |  |
| 13 | Verify lead / lag primary pump operation  |  |
| 14 | Verify lead / lag secondary pump operation |  |
| 15 | Verify lead / lag cooling tower operation |  |
| 16 | Verify lead / lag condenser pump operation |  |
| 17 | Verify operation of Heat Exchanger.Cold SideGPM: EWT: LWT:Hot Side:GPM: EWT: LWT:Compare with values on equipment schedule |  |
| 18 | **Miscellaneous Chiller System Functions** |  |
| 19 | Verify demand limiting operation |  |
| 20 | Verify OSAT Lockout |  |
| 21 | Verify CHWS reset operation |  |
| 22 | Verify CHW pressure control operation |  |
| 23 | Verify primary CHW pump failure operation |  |
| 24 | Verify secondary CHW pump failure operation |  |
| 25 | Verify cooling tower failure operation |  |
| 26 | Verify CW pump failure operation |  |
| 27 | **Chiller Safety Controls** |  |
| 28 | Verify operation of CHW flow switches |  |
| 29 | Verify operation of high condenser pressure cutout |  |
| 30 | Verify operation of loss of electrical power phase cutout |  |
| 31 | Verify operation of ground fault protection cutout |  |
| 32 | **Miscellaneous Cooling Tower Functions** |  |
| 33 | Verify operation of cooling tower fan failure alarm |  |
| 34 | Verify operation of cooling tower high water alarm |  |
| 35 | Verify operation of cooling tower low water alarm and makeup |  |
| 36 | Verify operation of cooling tower sump heaters |  |
| 37 | **Power Failure**  |  |
| 38 | Simulate power failure and observe response of chillers, cooling towers and associated pumps |  |
| 39 | Restore power and observe of chillers, cooling towers and associated pumps |  |

1. Record the following:

All points listed below which are control system monitored points shall be trended by the controls contractor.

| Point | Time Step(min.) | MinimumTime Periodof Trend | CSV File? (Y/N) |
| --- | --- | --- | --- |
| **For each unit being tested:** |  |  |
| OSAT | 5 | 5 days incl. weekend | Y |
| OSAT-WB or enthalpy | 5 | 5 days incl. weekend | Y |
| CHWST set point | 5 | 5 days incl. weekend | Y |
| CHWST  | 5 | 5 days incl. weekend | Y |
| ECDWT set point | 5 | 5 days incl. weekend | Y |
| ECDWT  | 5 | 5 days incl. weekend | Y |
| CHW diff. press. set point | 5 | 5 days incl. weekend | Y |
| CHW diff. press | 5 | 5 days incl. weekend | Y |
| Chiller status | 5 | 5 days incl. weekend | Y |
| Cooling tower status | 5 | 5 days incl. weekend | Y |
| Primary pump status | 5 | 5 days incl. weekend | Y |
| Secondary pump status | 5 | 5 days incl. weekend | Y |
| Condenser pump status | 5 | 5 days incl. weekend | Y |
| Primary GPM | 5 | 5 days incl. weekend | Y |
| Secondary GPM | 5 | 5 days incl. weekend | Y |
| Condenser GPM | 5 | 5 days incl. weekend | Y |
| Primary pump VFD RPM | 5 | 5 days incl. weekend | Y |
| Secondary pump VFD RPM | 5 | 5 days incl. weekend | Y |
| Condenser pump VFD RPM | 5 | 5 days incl. weekend | Y |
| Cooling tower fan VFD RPM | 5 | 5 days incl. weekend | Y |

# OUTSTANDING ITEMS

Note outstanding items in table below. Use numbers referenced above.

|  |  |  |
| --- | --- | --- |
| Resolved(Initial / Date) | **Note** | Description |
|  | **1.** |  |
|  | **2.** |  |
|  | **3.** |  |
|  | **4.** |  |
|  | **5.** |  |
|  | **6.** |  |
|  | **7.** |  |
|  | **8.** |  |
|  | **9.** |  |
|  | **10.** |  |

# FIELD NOTES

Fill in as appropriate.

|  |
| --- |
|  |
|  |
|  |
|  |
|  |

# SIGN OFF

System / Equipment has been installed in accordance with the Contract Documents and is ready for Owner acceptance.

|  |  |  |
| --- | --- | --- |
|  | **Signature** | **Date** |
| **Contractor’s Representative** |  |  |
| **A /E Representative** |  |  |
| **Commissioning Agent** |  |  |
| **Owner’s Representative** |  |  |

## END OF TEST