**Facility:**

**Commissioning Provider: Date:**

DIRECTIONS: Address each item listed or note why it was not tested/investigated. Add other items that were tested/investigated. Note what testing/investigation was done, how these were conducted and results of the testing/investigation. Indicate any operating parameters found. Put in EEI# for improvements to resolve items that are not optimal or explain why no improvements are recommended. Complete full EEI description and information in PSE NC Post Occ EEI Details form. Include other capital improvements that may be cost effective. Expand to fit information or note specific location of information. (Handwritten legible notes are acceptable.)

**SYSTEM TYPE: Chiller Plant (ID # or plant name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_)**

**EQUIPMENT & SEQUENCES INVESTIGATED** *(be specific)***:**

**Equip ID#s:** *Example: CH-1,2 & 3; BP-1, CT-1,2,3, CP-1 etc.*

**Area Serves/occupancy type:** *Example: north tower, out-patient services*

**Describe System:** *Example: 3 chillers (1 VFD, 2 non-VFD), primary & secondary flow (building loops), 3 cooling towers serving all chillers together and two stage fans*

**Sequences:** *Example: On/Off Schedule, Chiller Staging, CHW reset, Cooling tower fan staging and CW temp control, OA lockout*

**FINDINGS, TESTS and INVESTIGATION RESULTS:**

**Working Optimally?**

**Yes No N/A EEI# \_\_\_\_\_\_\_ Date(s)/time(s)\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**GENERAL SYSTEM CONDITION**: Equipment is generally in good shape and does not exhibit any abnormal nose or vibration. System is not in need of over-all replacement in the near future. Safety guards are in place. Working on and around equipment can be done safely.

Tests Conducted /Results/Findings:

**Yes No N/A EEI#\_\_\_\_\_\_\_ Date(s)/time(s)\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**SENSOR CALIBRATION & PT-to-PT**: Key controlling sensors are calibrated and in appropriate locations. Points are mapped correctly to the DDC front-end and chiller interface panel. Other sensor outputs seem reasonable. Key sensors include: CHWS/CHWR (chilled water supply/return) temperature sensors and flow meters, CWS/CWR (condensing water supply/return) temperature sensors.

Sensors checked: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Tests Conducted /Results/Findings:

**Yes No N/A EEI#\_\_\_\_\_\_\_ Date(s)/time(s)\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**OUTSIDE AIR (OAT) SENSOR CALIBRATION & PT-to-PT**: OA (wet and dry bulb) controlling sensor(s) is calibrated and in appropriate location(s). Point(s) is mapped correctly to the DDC front-end and/or chiller/cooling tower.

Tests Conducted /Results/Findings:

**Yes No N/A EEI#\_\_\_\_\_\_\_ Date(s)/time(s)\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**PT-to-PT** **OTHER**: Other critical points (chiller, pump etc.) points are mapped correctly to the DDC front-end and reflect existing system condition. Points checked:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Tests Conducted /Results/Findings:

**Yes No N/A EEI#\_\_\_\_\_\_\_ Date(s)/time(s)\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**SCHEDULING**: Operating schedule matches occupancy schedule including holiday scheduling. Chillers, cooling towers and pumps and all parts of Chiller plant are off in unoccupied mode as evidenced by energy internal data or walk-through (night typically).

Schedule: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Tests Conducted /Results/Findings:

**Yes No N/A EEI#\_\_\_\_\_\_\_ Date(s)/time(s)\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**LOCK-OUT**: Plant shuts down based on OA or other indicator of load to prevent chiller use when not needed. Optimal configuration of lock-out based on actual cooling load, not OAT alone, is in place.

Lockout criteria:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Tests Conducted /Results/Findings:

**Yes No N/A EEI#\_\_\_\_\_\_\_ Date(s)/time(s)\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**OPTIMUM START/STOP – COOL DOWN**: System is on as little as possible, prior to occupancy, to cool down building. Outside air used, rather than mechanical system, for cooling. System is not on for a lot of hours or being driven by one space keeping system on too long. System start time adjusts based on minimum time required to cool down the space by occupancy.

Tests Conducted /Results/Findings:

**Yes No N/A EEI#\_\_\_\_\_\_\_ Date(s)/time(s)\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**NIGHT MODE & SETBACK**: Chiller plant shuts down completely. For VAV systems, VAV box dampers close, VAV box fans turn off and heat is off. Night walkthrough and early morning reveal nothing on unless needed. For night cooling economizer is used, no mechanical cooling. AHU is on with only those zones needing cooling along with the minimum number of boxes to prevent duct over-pressurization.

Tests Conducted /Results/Findings:

**Yes No N/A EEI#\_\_\_\_\_\_\_ Date(s)/time(s)\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**CHW and CW TEMPERATURES**: Chilled water (CHW) temperatures and condensing water (CW) temperatures are controlled and optimized to minimize energy use of cooling tower, chiller, pumps and AHU fans combined. CHW and CW temperature controls are in place. Temperature range of resets is appropriate.

CHW temperature setpoints/reset schedule: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

CW temperature setpoint/reset schedule: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Tests Conducted /Results/Findings:

**Yes No N/A EEI#\_\_\_\_\_\_\_ Date(s)/time(s)\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**CHILLER** **DELTA T**: Temperature drop across chiller is near design or appropriate.

Appropriate delta T:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Tests Conducted /Results/Findings:

**Yes No N/A EEI#\_\_\_\_\_\_\_ Date(s)/time(s)\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**CT TEMPERATURE RANGE:** Temperature drop across Cooling Tower (CT ) is near design or appropriate. Tower approach temperature is appropriate

Appropriate delta T:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Approach Temperature:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Tests Conducted /Results/Findings:

**Yes No N/A EEI#\_\_\_\_\_\_\_ Date(s)/time(s)\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**CHILLER STAGING**: Chillers stage (load and unload) to use the most energy efficient chillers and to match actual load without excessive cycling. Chiller is off when 100% economization (free cooling) is possible.

Chiller Staging Scheme:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Tests Conducted /Results/Findings:

**Yes No N/A EEI#\_\_\_\_\_\_\_ Date(s)/time(s)\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**DX STAGING**: Compressors stage (load and unload) efficiently to match actual load and control to appropriate setpoint without excessive cycling. DX is off when 100%economization (free cooling) is possible.

Tests Conducted /Results/Findings:

**Yes No N/A EEI#\_\_\_\_\_\_\_ Date(s)/time(s)\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**CHW PLANT FLOW**: Chiller close off valves are not leaking by and opening and closing as needed. Water flow is per design and as low as possible. Chillers can be isolated so flow goes only through chillers that are operating. Bypass valves are set for proper flow or eliminated/closed if possible.

Tests Conducted /Results/Findings:

**Yes No N/A EEI#\_\_\_\_\_\_\_ Date(s)/time(s)\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**PUMPING HEAD**: Pumping head of building pumps is reasonable and not too high. “Non-balancing valves” are not being used for balancing or other reasons (no throttling). All balancing valves are necessary. No unnecessary flow restrictors. Appropriate head: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Tests Conducted /Results/Findings:

**Yes No N/A EEI#\_\_\_\_\_\_\_ Date(s)/time(s)\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**PUMPING CONTROL**: Variable flow is in place on pumps where flow could vary to meet building load. Differential pressure setpoint is as low as possible. Pumping is varying speed to meet actual load. VFD’s speed and pumping head of primary and secondary pumps is reasonable and not over-pumping.

Tests Conducted /Results/Findings:

**Yes No N/A EEI#\_\_\_\_\_\_\_ Date(s)/time(s)\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**COOLING TOWER (CT) STAGING – water-cooled only**: Cooling tower fans stage efficiently to use free cooling and control well to meet CW setpoint. Setpoints are appropriate for chiller/cooling optimization. Fans have multiple speeds to reduce fan energy.

CT/fan Staging Scheme:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Tests Conducted /Results/Findings:

**Yes No N/A EEI#\_\_\_\_\_\_\_ Date(s)/time(s)\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**CONDENSING FAN STAGING – air-cooled only**: Condensing fans stage efficiently to use minimum number of fans. Setpoints are appropriate for chiller/cooling optimization. There are multiple fans speeds to reduce fan energy. Fan Staging Scheme:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Tests Conducted /Results/Findings:

**Yes No N/A EEI#\_\_\_\_\_\_\_ Date(s)/time(s)\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**EVAPORATION**: Cooling Tower/evaporative surfaces/fill are clean to allow good evaporation. Water spray allows good evaporation. No plugged or misdirected nozzles. Drift eliminators in place etc.

Tests Conducted /Results/Findings:

**Yes No N/A EEI#\_\_\_\_\_\_\_ Date(s)/time(s)\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**AIR CIRCULATION:** Cooling tower exhaust air is not mixing with inlet air. Cooling tower exhaust air is not being drawn into an outside air intake.

Tests Conducted /Results/Findings:

**Yes No N/A EEI#\_\_\_\_\_\_\_ Date(s)/time(s)\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**WATER TREATMENT:** Water treatment is in place and operating. Water quality appears good. Regular checks are in place. Cycles of concentration are appropriate.

Tests Conducted /Results/Findings:

**Yes No N/A EEI#\_\_\_\_\_\_\_ Date(s)/time(s)\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**CW FLOW**: Cooling tower close off valves are not leaking by and are opening and closing as needed. Water flow is per design or efficient. Cooling tower can be isolated so flow does not go through unless the tower is in use.

Tests Conducted /Results/Findings:

**Yes No N/A EEI#\_\_\_\_\_\_\_ Date(s)/time(s)\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**SIMULTANEOUS HEATING & COOLING**: Cooling plant is not running at the same time as the heating plant. If both systems are operating and it is necessary do so, explain why.

Tests Conducted /Results/Findings:

**Yes No N/A EEI#\_\_\_\_\_\_\_ Date(s)/time(s)\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**HEAT EXCHANGERS**: Heat exchangers are clean with expected temperature difference (delta T) across them. Regular check of tubes in place. Appropriate Delta T: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Tests Conducted /Results/Findings:

**Yes No N/A EEI#\_\_\_\_\_\_\_ Date(s)/time(s)\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**OVERRIDES**: Controls, setpoints and equipment that can be easily overridden or circumvented are in normal/automatic operating mode. Examples – pump differential pressure, pump enable, chiller enable.

Tests Conducted /Results/Findings:

**Yes No N/A EEI#\_\_\_\_\_\_\_ Date(s)/time(s)\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**LOOP TUNING**: Loops are adequately tuned to prevent equipment breakdown and poor control.

Tests Conducted /Results/Findings:

**Yes No N/A EEI#\_\_\_\_\_\_\_ Date(s)/time(s)\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**INSULATION**: All pipes and valves of plant are insulated. Insulation is around valves but with removable covers so it can be replaced easily after accessing valves.

Tests Conducted /Results/Findings:

**Yes No EEI#\_\_\_\_\_\_\_ Date(s)/time(s)\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

***OTHER****: Describe other things tested/investigated.*

Tests Conducted /Results/Findings:

**Yes No EEI#\_\_\_\_\_\_\_ Date(s)/time(s)\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

***OTHER****: Describe other things tested/investigated.*

Tests Conducted /Results/Findings:

**CAPITAL EE IMPROVEMENTS**

**EEI# \_\_\_\_** *Brief Description of Capital Improvement*

Notes/Comments:

**EEI# \_\_\_\_** *Brief Description of Capital Improvement*

Notes/Comments:

**TRAINING**

**Yes No Date(s)/time(s)\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Staff (occupants and O&M) fully understands how the system works.**

**Staff (occupants and O&M) fully understands how to run the systems efficiently.**

Specific Staff evaluated:

Comments:

**Specific Training needs of staff (occupants and O&M):**

**Ideas for Facility Guide/Operational Aides/Persistence:** What needs to be added (for example: sensors or specific trends, explanation on DDC graphic, or signage), provided (for example: minimum flow rate) or done (for example: putting check in maintenance schedule) to help the operators keep the systems operating efficiently over time?