STANDARD COMMISSIONING PROCEDURE FOR ENERGY MANAGEMENT & CONTROL SYSTEMS

BUILDING NAME: _____ **APPLICATION #:** _____
BUILDING ADDRESS: _____
_____

NAME & FIRM OF PERSON(S) DOING TEST: _____
DATE(S) OF TEST: _____

General Notes:

1. This is a generic test procedure for energy management and control systems (EMCSs). If the complexity, configuration, or other aspects of a specific project require substitute tests or additional tests, explain on the comments sheets, and attach the additional test procedures and field data. Attach all relevant functional performance verification sheets, and always attach the final signed and dated procedure certification page.
2. In all test sections, circle or otherwise highlight any responses that indicate deficiencies (i.e. responses that don't meet the criteria for acceptance). Acceptance requires correction and retest of all deficiencies, as defined in each test section under "Criteria for Acceptance" or "Acceptance". Attach all retest data sheets. Complete the Deficiency Report Form for all deficiencies.
3. This Commissioning Procedure does not address fire and life safety or basic equipment safety controls.
4. To ensure that this Commissioning Procedure will not damage any equipment or affect any equipment warranties, have the equipment manufacturer's representative review all test procedures prior to execution.

PRE-VERIFICATION INSPECTION:
This section can be completed by a phone interview of the building operator or controls contractor. Verify interview answers on site when field testing begins.

Criteria for Acceptance: A "No" answer to any of items #1 - 5 shall be considered a deficiency.

INSPECTION ITEM	RESPONSE (add sheets as necessary to adequately describe)
1. Controls drawings, including sequences of operation, are complete, up-to-date, and on site.	
2. Operation manuals are complete and on site.	
3. Did controls contractor do a complete system check-out and start-up, including an all-points checkout? **(If it hasn't but is required by contract, do not proceed with this procedure until contractor check-up and start-up is complete.)**	
4. Does EMCS interface with an existing control system? If so, has existing system been calibrated and tested? **(It is recommended that you not proceed with this procedure until calibration and testing is complete.)**	
5. Is all specified EMCS master control room equipment installed and operating? Comment specifically on central computer (CCU), disk drive, monitor, logging printer, modem, and modem phone line.	

COMMENTS ON PRE-INSPECTION VERIFICATION ITEMS (add more sheets as needed):

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Building Name: _____

OPERATOR INTERVIEW (Existing Buildings Only):
Determine from a discussion with the building operator whether the EMCS is operating properly to the best of their knowledge. Use the table to note any known problems, and possible solutions.

NAME OF AFFECTED EQUIPMENT	PROBLEM DESCRIPTION & EFFECT	PROPOSED SOLUTION

CONTACTS:
Controls Contractor, name: _____ firm: _____
address _____
phones _____

Building Operator, name: _____ firm: _____
address _____
phones _____

COMMENTS ON OPERATOR INTERVIEW ITEMS (add more sheets as needed):
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Building Name: _____

EMCS, INSTALLED CHARACTERISTICS (From field inspection. Note under response if the feature as installed differs in any way from the design documents. If an item does not apply, write "NA" for not applicable):

Criteria for Acceptance: Installed characteristics must be in accordance with design intent documentation and/or approved submittals.

DESCRIPTION	RESPONSE (add sheets as necessary to adequately describe)
1. Manufacturer and Model	
2. Software name and version	
3. Equipment start/stop algorithms programmed & operational?	
4. HVAC optimal start/stop algorithms programmed & operational?	
5. Unoccupied temperature setback/up algorithms programmed & operational?	
6. Electrical demand limiting algorithms programmed & operational?	
7. Lighting sweep control algorithms programmed & operational?	
8. VAV terminal unit control algorithms programmed & operational?	
9. Ventilation and economizer control algorithms programmed & operational?	
10. Supply air temperature reset algorithms programmed & operational?	
11. Heating water temperature reset algorithms programmed & operational?	
12. Chilled water temperature reset algorithms programmed & operational?	
13. Chiller sequencing algorithms programmed & operational?	
14. Other equipment sequencing algorithms programmed & operational? (specify equipment)	
15. Other algorithms operational:	
16. Other algorithms operational:	
17. Other algorithms operational:	
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COMMENTS ON INSTALLED CHARACTERISTICS ITEMS (add more sheets as needed):

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Building Name: _____

INSTALLATION VERIFICATION:

Instructions: Under each unit write "Y" for yes, "N" for no, "NA" for not applicable, or a number to refer to any needed comments. If other information is requested such as temperature, write the appropriate values. Questions 28 - 34 require a systematic inspection of multiple sensors. Attach to this form a listing of inspected sensors. It is acceptable to include a copy of the EMS points list or all-points checkout form, with inspected sensors indicated.

Criteria for Acceptance: All items in this section require answers of "Y" (or "NA", where relevant) except where other criteria are noted.

DESCRIPTION	RESPONSE (add sheets as necessary to adequately describe)
1. Access to all EMCS equipment is adequate?	
2. High and low voltage wiring in separate conduit?	
3. Temperature sensors installed properly and in appropriate locations? (Pay special attention to all "global" sensors such as outdoor air, chilled water, etc.)	
4. Averaging temperature sensors installed where needed?	
5. Humidity sensors installed properly and in appropriate locations?	
6. Pressure sensors installed properly and in appropriate locations?	
7. Flow sensing devices installed properly and in appropriate locations?	
8. Pressure and flow sensing devices have flow straighteners or adequate lengths of straight pipe/duct upstream & downstream?	
9. Controlled dampers and valves move freely over required ranges? (This test will usually require exercising the dampers and valves through the EMCS.)	
10. Program and print trend logs for two variables for an 8 hour period to verify functionality of trend log capability. **Acceptance:** Successful trend-logging.	
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COMMENTS ON INSTALLATION VERIFICATION CHECKLIST ITEMS (add more sheets if needed):

ITEM # COMMENT

Building Name: _____

CONTROLS CALIBRATION:

Controls calibration tests: Perform the following calibration verifications by comparing the sensor input to the EMCS to the simultaneous field measurement made on a calibrated thermometer (or other instrument as required) held in close proximity. For thermostats and humidistats, slowly adjust the setpoint of each thermostat, humidistat, sensor, etc. until the controlled response begins (i.e. contact make or break). Note the setpoint when that occurs, and note the simultaneous reading on a calibrated thermometer (or other instrument as required) held in close proximity. Include units with all data (e.g. °F, % RH, psig, CFM). Label each column with sensor label, type (temp, humidity, pressure, etc.), and service (e.g. OSA, AHU-1 SA, etc.)

Sampling: Check calibration of all global or central system sensors (OSA, fan system, chillers, tower, pumps, etc.). For zone-level sensors (space temperature, VAV terminal unit flow, etc.), check calibration on 5% of the total number of that type of sensor. If more than 10% of the sample are found to be out of calibration, then all sensors of that type shall be considered to be not in conformance. In that case, follow the contractual procedures for reporting and correcting deficiencies.

Criteria for Acceptance: If sensor or stat is out of calibration by more than ± 2 degrees F, ± 5% relative humidity, ± 5% of reading for Amps or volts, or ± 10% of reading for flow or pressure, note that as a deficiency.

SENSOR # OR ID TYPE / SERVICE						
1. Sensor or stat, computer input signal, or setpoint when controlled action occurs 2. Sensor or stat, measured condition						
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1. Sensor or stat, computer input signal, or setpoint when controlled action occurs 2. Sensor or stat, measured condition						

COMMENTS ON CONTROLS CALIBRATION ITEMS (add more sheets if needed):

ITEM # COMMENT

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Building Name: _____

FUNCTIONAL PERFORMANCE VERIFICATION:

Instructions: Since there are many possible controls sequences for energy management systems, it is impossible to write generic tests that cover all such sequences. Use the following standard test procedures for start/stop control and the various temperature reset controls, if applicable. Attach only those test sheets that apply to control sequences ("software applications") that were identified on the Installed Characteristics checklist, page 2 of this form. If you were not able to complete a test, write "ND" for not done, and explain in a comment.

If the standard test procedures are not applicable or adequate, document the sequences, tests, and results on the pages that follow the standard procedures. First describe the control sequence. Next describe in detail what tests you plan to do to verify each control sequence. Finally, describe your test results and conclusions, including any deficiencies found. **See the attached example for the level of detail required.** Add sheets as necessary. It is not necessary to repeat any tests that were documented in the Standard Commissioning Procedure for VFDs, AHUs, or other equipment, but refer to those documents where relevant.

Attach to this form all relevant field data, monitored data, graphs, trend logs, and so forth. Annotate any data and graphs so that it is clear what the data are proving. EMS trend logs of EMS outputs, program print-outs, or schedule and setpoint print-outs are not acceptable as proof of operation, unless the information is first verified to be accurate and documentation is attached. Trend logs of sensor inputs to the EMS are acceptable.

Attach to this form the final signed and dated procedure certification page.

General Performance Tests: If a test does not apply, write "NA" for not applicable. If you were not able to complete a test, write "ND" for not done, and explain in a comment.	
TEST DESCRIPTION	COMPLETE, W/ DOCUMENTATION ATTACHED?
1. Print out and attach a listing of the status of all points controlled by the EMCS. Comment on any points that are overridden (i.e. not under automatic control.) If unable to print a listing, view point status on screen, attach notes, and comment. **Acceptance:** Points that should be under automatic control according to the approved controls submittal must not be overridden.	
2. If the EMCS includes multiple control panels that require inter-panel communication, verify proper communication by analysis of the programming and of the results of EMCS calculations that depend on inter-panel communication. Attach documentation. **Acceptance:** Inter-panel communication is properly programmed and operable on EMCSs where this is relevant.	

COMMENTS ON PERFORMANCE VERIFICATION CHECKLIST ITEMS - including attached application software tests. (reference specific test and add more sheets as needed):

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Building Name: _____

Scheduled Start/Stop and Unoccupied Setback/Setup Application Software Test: Perform the following tests by monitoring and /or observing each piece of controlled equipment under actual operation. It is permissible to adjust the programmed schedules and/or setpoints for easier testing. If this is done, reprogram to the original schedules and setpoints, or as directed by the building operator, at the conclusion of testing. If the original values are not consistent with energy efficient operation, discuss with the building operator. Use of dataloggers or trend logs of EMCS input channels over a one week period (minimum, two days) is recommended. Annotate any logger data and graphs so that it is clear what the data are proving, and attach these to this form. (See attached example of an annotated graph.) EMCS trend logs of EMCS output signals are not acceptable as proof of operation unless you have first verified and documented (attach) that the output signals accurately represent actual operation. For non-HVAC equipment, write "NA" in the appropriate column for any temperature questions.

Sampling: Test all equipment that draws 5 kW or more at full load. (This would generally apply to packaged equipment greater than 5 tons in capacity, 7 1/2 hp and greater motors, all chillers and towers, etc.) For equipment that draws less than 5 kW, but more than 2 kW, at full load, test 10% of the total number of such equipment. If more than 10% of the sample are found to be unacceptable, then all such equipment shall be considered to be not in conformance. In that case, follow the contractual procedures for reporting and correcting deficiencies. It is not necessary to test equipment less than 2 kW input power.

Criteria for Acceptance: The following shall be considered deficiencies: 1) Equipment doesn't start and/or stop within 15 minutes of the scheduled times, 2) Unoccupied space temperatures go more than 3 degrees F below (above) the setback (setup) temperature setpoints, 3) Unoccupied space temperatures are maintained more than 3 degrees F above (below) the setback (setup) setpoints.

EQUIPMENT # OR ID						
1. EMCS programmed start time. *(For the following tests, select 1 typical day from the observed data.)*						
2. Observed (or monitored) start time						
3. EMCS programmed occupied setpoints, heating / cooling (°F)	/	/	/	/	/	/
4. Observed (or monitored) stabilized space temperature range	/	/	/	/	/	/
5. EMCS programmed stop time						
6. Observed (or monitored) stop time						
7. EMCS programmed unoccupied setpoints, heating / cooling (°F)	/	/	/	/	/	/
8. Observed (or monitored) minimum / maximum unoccupied space temperature	/	/	/	/	/	/
9. If observed minimum (maximum) temperature is higher (lower) than the unoccupied heating (cooling) setpoint, does equipment operate to maintain that temperature? If "yes", this is a deficiency.						
10. Are final programmed schedules consistent with energy efficient operation? If "no", comment.						
11. Are final programmed occupied & unoccupied setpoints consistent with energy efficient operation? If "no", comment.						

COMMENTS ON SCHEDULED START/STOP AND SETBACK TEST ITEMS (add more sheets if needed):

ITEM # COMMENT

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Building Name: _____

Optimum Start/Stop Application Software Test: Perform the following tests by monitoring and /or observing each system under actual operation. It is permissible to adjust the programmed schedules and/or setpoints for easier testing. For testing this application, make sure that unoccupied temperature setpoints are at least 10 F degrees below (heating) and above (cooling) the occupied setpoints. If any programmed schedules and/or setpoints are changed for testing, reprogram to the original schedules and setpoints, or as directed by the building operator, at the conclusion of testing. If the original values are not consistent with energy efficient operation, discuss with the building operator. Use of dataloggers or trend logs of EMCS input channels to monitor relevant equipment status and temperatures over a one week period is highly recommended. Annotate any logger data and graphs so that it is clear what the data are proving, and attach these to this form. (See attached example of an annotated graph.) EMCS trend logs of EMCS output signals are not acceptable as proof of operation unless you have first verified and documented (attach) that the output signals accurately represent actual operation.

Sampling: Test all controlled units that draw 10 kW or more at full load. (This would generally apply to packaged equipment greater than 10 tons in capacity.) For equipment that draws less than 10 kW, but more than 5 kW, at full load, test 10% of the total number of such equipment. If more than 10% of the sample are found to be unacceptable, then all such equipment shall be considered to be not in conformance. In that case, follow the contractual procedures for reporting and correcting deficiencies. It is not necessary to test equipment less than 5 kW input power.

Test Conditions: Outside air temperature must be between 40°F and 55°F for at least 6 hours during scheduled unoccupancy.

Criteria for Acceptance: The following shall be considered deficiencies: 1) Reference space reaches occupied setpoint more than 30 minutes before scheduled occupancy, 2) Reference space temperature goes above (below, heating) occupied setpoint by more than 4 F degrees more than 30 minutes before the end of scheduled occupancy, 3) Discharge air temperature is reset rather than changing the fan start time in order to reach the occupied setpoint on schedule, 4) Outdoor air damper opens during optimal warm-up mode, unless this is called for as part of a purge or cool-down sequence, 5) Outdoor air damper closes during the optimal stop period, 6) Other spaces served by a single system differ significantly in optimal start and stop response from the reference space.

EQUIPMENT # OR ID						
1. EMCS programmed start of occupancy. *(For the following tests, select 1 typical day from the observed data.)* 2. Observed (or monitored) start time 3. Time at which reference space reaches occupied setpoint						
4. Outdoor air temperature at actual equipment start time (°F) 5. Outdoor air damper status during optimum start						
6. EMCS programmed end of occupancy 7. EMCS programmed occupied setpoint (°F) 8. Observed (or monitored) stop time 9. Temperature which reference space reaches at end of scheduled occupancy						
10. Outdoor air temperature at actual equipment stop time (°F)						
11. Outdoor air damper status during optimum stop 12. Do start & stop times vary on different days? **Acceptance:** Start/stop times must vary.						

COMMENTS ON OPTIMUM START/STOP TEST ITEMS (add more sheets if needed):

ITEM # COMMENT

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Building Name: _____

Discharge Air Temperature Reset Application Software Test: Perform the following tests by monitoring and /or observing each system under actual operation. If the reset algorithm is not a single variable function, or if it otherwise does not fit this procedure, use the "Other Control Sequences" form for verification. It is permissible to adjust the programmed setpoints for easier testing. If any programmed setpoints are changed for testing, reprogram to the original schedules and setpoints, or as directed by the building operator, at the conclusion of testing. If the original values are not consistent with energy efficient operation, discuss with the building operator. It is also permissible, and often advisable, to place the index temperature sensors in a temperature bath or substitute the index sensor with a temperature simulator. This permits accurate control of the index input to the algorithm.

Use of dataloggers or trend logs of EMCS input channels to monitor index and discharge air temperatures over a one or two day period is recommended if the index temperature is expected to vary widely (at least one half of the upper/lower setpoint range) during this time. Annotate any logger data and graphs so that it is clear what the data are proving, and attach these to this form. (See attached example of an annotated graph.) EMCS trend logs of EMCS output signals are not acceptable as proof of operation unless you have first verified and documented (attach) that the output signals accurately represent actual operation.

Test Conditions: The index temperature must vary over at least 1/2 of its upper/lower setpoint range during the test. If this condition cannot be met, simulate index temperatures or use temperature bath.

Criteria for Acceptance: The following shall be considered a deficiency: The measured discharge air (DA) temperature (lines #10 & 13) is more than ± 3 F degrees from the design DA temperature at the low and high index temperature tests (line #9 & 12).

EQUIPMENT # OR ID						
1. EMCS programmed index type (OSA temperature, space temp, return air temp, etc.)						
2. EMCS programmed discharge air (DA) temperature reset upper limit (°F)						
3. EMCS programmed DA temperature reset lower limit (°F)						
4. EMCS programmed DA upper setpoint versus lower index temp	/	/	/	/	/	/
5. EMCS programmed DA lower setpoint versus upper index temp	/	/	/	/	/	/
6. Does discharge air go above high limit setpoint?						
7. Does discharge air go below low limit setpoint?						
8. Lowest monitored or simulated index temperature						
9. Design DA temp at lowest monitored or simulated index temp (From reset curve or linear relation. Attach graph.)						
10. Discharge air temperature coincident with lowest index temperature						
11. Highest monitored or simulated index temperature						
12. Design DA temp at highest monitored or simulated index temp						
13. Discharge air temperature coincident with highest index temperature						

COMMENTS ON DISCHARGE AIR TEMPERATURE RESET TEST ITEMS (add more sheets if needed):

ITEM # COMMENT

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Building Name: _____

Heating Water Temperature Reset Application Software Test: Perform the following tests by monitoring and /or observing each system under actual operation. If the reset algorithm is not a single variable function, or if it otherwise does not fit this procedure, use the "Other Control Sequences" form for verification. It is permissible to adjust the programmed setpoints for easier testing. If any programmed setpoints are changed for testing, reprogram to the original schedules and setpoints, or as directed by the building operator, at the conclusion of testing. If the original values are not consistent with energy efficient operation, discuss with the building operator. It is also permissible, and often advisable, to place index temperature sensors, if applicable, in a temperature bath or substitute the index sensor with a temperature simulator. This permits accurate control of the index input to the algorithm.

Use of dataloggers or trend logs of EMCS input channels to monitor index and discharge air temperatures over a one or two day period is recommended if the index value is expected to vary widely (at least one half of the upper/lower setpoint range) during this time. Annotate any logger data and graphs so that it is clear what the data are proving, and attach these to this form. (See attached example of an annotated graph.) EMCS trend logs of EMCS output signals are not acceptable as proof of operation unless you have first verified and documented (attach) that the output signals accurately represent actual operation.

Test Conditions: The index value must vary over at least 1/2 of its upper/lower setpoint range during the test. If this condition cannot be met, simulate index values.

Criteria for Acceptance: The following shall be considered a deficiency: The measured heating water (HW) temperature (line #10 & 13) is more than ± 3 F degrees from the design HW temperature at the low and high index value tests (line #9 & 12).

EQUIPMENT # OR ID						
1. EMCS programmed index type (OSA temperature, coil valve position, etc.)						
2. EMCS programmed heating water (HW) temperature reset upper limit (°F) 3. EMCS programmed HW lower reset limit (°F)						
4. EMCS programmed upper HW setpoint versus lower index value	/	/	/	/	/	/
5. EMCS programmed lower HW setpoint versus upper index value	/	/	/	/	/	/
6. Does HW temperature go above high limit setpoint? 7. Does HW temperature go below low limit setpoint?						
8. Lowest monitored or simulated index value (°F, % valve position, etc.) 9. Design HW temp at lowest monitored or simulated index value. (From reset curve or linear relation. Attach graph.)						
10. HW temperature coincident w/ lowest index value						
11. Highest monitored or simulated index value 12. Design HW temp at highest monitored or simulated index value. 13. Heating water temperature coincident with highest index value						

COMMENTS ON HEATING WATER TEMPERATURE RESET TEST ITEMS (add more sheets if needed):

ITEM # COMMENT

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Building Name: _____

Chilled Water Temperature Reset Application Software Test: Perform the following tests by monitoring and /or observing each system under actual operation. If the reset algorithm is not a single variable function, or if it otherwise does not fit this procedure, use the "Other Control Sequences" form for verification. It is permissible to adjust the programmed setpoints for easier testing. If any programmed setpoints are changed for testing, reprogram to the original schedules and setpoints, or as directed by the building operator, at the conclusion of testing. If the original values are not consistent with energy efficient operation, discuss with the building operator. It is also permissible, and often advisable, to place index temperature sensors, if applicable, in a temperature bath or substitute the index sensor with a temperature simulator. This permits accurate control of the index input to the algorithm.

Use of dataloggers or trend logs of EMCS input channels to monitor index and discharge air temperatures over a one or two day period is recommended if the index temperature is expected to vary widely (at least one half of the upper/lower setpoint range) during this time. Annotate any logger data and graphs so that it is clear what the data are proving, and attach these to this form. (See attached example of an annotated graph.) EMCS trend logs of EMCS output signals are not acceptable as proof of operation unless you have first verified and documented (attach) that the output signals accurately represent actual operation.

Test Conditions: The index value must vary over at least 1/2 of its upper/lower setpoint range during the test. If this condition cannot be met, simulate index values.

Criteria for Acceptance: The following shall be considered a deficiency: The measured chilled water (CHW) temperature (line #10 & 13) is more than ± 3 F degrees from the design CHW temperature at the low and high index value tests (line #9 & 12).

EQUIPMENT # OR ID						
1. EMCS programmed index type (OSA temperature, valve position, space temp, etc.)						
2. EMCS programmed chilled water (CHW) temperature reset upper limit (°F)						
3. EMCS programmed CHW lower reset limit (°F)						
4. EMCS programmed upper CHW setpoint versus lower index value	/	/	/	/	/	/
5. EMCS programmed lower CHW setpoint versus upper index value	/	/	/	/	/	/
6. Does CHW temperature go above high limit setpoint?						
7. Does CHW temperature go below low limit setpoint?						
8. Lowest monitored or simulated index value (°F, % valve position, etc.)						
9. Design CHW temp at lowest monitored or simulated index value. (From reset curve or linear relation. Attach graph.)						
10. CHW temperature coincident w/ lowest index value						
11. Highest monitored or simulated index value						
12. Design CHW temp at highest monitored or simulated index value.						
13. CHW temperature coincident with highest index value						

COMMENTS ON CHILLED WATER TEMPERATURE RESET TEST ITEMS (add more sheets if needed):

ITEM # COMMENT

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Building Name: _____

Other Control Sequences (Add additional pages as required):

General Instructions: Since there are many possible controls sequences, it is impossible to write generic tests for all such sequences. On this form first describe in detail the controls sequence, then describe what tests were done to verify each, and finally describe your conclusions--including any deficiencies found. Attach to this test sheet all relevant field data, monitored data, graphs, trend logs, etc. Annotate any data and graphs so that it is clear what the data are proving. Energy Management System (EMS) trend logs of EMS outputs, program print-outs, or schedule and setpoint print-outs are not acceptable as proof of operation, though trend logs of sensor inputs to the EMS are acceptable. (Trend logs of EMS outputs are acceptable if you have first verified and documented that the output signals accurately represent actual operation.) See the attached example for the level of detail expected. Add sheets as necessary.

Criteria for Acceptance: The actual control sequence must be in accordance with the design intent documentation and/or approved controls submittal. Acceptance shall be based on thorough documented verification of each control mode.

Describe the control sequence:

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Describe the tests that were done to verify the control sequence:

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Conclusions:

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Building Name: _____

I certify that the data and test results as recorded herein are accurate.

_____ _____
Signature, Commissioning Agent Date

_____ _____
Firm Name (Area Code) Phone Number

file:emsqas1.pro

Building Name: _____

SAMPLE CUSTOM TEST DESCRIPTION

Describe the control sequence:

Waterside-Economizer: *The chiller is locked out, valve V4 is closed, and pumps P5 and P6 are off at OSA temperatures less than 60°F. Whenever any cooling coil valve (interior or perimeter wall units) opens, pumps P7 (CW) & P8 (secondary CHW) are enabled. If the OSA temperature is less than 60°F, valve V3 diverts secondary chilled water and valve V2 diverts condenser water through the heat exchanger. P7 speed modulates to maintain a constant temperature differential across the heat exchanger on the CW side. P8 speed modulates to maintain the secondary chilled water loop at a constant head. (Pump speed control testing is addressed in the VFD Standard Commissioning Procedure.)*

Describe the tests that were done to verify the control sequence:

We set up trend logs for a 72 hour period, with 15 minute data-recording intervals. We trended P5, 6, 7, and 8 status, OSA temperature, P7 and P8 speed (output signal from EMS), V2, 3, & 4 output signal, chiller status, and heat exchanger inlet and outlet temperatures on both the chilled water and condenser water sides. The accuracy of these points was verified and documented during the EMS calibration tests. We required test conditions that included an OSA temperature range of 55°F or below to 75°F or above during scheduled occupancy. Fortunately these conditions were met so we didn't have to consider alternate simulation testing techniques. We analyzed the trend logs to verify that pump and valve position, and chiller status, were appropriate in all cases during the different OSA temperature control bins (<60°F and >60°F). We allowed a tolerance of ±1 degree F for each setpoint for acceptance. We also verified that P7 speed was modulating to maintain the CW delta across the heat exchanger at 10 F degrees ±1 F degree. This is documented as part of the VFD Standard Commissioning Procedure documentation.

Conclusions:

See the attached annotated trend logs. As noted on these trend logs, we observed that, during those times that the OSA temperature was less than 60°F (±0.5 degrees), the chiller and pumps P5 & 6 were always off, and V4 was closed. We also observed that, when OSAT < 60°F (±0.5 degrees), valves V2 and V3 received signals to open to the heat exchanger, and the delta across the heat exchanger on the condenser water side was maintained between a range of 9.6 and 10.9 F degrees. During the times that the OSA temperature was above 60°F (±0.7 degrees), valves V2 & 3 were positioned to bypass flow to the heat exchanger, V4 was opened, P5 started, and finally the chiller started. In conclusion, the results of all tests satisfied the criteria for acceptance.

Note: We believe that it may be possible to achieve greater savings from the waterside economizer if the OSAT setpoint is elevated somewhat. Based on our observations, we guess that the setpoint could be raised to about 62 to 64°F. We recommended to the building operator that he raise the setpoint 1 F degree at a time, wait a week to see if any zonal comfort complaints arise, and then raise it another degree, and so forth. (We suggested he stop this trial and error setpoint adjustment at 65°F or the end of August, whichever comes first.)