DOCKETED

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Project Title:	Acceptance and Training Certification
TN #:	223082
Document Title:	NEMIC Letter Answering CEC Staff's Questions on ATTCP
Description:	California Code of Regulations, Title 24, Part 1 10-103.2-Nonresidential Mechanical Acceptance Test Training and Certification
Filer:	David Bernett
Organization:	National Energy Management Institute Committee (NEMIC)
Submitter Role:	Applicant
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March 29, 2018

Attn: Dockets Unit (MS-14)
California Energy Commission
1516 Ninth Street
Sacramento, CA 95814

Re: *California Code of Regulations, Title 24, Part 1 10-103.2 – Nonresidential Mechanical Acceptance Test Training and Certification*

Dear Docket Unit,

This report addresses the issues (*in italics*) Mr. Randy Brumley raised in his letter of October 6, 2016 w.

1. *Describe how NEMIC will implement the 2016 recertification of ATTs, including how NEMIC plans to offer 2016 recertification (partially online and in person, completely in person, or both) and how NEMIC will ensure the integrity of its recertification curriculum and the ATTCP program, if training is conducted on line. Specify what the cost is to ATTs for recertification and whether it is included in the annual maintenance fee or if it is separate.*

   To be recertified for the 2016 *Building Energy Efficiency Standards* (Standards), the Building Energy Efficiency Standards (Standards), we have developed a webinar, that each NEMIC ATTCP-certified Acceptance Test Technician (ATT) (and Acceptance Test Employer (ATE)) will have to attend to recertify. The webinar is self-paced that the ATT can review at his leisure. It is offered as a download from our ATTCP website, www.attcp.org. This format has been developed by our industry partners who offer hundreds of self-paced curricula online. There is no cost to either the ATT or the ATE for recertification. The webinar was reviewed and approved by CEC as indicated in their letter of October 6, 2016

2. *Provide more information about how NEMIC will address the update to §10-103.2(c)3F of the Standards, which requires the ATTCP to review a random sample of no less than one percent of each ATT's completed compliance forms, and randomly perform selected onsite audits of no less than one percent of each ATT's completed acceptance tests. The quality assurance program NEMIC currently employs is acceptable under the 2013 Standards, but needs to be updated to meet the new 2016 Standards.*

NEMIC in conjunction with ICF Inc. has developed a Quality Assurance Program (QAP) that meets the mandates of 2016 California Building Energy Efficiency Standards, Section 120.5. A copy of NEMIC QAP is attached. The NEMIC QAP mirrors the quality assurance program of the CALCTP, which is administered by ICF as well, including extent, type and frequency of paper and onsite audits.

At this time, NEMIC respectfully request the California Energy Commission to review our submission and approve NEMIC as a Mechanical Acceptance Test Technician Certification Provider under the 2016 Building Energy Efficiency Standards

Sincerely,

David Bernett
NEMIC ATTCP Administrator

cc.: Joe Loyer, Senior Mechanical Engineer, California Energy Commission
Davor Novosel, Chief Technology Officer, NEMIC

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NEMIC ATTCP Quality Assurance Program in Accordance with the 2016 California Building Energy Efficiency Standards

Version 180328

National Energy Management Institute Committee

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Contents

1 Scope

The NEMIC Quality Assurance Program (QAP) as outlined here meets the mandates of 2016 California Building Energy Efficiency Standards, Section 120.5., which states:

The Application shall describe how applicant's certification business practices include quality assurance, independent oversight and accountability measures such as independent oversight of the certification processes and procedures, visits to building sites where certified technicians are completing acceptance tests, certification process evaluations, building department surveys to determine acceptance testing effectiveness, and expert review of the training curricula developed for Building Energy Efficiency Standards, Section 120.5. (Section 10-103-A, subds. (c)(1) & (c)(3)(F).)

All NEMIC ATTCP-certified acceptance test employers (ATE) and acceptance test technicians (ATT) must participate in the NEMIC ATTCP QAP. To administer the NEMIC QAP, NEMIC has hired an independent third party, ICF Inc.

2 Conformance to NEMIC ATTCP Code of Conduct

Each technician and employer certified by NEMIC under California Code of Regulations Title 24 Part 1, Sections 10-102 and 10-103-B is expected to practice his or her profession consistent with the standards and procedures applicable to the certification, and the highest quality workmanship and to adhere to the NEMIC ATTCP *Code of Conduct* at all times (see NEMIC ATTCP Certification Manual, Section 4.5 *Employer Certification Obligations and Code of Conduct*).

NEMIC ATTCP-certified ATTs must maintain TABB certification at all times. Failure to maintain TABB certification shall result in immediate loss of the NEMIC ATTCP ATT certification. The ATT must adhere to the *Code of Conduct* as describe in the ITI Certification Manual, Section 2.6 *Code of Conduct* at all times.

NEMIC ATTCP-certified ATEs must maintain a system of quality controls governing their operations. These are the procedures a company puts in place that help the company ensure the delivery of quality services to the customer. These procedures include clearly established protocols and best practices for the work that is being done. NEMIC ATTCP certified ATEs must follow these policies and procedures.

3 Employ NEMIC ATTCP-certified Technicians

NEMIC ATTCP-certified ATEs agree to employ NEMIC ATTCP-certified ATTs in quantity and designation for the scope of the business operation at each location sufficient to conduct testing to 2016 Building Energy Efficiency Standards and sign off on certificates of completion. NEMIC ATTCP-certified ATEs agree to use only NEMIC ATTCP-certified ATTs for acceptance testing.

4 Equipment

NEMIC ATTCP-certified ATTs must ensure that they have the necessary serviceable, calibrated tools, equipment and instruments available for conducting mechanical acceptance testing work. NEMIC ATTCP-certified ATTs are required to provide diagnostic equipment and instrument calibration records upon request. NEMIC does not mandate the purchase or ownership of any specific piece or brand or tool, equipment or instrument for purposes of certification. NEMIC may request and review an organization's tool and equipment inventory to determine whether the organization has the capability to be certified for mechanical acceptance testing as mandated by the Standards based on the tools, equipment, and instruments in the inventory.

5 Disclosure of Information

To verify the scope of the organization's work, upon request, NEMIC ATTCP-certified ATEs will provide NEMIC with access to certain records or data that substantiate ATT findings.

Based on the program parameters, a percentage of projects, chosen randomly, will receive either a paperwork "desk" review, or an onsite, in-person, quality-assurance review. Each review will be based upon the following fee structure.

Table 1. ICF Audit Fee Structure

Type of Review/Audit	Fee Paid to ICF
For Each Quality Assurance Desk Review	$300
Per On-Site, In Person Quality Assurance Visit	$950

6 General Objections

Any and all objections with regard to the NEMIC QAP will be resolved according to the procedures set forth in the NEMIC ATTCP Certification Manual Section 2.5 *Certification-Related Objections Procedures*. All objections will be categorized as General Objections.

7 Audit Sampling Background

NEMIC and ICF have designed a quality assurance "audit" program utilizing best practices around a "quality assurance audit model." NEMIC follow the guidelines established by the American Institute of CPA's (AICPA) in the "*Audit Sampling Considerations of Circular A-133 Compliance Audits*" to address sampling size in an audit environment.

A-133 audits are required by the federal government and provide a statistically reliable method of quality assurance. In the "Audit Sample"" chapter AICPA recommends, "*If the auditor determines that internal control over compliance is effectively designed and implemented, Circular A-133 requires that the auditor plan the audit to support a low level of assessed control risk. This requires the auditor to plan to obtain a high level of assurance that controls operate as designed.*

Therefore, generally, samples for control tests are designed to achieve a 90 percent to 95 percent confidence level."

However, AICPA state that there are several inherent risk factors that could impact noncompliance, which included, specifically:

- New program with little history with compliance requirement;
- Complex processing or judgment;
- Significant deficiencies or material weaknesses observed in the past;
- Correspondence from program officials indicating potential problems;
- Lack of adherence to applicable laws and regulations in prior years;
- High auditee turnover in a particular area;
- Very high volume of activity; and/or
- Substantial change in the policies, processes, or personnel associated with the compliance requirement.

For new programs, it is recommended the audit program require a 98 percent confidence level at first to ensure that any initial issues with noncompliance are identified and addressed. Because the NEMIC QAP is a new program that will initially consist entirely of newly certified mechanical ATTs, ICF has set a goal of conducting enough quality assurance audits during the first three years of the program to have a 98% confidence level that all acceptance test assessments are done correctly. As the program becomes more established and the NEMIC ATTCP-certified ATT workforce becomes more experienced, these quality assurance visits will decrease to a 95% confidence level in years 3-5 and then a 90% confidence level when the program is established in year 5 and beyond. The confidence levels for the program are described in the table below.

Table 2. Confidence Levels of the NEMIC QAP

Time Period	Confidence Level
2016/2019 Code	98%
2022 Code and Beyond	95%

The formula for determining the appropriate confidence level is:

$$\hat{p} \pm z * \sqrt{\frac{\hat{p}\,(1-\hat{p})}{n}}$$

where

$\hat{p}$ = percentage estimator
z = z-Score or standard score which is the number of standard deviations above the mean
n = sample size

As requested by the California Energy Commission (CEC) staff, NEMIC, in its role as a mechanical ATTCP, will conduct two types of audits. A paper quality assurance audit and an on-site quality assurance audit. Table 3 shows the type and frequency of audits to be conducted under the NEMIC QAP.

Table 3. Type And Frequency Of Audits To Be Conducted Under The NEMIC QAP

Time Period	Confidence Level	% of Projects Audited*	Paper Audits	On-Site Audits
2016/2019 Code Cycle	98%	4%	3%	1%
2022 Code Cycle and Beyond	95%	8%	1%	1%

*the actual number of projects audited will depend on the total number of projects, the above identified is the anticipating a minimum pool of 8,000 projects in the course of a year. If more projects are completed the % of projects audited will decrease. 8,000 was the number of CALCTP audits conducted in 2017.

ICF will use the following formula to determine the appropriate sample size:

$$n = \left[\frac{z\,\sigma}{E}\right]^2$$

Where

n = sample size
z = z-Score which is determined by the confidence level
Φ =1-standard deviation
E = Estimate of error

NEMIC's third party QAP provider, ICF, will contact the ATT and the ATE regarding a site audit. For on-site audits, ICF will conduct the audit simultaneously as the ATT is conducting the site's acceptance test.

8 Failed Item versus a Failed Test

A "failed Item" constitutes a category of failure on the part of the mechanical ATT, such as:

- failure to ensure appropriate documentation is available and complete;
- failure to conduct all or elements of a construction inspection, failure to verify equipment information is posted, and
- failure to verify installed mechanical controls are certified to the California Energy Commission .

A "failed test" occurs when at least one of the threshold specifications is not met during the testing and inspection process. "Threshold Specifications" is a set of specific pass/fail criteria for each mechanical control device or system requiring acceptance testing. A description of failed items and test failures per mechanical acceptance test forms are listed in Section 9.

9 Auditor Qualifications

All audits, written and onsite, will be performed by NEMIC ATTCP-certified Acceptance Test Technicians.

10 Random Audit Sampling Process

The information below sets forth the random audit sampling process and identifies the items that can result in a failed audit.

As requested by the California Energy Commission (CEC) staff, NEMIC as a mechanical ATTCP will conduct two types of audits. A paper quality assurance audit and an on-site quality assurance audit. The breakdown of audits of the NEMIC ATTCP-certified ATTs will be as shown in Table 4.

Table 4. Breakdown of Frequency and Type of Audits by Code Cycle

Time Period	Confidence Level	% of Projects Audited*	Paper Audits	On-Site Audits
2016/2019 Code Cycle	98%	4%	3%	1%
2022 Code Cycle and Beyond	95%	8%	1%	1%

* the actual number of projects audited will depend on the total number of projects, the above identified is the anticipating a minimum pool of 8,000 projects in the course of a year. If more projects are completed the % of projects audited will decrease. 8,000 was the number of CALCTP audits conducted in 2017.

If a ATT has failed either a paper quality assurance audit or an on-site-quality audit the NEMIC ATTCP-certified ATT will receive additional quality assurance oversight. As opposed to the anticipated percentage referenced above, ATTs who fail a quality assurance site visit will receive scrutiny as listed in Table 5.

Table 5. Breakdown of Frequency and Type of Additional Audits Following a Failed Paper of On-site Audit

Result	% of Projects Audited	Action That Will Be Take
Failed Either a Paper or On-Site Quality Assurance Audit	50% of future projects audited until they have passed 2 on-site audits	On-Site Quality Assurance Audit only
Failed a Second Quality Assurance Audit, the Second is an On-Site Audit	100% of future projects audited, until passed 4 on-site audits	On-Site Quality Assurance Audit Only
Failed a Third Quality Assurance Audit, while still in the failed pool.		ATT will decertified according to the NEMIC ATTCP Certification Manual Section 3.5

11 Individual Acceptance Test Onsite Audit Pass/Fail Criteria

The on-site audit pass/fail criteria are derived from Appendix NA7.5 *Mechanical Systems Acceptance Tests* in the document CEC-400-2015-038-CMF, *2016 Reference Appendices for The 2016 Building Energy Efficiency Standard*.

11.1 NA7.5.1 Outdoor Air (Document NRCA-MCH-02-A)

11.1.1 Construction Inspection Failure

1. The ATT failed to indicate method and equipment used to measure airflow during the functional test.
2. The ATT failed to attach the calibration certificate or field calibration results to the acceptance test document.
3. The ATT failed to review the operation sequences to ensure the system performs dynamic control of minimum outdoor air and reviews the installation to confirm all of the devices of that sequence are present.
4. The ATT failed to Indicate the dynamic control method used to control OSA in the system and/or failed to indicate the method used to deliver outside air to the unit.
5. The ATT failed to conduct a preoccupancy purge for the 1-hour period immediately before normal occupancy of the building per §120.1(c)2.

11.1.2 Functional Test Failure

The ATT failed to follow one or more of the steps.

Step 1. Disable demand control ventilation, if applicable.

Step 2. Verify unit is not in economizer mode. Disable the air economizer, if applicable. The ATT needs to measure and document the outdoor air flow in one of the accepted ways. The outdoor airflow rate needs to be confirmed within 10 percent of what is found on mechanical plan check document NRCC-MCH-03-E Column M, or mechanical equipment schedules.

Step 3. Modify VAV boxes to achieve full design airflow. The ATT needs to

- Document the supply airflow at full cooling on the acceptance document.
- Document VFD speed; VFDs should be at or near 60Hz.
- Document the measured outdoor air reading. Document the required outdoor airflow as found on mechanical plan check document NRCC-MCH-03-E Column M, or mechanical equipment schedules. In the “Testing Calculation and Results” section of the acceptance document, confirm that measured outdoor air flow is within 10 percent of design outdoor air flow rate.
- Document time for OSA damper to stabilize after the VAV boxes open on the acceptance document. Confirm that dampers stabilize within 5 minutes.

Step 4. Drive all VAV boxes to either the minimum airflow, full heating airflow, or 30 percent of total design airflow. The ATT needs to:

- Document the supply airflow on the acceptance document.
- Document VFD speed.
- Document the measured outdoor air reading. In the "Testing Calculation and Results" section of the acceptance document, confirm that measured outdoor air flow is within 10 percent of design outdoor air flow rate found on mechanical plan check document NRCC-MCH-03-E Column M, or mechanical equipment schedules.
- Document time for OSA damper to stabilize after the VAV boxes open on the acceptance document. Confirm that dampers stabilize within 5 minutes. The intent is to ensure the PID control loops are tuned properly.

11.2 NA7.5.2 Constant Volume, Single-Zone, Unitary Air Conditioner and Heat Pumps Systems Acceptance (Document NRCA-MCH-03-A)

11.2.1 Construction Inspection Failure:

1. The ATT fails to verify the thermostat, or temperature sensor, is within the zone that the respective HVAC system serves.
2. The ATT fails to verify the thermostat is wired to the HVAC unit correctly. In particular, ensure that multiple stage terminals (that is, first and second stage wires) on the thermostat, both cooling and heating stages, are wired to the corresponding circuits at the HVAC unit.
3. The ATT fails to verify no factory-installed or field-installed jumpers exist across the first and second stage cooling terminals at the unit.
4. The ATT fails to verify on heat pumps the "O" terminal on the thermostat is wired to the reversing valve at the unit. The ATT also fails to verify the thermostat dip switch or programmable software is set to heat pump.
5. The ATT fails to verify the thermostat meets the temperature adjustment and dead band requirements of §120.2(b): The thermostat shall allow a heating setpoint of 55°F or lower and a cooling setpoint of 85°F or higher. The dead band shall be at least 5°F, where heating and cooling is shut off. On the acceptance document MECH-04A, note the minimum heating setpoint, maximum cooling setpoint, and dead band.
6. The ATT fails to verify occupied, unoccupied, and holiday schedules have been programmed per the schedule of the facility.
7. The ATT fails to verify the preoccupancy purge has been programmed to meet the requirements of §120.1(c)2.

11.2.2 Functional Test Failure

The ATT failed to follow one or more of the steps.

Step 1. Disable economizer control and demand-controlled ventilation systems to prevent unexpected interactions.

Step 2. Simulate a heating demand during occupied condition and verify:

- Supply fan operates continually during occupied condition.
- Ensure all available heating stages operate; the heater stages on.
- No cooling is provided by the unit and outdoor air damper is open to minimum ventilation position

Step 3. Simulate operation in the dead band (no-load condition) during occupied condition. Verify and document that

- Supply fan operates continually during occupied condition;
- Heating and cooling is not provided by the unit; and
- Outdoor air damper is open to minimum ventilation position.

Step 4. Simulate a cooling demand during occupied condition. Verify and document that

- Supply fan operates continually during occupied condition;
- All available cooling stages operate; the compressor stages on;
- No heating is provided by the unit; and
- Outdoor air damper is open to minimum ventilation position.

Step 5. Simulate operation in the dead band (no-load condition) during unoccupied condition. Verify and document that

- Supply fan shuts off during unoccupied condition;
- Unit does not provide heating or cooling; and
- Outdoor air damper is fully closed.

Step 6. Simulate heating demand during unoccupied condition. Verify and document that

- Supply fan cycles on with call for heating;
- Heating is provided by the unit; heater stages on;
- No cooling is provided by the unit; and
- Outdoor air damper is either fully closed or at minimum position

Step 7. Simulate cooling demand during unoccupied condition. Verify and document that

- Supply fan cycles on with call for cooling;
- No heating is provided by the unit;
- Cooling is provided by the unit; and
- Outdoor air damper is either fully closed or at minimum position.

Step 8. Simulate manual override during unoccupied condition. The ATT needs to:

- Verify and document that the system reverts back to an "occupied" condition. For a DDC control system, verify the "active" heating and cooling setpoints correspond to those programmed for the occupied condition. For a programmable thermostat, the thermostat may display that it is in the "occupied" mode;
- Verify and document that that the system reverts back to an "unoccupied" condition when manual override period expires. It may be necessary to adjust the length of the override period to minimize test time;
- Check that the supply fan operates continually during occupied condition; and
- Check that outside air damper is open to minimum ventilation position.

11.3 NA7.5.3 Air Distribution Systems Acceptance (Document NRCA-MCH-04-A)

11.3.1 Construction Inspection Failure

The ATT fails to review the drawings and construction to verify that the following items are specified in the construction set and installed in the field.

- Drawbands are either stainless steel worm-drive hose clamps or UV-resistant nylon duct ties. Verify compliance by reviewing material cut sheets and visual inspection;
- Flexible ducts are not constricted in any way;
- Joints and seams are not sealed with a cloth-backed rubber adhesive tape unless used in combination with mastic and drawbands;
- Duct insulation R-value shall comply with §120.4(a), §120.4(c), and §120.4(d) and can be verified by reviewing material cut sheets and through visual inspection; and
- Insulation is protected from damage or is suitable for outdoor usage, per §120.4(f). Compliance is verified by reviewing material cut sheets and through visual inspection.

11.3.2 Functional Test Failure

The ATT failed to follow the steps below or it is a failed test.

For **new duct systems**, the ATT blocks all of the supply and return registers or diffusers. Then, the ATT pressurizes the ducts with a fan flowmeter to a positive 25 Pa (0.10 inches of water) and record the leakage airflow measured by the fan flowmeter. This measured leakage is divided by the total fan flow to generate the leakage percentage value. When this leakage percentage is less than or equal to 6 percent, the system passes.

For **existing duct systems** needing additional ducts added, undergoing major repairs, or having equipment replaced that connects to the ducts, the leakage rate of the existing duct system shall be tested first before proceeding with any alterations. This leakage amount is the pretest leakage value. Next, proceed with the test method described above for new duct systems to measure the final test leakage rate, with the only exception that the maximum leakage allowed is increased to 15 percent.

After completing the air distribution system acceptance test, the ATT shall affix a sticker to the air handler access door describing whether the system met the prescriptive leakage requirements (6 percent leakage for new systems and 15 percent for existing systems) or if the system failed to meet this standard but all accessible leaks were sealed.

11.4 NA7.5.4 Air Economizer Controls Acceptance (Document NRCA-MCH-05-A)

11.4.1 Construction Inspection Failure

1. The ATT failed to check that the air economizer outside (lockout) sensor location is adequate to achieve the desired control and prevent false readings.
2. The ATT failed to check the economizer reliability features are present per §140.4(e)4. This includes the following:
   - Verify the economizer has a 5-year warranty of the assembly.
   - Provide a product specification sheet proving economizer assembly capability of at least 60,000 actuations.
   - Provide a product specification sheet proving economizer damper sections are certified by AMCA 511 for a maximum damper leakage rate of 10 cfm/sf at 1.0 in. w.g. (Class 1A, 1, and 2 are acceptable.)
   - If the high limit setpoint is fixed dry-bulb or fixed enthalpy + fixed dry-bulb, then the control shall have an adjustable setpoint.
   - Outdoor air, return air, mixed air, and supply air sensors shall be calibrated as follows:
     - ✓ Dry-bulb and wet-bulb temperatures accurate to ±2°F over the range of 40°F to 80°F.
     - ✓ Enthalpy accurate to ±3 Btu/lb over the range of 20 Btu/lb to 36 Btu/lb.
     - ✓ Relative humidity (RH) accurate to ±5 percent over the range of 20 percent to 80 percent RH.
   - Check that the sensor performance curve(s) is provided by the factory with economizer instruction materials, and that sensor output values measured during sensor calibration are plotted on the performance curve(s).
   - Sensors used for high limit control shall be located to prevent false readings, including, but not limited to, being properly shielded from direct sunlight.
   - For unitary systems 65,000 Btu/hr or less, verify that a two-stage thermostat is used, and that the system is wired so that the economizer is the first stage of cooling and the compressor is the second stage.
   - The ATT failed to check that all systems have some method of relief to prevent over pressurization of the building when in full economizing mode (100 percent outdoor air).
   - For systems with DDC controls, the ATT failed to check that lockout sensor(s) are either factory calibrated or field calibrated. For systems with non-DDC controls, the ATT failed to check that manufacturer's startup and testing procedures have been applied.

11.4.2 Functional Test Failure

The ATT failed to follow one or more of the steps.

11.4.2.1 Steps for Stand-Alone Package – Trane Voyager and Precedent Series

Step 1. Disable demand control ventilation (DCV) system mode.

Step 2. Use internal test sequences to enable operating modes.

- 1st jumper – supply fan is enabled
- 2nd jumper – economizer mode is enabled
- 3rd jumper – compressor is enabled
- 4th jumper – heating stage is enabled

Verify and document that

- The outdoor air damper opens completely and the return damper closes completely during economizer mode;
- The outside air damper remains 100 percent open while using mechanical cooling when the demand cannot be met by outside air alone and the system is still below the lockout point;
- Outdoor air damper is at minimum position when the supply fan is enabled;
- Outdoor air damper is at minimum position when the compressor is enabled and economizing is disabled;
- Outdoor air damper is at minimum position when heating is enabled and economizing is enabled; and
- The mixed/discharge cut-out sensor wire is landed on the SA terminal on the OEM board. If the sensor wire is not landed on the SA terminal, the economizer will not operate.

Step 3. Turn off the unit and verify that

- Economizer dampers close completely.
- Return air damper opens.

Step 4. Return system to normal operation.

After restoring power, the unit returns to normal operation, verifying the final economizer changeover dip-switch settings comply with Energy Standards Table 140.4-B per §140.4(e)3.

11.4.2.2 Honeywell Controllers

Step 1. Disable demand controlled ventilation (DCV) system modes

Step 2. Simulate a cooling load and enable the economizer. Verify and document that

- Outdoor air dampers open fully. Adjust linkages, if necessary, to ensure dampers are at the desired position;
- Return air dampers close completely. Adjust linkages, if necessary, to ensure dampers are at the desired position; and

- Compressor runs when cooling load becomes too high for economizing to meet alone. The outdoor air dampers should remain 100 percent open at this point.

Step 3. Simulate a cooling load and disable the economizer. Verify and document that

- Outdoor air dampers close to minimum position. Adjust linkages, if necessary, to ensure dampers are at the desired position;
- Return air dampers open completely. Adjust linkages, if necessary, to ensure dampers are at the desired position; and
- The compressor operates.

Step 4. If the unit is equipped with heating, simulate a heating load with the economizer enabled. Verify and document that

- Outdoor air dampers remain at minimum position;
- Heating is enabled; and
- The compressor does not operate.

Step 5. Turn off unit. Verify and document that

- Economizer dampers close completely.
- Return air damper opens.

Step 6. Return system back to normal operating condition. Verify and document that the final economizer changeover setting (A, B, C, D) complies with Energy Standards Table 140.4-B per §140.4(e)3.

11.4.2.3 Carrier Durablade

Step 1. Disable demand controlled ventilation (DCV) system modes, if applicable to the unit.
Step 2. Simulate a cooling load and enable the economizer. Verify and document that

- Damper blade slides completely across the return air duct, and mixed air plenum is open to the outdoor air intake. Adjust end switches as necessary to achieve the desired position; and
- The compressor does not run.

Step 3. Simulate a cooling load and disable the economizer. Verify and document that

- Damper blade returns to minimum outdoor air position. Adjust end switches as necessary to achieve the desired position; and
- The compressor operates

Step 4. If the unit is equipped with heating, simulate a heating load with the economizer disabled. Verify and document that

- Economizer dampers close completely; and
- Return air damper opens.

Step 5. Turn off unit. Verify and document that

- Economizer dampers close completely.
- Heating and cooling do not operate.

Step 6. Return system back to normal operating condition, Verify and document that final economizer changeover setting complies with Energy Standards Table 140.4-B per §140.4(e)3

11.4.2.4 DDC Controls

Step 1. Disable demand controlled ventilation (DCV) system modes.

Step 2. Simulate a cooling load and enable the economizer. Verify and document that

- Outdoor air damper modulates open to a maximum position;
- Return air damper modulates closed and is 100 percent closed when the outdoor air dampers are 100 percent open; and
- Outdoor air damper is 100 percent open before mechanical cooling is enabled.

Step 3. Simulate a cooling load and disable the economizer. Verify and document that

- Outdoor air damper closes to a minimum position;
- Return air damper opens to normal operating position when the system is not in economizer mode; and
- Mechanical cooling remains enabled to satisfy discharge air temperature setpoint.

Step 4. If the system has heating, simulate a heating demand and enable the economizer. Verify and document that

- Outdoor air dampers remain at a minimum position;
- Return air dampers remain open;
- Heating is enabled to satisfy discharge air temperature setpoint; and
- Mechanical cooling is disabled.

Step 5. Turn off all systems. Verify and document that

- Outdoor air dampers close completely; and
- Heating and cooling do not operate.

Step 6. Return system back to normal operating condition.

11.5 NA7.5.5 Demand Control Ventilation (DCV) Systems Acceptance (Document NRCA-MCH-06-A)

11.5.1 Construction Inspection Failure

The CO_2 sensor is either factory calibrated or field calibrated. A calibration certificate from the manufacturer will satisfy this requirement. If not, a field calibration is to be conducted. An ATT fails if neither of these inspections are performed.

11.5.2 Functional Test Failure

The ATT failed to follow one or more of the steps.

Step 1. Disable the economizer.
Step 2. Simulate a high space occupancy and verify the outdoor air damper modulates open.
Step 3. Simulate a low occupant density and verify the outdoor air damper modulates towards minimum position.

11.6 NA7.5.6 Supply Fan Variable Flow Controls Acceptance (Document NRCA-MCH-07-A)

11.6.1 Construction Inspection Failure

1. The ATT fails to check that the static pressure sensor location, setpoint, and reset control meet the requirements of §140.4(c)2.
2. The ATT fails to verify the supply fan includes a means to modulate airflow such as a variable speed drive.
3. The ATT fails to perform a static pressure sensor(s) field calibration. When the value measured by the BAS is within 10 percent of the field-measured value, the sensor is calibrated. In addition, the ATT fails to attach supporting documentation to the NRCA-MCH-07-A document.

11.6.2 Functional Test Failure

The ATT failed to follow one or more of the steps.

Step 1. Drive all VAV boxes to achieve full design airflow. The ATT needs to

- Verify and document the system full design airflow in cfm (e.g. from design documents);
- Check that supply fan speed modulates to increase capacity. For VFD, record fan motor frequency (Hz);
- For multi-zone systems, check that supply fan maintains discharge static pressure setpoint within ±10 percent of the current operating set point. Verification can be accomplished by simply reading the value measured by calibrated pressure sensor and comparing it to setpoint;

- When tests depart from NA7.5.1 (document NRCA-MCH-02-A), check if another method was used for verifying VFD operation (besides commanding to maximum flow and cooling); and
- Verify system operation and supply fan control stabilizes within 5 minutes.

Step 2. Drive all VAV boxes to a low airflow condition. Verify and document that

- Supply fan speed decreases to meet flow conditions. For VFD, record fan VFD frequency (Hz);
- For systems with DDC to the zone level, check that current operating static pressure setpoint has decreased;
- For multi-zone systems, check that supply fan maintains discharge static pressure setpoint within ± 10 percent of the current operating set point. Verification can be accomplished by simply reading the value measured by calibrated pressure sensor and comparing it to setpoint; and
- System operation and supply fan control stabilizes within 5 minutes.

Step 3. Return system back to normal operating condition.

11.7 NA7.5.7 Valve Leakage Acceptance (Document NRCA-MCH-08-A)

11.7.1 Construction Inspection Failure

1. The ATT fails to collect the pump curve data and note the impeller size.
2. The ATT fails to ensure installation of all valve and piping arrangements per the design drawings.
3. The ATT fails to confirm measuring devices are located adequately to achieve the most accurate results measurements.
4. The ATT fails to confirm piping arrangements are correct located.

11.7.2 Functional Test Failure

The ATT failed to follow one or more of the steps.

Step 1. Dead head One Pump. Verify and Document:

Isolate one circulation pump and ensure all chillers (or boilers) are off. Close the isolation valve at the pumps discharge. Turn the pump on for no more than 5 minutes. Measure and note the pressure across the pump at this “dead head” condition. When the system is piped primary/secondary make sure there is a secondary pump. At the end of the measurement, turn off the pump and re-open the discharge valve.

Step 2. Step 2: Close control valves. Verify and Document

Ensure each control valve closes completely under normal operating pressure. The intent is to confirm the actuator-valve torque requirements are adequate to shut the valve under normal operating system pressure. Verify complete closure by measuring the pressure across the operating pump. If the pressure is more than 5 percent less than the previous test, then one or more valves have not fully closed. Fix any leaks and retest.

11.8 NA7.5.8 Supply Water Temperature Reset Controls Acceptance (Document NRCA-MCH-09-A)

11.8.1 Construction Inspection Failure

1. The ATT failed to verify if the temperature sensors were either factory calibrated or field calibrated by a controls contractor, or other appropriate person.
2. If field calibrated, the ATT failed to provide supporting calibration documentation and attach to the NRCA-MECH-09-A document.

11.8.2 Functional Test Failure

The ATT failed to follow the steps below or it is a failed test.

Step 1. Change reset control variable to its maximum value. Verify and document that

- Chilled and/or heating hot water supply temperature setpoint is reset to the appropriate value determined by the designer per the control strategy.
- Actual supply water temperature changes to within 2 percent of the control setpoint.

Step 2. Change reset variable to its minimum value. Verify and document that

- Chilled and/or heating hot water supply temperature setpoint is reset to the appropriate value determined by the designer per the control strategy; and
- Actual supply water temperature changes to within 2 percent of the control setpoint.

Step 3. Test automatic control of reset control variable to automatic control. Verify and document that

- Chilled and/or heating hot water supply set-point is reset to the appropriate value;
- Actual supply temperature changes to meet the setpoint; and
- The supply temperature is within 2 percent of the control setpoint.

11.9 NA7.5.9 Hydronic System Variable Flow Control Acceptance (Document NRCA-MCH-10-A)

11.9.1 Construction Inspection Failure

1. The ATT fails to verify the static pressure location, setpoint, and reset control must meet the requirements of the §140.4(k)6B.
2. The differential pressure sensor (when applicable) is factory or field calibrated by a controls contractor or other qualified person. Field calibration requires measuring system pressure (or differential pressure), as close to the existing sensor as possible using a calibrated hand-held measuring device. All pressure sensors must be within 10 percent of the calibrated reference sensor.
3. The ATT fails to provide supporting documentation must be attached to the Acceptance Document NRCA-MCH-10-A.

11.9.2 Functional Test Failure

The ATT failed to follow one or more of the steps.

Step 1. Modulate control valves to reduce water flow to 50 percent of the design flow or less, but not lower than the pump minimum flow. Verify and document that

- Current pump operating speed decreased (for systems with DDC to the zone level);
- Current operating setpoint has not increased (for all other systems that are not DDC);
- System pressure is within 5 percent of current operating setpoint. Record the measured system pressure at the control sensor. Record the system pressure setpoint; and
- System operation stabilizes within 5 minutes after test procedures are initiated.

Step 2. Open control valves to increase water flow to a minimum of 90 percent design flow. Verify and document that

- Pump speed increases to 100 percent.
- System pressure increases and is within 5 percent of current operating setpoint, record the measured system pressure at the control sensor. Record the system pressure setpoint.
- System pressure setpoint is greater than the setpoint recorded in step 1.
- System operation stabilizes within 5 minutes after test starts.

Step 3. Restore system to initial operating conditions.

11.10 NA7.5.10 Automatic Demand Shed Control Acceptance (Document NRCA-MCH-11-A)

11.10.1 Construction Inspection Failure

The ATT failed to inspect that the EMCS interface was able to activate the central demand shed controls.

11.10.2 Functional Test Failure

The ATT failed to follow one or more of the steps.

Step 1. Engage the global demand shed system. Verify and document that

- The cooling setpoints in the non-critical spaces increase by the expected amount.
- The cooling setpoints in the critical spaces do not change.

Step 2. Disengage the global demand shed system. Verify and document that

- The cooling setpoints in the non-critical spaces return to their original setpoint.
- The cooling setpoints in the critical spaces do not change.

11.11 NA7.5.11 Fault Detection and Diagnostics (FDD) for Packaged Direct-Expansion (DX) Units Acceptance (Document NRCA-MCH-12-A)

11.11.1 Construction Inspection Failure

The ATT failed to verify the installed FDD has been certified to the California Energy Commission and is listed on the California Energy Commission's website.

11.11.2 Functional Test Failure

The ATT failed to follow one or more of the steps. For each HVAC unit to be tested:

11.11.2.1 Test for Air Temperature Sensor Failure/Fault

Step 1. Verify the FDD system indicates normal operation.
Step 2. Disconnect outside air temperature sensor from unit controller. Verify and document that the FDD system reports a fault.
Step 3. Connect outside air temperature sensor to unit controller. Verify and document that the FDD system indicates normal operation.

11.11.2.2 Test for Excessive Outside Air

After passing the tests described in NA7.5.1 Outdoor Air, verify FDD system indicates normal operation.

11.11.2.3 Test for Economizer Operation

Step 1. Interfere with normal unit operation to generate an Air Economizer Control failure by immobilizing the outdoor air economizer damper according to manufacturer's instructions. After Air Economizer Controls fails, verify FDD system reports a fault.

Step 2. Successfully complete and pass tests described in NA7.5.4 Air Economizer Controls. Verify that the FDD system reports normal operation.

11.12 NA7.5.12 FDD for Air Handling Units and Zone Terminal Units Acceptance (Document NRCA-MCH-13-A)

11.12.1 Construction Inspection Failure

The ATT fails to test a minimum of 5 percent of the terminal boxes (VAV box) to any FDD system installed on an air handling unit or a zone terminal unit.

11.12.2 Functional Test Failure

11.12.2.1 Testing of each Air Handling Units with FDD controls

The ATT failed to follow the steps below or it is a failed test.

1 Sensor Drift/Failure

The threshold for a sensor drift fault should be given in percentage of full range, or in units for each type of sensor (temperature, differential pressure / airflow rate, etc.).

Step 1. Disconnect outside air temperature sensor from unit controller.
Step 2. Verify the FDD system reports a fault.
Step 3. Connect OATT sensor to the unit controller.
Step 4. Verify that FDD indicates normal system operation.

2 Damper/actuator fault

Step 1. From the control system workstation, command the mixing box dampers to full open (100 percent outdoor air), by lowering the supply air temperature setpoint.
Step 2. Disconnect power to the actuator and verify that a fault is reported at the control workstation.
Step 3. Reconnect power to the actuator and command the mixing box dampers to full open by maintaining the supply air temperature setpoint.
Step 4. Verify that the control system does not report a fault.
Step 5. From the control system workstation, command the mixing box dampers to a minimum position (0 percent outdoor air) by raising the supply air temperature setpoint.
Step 6. Disconnect power to the actuator and verify that a fault is reported at the control workstation.
Step 7. Reconnect power to the actuator and command the dampers closed.

Step 8. Verify that the control system does not report a fault during normal operation.

3 Valve/actuator fault

Step 1. From the control system workstation, command the heating coil valve to the full open position by temporarily setting the space heating setpoint higher than the current space temperature, if the system is not in heating mode.
Step 2. Disconnect power to the actuator and verify that a fault is reported.
Step 3. Reconnect power to the actuator and command the heating coil valve to full open.
Step 4. Verify that the control system does not report a fault.
Step 5. From the control system workstation, command the cooling coil valve to the full open position by temporarily setting the space cooling setpoint lower than the current space temperature, if the system is not in cooling mode.
Step 6. Disconnect power to the actuator and verify that a fault is reported.
Step 7. Reconnect power to the actuator and command the cooling coil valve to full open.
Step 8. Verify that the control system does not report a fault.

11.12.2.2 Improper Mode Fault Tests

The ATT failed to follow the steps below or it is a failed test.

Step 1. From the control system workstation, override the heating coil valve and verify that the control workstation reports a fault.
Step 2. From the control system workstation, override the cooling coil valve and verify that the control workstation reports a fault.
Step 3. From the control system workstation, override the mixing box dampers and verify the control workstation reports a fault.

11.12.2.3 Terminal Unit (VAV box) Tests

The ATT failed to follow the steps below or it is a failed test.

1 Sensor drift/failure

Step 1. Disconnect the tubing to the differential pressure sensor of the VAV box.
Step 2. Verify the control system detects and reports the fault.
Step 3. Reconnect the sensor and verify proper sensor operation.
Step 4. Verify that the control system does not report a fault.

2 Damper/actuator fault – damper stuck open

Step 1. Command the damper to be fully open. Override the space temperature setpoint below the current space temperature to force the system into maximum cooling. Another option is to command the VAV box to the maximum position through the control workstation.
Step 2. Disconnect the actuator to the damper.
Step 3. Adjust the cooling setpoint such that the room temperature is below the cooling setpoint to command the damper to the minimum position. Verify that the control system reports a fault.

Step 4. Reconnect the actuator and restore to normal operation.

3 Damper/actuator fault – damper stuck closed

Step 1. Set the damper to the minimum position.
Step 2. Disconnect the actuator to the damper.
Step 3. Set the cooling setpoint below the room temperature to simulate a call for cooling. Verify that the control system reports a fault.
Step 4. Reconnect the actuator and restore all setpoints to their original values to resume normal operation.

4 Valve/actuator fault (For systems with hydronic reheat)

This test is only applicable to systems with hydronic reheat.

Step 1. Command the reheat coil valve to (full) open by setting the heating setpoint temperature above the space temperature setpoint. Wait for the controls to respond to the command to open the reheat coil valve.
Step 2. Disconnect power to the actuator. Set the heating setpoint temperature to be lower than the current space temperature, to command the valve closed. Verify that the fault is reported at the control workstation.
Step 3. Reconnect the actuator and restore all setpoints to their original values to resume normal operation.

5 Feedback loop tuning fault

Step 1. Set the integral coefficient of the box controller (reset action) used for airflow control to a value 50 times the current value. Reduce the space temperature setpoint to be 3°F below the current space temperature to simulate a call for cooling.
Step 2. Verify the damper cycles continuously over a period of several minutes. (The cycling period time depends on the type of controller used but is typically on the order of a few minutes.) Verify that the control system detects and reports the fault.
Step 3. Reset the integral coefficient of the controller to its original value and reset the space setpoint to its original value to restore normal operation.

6 Disconnected inlet duct

Step 1. From the control system workstation, command the damper to a minimum position (full closed) by raising the space temperature setpoint.
Step 2. Then disconnect power to the actuator and verify that a fault is reported at the control workstation.
Step 3. Reset the space temperature setpoint back to its original value.

7 Discharge air temperature sensor

Step 1. Adjust zone setpoints to drive the box from dead band to full heating.
Step 2. Verify the supply air temperature resets to the maximum setpoint while the airflow maintains at the dead band flow rate.

Step 3. Verify that the airflow rate increases to the heating maximum flow rate to meet the heating load.

11.13 NA7.5.13 Distributed Energy Storage DX AC System Acceptance (Document NRCA-MCH-14-A)

11.13.1 Construction Inspection Failures

1. The ATT fails to verify the water tank is filled to the proper level.
2. The ATT fails to verify the water tank is sitting on a foundation with adequate structural strength to support the weight of the filled vessel
3. The ATT fails to verify the water tank is insulated and the top cover is in place.
4. The ATT fails to verify the DES/DXAC is installed correctly (refrigerant piping, etc.).
5. The ATT fails to verify the correct model number is installed and configured.

11.13.2 Functional Test Failure

The ATT failed to follow one or more of the steps.

Step 1. Simulate cooling load during daytime period. Verify and document that

- The supply fan operates continually;
- If the system has ice storage, verify that the DES/DXAC runs in ice melt mode and that the compressor remains off. The supply fan operates continuously to provide cooling to the space. The refrigerant pump operates to circulate refrigerant to the evaporator coil(s).
- If the DES/DXAC system has no ice and there is a call for cooling, verify that the DES/DXAC system runs in direct cooling mode, with the compressor running. Verify that cooling is provided to the space.

Step 2. Simulate no cooling load during daytime conditions. Verify and document that

- Supply fan operates as per the facility thermostat or control system.
- The DES/DXAC and the condensing unit do not run.

Step 3. Simulate no cooling load during the morning shoulder time period (before noon).Verify and document that the DES/DXAC system remains idle.

Step 4. Simulate a cooling load during the morning shoulder time period (between 6 am and noon). Verify and document that

- The DES/DXAC system runs in direct cooling mode, with the compressor running; and
- The tank does not discharge during this period.

Step 5. Set the date and time back to the current date and time after completion of the acceptance tests, following manufacturer's instructions.

11.14 NA7.5.14 Thermal Energy Storage (TES) System Acceptance (Document NRCA-MCH-15-A)

11.14.1 Construction Inspection Failures

ATT fails to verify the following chiller information is provided on the plans to document the key TES System parameters.

1. Chiller(s)
   - Manufacturer Brand and Model
   - Type (Centrifugal, Reciprocating, etc) and quantity
   - Heat rejection type (air, water, other)
   - Charge mode capacity (tons) at average fluid temperature
   - Discharge mode capacity (tons) at temperature
   - Discharge mode efficiency (kW/ton or EER) at design ambient temperature
   - Charge mode efficiency at nighttime design ambient temperature (kW/ton or EER)
   - Fluid type and percentage (nameplate)
2. Storage
   - Type (Ice-on-Coil Internal Melt, Ice-on-Coil External Melt, Encapsulated (e.g. ice balls), Ice Harvester, Ice Slurry, Other Phase Change Material (e.g. paraffin), Chilled Water, Brine (or chilled water with additives), Eutectic Salt, Clathrate Hydrate Slurry (CHS) Cryogenic, Other (specify)
   - Brand and Model
   - Number of Tanks
   - Height/width/depth, or height/diameter (if custom tanks)
   - Storage capacity per tank (ton-hours) at entering/leaving temperatures and hours discharged
   - Storage rate (tons) at flow rate (gpm) per tank
   - Minimum charging temperature based on chiller and tank selections
   - Discharge rate (tons) at entering/leaving temperatures and hours discharged

11.14.2 Functional Test Failure

The ATT failed to follow one or more of the steps.

Step 1. TES System Design Verification. The ATT verifies the installing contractor certified the following information:

- Chiller(s) start-up procedure has been completed
- System fluid test and balance has been completed
- Air separation and purge has been completed
- Fluid (e.g. glycol) has been verified at the concentration and type indicated on the design documents
- The TES system has been fully charged at least once and charged duration noted
- The system has been partially discharged at least once and discharged duration noted

- The system is in partial charge state in preparation for Step 2
- Schedule of operation has been activated as designed
- Mode documentation describes the state of system components in each mode of operation

Step 2. TES System Controls and Operation Verification. The ATT shall verify the following information:

- The TES system and the chilled water plant is controlled and monitored by an EMS.
- The system has controls in place configured for the operator to manually select each mode of operation or use an EMS schedule to specify the mode of operation.
- The scheduled operations listed below, not the times when the system will be in each mode of operation:
  - ✓ **Storage/charge mode**. Manually select storage mode. Verify that the TES system stores energy. If the TES operates on a schedule, note the times, what causes the TES to engage, and that the TES system enters energy storage mode.
  - ✓ **End of charge signal**. Simulated a full storage charge by changing the thermal storage manufacturer's recommended end of charge output sensor to the EMS. Verify that the storage charging stops.
  - ✓ **Discharge Mode**. Simulate a call for cooling. Manually select storage only discharge mode. Verify that the TES system starts discharging with the compressors off. Return to the off/secured mode. If the TES operates on a schedule, note times, what causes the TES to engage, and that the TES system starts discharging with the compressor(s) off.
  - ✓ **Mechanical cooling only mode**. Simulate a call for cooling. Manually select mechanical cooling only mode and verify that the storage does not discharge and the cooling load is met by the compressor(s) only. Return to the off/secured mode. If the TES operates on a schedule, not the times, what causes the TES to engage, and that the storage does not discharge and the cooling load is met by the compressor(s) only.
  - ✓ **Discharge and mechanical cooling mode**. Simulate a call for cooling. Manually select discharge and mechanical cooling mode. Verify that the TES system discharges with the chiller(s) sharing the load. Return to the off/secured mode. If the TES operates on a schedule, not the times, cause the TES to engage, and verify that the storage starts discharging with the compressor(s) sharing the load.
  - ✓ **Off/storage-secured mode**. Manually select the off/storage-secured mode. Verify that the storage does not discharge and all compressors are off. If the TES operates on a schedule, note the times, what causes the TES to engage, and that the storage does not discharge and all compressor(s) are off, regardless of the presence of calls for cooling.

- ✓ **Charge plus cooling mode**. If the provisions for this mode have been made by the system designer, verify that the tank(s) can be charged while serving an active cooling load, simulated by generating a call for cooling and entering the charge mode either manually or by time schedule. If the system disallows this mode of operation, verify that energy storage is disallowed or discontinued while an active cooling load is present.

11.15 NA7.5.15 Supply Air Temperature Reset Controls Acceptance (Document NRCA-MCH-16-A)

11.15.1 Construction Inspection Failures

1. The ATT fails to verify supply air temperature reset controls are installed per the requirements of the 2016 Energy Standards §140.4(f).
2. The ATT fails to document all system air temperature sensor(s) are factory or field calibrated.
3. The ATT fails to document the current supply air temperature.

11.15.2 Functional Test Failure

The ATT failed to follow one or more of the steps.

Step 1. During occupied mode, adjust the reset control parameter to decrease the supply air temperature (to the lower supply temperature limit). Verify and document that

- Supply air temperature controls modulate as intended.
- Actual supply air temperature decreases to meet the new set point within +/- 2°F.
- Supply air temperature stabilizes within 15 minutes.
- Document both supply air temperature setpoint and actual supply air temperature.

Step 2. During occupied mode, adjust the reset control parameter to increase the supply air temperature (to the upper supply temperature limit). Verify and document that

- Supply air temperature controls modulate as intended.
- Actual supply air temperature decreases to meet the new set point within +/- 2°F.
- Supply air temperature stabilizes within 15 minutes.
- Document both supply air temperature setpoint and actual supply air temperature.

Step 3. Restore reset control parameter to automatic control. Verify and document that

- Supply air temperature controls modulate as intended.

- Actual supply air temperature decreases to meet the new set point within +/- 2°F. Document both supply air temperature setpoint and actual supply air temperature.
- Supply air temperature stabilizes.

11.16 NA7.5.16 Condenser Water Temperature Reset Controls Acceptance (Document NRCA-MCH-17-A)

11.16.1 Construction Inspection Failures

1. The ATT fails to check if the condenser water supply system and control system are installed per the system design, as documented on the building plans or as-builts.
2. The ATT fails to check if condenser water supply temperature control sequence, including condenser water supply high and low limits, are available and documented in the building documents.
3. The ATT fails to check if all cooling tower fan motors are operational, cooling tower fan speed controls are installed, operational, and connected to cooling tower fan motors per OEM start- up manuals and sequence of operation.
4. The ATT fails to check if cooling tower fan control sequence, including tower design wetbulb temperature and approach, are available and documented in the building documents.
5. The ATT fails to check if the following temperature sensors are installed per plans: outdoor air drybulb and wetbulb, entering condenser water, and leaving chilled water. Note any discrepancies on the Acceptance Document.
6. The ATT fails to check all ambient dry bulb temperature, and relative humidity/wet bulb sensors used by controller must be factory calibrated (with certificate), field calibrated by TAB technician or other technician (with calibration results), or field checked against a calibrated reference standard by test technician (with results). Attach supporting documentation to the Acceptance Document. When field calibrating temperature sensors, it is recommended that you perform a “through system” calibration that compares the reference reading to the reading at the EMCS front end or inside the controller (e.g. it includes any signal degradation due to wiring and transducer error).
7. The ATT fails to document the following from the control system or using test sensors:
   - Current outdoor air dry bulb and wet bulb temperatures
   - Current entering condenser water supply temperature
   - Current leaving chilled water temperature

11.16.2 Functional Test Failure

The ATT failed to follow one or more of the steps.

Step 4. Adjust the reset control parameter to decrease the condenser water temperature (toward the lower supply temperature limit). Verify and document that
- Condenser water temperature controls modulate as intended.
- Actual condenser water supply temperature decreases to meet new set point within ± 2°F.
- Cooling tower fan(s) stage properly and/or adjust speed accordingly to meet lower set point.
- Chiller load amps decrease.

Step 5. Adjust the reset control parameter to increase the condenser water temperature (toward the upper supply temperature limit). Verify and document that
- Condenser water temperature controls modulate as intended.
- Actual condenser water supply temperature increases to meet new set point within
- ± 2°F.
- Cooling tower fan(s) stage properly and/or adjust speed accordingly to meet upper set point.
- Chiller load amps increase.

Step 6. Restore reset control parameter and system to automatic control. Verify and document that
- Condenser water temperature controls modulate as intended.
- Actual condenser water supply temperature changes to meet new set point within ± 2°F.
- Cooling tower fan(s) stage properly and/or adjust speed accordingly to meet set point.
- All equipment returns to normal operation.

11.17 Energy Management Control System Acceptance (Document NRCA-MCH-18-A)

11.17.1 Construction Inspection Failures

The ATT fails to ensure the following actions have been completed:

1. Factory start-up and check-out complete
2. I/O point lists available
3. Point-to-point verification completed
4. Sequence of operations of each system are programmed
5. Written sequences are available
6. Input sensors are calibrated

11.17.2 Functional Test Failure

The ATT failed to follow one or more of the steps.

Conduct the following verification checks to validate the functionality of the EMCS:

1. Verify the control graphics represent the system configuration.
2. Verify control points are properly mapped to the graphics screen.
3. Raise and lower a sampling of space temperature setpoints in the software and verify the system responds appropriately.
4. Verify the time-of-day start-up and shut-down function initiates a proper system response.
5. Verify trending capabilities by establishing trend logs for a sampling of control points.
6. Verify alarm conditions are monitored.
7. Verify the EMCS panel is installed on an emergency power circuit or has adequate battery back-up.

12 Paper Audit Pass/Fail Criteria

The purpose of the paper audit is to verify that the individual acceptance test form has been completed correctly.

The ATT fails a paper audit if

1. **Project Information** on top of each page of the NRCA-MCH documents is incomplete or missing.
2. **Construction Inspection** information is missing or incomplete, i.e., the appropriate boxes have not been checked or pertinent information has not been provided.
3. **Functional Inspection** information is missing or incomplete, i.e., the appropriate boxes have not been checked or pertinent information has not been provided.
4. If applicable, **Testing Calculations and Results** information is missing or incomplete, i.e., the appropriate boxes have not been checked or pertinent information has not been provided.
5. **Evaluation** information is missing or incomplete.
6. The **Documentation Author's Declaration Statement** has not been completed or information is missing.
7. The **Field Technician's Declaration Statement** has not been completed or information is missing.
8. The **Responsible Person's Declaration Statement** has not been completed or information is missing.