Proposal Summary

Nonresidential Cooling Towers

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Introduction

The document summarizes proposed revisions to the California Energy Code (Title 24, Part 6) that will be discussed during a utility-sponsored stakeholder meeting on February 13, 2023. The Statewide Utility Codes and Standards Enhancement (CASE) Team is seeking input and feedback. To provide your comments, email info@title24stakeholders.com by March 1, 2023.

Measure Description

This measure seeks to improve energy and water efficiency in nonresidential and multifamily building cooling systems through three measures.

Cooling tower efficiency

This measure seeks to improve the energy efficiency of cooling towers in nonresidential and multifamily buildings. This would apply to new construction and alterations. The measure examines modifications to Section 140.4(h)5 and 170.2(F)v to increase the existing prescriptive efficiency requirements for axial fan, open-circuit cooling towers of 900 gallons per minute (gpm) or greater from 60 gallons per minute per horsepower (hp) to a higher value which will be determined based on energy modeling.

Air-Cooled Chiller Threshold

This measure seeks to improve energy and water efficiency in nonresidential and multifamily buildings by determining if the existing 300-ton prescriptive limitation on air-cooled chillers (ACC) is still appropriate in light of recent advancements in technology since the limit was imposed in the 2005. At the time, ACC equipment was less efficient than WCCs, particularly in part load operating conditions. The goal will be to determine whether raising the ACC tonnage limit can achieve net energy and/or water savings. Furthermore, the language would be updated to account for air-to-water heat pump

technology, and modified if any additional clarity around air-to-water heat pumps is warranted.

Blowdown Controls

This measure seeks to improve water efficiency in nonresidential and multifamily buildings by investigating modifications to Section 110.2(e) – mandatory cycles of concentration (CoC) language – and 120.5 (acceptance testing and fault detection diagnostics) to ensure blowdown controls are working properly. This would apply to new construction buildings and new cooling towers in existing buildings. The measure would require the use of conductivity-based controls by eliminating the option for flow-based controls, update the existing CoC calculator to correctly assess maximum achievable CoC for site, and add an acceptance test to verify installation and programming of controls to achieve documented CoC.

Data Needs/Stakeholder Information Requests

Data needs include:

- Material and installation costs for cooling towers, water-cooled chillers, air-cooled chillers, and air-to-water heat pumps at a variety of efficiency levels.
- Maintenance costs for cooling tower/WCC systems as compared to ACC systems.
- Material, installation, and operating costs for cooling tower chemical treatment systems.
- Technical performance of cooling towers (at a variety of gpm/hp levels), WCCs, ACCs, and air-to-water heat pumps.
- Information regarding the highest efficiency cooling towers offered by manufacturers (in terms of gpm/hp).
- Cost of acceptance testing for conductivity controllers.
- Input and sources on water and sewage costs in representative California water districts.

Data may be provided anonymously. To participate or provide information, please email Sean Wynne, swynne@energy350.com and cc info@title24stakeholders.com.

Draft Code Language

The proposed changes to the Standards and Reference Appendices are provided below. Changes to the 2022 documents are marked with red underlining (new language) and ~~strikethroughs~~ (deletions). Expected sections or tables of the proposed code (but not specific changes at this time) are highlighted in yellow.

Standards

SECTION 110.2 – MANDATORY REQUIREMENTS FOR SPACE-CONDITIONING EQUIPMENT

(e) Open and Closed-Circuit Cooling Towers. All open and closed cooling tower installations shall comply with the following:

1. Be equipped with conductivity ~~or flow-based~~ controls that maximize cycles of concentration based on local water quality conditions. Controls shall automate system bleed and chemical feed based on conductivity~~, or in proportion to metered makeup volume, metered bleed volume, recirculating pump run time, or bleed time~~. Conductivity controllers shall be installed in accordance with manufacturer's specifications in order to maximize accuracy.
2. Documentation of maximum achievable cycles of concentration. Building owners shall document the maximum cycles of concentration based on local water supply as reported annually by the local water supplier, and using the calculator ~~approved by the Energy Commission.~~embedded in the NRCC-MCH-E compliance document. The calculator is intended to determine maximum cycles based on a Langelier Saturation Index (LSI) of 2.5 or less. Building owner shall document maximum cycles of concentration on the mechanical compliance form which shall be reviewed and signed by the Professional Engineer (P.E.) of Record.
3. Be equipped with a flow meter with an analog output for flow either hardwired or available through a gateway on the makeup water line.
4. Be equipped with an overflow alarm to prevent overflow of the sump in case of makeup water valve failure. Overflow alarm shall send an audible signal or provide an alert via the energy management control system to the tower operator in case of sump overflow.
5. Be equipped with efficient drift eliminators that achieve drift reduction to 0.002 percent of the circulated water volume for counter-flow towers and 0.005 percent for cross-flow towers.

   Exception to Section 110.2(e): Open and closed-circuit cooling towers with rated capacity < 150 tons.

SECTION 120.5 – REQUIRED NONRESIDENTIAL MECHANICAL SYSTEM ACCEPTANCE

19. Conductivity controls shall be verified according to [NA X, to be written]

SECTION 140.4 – PRESCRIPTIVE REQUIREMENTS FOR SPACE CONDITIONING SYSTEMS

(h) Heat Rejection Systems. Heat rejection equipment used in comfort cooling systems, such as air-cooled condensers, open cooling towers, closed-circuit cooling towers and evaporative condensers shall include the following:

1. **Fan Speed Control.** Each fan powered by a motor of 7.5 hp (5.6 kW) or larger shall have the capability to operate that fan at 2/3 of full speed or less, and shall have controls that automatically change the fan speed to control the leaving fluid temperature or condensing temperature or pressure of the heat rejection device.

   Exception 1 to Section 140.4(h)1: Heat rejection devices included as an integral part of the equipment listed in TABLE 110.2-A through TABLE 110.2-N.

   Exception 2 to Section 140.4(h)1: Condenser fans serving multiple refrigerant circuits.

   Exception 3 to Section 140.4(h)1: Condenser fans serving flooded condensers.

   Exception 4 to Section 140.4(h)1: Up to one third of the fans on a condenser or tower with multiple fans where the lead fans comply with the speed control requirement.

2. **Tower Flow Turndown.** Open cooling towers configured with multiple condenser water pumps shall be designed so that all cells can be run in parallel with the larger of:

   A. The flow that is produced by the smallest pump; or

   B. 50 percent of the design flow for the cell.

3. **Limitation on Centrifugal Fan Cooling Towers.** Open cooling towers with a combined rated capacity of 900 gpm and greater at 95°F condenser water return, 85°F condenser water supply, and 75°F outdoor wet-bulb temperature, shall use propeller fans and shall not use centrifugal fans.

   Exception 1 to Section 140.4(h)3: Cooling towers that are ducted (inlet or discharge) or have an external sound trap that requires external static pressure capability.

   Exception 2 to Section 140.4(h)3: Cooling towers that meet the energy efficiency requirement for propeller fan towers in Section 110.2, TABLE 110.2-F.

4. **Multiple Cell Heat Rejection Equipment.** Multiple cell heat rejection equipment with variable speed fan drives shall:

   A. Operate the maximum number of fans allowed that comply with the manufacturer's requirements for all system components, and

   B. Control all operating fans to the same speed. Minimum fan speed shall comply with the minimum allowable speed of the fan drive as specified by the manufacturer's recommendation. Staging of fans is allowed once the fans are at their minimum operating speed.

5. **Cooling tower efficiency.** Axial fan, open-circuit cooling towers serving condenser water loops for chilled water plants with a total of 900 gpm or greater,

shall have a rated efficiency of no less than ~~60 gpm/hp~~ XXXX gpm/hp when rated in accordance with the conditions as listed in Table 110.2-F.

Exception 1 to Section 140.4(h)5: Replacement of existing cooling towers that are inside an existing building or on an existing roof.

Exception 2 to Section 140.4(h)5: Cooling towers serving buildings in Climate Zone 1 or 16.

(i) Minimum chiller efficiency. Chillers shall meet or exceed Path B from Table 110.2-D.

Exception 1 to Section 140.4(i): Chillers with electrical service > 600V.

Exception 2 to Section 140.4(i): Chillers attached to a heat recovery system with a design heat recovery capacity > 40 percent of the design chiller cooling capacity.

Exception 3 to Section 140.4(i): Chillers used to charge thermal energy storage systems where the charging temperature is < 40°F.

Exception 4 to Section 140.4(i): In buildings with more than three chillers, only three chillers are required to meet the Path B efficiencies.

(j) Limitation of Air-Cooled Chillers. Chilled water plants shall not have more than ~~300 tons~~ XXXX tons provided by air-cooled chillers.

Exception 1 to Section 140.4(j): Where the water quality at the building site fails to meet manufacturer's specifications for the use of water-cooled chillers.

Exception 2 to Section 140.4(j): Chillers that are used to charge a thermal energy storage system with a design temperature of less than 40° F (4° C).

Exception 3 to Section 140.4(j): Systems serving healthcare facilities.

SECTION 170.2 – PRESCRIPTIVE APPROACH

F. Heat rejection systems. Heat rejection equipment used in comfort cooling systems such as air-cooled condensers, open cooling towers, closed-circuit cooling towers and evaporative condensers shall include the following:

i. **Fan speed control.** Each fan powered by a motor of 7.5 hp (5.6 kW) or larger shall have the capability to operate that fan at 2/3 of full speed or less, and shall have controls that automatically change the fan speed to control the leaving fluid temperature or condensing temperature or pressure of the heat rejection device.

Exception 1 to Section 170.2(c)4Fi: Heat rejection devices included as an integral part of the equipment listed in Table 110.2-A through Table 110.2-N.

Exception 2 to Section 170.2(c)4Fi: Condenser fans serving multiple refrigerant circuits.

Exception 3 to Section 170.2(c)4Fi: Condenser fans serving flooded condensers.

Exception 4 to Section 170.2(c)4Fi: Up to one-third of the fans on a condenser or tower with multiple fans where the lead fans comply with the speed control requirement.

ii. **Tower flow turndown.** Open cooling towers configured with multiple condenser water pumps shall be designed so that all cells can be run in parallel with the larger of:

a. The flow that is produced by the smallest pump; or

b. 50 percent of the design flow for the cell.

iii. **Limitation on centrifugal fan cooling towers.** Open cooling towers with a combined rated capacity of 900 gpm and greater at 95°F condenser water return, 85°F condenser water supply and 75°F outdoor wet- bulb temperature shall use propeller fans and shall not use centrifugal fans.

Exception 1 to Section 170.2(c)4Fiii: Cooling towers that are ducted (inlet or discharge) or have an external sound trap that requires external static pressure capability.

Exception 2 to Section 170.2(c)4Fiii: Cooling towers that meet the energy efficiency requirement for propeller fan towers in Section 110.2, Table 110.2-F.

iv. **Multiple cell heat rejection equipment.** Multiple cell heat rejection equipment with variable speed fan drives shall:

a. Operate the maximum number of fans allowed that comply with the manufacturer's requirements for all system components, and

b. Control all operating fans to the same speed. Minimum fan speed shall comply with the minimum allowable speed of the fan drive as specified by the manufacturer's recommendation. Staging of fans is allowed once the fans are at their minimum operating speed.

v. **Cooling tower efficiency.** Axial fan, open-circuit cooling towers serving condenser water loops for chilled water plants with a total of 900 gpm or greater shall have a rated efficiency of no less than ~~60 gpm/hp~~ XXXX gpm/hp when rated in accordance with the conditions as listed in Table 110.2-F.

Exception 1 to Section 170.2(c)4Fv: Replacement of existing cooling towers that are inside an existing building or on an existing roof.

Exception 2 to Section 170.2(c)4Fv: Cooling towers serving buildings in Climate Zone 1 or 16.

G. Minimum chiller efficiency. Chillers shall meet or exceed Path B from Table 110.2-D.

Exception 1 to Section 170.2(c)4G: Chillers with electrical service > 600 V.

Exception 2 to Section 170.2(c)4G: Chillers attached to a heat recovery system with a design heat recovery capacity > 40 percent of the design chiller cooling capacity.

Exception 3 to Section 170.2(c)4G: Chillers used to charge thermal energy storage systems where the charging temperature is < 40°F.

Exception 4 to Section 170.2(c)4G: In buildings with more than three chillers, only three chillers are required to meet the Path B efficiencies.

H. **Limitation of air-cooled chillers.** Chilled water plants shall not have more than ~~300 tons~~ XXXX tons provided by air-cooled chillers.

Exception 1 to Section 170.2(c)4H: Where the water quality at the building site fails to meet manufacturer's specifications for the use of water-cooled chillers.

Exception 2 to Section 170.2(c)4H: Chillers that are used to charge a thermal energy storage system with a design temperature of less than 40°F (4°C).

Reference Appendices

There are no proposed changes to the Reference Appendices.