Proposal Summary

Unitary HP/ER Hybrid Heaters

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Prepared by: Matt Stevens (TRC)

Measure Description

This measure would add prescriptive requirements to Title 24 Part 6 to ensure that unitary Heat Pump / Electric Resistance (HP/ER) hybrid water heaters are specified and installed in a way that minimizes electric resistance use. The proposed measure would apply to new construction, alterations, and additions in Nonresidential (NR) buildings.

The measure would require unitary HP/ER HPWHs to be installed according to the manufacturer's design and installation guidelines, set a minimum compressor cutoff temperature for both heat pump only and hybrid (heat pump and electric resistance) operating modes, and require that the HP/ER HPWH can operate in heat pump-only mode under the heating design day 0.6% dry bulb temperature.

Table 1 summarizes the scope of the proposed code change.

Table 1: Scope of Proposed Code Change

An "X" indicates the proposed code change is relevant.

Building Type(s)		single family	**Construction Type(s)**	X	new construction
		multifamily		X	additions
	X	nonresidential		X	alterations
Type of Change		mandatory	**Updates to Compliance Software**		no updates
	X	prescriptive		X	update existing feature
		performance		X	add new feature
Third Party Verification	X	no changes to third party verification			
		update existing verification requirements			
		add new verification requirements			

Justification for Proposed Change

In California approximately 22 trillion BTUs are used for water heating in commercial buildings (CBECS microdata 2018). The majority of the SHW energy use (79%) is from natural gas with just 19% from electricity (CBECS microdata 2018). Utility incentive programs for HP/ER HPWHs have attempted to capture a portion of this opportunity, but configuration and operation issues are demonstrating lower than expected performance (in terms of coefficient of performance, COP) when HP/ER HPWH are installed as the heat source for central DHW systems.

One key component contributing to reduced COP is the activation of the ER heating elements. ER heating can be triggered for several reasons including but not limited to:

- HPWH supply air temperature is too low for compressor operation as a result of
    - Insufficient ventilation in installation location
    - Cool winter temperatures
    - HPWH operating mode: some models have 10°F lower compressor cut out temperature in efficiency (HP only) mode versus Hybrid mode setting
- HPWH control algorithm is attempting to avoid a perceived potential hot water runout event[1] from:
    - The use of master mixing valves or pump controls that improve tank stratification with more cold water in the lower part of the tank but trigger more heating activations
    - Elevated HPWH temperature setpoints that may trigger more heating activations from the algorithm identifying a larger temperature difference from the top to bottom of the tank which can be related to draws or return temperatures from a recirculation loop
- HPWH set point temperature is higher than the HPWH can achieve using HP only

Ensuring that installed Hybrid HPWHs comply with the manufacturer's installation guidelines will minimize the chance that HPWHs will overcool the space in which they are installed and reduce excessive ER heating. Enforcing a specific HPWH compressor

[1] Runout event: Any period where the delivered supply water temperature from the water heating equipment falls below the intended temperature for the application as determined by the project requirements and the designer.

cutoff temperature will improve efficiency and help designers understand the HPWH operation characteristics to ensure that it can deliver hot water in all conditions.

By accomplishing the above goals, installations of central systems with unitary hybrid HPWHs will be more successful and demonstrate the capability for electrification without the high energy costs associated with ER heating.

Data Needs / Information Requests

The Statewide CASE Team is seeking the following information to inform the code change proposal. Data may be provided anonymously. To participate or provide information, please email [Matt Stevens, MStevens@trccompanies.com] directly and copy info@title24stakeholders.com.

Data needs:

- Design drawings and compliance forms from utility programs and design consultants to understand current design practice, technical feasibility, and market readiness, and to inform energy analysis assumptions.
- Surveys and interviews with HPWH manufacturers, designers, energy consultants, program implementers, and advocates to assess market readiness, technology adoption and building practitioner capability.
- Literature to inform energy analysis approach / assumptions, establish baseline, understand design practice, technical feasibility, and environmental and non-energy impacts, including:
    - Manufacturer resources, such as design guides, installation and operational manuals sizing tools, product performance and feasibility reports, and training material.
    - Industry publications, such as industry standards and design guides, technical reports, conference presentations, and case studies.
    - Resources from advocacy groups and trade associations, including the NEEA, NREL, and the New Building Institute (NBI)-led Advanced Water Heating Initiative (AWHI).
- Publications from research projects funded by CEC EPIC, U.S. DOE, and utilities.
- Field demonstration and/or lab testing data to understand the impact of sizing, recirculation, and ventilation of central HPWH systems on their performance.

Draft Code Language

1.1 Title 24, Part 1

There are no proposed changes to Title 24, Part 1.

1.2 Title 24, Part 6

SECTION 140.5(a) Nonresidential occupancies. Service water heating systems in nonresidential buildings shall meet the requirements of 1 or 2 and 3 below, or meet the performance compliance requirements of Section 140.1:

1. School buildings less than 25,000 square feet and less than 4 stories in climate zones 2 through 15. A heat pump water heating system that meets the applicable requirements of Sections 110.1, 110.3, and 120.3.

2. All other occupancies. A service water heating system that meets the applicable requirements of Sections 110.1, 110.3, 120.3, and 140.5(b)

3. For unitary heat pump water heating systems with integrated electric resistance serving all nonresidential buildings, the water heating system shall meet i or ii:

i. be installed according to the manufacturers' design and installation guidelines and meet the following requirements,

a. The minimum heat pump water heater compressor cut-off temperature shall be equal to or lower than 40°F [TBD] ambient air temperature in efficiency mode and equal to or lower than 47°F [TBD] in hybrid mode.

b. If the primary heat pump water heater is a unitary system without direct ducting to the outside, it must meet manufacturer's minimum supply air requirements, including volume, thermal energy, and/or ventilation rates.

c. If outside air is used to meet the heat source requirements, the primary heat pump water heater shall be able to operate in heat pump mode under Heating Design Drybulb (0.6%) as described in Table 2.3 from JA2.

ii. meet the requirements of NEEA Advanced Water Heater Specification for integrated commercial heat pump water heater Tier 2 or higher, and have no continuous recirculation system

Exception to Section 140.5(a)3: Systems with a peak design recirculation flow rate less than 1 [TBD] GPM per Btu/hr of heat pump capacity, excluding electric resistance capacity, as rated at 40°F [TBD] ambient conditions and 130°F [TBD] water heater set point.

1.3 Reference Appendices

There are no proposed changes to the reference appendices.