

Proposal Summary

Return-to-Primary Configuration

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Measure Description

This measure proposes to create a prescriptive pathway to require return-to-primary (RtP) configuration for split-system Heat Pump Water Heater (HPWH) systems in nonresidential (NR) buildings. This proposal would include an alternative pathway for products on the NEEA Tier 2 qualified product list, including standardized configurations and manufacturer's requirements. The Statewide CASE Team would update JA14 – Qualification Requirements for Central Heat Pump Water Heater Systems to include new requirements for the design documents, installation, equipment and control start up, performance data reporting (COP, Defrost derate, Input power, Output Capacity, Refrigerant type, etc.), and RtP back up heating.

This proposal would apply to new construction, additions, and alterations of NR buildings in all CA climate zones. This requirement would apply to additions and alterations with a proposed water heater replacement with split HPWHs. The proposal does not require installation of HPWHs.

This proposal would require additions to the compliance forms, changes to the compliance software, and new plan check and building inspector activities.

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

The current NR prescriptive requirements for water heating do not include requirements specific to HPWH performance despite the increasing use of HPWH in NR applications. Due to air quality rules by the South Coast Air Quality Management District (SCAQMD) and the Bay Area Air Quality Management District (BAAQMD), future HPWH installations in California are expected to apply to about 61% of the NR building stock. This measure, which is focused on NR applications, draws on lessons learned from the development of multifamily (MF) requirements including recent research that indicates that RtP is advantageous over swing tank configuration in many cases. The proposed change is needed to establish a baseline configuration that ensures adequate hot water delivery and reduces energy use and energy costs associated with split-system HPWH in NR applications.

During the 2022 code cycle, in response to reliability concerns when split HPWHs were emerging, the Statewide CASE Team introduced the swing tank configuration as the baseline for new multifamily (MF) construction. However, recent lab tests performed by PG&E Applied Technology Services (PG&E, SCE 2024) to characterize the central HPWHs with recirculation show that RtP with R-134a can maintain reliability while reducing equipment requirements and increase Coefficient of Performance (COP) compared to swing tank configuration. The Association for Energy Affordability (AEA) performed field testing with large CO2 systems (Brooks, Neal and Young 2024) and found that RtP configuration operates at a higher COP and higher reliability compared to swing tank configuration. Additionally, AEA is currently conducting a series of demonstration studies for low global warming potential (GWP) HPWHs with recirculation for a Code Readiness project funded by SCE. If these tests show that the RtP configuration can maintain sufficient hot water delivery performance with high return temperatures for a broader range of refrigerants, they can further support this measure. The Statewide CASE Team expects to obtain the results in August 2025.

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 Yiyi Chu, YChu@trccompanies.com directly and copy info@title24stakeholders.com.

Data Needs include:

- Energy Savings

- The percentage of NR buildings with a DHW system with recirculation, the percentage of DHW systems that are HPWHs, and the percentage of HPWHs that are split systems for both new construction and existing buildings
- A breakdown of the percentage of different split HPWH configurations
- Circulation loop heat loss for NR new construction and existing buildings
- The rate of permitting for additions/alterations to existing buildings
- Energy consumption of gas systems compared to a RtP HPWH configuration
- First Costs
 - Material costs for RtP HPWH Plant
 - Labor costs for the installation of a RtP HPWH plant, both in a new installation and retrofit context
- Technical Feasibility
 - Current design practice for HPWH configurations and sizing in NR buildings based on building type, building size, and layout
- Market Readiness
 - The availability of different HPWH products and the design and installation characteristics of DHW systems with a RtP HPWH configuration
 - Design drawings and system specifications for projects with implementation of HPWHs with RtP configurations
- Current Practices/Naturally Occurring Market Adoption (NOMAD)
 - Market forces that drive the adoption of RtP configurations in the coming years.
- Expected Useful Life and Maintenance Costs
 - Maintenance costs to ensure that the system functions as intended
 - frequency of product maintenance

Draft Code Language

1.1 Guide to Marked Up Language

The proposed changes to the Standards and Reference Appendices are provided below. Changes to the 2025 documents are marked with blue underlining (new language) and ~~strikethroughs~~ (deletions).

1.2 Title 24, Part 1

There are not proposed changes to Title 24, Part 1.

1.3 Title 24, Part 6

SECTION 100.1 – Definitions and Rules of Construction

Series Temperature Maintenance Heater Configuration: Formerly known as swing tank configuration. It uses electric resistance storage water heater upstream in series with the primary heat pump generation and storage system. The role of this heater is to maintain the temperature in the recirculation loop to meet the temperature maintenance load and secondarily provide back up water heating source.

Primary Heat Pump Storage Tank: Is a tank that is primarily heated by water circulated through heat pump water heaters. This tank may have supplemental electric resistance heating located inside the tank or as part of the heat pump water heater system serving the tank.

Service Hot Water Systems: is heating, storage, and distribution of hot water to the point of use for sanitary purposes for human occupancy, other than for comfort heating.

SECTION 140.5(a) Prescriptive Requirements for Service Water Heating Hot Water Systems

Nonresidential occupancies. Service water-heating hot water 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(c).
3. For Service Hot Water Systems with split heat pump water-heating systems installation shall meet either requirement A or requirement B:
 - A. Installation shall follow manufacturer's design and installation guidelines and meet the requirements below:
 - i. The hot water returned from the recirculation loop shall directly connect to the inlet of primary heat pump water heater or the primary heat pump storage tanks.
 - ii. In all heat pump operating modes, the maximum heat pump water heater

compressor cut-off temperature shall be, no greater than 35°F (TBD)¹ ambient air temperature.

iii. Design documentation shall be provided in accordance with JA14.4.

B. Installation shall meet the requirements of NEEA Advanced Water Heater Specification v8.1 for commercial heat pump water heater Tier 2 or higher. If installed in a swing tank configuration, the system shall satisfy the following additional requirements:

- i. The primary storage tank temperature setpoint shall be at least 135°F.
- ii. The recirculation loop tank temperature setpoint shall be at least 10°F lower than the primary thermal storage tank temperature setpoint.
- iii. The fuel source for the recirculation loop tank shall be electricity.

Exception to Section 140.5(a)1 and 2: A water-heating system serving an individual bathroom space may be an instantaneous electric water heater.

Section 141.0(a) Additions. Additions shall meet either Item 1 or 2 below. 1. Prescriptive approach. The envelope and lighting of the addition; any newly installed spaceconditioning system, electrical power distribution system, or water-heating system; any addition to an outdoor lighting system; and any new sign installed in conjunction with an indoor or outdoor addition shall meet the applicable requirements of Sections 110.0 through 120.7, 120.9 through 130.5, and 140.2 through 140.9. Additions of service hot water system with split HPWHs shall meet the requirements of Section 140.5(a).

Section 141.0(b) Alterations

2S. Altered Service Hot Water System. Alterations that replace service water heaters with split HPWHs shall meet the requirements of Section 140.5(a).

1.4 Reference Appendices

JA14 – SECTION JA14.3.2 Performance Data Reporting

The following performance specifications shall be submitted to the Energy Commission:

- a) Water heater input power;
- b) Water heater output capacity; and
- c) Water heater COP System COP for each California climate zone as modeled or

¹ Split systems are generally capable to operate at a cutoff lower than 40°F and this should be reflected in the code. However, some market research is needed to determine an appropriate value.

referencing the four IECC climate zones in NEEA Advanced Water Heater Specification, computed based on the approved method² of the Specification.

The performance data shall be provided in accordance with the NEEA Advanced Water Heater Specification Product Assessment Datasheet (PADS)³. The data shall include;at the following conditions:-

- a) information required under the 'PADS documentation' worksheet, except:
 - a. Exceptions TBD
- b) information required by the 'PADS performance' worksheet.
 - d) ~~Inlet ambient air temperature: Maximum, minimum, and two midpoint temperatures of the manufacturer specified operating range.~~
 - e) ~~Inlet water temperature: Maximum, minimum, and two midpoint temperatures of the manufacturer specified operating range.~~
 - f) ~~Outlet water temperature: Maximum, midpoint, and minimum of outlet water (setpoint) temperatures of the manufacturer specified operating range.~~

For conditions where defrost strategies operate, reported data shall include at least one complete defrost cycle, or alternatively, for each model submitted for approval, provide a description of the defrost strategy including method, cycle length, and process.

JA14 – SECTION JA14.4 Design Condition Documentation Requirements

The Central HPWH system shall be capable of supplying hot water at design outlet water temperature under specified operating ranges for:

- a) Minimum and maximum ambient air temperature;
- b) Minimum and maximum cold-water temperature;
- c) Minimum and maximum building demand at design draw and recovery conditions and duration; and
- d) Recirculation loop heat loss.

Design documentation shall specify the operating conditions at which the primary heat pump water heater can supply hot water at design outlet water temperature without engaging auxiliary heating mechanism.

² See Section 3.4.1 and Appendix F of the [NEEA advanced Water Heating Specification](#).

³ [Commercial-HPWH-Product-Assessment-Datasheet.xlsx](#)

Design documentation shall document defrost derate factors for calculating output capacity on design day.

JA 14 – SECTION JA14.5 Design, installation and start up documentation requirements and/or NA10 CHPWH Design, installation and start up requirements.

We will be looking at HPWH controls, temperature maintenance or back up heater controls, alarms, loss of power restoration, etc. and add these into appropriate sections.

Bibliography

- Brooks, Andrew, John Neal, and Nick Young. 2024. *Eliminating the Swing Tank and Other Design Considerations in Large-Capacity CO2 Heat Pump Water Heating*. 2024 ACEEE Summer Study on Energy Efficiency in Buildings.
<https://www.aceee.org/sites/default/files/proceedings/ssb24/pdfs/Eliminating%20the%20Swing%20Tank%20and%20Other%20Design%20Considerations%20in%20Large-Capacity%20CO2%20Heat%20Pump%20Water%20Heating.pdf>.
- PG&E, SCE. 2024. "PG&E and SCE HPWH Laboratory Testing and Software Updates for Multifamily Applications." https://ecotope-publications-database.ecotope.com/2024_032_Final_Report_MF_HPWH_Lab_Testing_V2.pdf.