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 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 that do not operate in return-to-primary configuration. The Statewide CASE Team would also update **JA14.3.2 Performance Data Reporting** for specifying the system COP and **JA14.4 Design Condition Documentation Requirements** to document defrost derate factors for calculating Design Day output capacity on the.

This proposal would apply in all CA climate zones and would require additions to the compliance forms, changes to the compliance software, and new plan check and building inspector activities. This proposal would also include new requirements for the design documents, installation, and start up.

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

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 return-to-primary 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 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 return-to-primary 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 return-to-primary 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 return-to-primary configuration can maintain sufficient hot water delivery performance with high return temperatures for a broader range of refrigerants, they can further support this measure.

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 return-to-primary HPWH configuration
- First Costs
    - Material costs for return-to-primary HPWH Plant
    - Labor costs for the installation of a return-to-primary 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 return-to-primary HPWH configuration
    - Design drawings and system specifications for projects with implementation of HPWHs with return-to-primary configurations
- Current Practices/Naturally Occurring Market Adoption (NOMAD)
    - Market forces that drive the adoption of return-to-primary 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 no proposed changes to Title 24, Part 1.

1.3 Title 24, Part 6

SECTION 100.1 – Definitions and Rules of Construction

Swing Tank: Swing Tank design uses electric resistance storage water heater upstream in series with the primary heat pump generation and storage system. The role of the swing tank is to maintain the temperature in the recirculation loop to meet the temperature maintenance load and secondarily provide back up water heating source.

SECTION 140.5(a) Domestic Hot Water Systems

Nonresidential occupancies. Service water-heating systems in nonresidential buildings shall meet the requirements of 1 or 2 below, or meet the performance compliance requirements of Section 140.1. Systems with recirculation shall also meet the requirements of 3:

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 split-system heat pump water-heating systems, the water-heating system shall be installed according to the manufacturer's design and installation guidelines and meet the following requirements:

    i. The hot water return from the recirculation loop shall directly connect to the primary heat pump water heater inlet or the primary thermal storage tanks.

    ii. The minimum heat pump water heater compressor cut-off temperature shall be, in all operating modes of the heat pump water heater, equal to or lower than 35°F

(TBD)[1] ambient air temperature.

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

4. Or meet the requirements of NEEA Advanced Water Heater Specification for commercial heat pump water heater Tier 2 or higher:

(1) 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.

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 referencing the four climate zones in NEEA Advanced Water Heater Specification, computed based on the approved method[2] 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:~~

1. The information required under the 'PADS documentation' worksheet, except:

a. *Exceptions TBD*

2. The 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~~

[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.

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

[3] Commercial-HPWH-Product-Assessment-Datasheet.xlsx

~~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.

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

1.4 Reference Appendices

There are no proposed changes to the reference appendices.

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.