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Executive Director Determination Pursuant to Section 150.1(c)8C

The 2019 California Energy Code (Energy Code) specifies two prescriptive pathways for installation of a domestic water heating system serving multiple dwelling units, applicable both to low-rise residential (Title 24, California Code of Regulations, Part 6, Section 150.1(c)8) and to high-rise residential and hotel/motels (Section 140.5(b), which refers to 150.1(c)8).

The first option specified in subsection B, permits the installation of a gas or propane water heating system that incorporates a recirculation system with a minimum of two loops and sufficient solar thermal water heating equipment to achieve a minimum solar savings fraction. The second pathway, specified in subsection C, permits "[a] water heating system serving multiple dwelling units determined by the executive director to use no more energy than the one specified in subsection B."

Staff has received multiple requests from stakeholders pursuant to section 150.1(c)8C to approve water heating systems designed to use electric heat pump technology that deliver equivalent or superior efficiency compared to the gas system specified in 150.1(c)8B. In response to these requests, staff have assessed the attached central heat pump water heating system specification and recommended executive director approval on the basis of this assessment.

In accordance with Section 150.1(c)8C, the executive director hereby determines that a central heat pump water heating (CHPWH) system that meets the installation criteria in attachment 1 and attachment 2 with the following additional requirements will consume no more energy than the pathway specified in Section 150.1(c)8B, and therefore may be used to show compliance with Section 150.1(c)8C:

- For Climate Zones 1 through 9, a solar water-heating system with a minimum solar savings fraction (SSF) of 0.20, or additional photovoltaic system capacity of 0.1 kWdc per dwelling unit in excess of the requirement specified in Section 150.1(c)14.

- For Climate Zones 10 through 15, a solar water-heating system with a minimum SSF of 0.35, or additional photovoltaic system capacity of 0.1 kWdc per dwelling unit in excess of the requirement specified in Section 150.1(c)14.

- For Climate Zone 16, a minimum of 2 inches of pipe insulation for the recirculation loop and a solar water-heating system with a minimum SSF of 0.35; or a minimum of 2 inches of pipe insulation for the recirculation loop and additional photovoltaic system capacity of 0.1 kWdc per dwelling unit in excess of the requirement specified in Section 150.1(c)14.

Based on this information, the central heat pump water heater system will use no more energy than the one specified in Title 24, California Code of Regulations, Part 6, Section 150.1(c)8B and 140.5(b), and therefore may be used to satisfy the prescriptive requirement for low-rise residential and high-rise residential and hotel/motel building water-heating systems serving multiple dwelling units specified by Section 150.1(c)8C.

Sincerely,

Drew Bohan
Executive Director

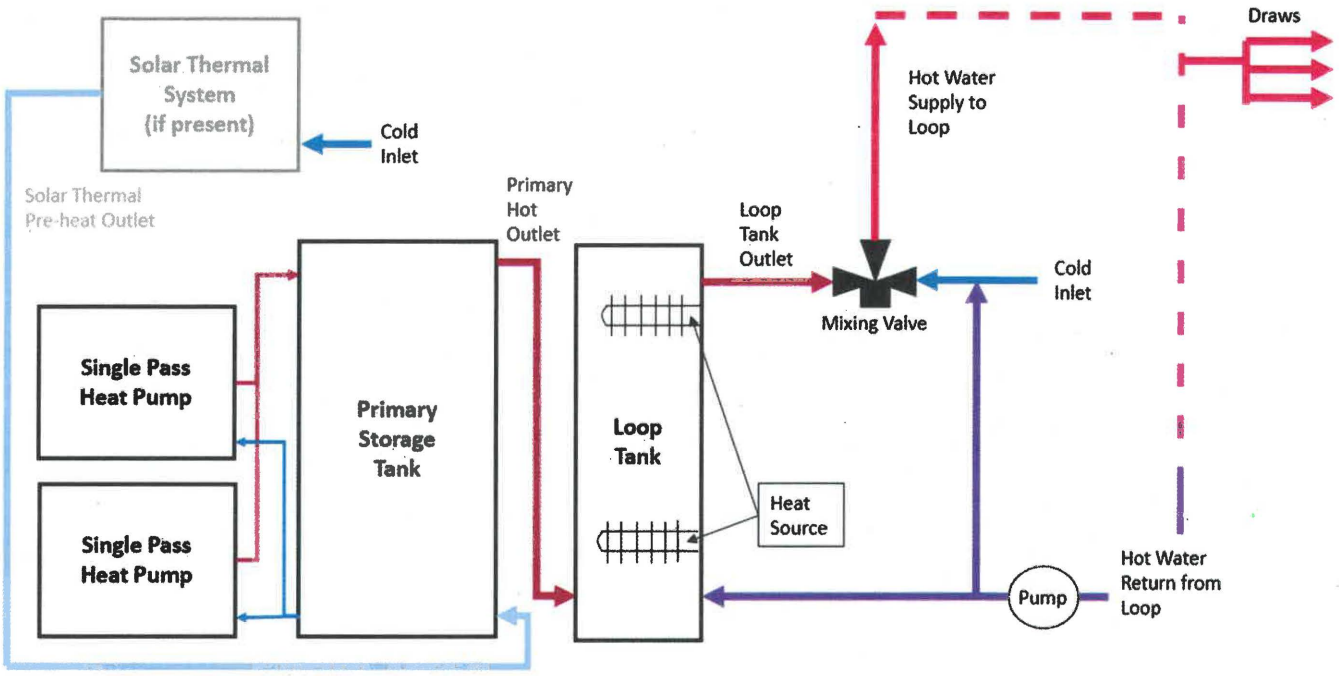
ATTACHMENTS

Attachment 1	Prescriptive Sizing and Layout Requirements for Central Heat Pump Waters Heaters
Attachment 2	Piping Schematic

Attachment 1

Prescriptive Sizing and Layout Requirements for Central Heat Pump Water Heaters for Multifamily Buildings

System Schematic



Minimum Requirements

1. Piping (Equipment and Storage)

    a. The primary heating load shall be separated from the temperature maintenance load (also known as a loop tank). The primary storage and loop tank shall be piped in series. The primary storage shall precede the loop tank.

    b. The primary storage shall be in series arrangement if multiple tanks are used (See Attachment 2). In a series configuration, the hot outlet (top of tank) shall be connected to cold inlet (bottom of tank) of next tank.

    c. Loop tank piping connections

        i. The primary storage hot outlet shall be piped to the bottom of the loop tank.

        ii. The return from hot water circulation loop shall be piped to the bottom of the loop tank.

        iii. Hot water delivered to the mixing valve (described below) shall be piped from the top of the loop tank.

d. The primary heat pump water heater(s) shall draw cold water from the bottom of the primary storage and return hot water to the top of the primary storage. For a series storage tank configuration, the cold water shall be drawn from the bottom of the first tank and return the hot water to the top of the last tank.

e. Multiple heat pump water heater (HPWH) compressors shall be installed to operate in parallel with each other.

f. Follow manufacturers requirements on total allowed pipe length between HPWHs and storage tanks, total allowed vertical separation, and appropriate tank connections.

g. Provide thermostatic mixing valve.

h. Size piping per California Plumbing Code or other standards of good practice.

2. Pipe Insulation

   a. In Climate Zones 1 through 15, all domestic hot water piping shall be insulated to code minimum values. For Climate Zone 16, the recirculation loop shall have at least 2 inches of pipe insulation.

   b. Pipe clamp mechanisms shall be free of thermal bridging.

3. Water quality

   a. Strainers shall be included at the cold water supply line to the HPWHs to prevent fouling of heat exchangers and other components.

4. Control

   a. Tank temperature sensor shall be located in the primary storage volume at 30-50% of the effective volume from the bottom of the tank. For tanks in series, the effective volume is defined as the sum of all tank volumes. The bottom height corresponds to the bottom of the first tank and the top height corresponds to the top of the last tank. For example, for three equal size tanks in series, the middle of tank 2 is the 50% volume point, the top of the first tank is the 33% volume point, and the top of the last tank is the 100% point.

   b. Temperature set point of primary storage shall be at least 150°F.

   c. Loop tank temperature set point shall be at least 20°F degrees below the primary storage tank temperature.

   d. Control system shall be capable of sending error alarms to building personnel upon detection of equipment fault, low primary storage tank temperature, and low hot water supply delivery temperature.

Equipment

e. HPWH

i. Unit shall be a split system with the compressor located outdoors and shall operate in a single-pass configuration: the unit shall heat water from the incoming temperature to set point in a single pass.

ii. Unit shall operate with a minimum ambient air temperature of -20°F.

iii. Unit shall be capable of providing hot water greater than 150°F when the ambient air temperature is between 5°F and 110°F.

f. Storage

i. All hot water storage tanks shall be insulated to a minimum of R-22 and be set on a minimum R-10 pad.

ii. If required primary storage volume is greater than that provided by a HPWH system manufacturer, alternative tanks that have appropriate ports for inlet, outlet, and control points may be installed that meet the sizing requirements.

g. Mixing valve

i. System shall be installed with a mixing valve. Inlets to the mixing valve shall include hot water outlet from loop tank, return from circulation loop and cold water supply.

ii. Mixing valve shall be capable of suppling hot water to the building, at the user set temperature, consistent with the requirements of the California Plumbing Code. The mixing valve shall be capable of supplying the hot water to the building while accepting the following inlet water temperature ranges: hot inlet side 120°F-170°F and cold side 40°F to 119°F.

iii. Mixing valve shall be capable of suppling hot water at the user set temperature at the minimum and maximum building demand flow rates.

5. System Sizing

a. The number of HPWH compressors shall be no less than calculated by Equation 6.1. (Each compressor heating capacity assumed to provide 15,400 BTU/hr)

Equation 6.1 Compressor(s) = (0.037 * Bedrooms) + (0.106 * Dwelling Units)

b. The primary storage capacity shall be no less than shown by Equation 6.2.

Equation 6.2 Primary Storage = 80 gallons * number of compressors

c. The loop tank storage capacity shall be no less than as shown in the table below.

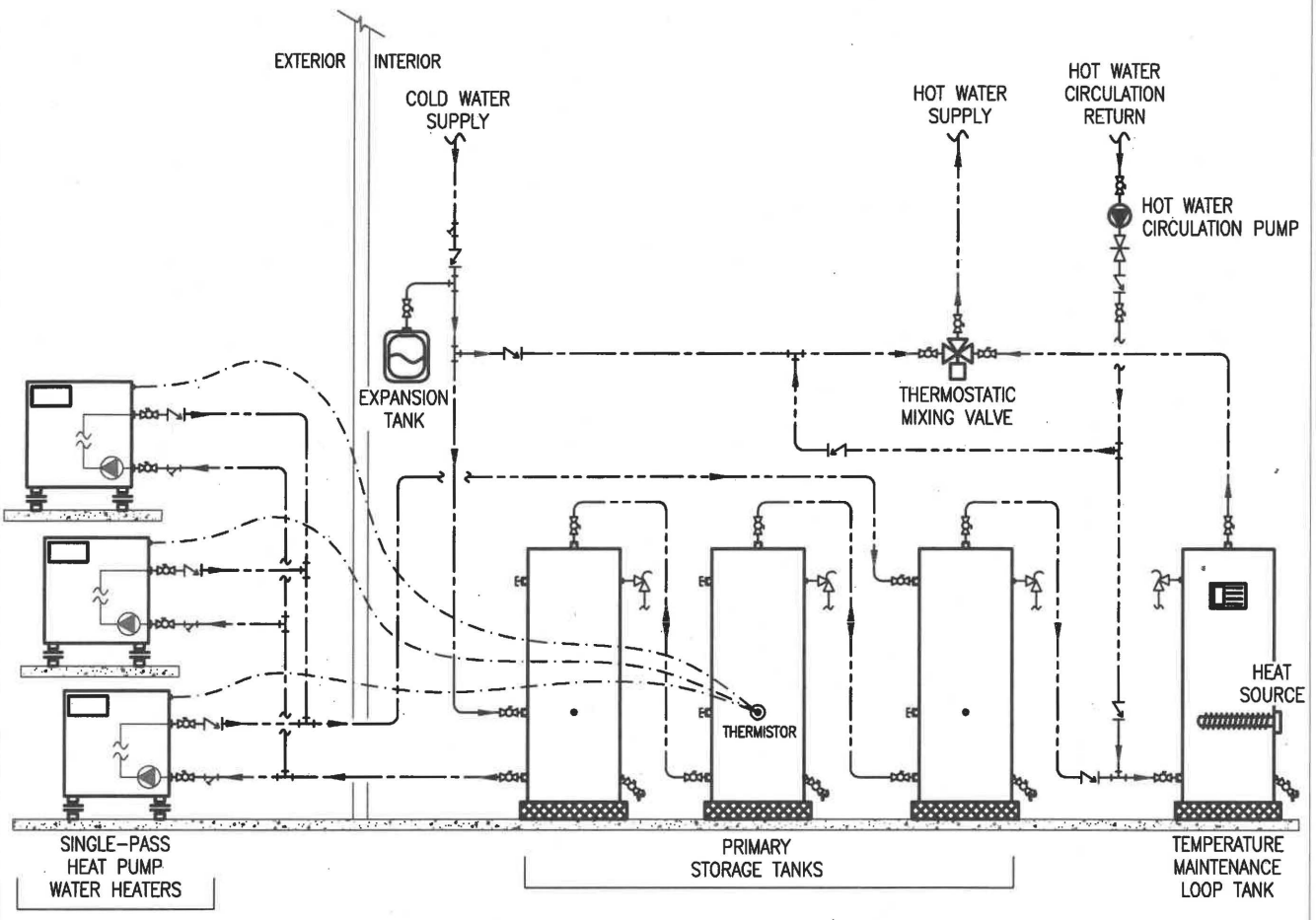
Loop Tank Sizing Table

Number of Dwelling Units	Minimum Capacity (Gallons)
1 - 7	40
8 - 11	80
12 – 23	96
24 – 47	168
48 – 95	288
96 and greater	480

i. Loop tank heating output capacity shall be no less than the losses from the circulation loop as determined by the designer.

ii. Loop tank can be heated by any energy source as long as the loop tank system is capable of multi-pass water heating operation within its design operating temperature range.

ATTACHMENT 2



DESCRIPTION

This is an example of multiple single-pass heat pump water heaters serving multiple primary storage tanks arranged in series. The hot water circulation system is treated by a dedicated temperature maintenance loop tank configured as a swing tank with backup heat source.

LEGEND

SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION
	PUMP		THROTTLING VALVE
	MIXING VALVE		CAPPED PIPE
	BALL VALVE	T	TEMPERATURE SENSOR
	STRAINER		CONTROL WIRE
	CHECK VALVE		CW PIPING
	T&P RELIEF VALVE		HW PIPING
	PIPE TEE	1"	HWC PIPING
			PIPE SIZE & FLOW DIRECTION