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Comment on Title 24 HHW systems

Please see attached comments.

Additional submitted attachment is included below.

To: CEC
From: Hwakong Cheng
Subject: Docket # 19-BSTD-03, 2022 Energy Code Pre-Rulemaking – HHW System Comments
Date: June 22, 2021

1. Please consider deleting Exception 1 to Section 140.4(k)4.

Rationale:

- a. 140.4(k)4 defines a prescriptive requirement for chilled and hot water temperature reset controls. However, exception 1 waives this requirement for variable flow hydronic systems.

4. **Chilled and Hot Water Temperature Reset Controls.** Systems with a design capacity exceeding 500,000 Btu/hr supplying chilled or heated water shall include controls that automatically reset supply water temperatures as a function of representative building loads or outside air temperature.

EXCEPTION 1 to Section 140.4(k)4: Hydronic systems that use variable flow to reduce pumping energy in accordance with Section 140.4(k)1.

EXCEPTION 2 to Section 140.4(k)4: Systems serving healthcare facilities.

Variable flow chilled and hot water systems are commonplace for systems of this size, as are chilled and hot water temperature reset controls, particularly with DDC controls and resources such as ASHRAE Guideline 36. They are not mutually exclusive options. The 2022 version of Guideline 36 (in press) will include best-practice sequences of operation that reset both chilled and hot water temperatures based on valve demand. Hot water temperature reset is particularly critical for condensing boiler systems to achieve high efficiency performance and with condensing entering water conditions, and is also of concern due to the potential for increased distribution losses that may occur at higher hot water supply temperatures. As has been documented by many studies of recirculating domestic water systems, a [previous field study](#) showed that distribution losses may account for a significant portion of the total system energy – as much as 44% of the annual heat output from the building’s boiler.

2. Please consider revising Section 140.4(k)4 to reset temperatures based on valve position.

Rationale:

- a. Chilled and hot water temperature reset controls are increasingly commonplace in new construction with DDC controls and new momentum around resources such as ASHRAE Guideline 36. The current language prescriptively requires chilled and hot water temperature reset but only vaguely suggests that the reset should be accomplished “as a function of representative building loads or outside air temperature.” Open-loop reset strategies (such as OAT-based reset) are good for retro-commissioning applications to implement temperature resets with low-to-no-cost energy conservation methods, but run the risk of not meeting thermal loads (due to the lack of a feedback loop) and being disabled or otherwise ineffective. In new construction, best and common practices employ valve demand to implement hydronic temperature resets. ASHRAE Standard 90.1 also specifically



requires the use of valve position to reset setpoints where DDC is available:

6.5.4.4 Chilled- and Hot-Water Temperature Reset Controls

Chilled- and hot-water *systems* with a *design capacity* exceeding 300,000 Btu/h supplying chilled or heated water to comfort conditioning *systems* shall include *controls* that *automatically reset* supply water temperatures by representative *building loads* (including return water temperature) or by *outdoor air* temperature. Where *DDC* is used to *control valves*, the **set point shall be reset based on valve positions** until one valve is nearly wide open or *set-point* limits of the *system equipment* or application have been reached.

3. Please consider adding boiler turndown requirements to Section 140.4(k).

Rationale:

- a. ASHRAE Standard 90.1 includes minimum boiler turndown requirements for systems with design inputs of at least 1 million Btu/h. Boiler efficiency degrades at very low part loads due to standby and cycling losses.

6.5.4.1 Boiler Turndown

Boiler systems with design input of at least 1,000,000 Btu/h shall comply with the turndown ratio specified in Table 6.5.4.1.

The *system* turndown requirement shall be met through the use of multiple single-input *boilers*, one or more modulating *boilers*, or a combination of single-input and modulating *boilers*.

All *boilers* shall meet the minimum *efficiency* requirements in Table 6.8.1-6.

Table 6.5.4.1 Boiler Turndown

Boiler System Design Input, Btu/h	Minimum Turndown Ratio
≥1,000,000 and ≤5,000,000	3 to 1
>5,000,000 and ≤10,000,000	4 to 1
>10,000,000	5 to 1

4. Please consider revising hydronic variable flow system requirements in 140.4(k)1 to achieve flow rates of 25% of the design flow rate.

Rationale:

- a. Title 24 currently requires hydronic systems to be capable of reducing pump flow rates to no more than the larger of 50% of the design flow rate or the minimum flow required by the equipment. ASHRAE Standard 90.1 includes similar language, but requires that flow rates “be capable of and configured to reduce pump flow rates to no more than” 25% of the design flow rate or the minimum flow required by the equipment.

6.5.4.2 Hydronic Variable Flow Systems

Chilled- and hot-water *distribution systems* that include three or more *control valves* designed to modulate or step open and close as a function of load shall be designed for variable fluid flow and shall be capable of and configured to reduce pump flow rates to no more than the larger of 25% of the design flow rate or the minimum flow required by the heating/cooling *equipment manufacturer* for the proper operation of *equipment*. Individual or paral-

5. The final CASE report “High Efficiency Boilers and Service Water Heating Code Change Proposal” includes suggested revisions to the ACM manual to correspond with the prescriptive code changes. The report includes a requirement for the standard design to have “flow rates that are 20% of the design flow rates of an operating boiler.” This requirement does not makes sense and would almost certainly prevent the standard design from meeting loads at the design condition. Care must be applied when establishing the ACM Manual requirements and considering modeling capabilities



(limitations) in CBECC-Com and EnergyPlus.

<u>Supply hot water flow rate</u>	
<u>Applicability</u>	<u>Gas-fired hot water boiler systems with capacity between 1 million Btu/h (1,000,000 Btu/h) and 10 million Btu/h</u>
<u>Definition</u>	<u>Supply hot water flow rate is the rate by which water that recirculates into the boiler systems when compared to the design flow</u>
<u>Units</u>	<u>Percentage of design flow</u>
<u>Input Restrictions</u>	<u>Percentages range from 0 to 100</u>
<u>Standard Design</u>	<u>The standard design shall have flow rates that are 20% of the design flow rates of an operating boiler.</u>
<u>Standard Design: Existing Buildings</u>	



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