Proposal Summary

Process Steam #2 Condensate Return in Process Systems

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Prepared by: Ryan Swanson, Amy Droitcour, Lily Baldewicz, Shafi Amoni, Eva Hidalgo, Emma Conroy

Measure Description

For newly constructed process steam systems and for additions and alterations that add a process steam load that generates condensate during normal operation, this proposed measure would require a condensate return system that returns condensate to the boiler plant for reuse. The proposed measure would only apply to steam systems that meet certain criteria for load size and condensate return piping lengths and would exempt condensate return from direct steam injection (that comes in direct contact with the process). Compliance with this measure would be demonstrated through documentation on construction documents.

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	X	mandatory	**Updates to Compliance Software**	X	no updates
		prescriptive			update existing feature
		performance			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 process steam systems, condensate is formed when steam releases its heat of condensation in a heat exchanger and condenses into liquid. Facilities that recover condensate reduce the need for makeup water, pre-heating fuel, and chemicals for water treatment. Some sites may also benefit from a reduction in wastewater costs. Because condensate is effectively distilled water, its recovery also reduces the need for boiler blowdown, which results in additional energy savings.

Department of Energy (DOE) literature has recommended increasing the percentage of returned condensate as a steam system best practice in since at least the early 2000s, and the DOE provides a steam tip sheet specifically on improving condensate return. This proposed code change originated from discussions with California-based consulting engineers from strategic energy management programs and the DOE Industrial Assessment Center program.

Depending on site conditions, this measure is expected to yield energy savings of approximately 5% to 8% of baseline boiler system fuel use. There are two main sources of savings: (1) the energy difference between returned condensate and cold makeup water and (2) reduced blowdown losses resulting from increased condensate return.

To the knowledge of the Statewide CASE Team, condensate return requirements have not been proposed in previous code cycles. In 2013, Title 24 Part 6 first adopted requirements for process boilers. In 2022, Title 24 Part 6 adopted requirements for strainers and fault detection and diagnostics in steam trap assemblies.

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 Emma Conroy emmaconroy@2050partners.com directly and copy info@title24stakeholders.com.

- Typical percentages of condensate return
- Failures or maintenance needs in condensate return equipment such as tanks, pumps, or piping
- Any major limitations for returning condensate, such as undersized condensate return equipment (pump, piping, tank) undersized or pipe rack needed to accommodate new condensate return piping at capacity.

- Typical lifetimes of condensate return equipment
- Typical maintenance performed on condensate return equipment
- Typical maintenance costs for condensate return equipment
- Any steam load threshold below which adding condensate return lines becomes not cost-effective for new steam projects
- Costs for condensate return systems as a function of steam load size and piping length
- Items that impact cost-effectiveness of condensate return, such as design cost, installation labor costs, equipment cost, or others
- Typical per-unit makeup water costs, boiler treatment water costs, and wastewater costs for discharged condensate
- Any market barriers to requiring installation of condensate return piping
- Market growth rate for process steam systems in California

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).

Note: This mandatory code has been written as a new section 120.6(l) for Process Steam Systems, but the Statewide CASE Team believes it may be prudent to change Section 120.6(i) "Mandatory Requirements for Steam Traps", to be "Mandatory Requirements for Process Steam Systems", and to include requirements for steam traps, flash steam, and condensate return in that section.

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 RULES OF CONSTRUCTION AND DEFINITIONS

…

(b) **Definitions.** Terms, phrases, words and their derivatives in Part 6 shall be defined as specified in Section 100.1. Terms, phrases, words and their derivatives not found in Section 100.1 shall be defined as specified in the "Definitions" chapters of Title 24, Parts

1 through 5 of the California Code of Regulations. Where terms, phrases, words and their derivatives are not defined in any of the references above, they shall be defined as specified in *Webster's Third New International Dictionary of the English Language, Unabridged* (1961 edition, through the 2002 addenda), unless the context requires otherwise.

…

CONDENSATE RETURN SYSTEM is a system designed to return steam condensate to a boiler plant for reuse that includes piping and may also include condensate collection tanks and mechanical pumping.

…

PROCESS STEAM SYSTEM is a type of steam system that serves a process with a design load above [TBD] lbs/hr.

…

SECTION 120.6 – MANDATORY REQUIREMENTS FOR COVERED PROCESSES

…

(I) Mandatory requirements for process steam systems. Process steam systems shall meet the following requirements:

1. **Condensate Return.** For newly constructed process steam systems and added process steam loads that generate condensate during normal operation, if there is a boiler or condensate tank within the condensate return distance specified in table 120.6-X as calculated using Non-Residential Reference Appendix 9 (NA9), Process Steam Design Qualification Requirements, a condensate return system shall be installed to return all condensate from process steam loads that use heat exchangers to the boiler plant for reuse.

   Exception to 120.6(i)1 Processes that use steam in direct contact with a product or contaminant per design or during normal operation.

TABLE 120.6-X CONDENSATE RETURN DISTANCE

Steam Flow (lbs/hr)	**Maximum Length (ft)**
< 1,000	Exempt
≥1,000, <2,000	350
≥2,000, <3,000	600
≥3,000, <3,500	800
≥4000	Any

2. **Steam System Design Documents.** Process Steam System construction documents shall:
    A. Clearly identify condensate return piping, pipe sizing, pipe length, and pipe material.

1.4 Reference Appendices

NA9 – Process Steam System Design Qualification Requirements

NA9.1 Purpose and Scope

Non-residential appendix NA9 provides the qualification requirements for a process steam system to meet the requirements for flash steam in Title 24, Part 6, Sections 120.6(l).

NA9.2 Condensate Return Piping Length Calculations

The condensate return distance for the newly added steam load for measures in Title 24, Part 6, Sections 120.6(l)(1) shall be calculated as follows:

[TBD]