# Proposal Summary

## Process Steam #2 Condensate Return

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# Measure Description

A process steam system is a steam-producing boiler system that serves loads other than space heating or service water heating for human occupants, such as manufacturing or industrial processes. A condensate return system, consisting of piping, collection tanks, and pumps, returns hot condensate—which is generated after process loads use steam—to the boiler system for reuse.

This proposed measure would require newly constructed process steam systems and newly added process steam loads that a) use indirect-contact heat exchangers and b) generate condensate during normal operation to return steam condensate to the boiler for reuse via a condensate return system. Qualifying process steam systems must also return condensate from associated drip legs.

The proposed measure would only apply to steam systems that meet certain criteria for load size and condensate return piping lengths. Condensate return from direct steam injection (that comes in direct contact with the process) would be exempt from the requirement for condensate return.

To meet the criteria for load size and condensate return piping lengths, the linear distance from the load to the condensate return tank or the deaerator, measured across both horizontal and vertical dimensions, must be under a maximum length depending on the system steam flow. The distances for each steam flow range of the individual load are specified in Table 18.

**Table 1: Condensate Return Code Trigger Criteria**

| Steam Flow (lb/h) | Linear Length[1] (ft) less than |
|---|---|
| <1,000 | Exempt |

| | |
|---|---|
| ≥1,000, <2,000 | 400 |
| ≥2,000, <3,000 | 600 |
| ≥3,000, <4,000 | 800 |
| ≥4,000, <6,000 | 1,100 |
| ≥6,000 | 1,300 |

All steam loads that are above the maximum length for their steam flow shall include the condensate return distance calculations from NA9 in the steam system construction documents to prove that the requirement is not applicable to that steam load.

Table 1 summarizes the scope of the proposed code change.

**Table 2: 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 make-up 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 and maintenance costs
- Any steam load threshold below which adding condensate return lines becomes not cost-effective for new steam projects
- 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

# 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 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 – DEFINITIONS AND RULES OF CONSTRUCTION

**Section 100.1(b) – Definitions: Recommends new or revised definitions for the following terms:**

**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.

### SUBCHAPTER 3 – NONRESIDENTIAL, HIGH-RISE RESIDENTIAL, HOTEL/MOTEL OCCUPANCIES, AND COVERED PROCESSES--MANDATORY REQUIREMENTS

### SECTION 120.6 – MANDATORY REQUIRMENTS FOR COVERED PROCESSES

**120.6(l) Mandatory requirements for process steam systems.**

**(l) Mandatory requirements for process steam systems.**

1. The following requirements apply to newly constructed process steam systems and new, non-replacement process steam loads at existing facilities that meet the below conditions:

a. have one or more connected boilers with an input rating (capacity) of 10 MMBtu/h or greater
b. use indirect-contact heat exchangers,
c. generate condensate during normal operation, and
d. meet the criteria for load size and condensate return piping lengths in Table 120.6-X

TABLE 120.6-X CONDENSATE RETURN DISTANCE CODE TRIGGER CRITERIA

| **Steam Flow (lbs/hr)** | **Linear Length[2] (ft) Less Than** |
|---|---|
| < 1,000 | Exempt |
| **≥1,000, <2,000** | **400** |
| ≥2,000, <3,000 | 600 |
| ≥3,000, <4,000 | 800 |
| ≥4,000, <6,000 | 1,100 |
| ≥6,000 | 1,300 |

Qualifying process steam systems shall install a condensate return system to return all uncontaminated condensate, including condensate from associated drip legs, to the boiler plant for reuse. Condensate from processes that use steam in direct contact with a product or contaminant per design or during normal operation does not need to be returned.

All steam loads that do not qualify for 120.6(l)2 based on the criteria in Table 120.6-X shall include the following in the steam system construction documents:

a. Sum of all horizontal and vertical pipe runs that make up the linear distance from the steam trap serving the load to the nearest condensate return tank or the deaerator serving the steam boiler, whichever is closer. Elbows and pipe fittings, including reducers, shall be excluded from the distance calculation.

## 1.4 Reference Appendices

There are no proposed updates to the Non-Residential Appendices.

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[2] Footnote to TABLE 120.6-X: Linear distance from the steam trap serving the load to the nearest condensate return tank or the deaerator serving the steam boiler, whichever is closer. The linear distance shall include the sum of all horizontal and vertical pipe runs. Elbows and pipe fittings, including reducers, shall be excluded from the distance calculation.