Steam Trap Fault Detection & Diagnostics in Existing Industrial Facilities

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Program & Team

PG&E Code Readiness Program

— Supports the development, adoption, and implementation of California's building and appliance energy codes through long-range planning and data collection.

Project Team

| Company	Role
Pacific Gas & Electric (PG&E)	Project Sponsor, Program Administrator
2050 Partners	Project Manager, Program Implementer
Enesfere	Technical Lead
Quantum Energy Analytics	Market Characteristic Surveys & CPUC Data Mining

Background

2022 Title 24 Code Cycle

– Title 24 adopts steam trap requirements for new construction and additions

  o Central monitoring with fault detection

  o Strainer with blowdown valve

  o Applies to systems with more than 5 MMBtu/h of connected steam boiler capacity and steam trap assemblies at pressures above 15 psig

Code Readiness Research—2023-2025

– What would be the impact and feasibility of extending these requirements to steam trap assemblies in existing steam systems?

Final report: https://etcc-ca.com/reports/steam-trap-fault-detection-diagnostics-existing-industrial-applications

California steam-using industries
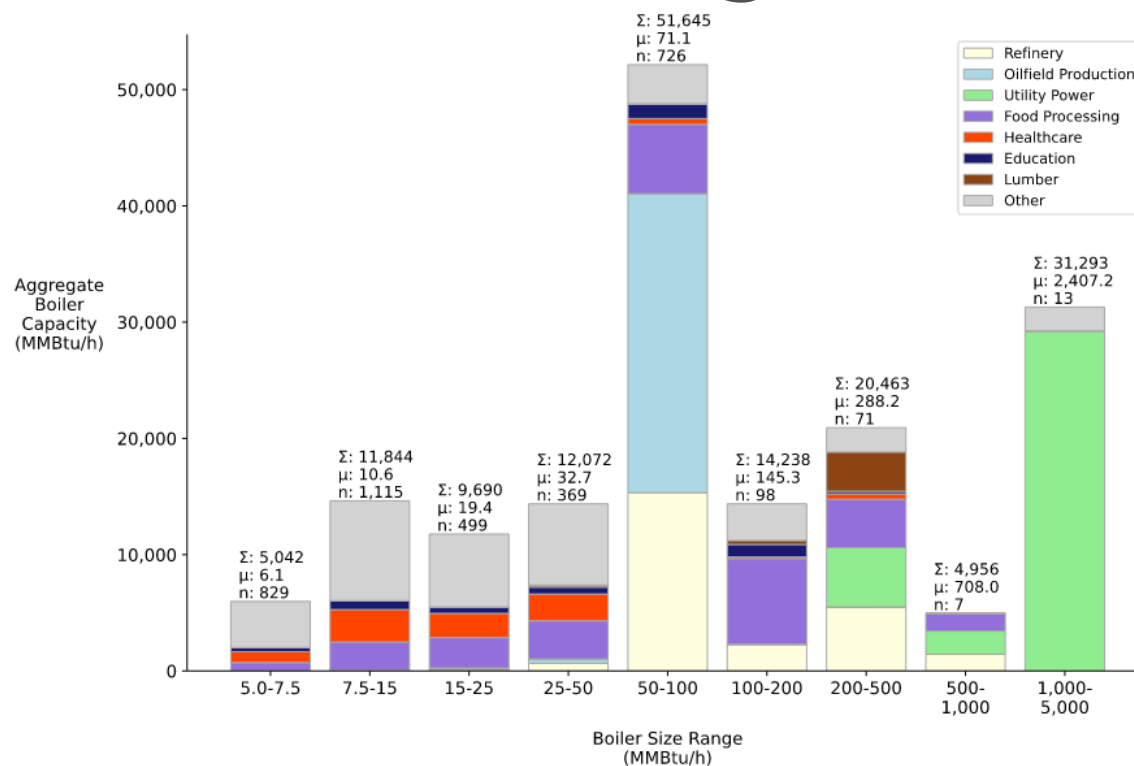
Source: PG&E Code Readiness Compilation of Local Air District Boiler Permits

Steam trap basics

Function

Self-acting valve that discharges air and condensate from the steam systems

Applications

- Drip
- Process
- Tracer

Failure Consequences

- Closed → safety and process issue
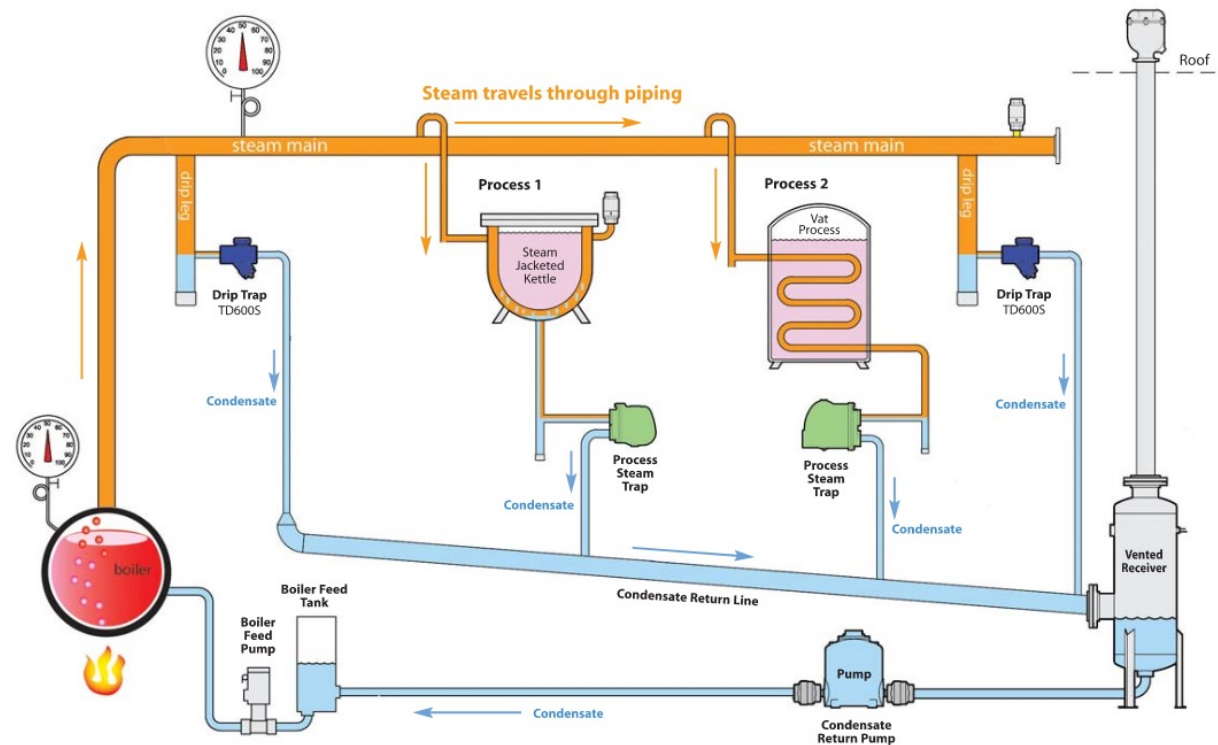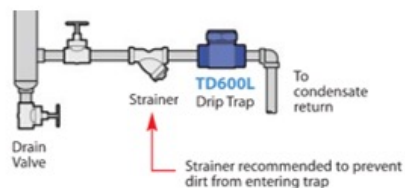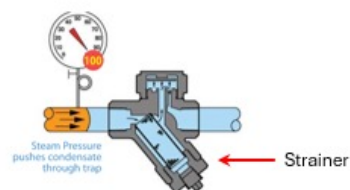- Open → **wastes energy**

Image Credit: Watson McDaniel

Steam trap strainers & blowoff valves

External Strainer
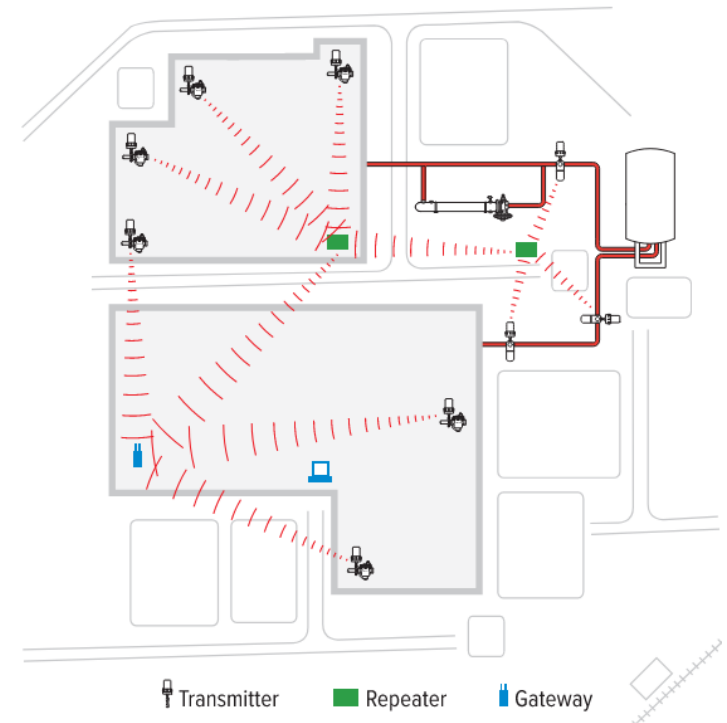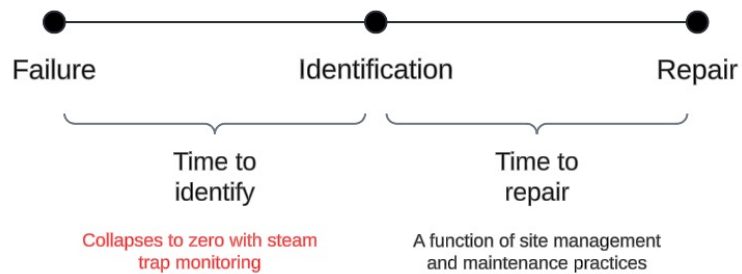

Integral Strainer

Strainer Blowoff Valve

Source: Watson McDaniel (left and middle), Steam Trap Survey LLC (right)

Steam trap monitoring

Source: Armstrong International (left), Everactive (middle), Spirax Sarco (right)

Failure — Identification — Repair

Time to identify
Collapses to zero with steam trap monitoring

Time to repair
A function of site management and maintenance practices

Transmitter · Repeater · Gateway

Source: Armstrong International

Methods

Activity	Notes
Existing Dataset Reviews	– <u>Local Air District Boiler Permits</u>: 9,000+ boiler entries – <u>DOE Industrial Assessment Centers:</u> Audit data for 128 steam-using plants in California – <u>CPUC Impact Evaluations:</u> Survey data for ≈15,000 steam traps – <u>Steam Trap Survey Data from a Major Vendor:</u> Three facilities – <u>Major Industrial Plant Database:</u> 200+ steam-using plants in California
Market Characteristic Surveys	– Ten (10) surveys with owners and operators about steam trap maintenance
Stakeholder Interviews	– Interviews with thirty-four (34) stakeholders, including vendors, owners, operators, trade organizations, steam industry professionals, air district personnel, and code enforcement officials
Statewide Impacts & Cost-Effectiveness Analysis	– Statewide energy savings estimates – Cost-effectiveness analysis – Payback and incremental measure cost uncertainty analysis – ASHRAE scalar analysis for heating systems

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Conclusions

We do not recommend extending the current Title 24 requirements to existing steam systems.

– Steam trap monitoring lacks third-party evaluations.
  – Stakeholders have asked for hard data.
– Savings persistence is a major area of uncertainty.
– Cogeneration is common at oil refineries and lumber mills, which are major steam users in California.
  o Reducing steam use may or may not reduce emissions.
– Hazardous locations can make implementation of steam trap monitoring challenging or infeasible.

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Recommendations

- Clean up the existing code language.
  - Define monitoring system capabilities that satisfy the code requirement.
  - Exempt applications with harsh environmental conditions.
- Consider developing a utility measure workpaper for steam trap fault detection.
- Focus future research on technological efficacy and operator behavior.
- Consider hardware-only solutions for steam traps.
- Consider steam trap monitoring and strainers for future code cycles.

Thank You for Your Attention

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