Research Finding on Valves to Support Product and C&S Development

Update on California Research & Policy Activities

Emerging Water Technologies Symposium

May 15, 2024

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INTEGRATED

[RESILIENT]

SUSTAINABLE

Code Readiness Activities to Prepare for Tomorrow

Research and advocacy to overcome barriers for adoption of new technology

- **PG&E Code Readiness Program** conducts planning to set the stage for effective code development by gathering robust data on technologies and systems in advance of multi-year rulemakings at the state/federal level, and helps bring various agencies to the table
- **CalNEXT program** is a statewide initiative to identify, test, and grow electric technologies and delivery methods to support California's decarbonized future.

Code Readiness can help overcome various code barriers with new building requirements, and can help building systems researchers prepare for the development of Codes and Standards Enhancement (CASE) Initiative Reports

CASE reports summarize the need and viability of proposed code measures and provide sample code language to support the energy code rulemaking process to make changes to the Title 24 Part 6 Building Energy Efficiency Standards

Collaboration with IAPMO has been a fruitful partnership and helps with concurrent improvements to both plumbing and energy code

- Title 24 Part 5 is the California Plumbing Code which utilizes IAPMO's Uniform Plumbing Code with necessary California amendments

Project Funders

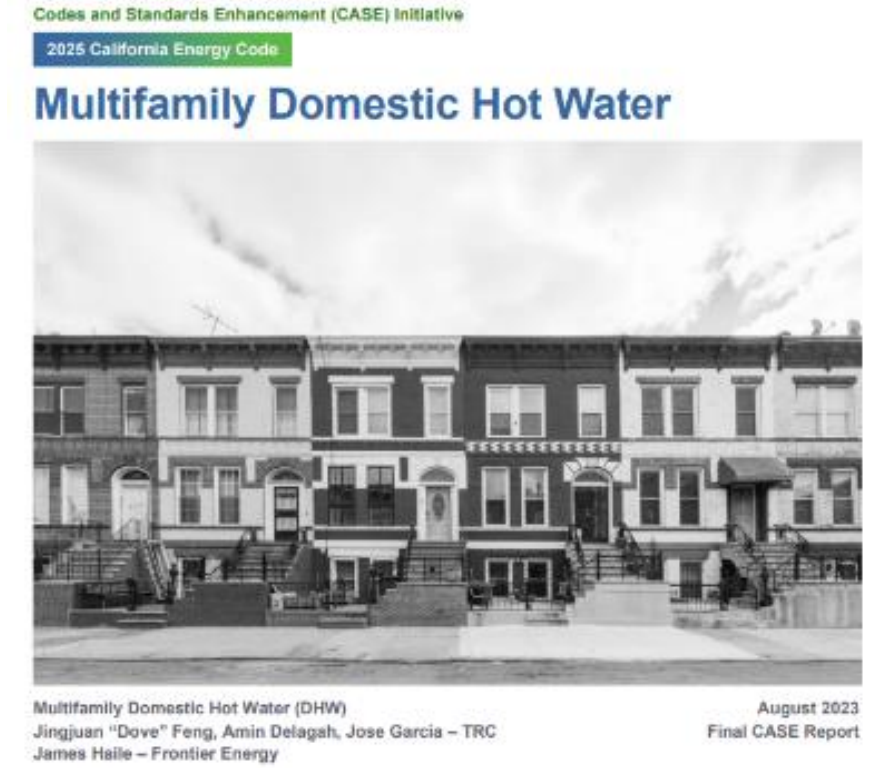
Project Partners

Multifamily DHW CASE Effort

- **Topics cover heat pumps, electric readiness, and distribution systems**
  - Central HPWH Cleanup
  - Individual HPWH Ventilation
  - Individual DHW Electric Ready
  - Central DHW Electric Ready
  - CPC Appendix M Pipe Sizing
  - Pipe Insulation Enhancement
  - Thermostatic Balancing Valves
  - Master Mixing Valves

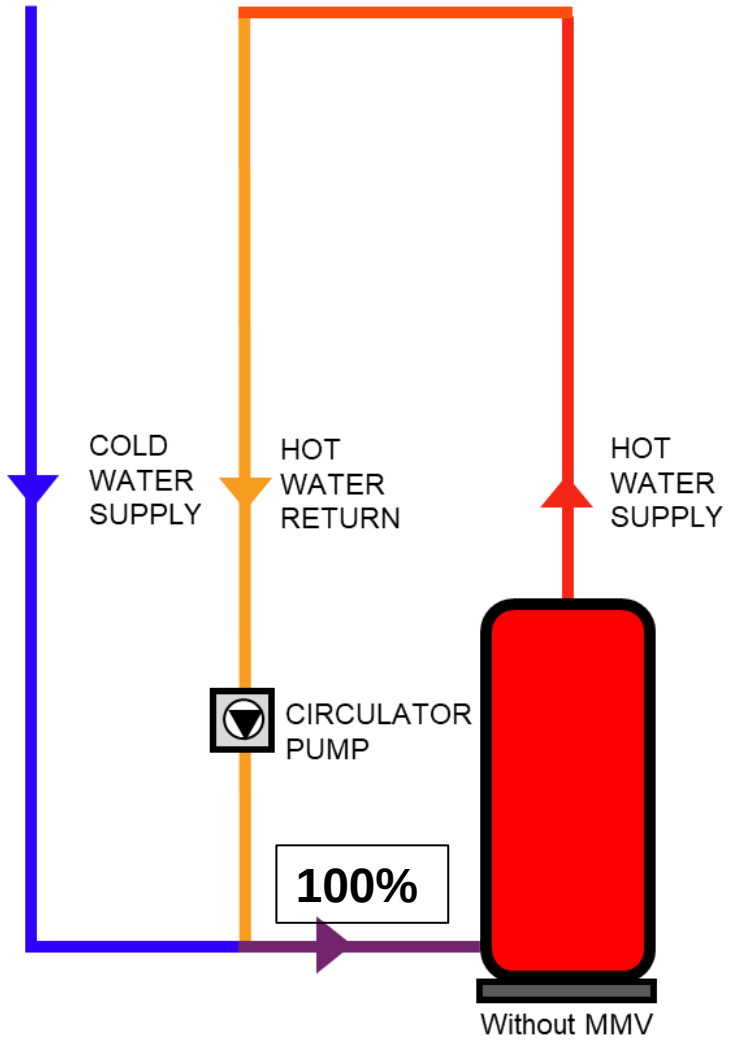
Visit Title24stakeholders.com for CASE report and stakeholder meeting materials

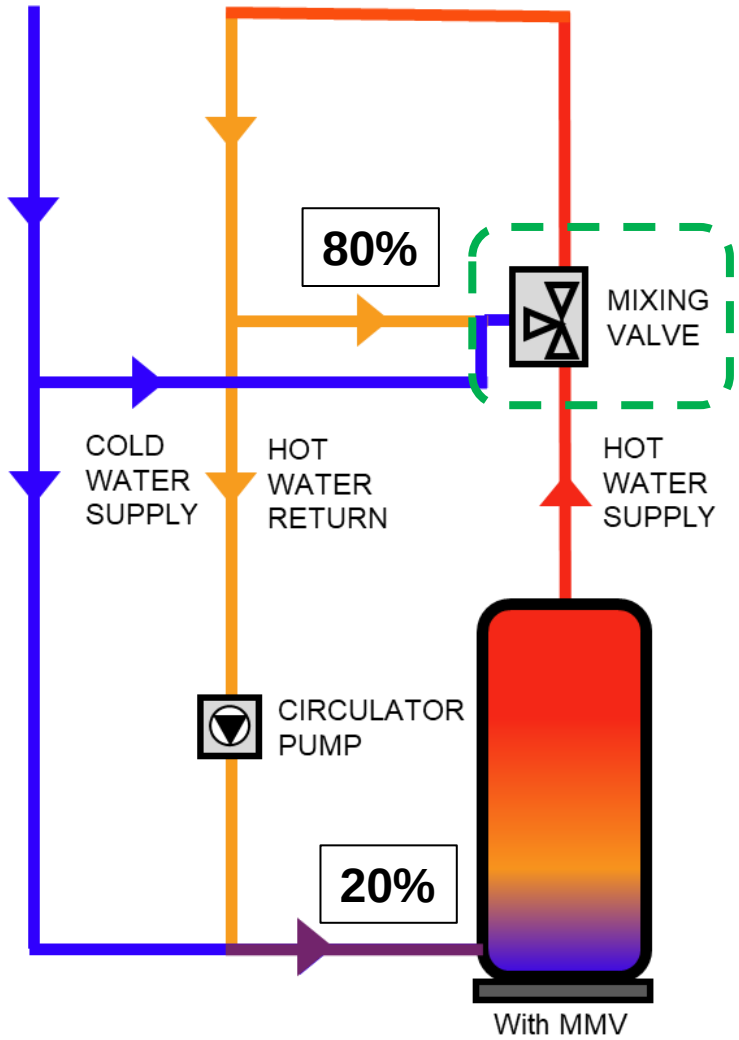
Links: https://title24stakeholders.com/measures/cycle-2025/multifamily-domestic-hot-water/



Justification for Multifamily MMV Energy Code Measure

- The California Plumbing and Energy Codes do not require the use of master mixing valves (MMV) for central DHW distribution systems with recirculation even though 80% of multifamily buildings use them.
- MMV results in energy savings from reduced pipe heat loss from lower temperature recirculation loops.
- Yields energy savings at the heating plant by diverting approx. 80% of return water back to the mixing valve versus going to the storage tank.
- Ability to safely increase storage heating capacity improves load shifting capabilities or reduces size of HP or storage tank volume.





Results from 24-h Application Lab Testing at PG&E ATS

HP-based DHW systems were tested to mimic real world operation in multifamily buildings with:

- No MMV
- Single mechanical MMV
- High/Low mechanical MMV
- Single digital MMV

Preliminary testing was limited, but very useful

- 4 HP configurations tested
  - Single pass with recirc tank (ER in series, HP in parallel)
  - Single and multi pass HPs (return to primary)

Key Findings

- Average electricity **savings of 10%** for heating with a MMV versus no MMV.
- **4% savings** from using **digital versus High/Low mechanical MMV** for SP return to primary configuration.
- **Single mechanical MMV** was not able to maintain 120˚F.

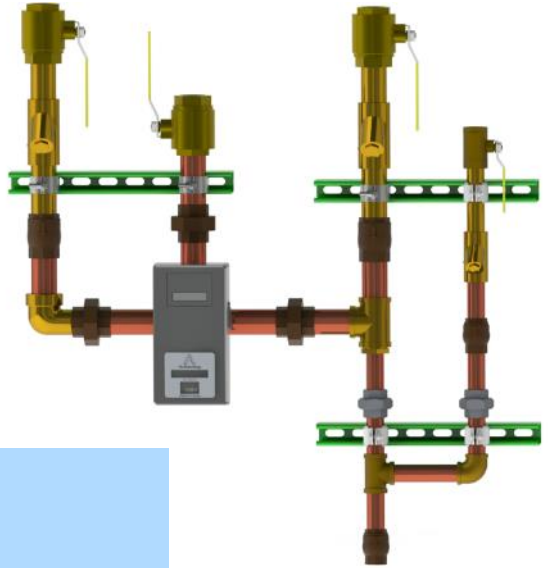
CALIFORNIA ENERGY CODES & STANDARDS
A STATEWIDE UTILITY PROGRAM

Source: PG&E ATS

Energy Code Change

Summary of Draft Language

- Prescriptively would require the use of a mechanical or digital thermostatic MMV on each distribution supply and return loop for centralized water heating plants.
- The MMV would be installed and commissioned as defined in Reference Appendix



2022

No Requirement

Proposed 2025

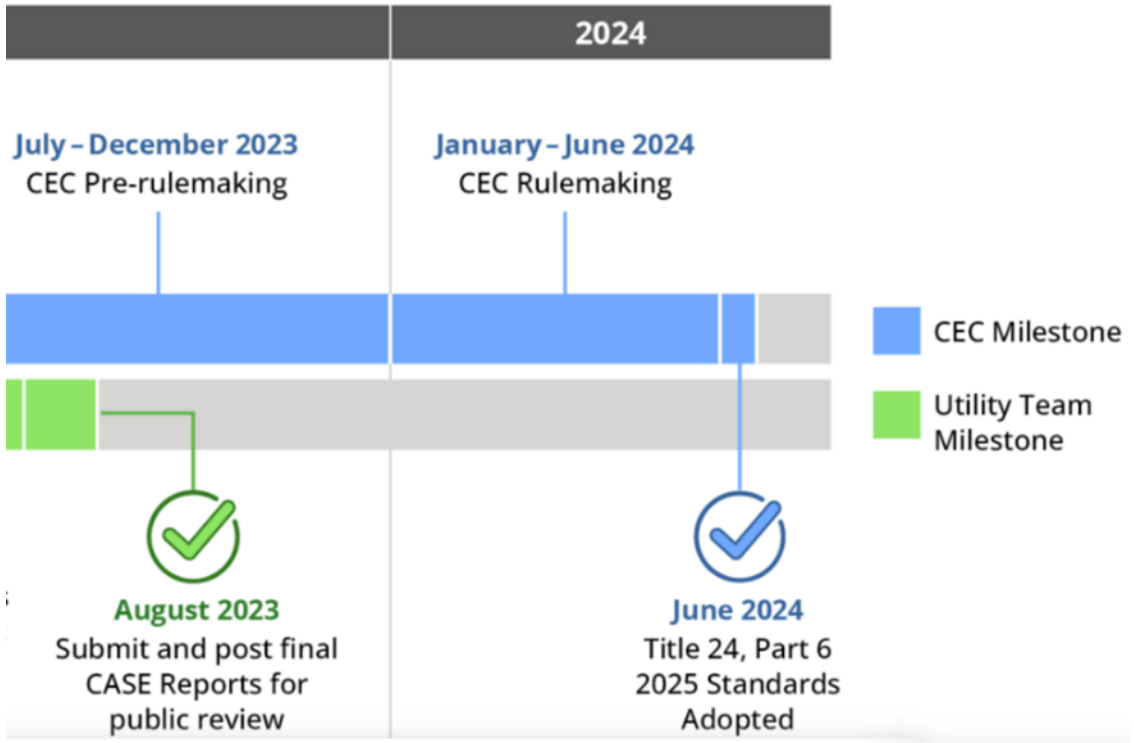
Prescriptive Requirement in Title 24 Part 6, Section 170.2

Photo Credit Powers and Armstrong.

Energy Code Update and Building Off the Momentum

CEC T24 Energy Code

- Currently in CEC Rulemaking process
- MMV measure will be adopted in June 2024
- Effective date of January 1, 2026



Source: title24stakeholders

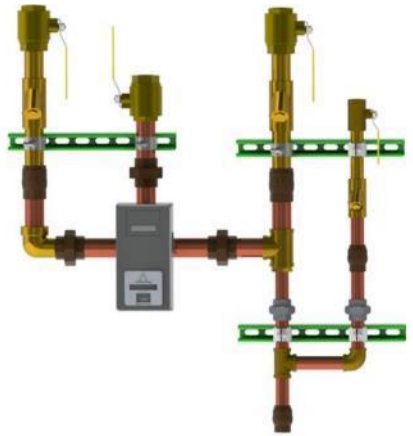
Deepening Industry Collaboration

- Continued discussions with IAPMO and Armstrong International relating to design trends, research outcomes, digital MMV standard, and energy code measure.
- Led to proposing new research and policy initiatives
- One opportunity was working together to update the Uniform Plumbing Code

New measure proposed for the 2027 Uniform Plumbing Code

- Armstrong International, TRC and 3D Engineering Consultants developed proposal language and justification on MMV Appendix L 503.3.5 (3) to the UPC.
- Requires recirculation systems in health care and hospitality shall be controlled by a digital master mixing valve that meets IGC-384.

2027 Code Proposal



Definitions (copied from above)

Adiabatic Mixing - The mixing of two (or more) streams of fluid of differing temperatures to achieve a new mixed temperature.

Master Mixing Valve - Temperature actuated mixing valves for hot water distribution systems are used for controlling water temperature in hot water systems. They are not intended for point-of-use temperature limiting, control, or end use applications including emergency eyewash and shower equipment. These devices consist of a hot water inlet connection, a cold water inlet connection, a mixed water outlet connection, a thermal element or thermostatic sensor and a means for adjusting the mixed water outlet temperature. These devices can be either mechanically actuated or electronically controlled device.

Mechanical Master Mixing Valve - Master Mixing Valve that utilizes mechanical means such as a thermostatic element to cause adiabatic mixing of hot and cold water to a specified outlet temperature.

Digital Master Mixing Valve - master mixing valves that utilize electronic means such as digital controls to cause adiabatic mixing of hot and cold water to a specified outlet temperature.

Appendix L 503.3.5 (3) Hot water distribution main temperature shall be controlled by a device that complies with IGC 384.

MMV Field Study in Commercial Systems

5 Retrofit Sites

- **Full-service restaurant**
- **Multifamily building**
- Hospital Clinic
- Assisted Living Community
- Supermarket (Heat Pump)

Testing the system for energy use prior and post MMV install to measure savings from:

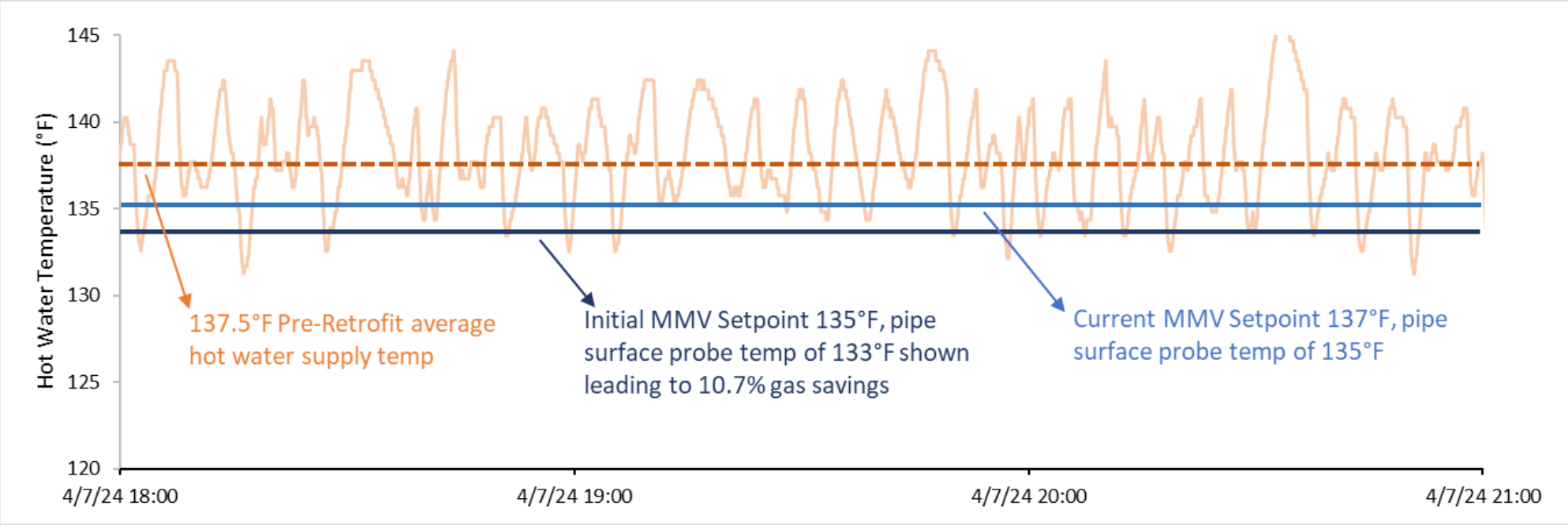
- Reduction in distribution loop pipe heat loss from precisely controlled supply temperature
- Improved tank water temperature stratification from recirculation return water mostly bypassing the heater

MMV Field Study in Restaurant

Pre and post retrofit data is being gathered

- Heater provides hot water at average 137.5F with 10°F deadband (133 to 143°F).
- MMV reduces the deadband and allows for lower setpoint while ensuring hot water gets delivered at suitable temperature closer to lower deadband temp.

- Preliminary restaurant site analysis findings show 10.7% gas savings from adding MMV and tightening the delivery temp dead from delivery temp reduction
- In next test site we will test savings with MMV at average delivery temp from baseline pre-MMV monitoring to isolate savings due to improved tank water temperature stratification.

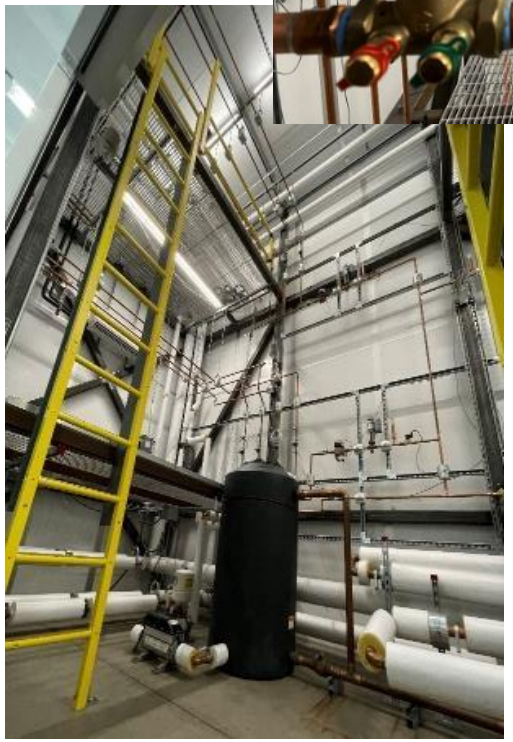


Lab Testing of Balancing Valves Underway

ZYD Energy leads hot water distribution system performance testing at PG&E Applied Technology Services Group's Performance Testing & Analysis Unit Team on behalf of PG&E Code Readiness Team

- Focused initially on testing various balancing valves and pipe insulation levels on a 12-riser distribution system mimicking a 48-unit building
- Have tested an assortment of manual and automatic valves
- Testing will expand to understand the overall distribution system performance from a combination of components (balancing valve, MMV, and pump with controls) working together and measure savings at the water heater

This research supports Energy code proposals for future rule-making cycles and may support future plumbing code updates

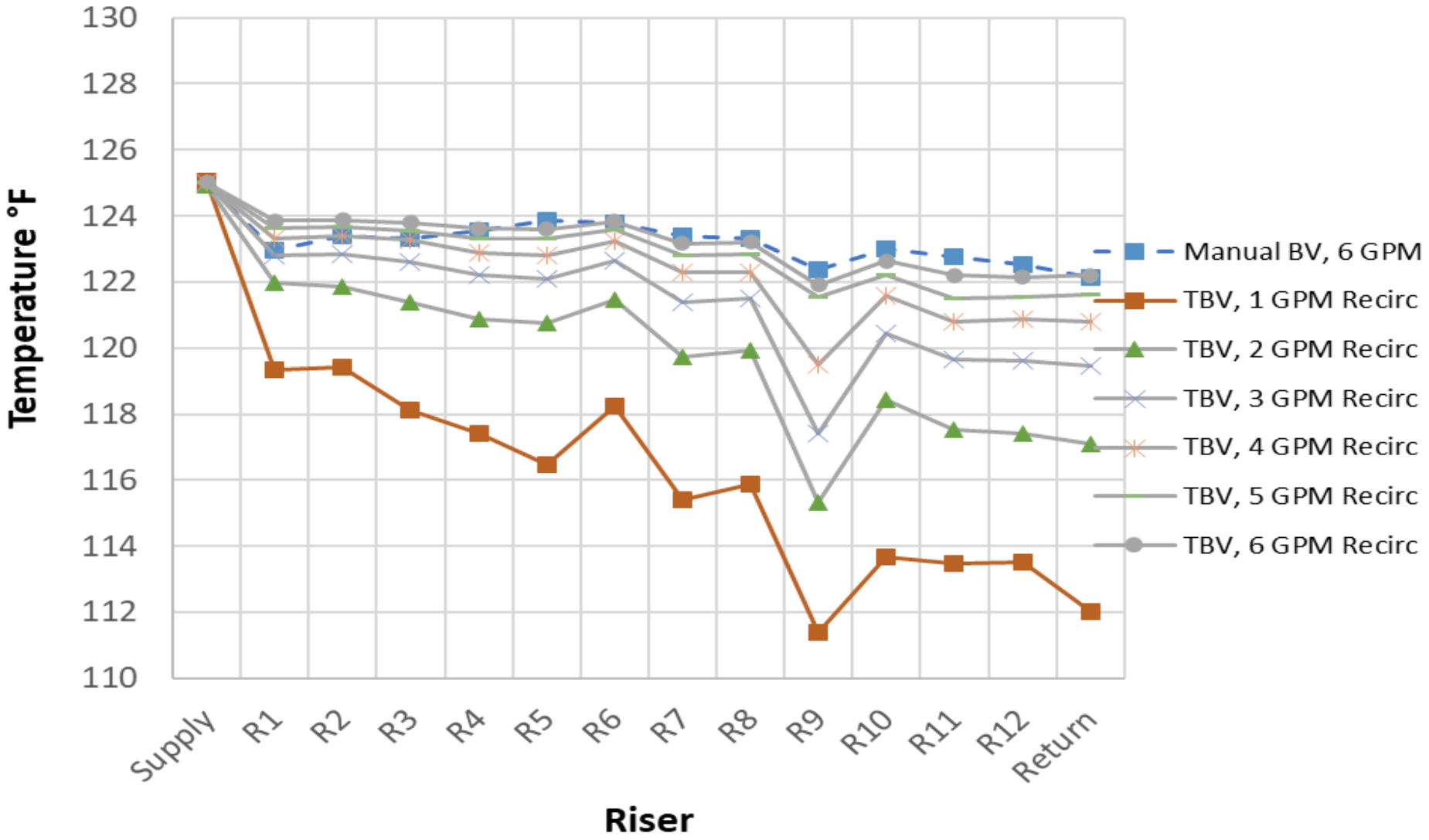


Applied Technical Services

ZYD ENERGY

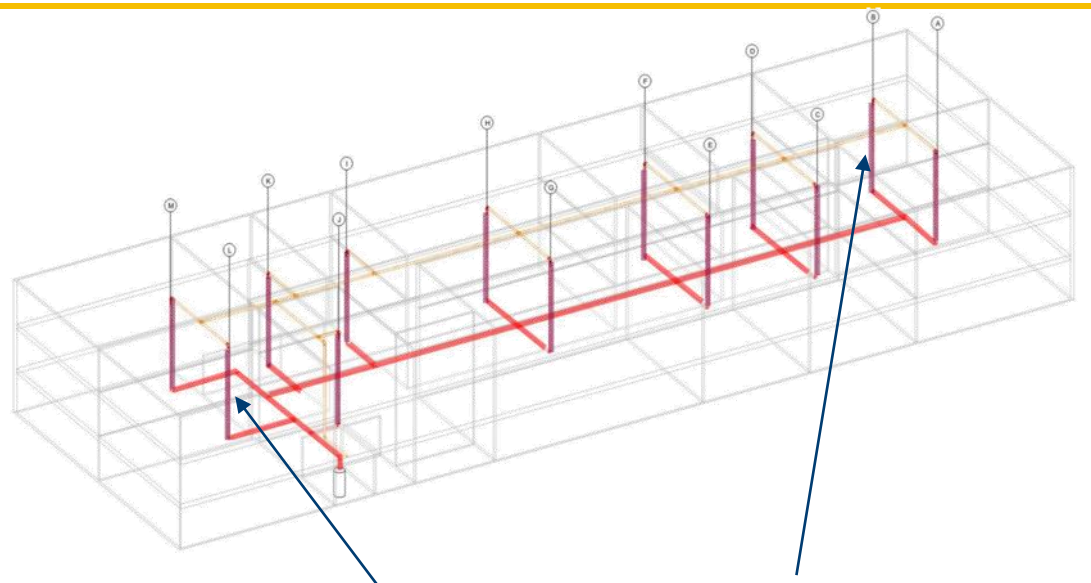
Photo Credit: ATS

Lab Testing at PG&E ATS



Justification for Multifamily ABV Energy Code Measure

- Multifamily buildings typically include multiple return risers or return piping zones (multi-riser), which require flow balancing at each riser to work properly
- Riser flow rates are not always clearly specified
  - Example from plans review: “Set balancing valves partly open to restrict but not stop flow.”
- When specified, riser flow rates are typically the same for all risers, resulting in higher temperatures at the risers near the water heater
- **Manual valves are often not balanced at all**
- If balancing is actually performed, instrumentation is rarely used to verify flow rates



Closest riser

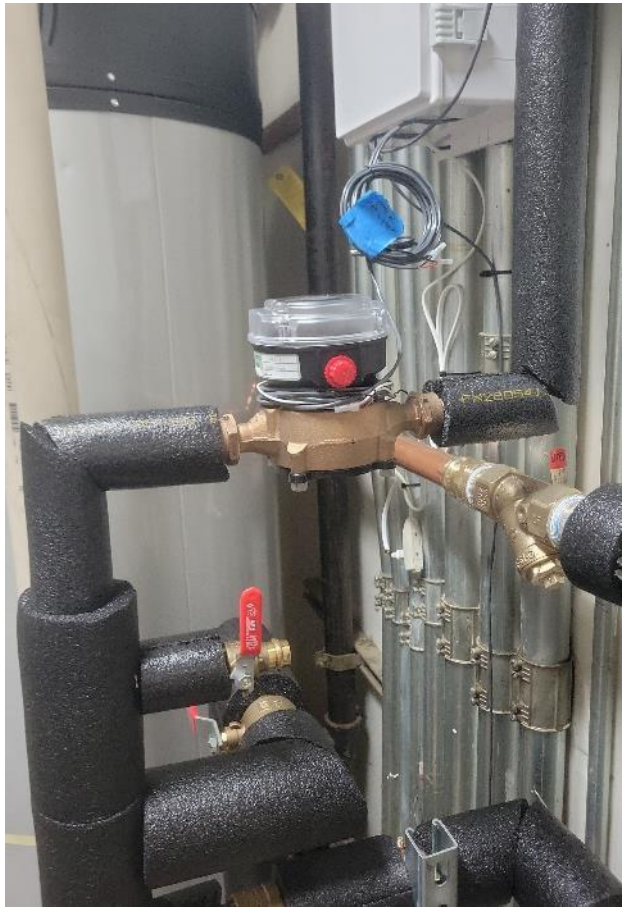
Furthest riser

T24 Energy Code Change

- For a compliance credit, the project shall include:
- Have more than one DHW supply riser
- Each DHW supply riser shall have an accessible TBV
  - Located after the last supply branch from the supply riser, in the direction of flow
  - Set to a maximum temperature of 120 °F.
- Variable speed hot water return circulating pumps installed to operate with differential pressure control.
- For systems with one return pipe loop, hot water return piping that does not exceed 160 feet in length.
- For systems with multiple recirculation return pipe loops, no return pipe may exceed 160 feet in length
- **Cost and energy savings vs. manually balanced valves**
- **Significant energy savings and safety improvements when manual valves are not balanced**

Wrap Up

Q/A



Thank You

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