DOE Zero Energy Ready Home

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

Efficient Hot Water Distribution in Zero Energy Ready Multifamily Buildings

April 25, 2017

DOE ZERH Framework
- *Per Rev.06 ZERH Specs*

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

Exhibit 1: DOE Zero Energy Ready Home Mandatory Requirements for All Labeled Homes

Area of Improvement	Mandatory Requirements
1. ENERGY STAR for Homes Baseline	☐ Certified under ENERGY STAR Qualified Homes Program Version 3 or 3.1 [10, 11]
2. Envelope[12]	☐ Fenestration shall meet or exceed ENERGY STAR requirements. See End Note for specific U, SHGC values, and exceptions. [13] ☐ Ceiling, wall, floor, and slab insulation shall meet or exceed 2012 or 2015 IECC levels[14, 15]
3. Duct System	☐ Duct distribution systems located within the home's thermal and air barrier boundary or an optimized location to achieve comparable performance[16]
4. Water Efficiency	☐ Hot water delivery systems (distributed and central) shall meet efficient design requirements[17]
5. Lighting & Appliances[18]	☐ All installed refrigerators, dishwashers, and clothes washers are ENERGY STAR qualified. ☐ 80% of lighting fixtures are ENERGY STAR qualified or ENERGY STAR lamps (bulbs) in minimum 80% of sockets ☐ All installed bathroom ventilation and ceiling fans are ENERGY STAR qualified
6. Indoor Air Quality	☐ Certified under EPA Indoor airPLUS [11]
7. Renewable Ready	☐ Provisions of the DOE Zero Energy Ready Home PV-Ready Checklist are Completed [19]

DOE ZERH Building Eligibility
- Per Rev06 ZERH Specs

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The following homes are eligible for DOE Zero Energy Ready Home qualification:

- Detached dwelling units[3] (e.g. single family homes)
- Dwelling units in any multifamily building with 4 units or fewer
- **Dwelling units in multifamily buildings with 3 stories or fewer above-grade**
- **Dwelling units in multifamily buildings with 4 or 5 stories above-grade where dwelling units occupy 80% or more of the occupiable square footage of the building.**

Dwellings in eligible multifamily buildings as listed above may be served by central heating, cooling, or hot water systems.

DOE ZERH Central Hot Water Distribution Requirements (*Per Rev06*)

17. Central hot water delivery systems in multifamily buildings must include on-demand recirculation which operates based on:

- a demand indicator, ***and***
- the loop water temperature

Verifiers must confirm:

- pump is installed with flow in the correct direction
- temperature sensors are installed

Advisories:

- Stored volume between the recirculation loop and the furthest fixture ≤ 1.0 gallon encouraged.
- R-4 pipe insulation encouraged
- Recirculation pump set to operate at a temperature which is at least 5^0 F less than the water heater set point temperature encouraged

Today's Webinar

1. Hot water energy use in multifamily buildings

2. CDHW Distribution Design Elements
   - Pipe Insulation
   - On-Demand Recirculation
   - System Balancing
   - Crossover Prevention
   - Optimized Loop Design

Quick Poll!

Efficient Hot Water Distribution in ZERH Multifamily Buildings (1-5 Stories)

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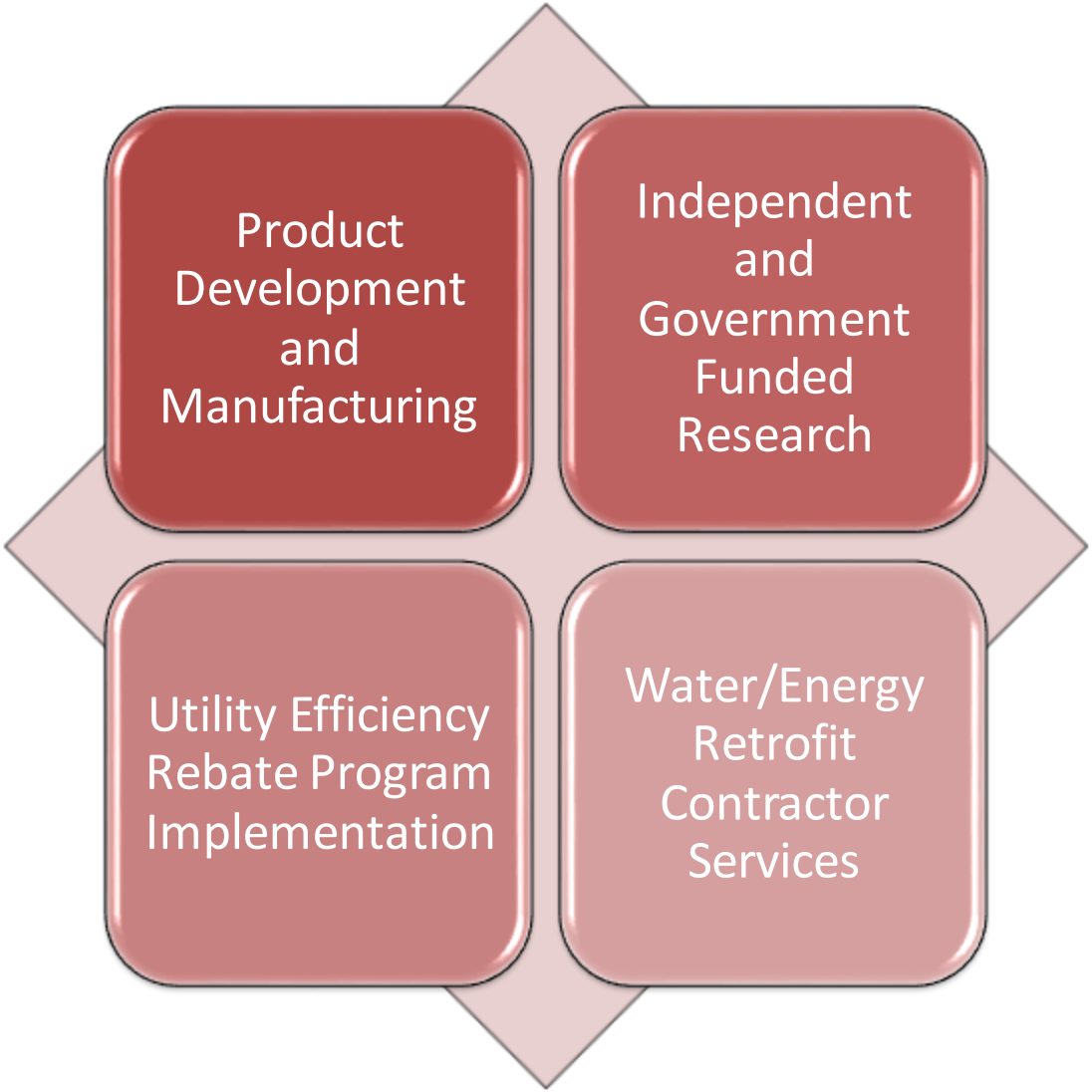
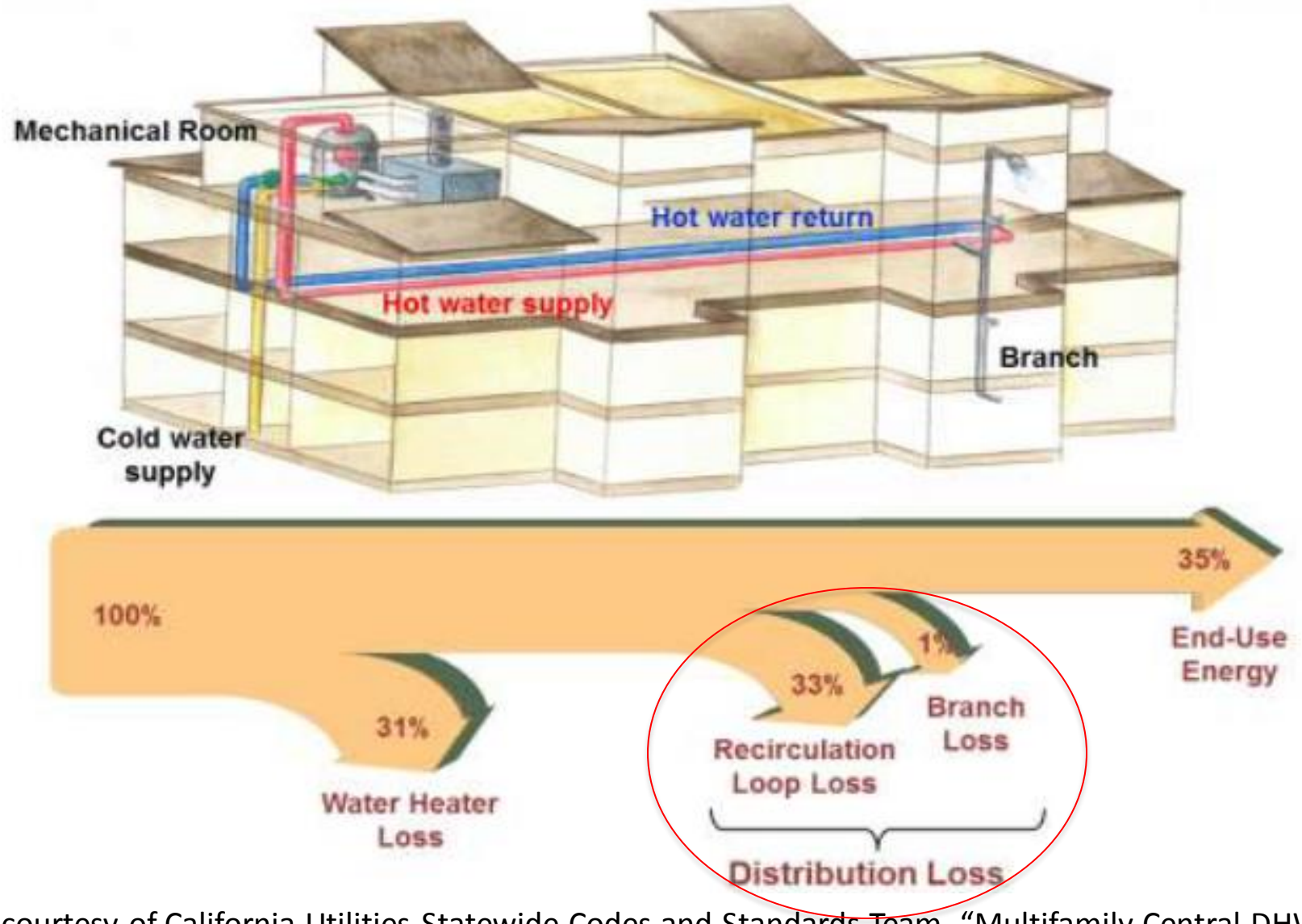

Product Development and Manufacturing
Independent and Government Funded Research
Utility Efficiency Rebate Program Implementation
Water/Energy Retrofit Contractor Services

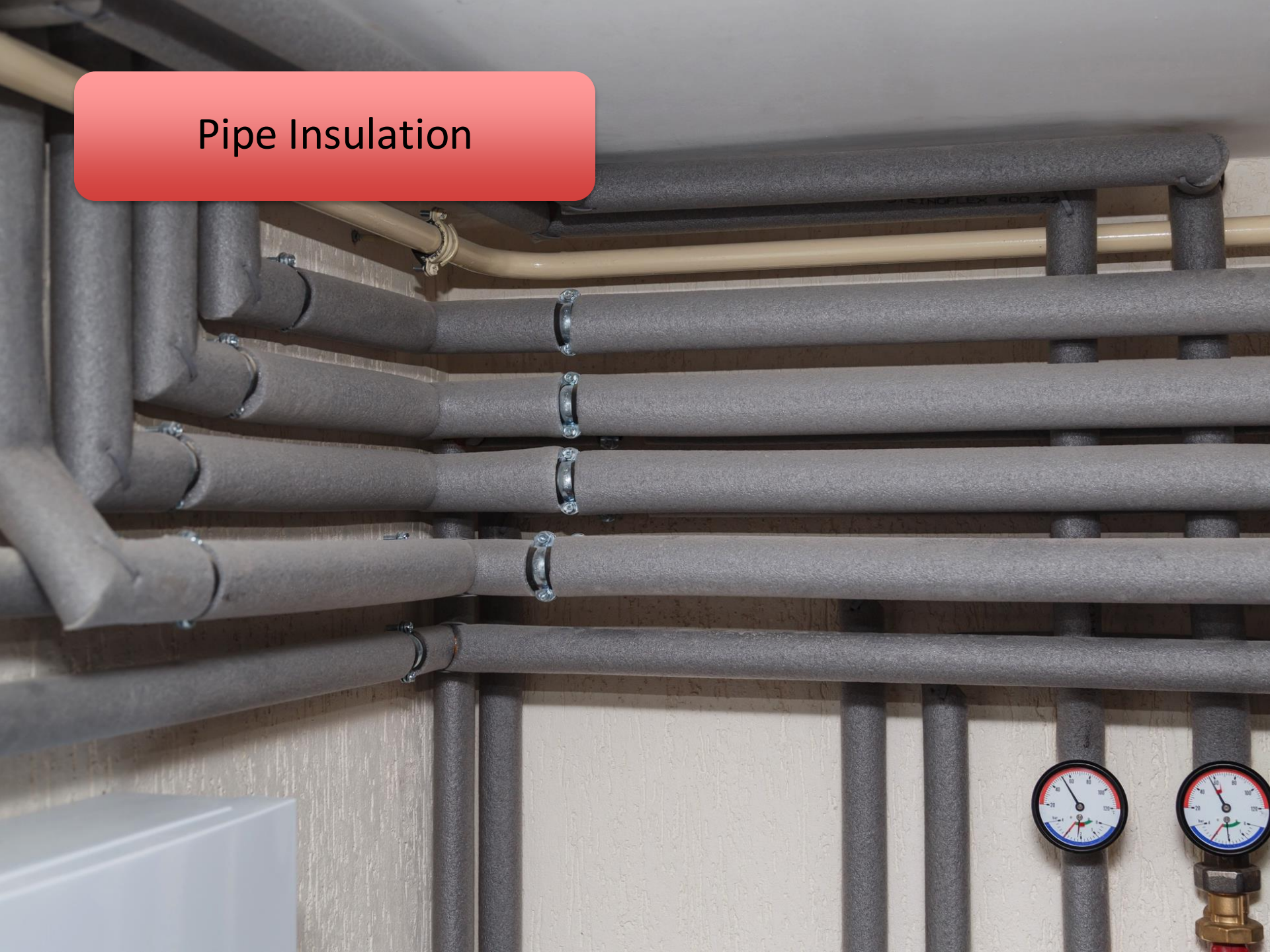
Central Domestic Hot Water (CDHW)

CDHW Energy Flow



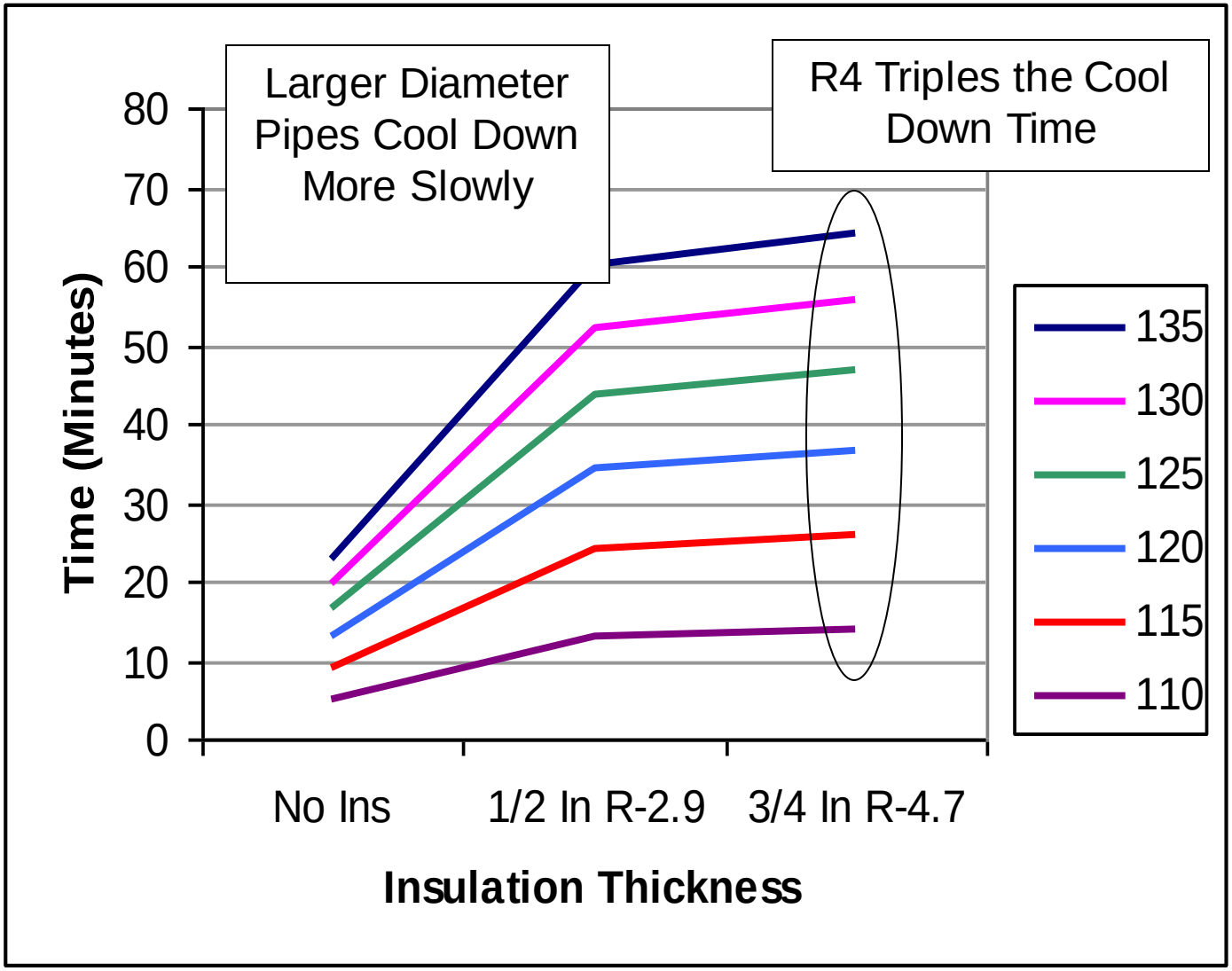
Graph courtesy of California Utilities Statewide Codes and Standards Team, "Multifamily Central DHW and Solar Water Heating", Oct. 2011

CDHW Distribution Design Elements


Pipe Insulation

Pipe Insulation

- Minimum R4 insulation on all portions of the recirculation loop
- All additional branch lines or risers ¾” diameter or higher (ideally all piping)
- R4 insulation triples cool down time on ¾” pipe

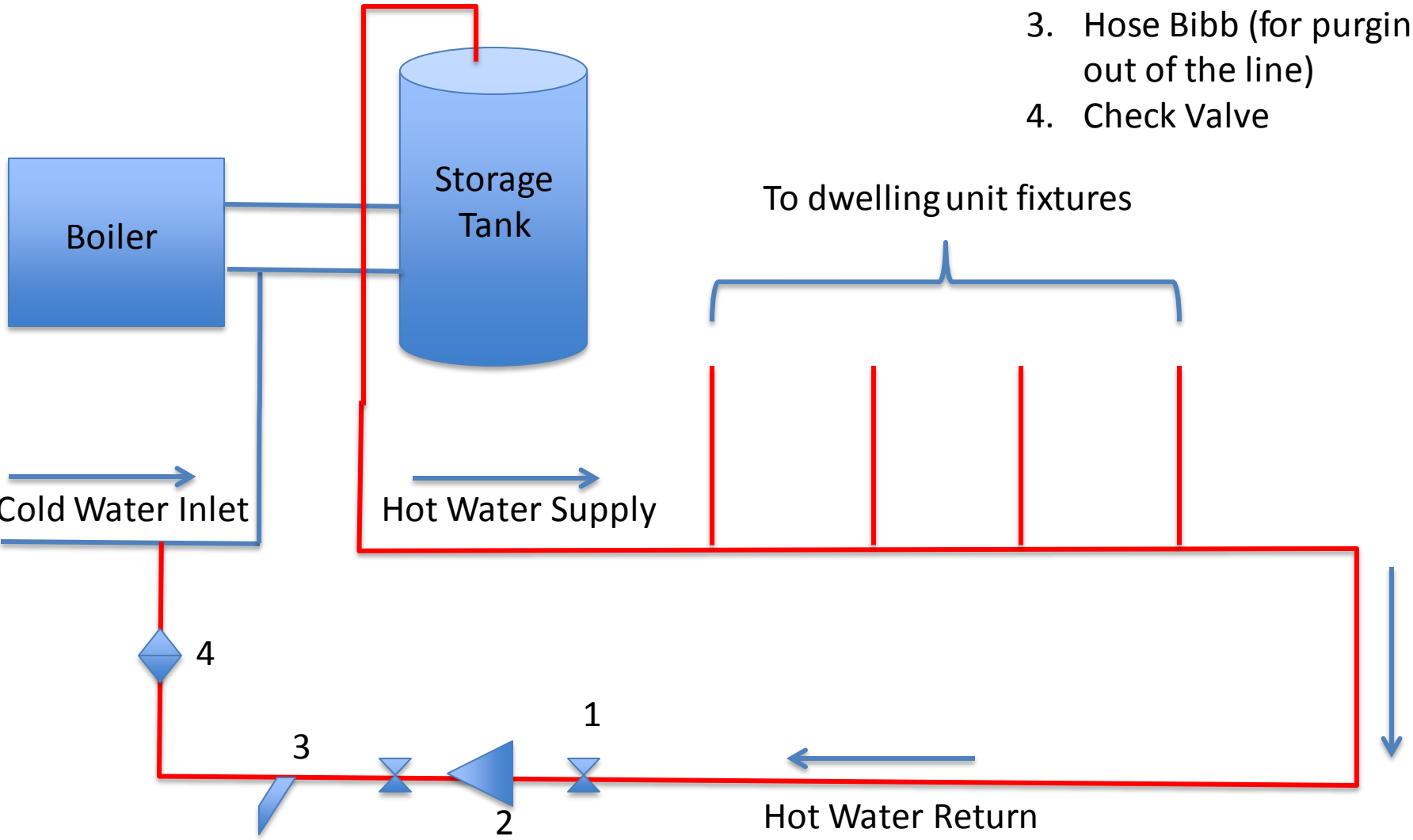


Graph source: Gary Klein, 2017


Recirculation Pump Controls

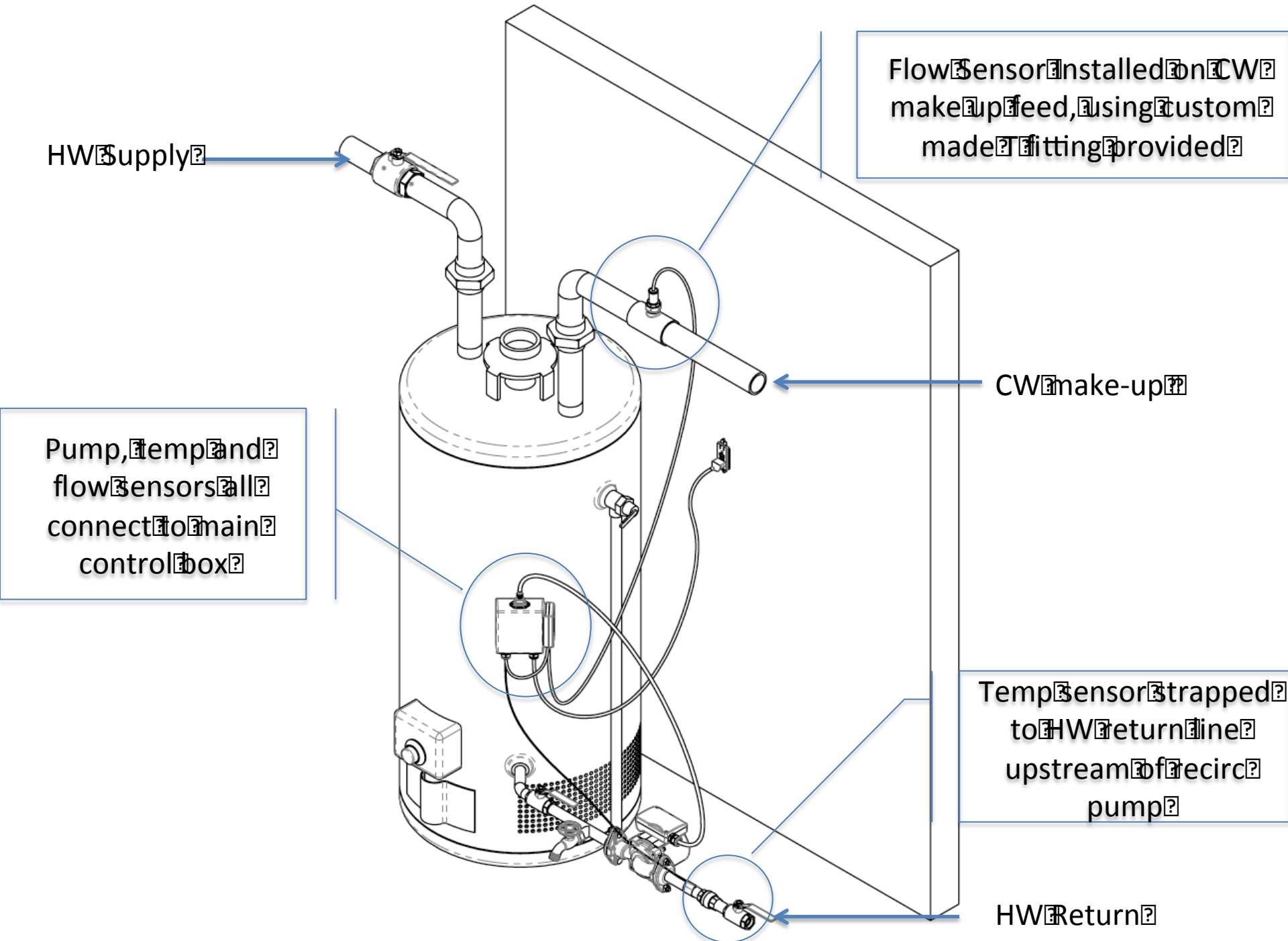
Proper Recirculation Loop Configuration

1. Ball Valves (for isolating the pump
2. Recirculation Pump (Demand Control)
3. Hose Bibb (for purging air out of the line)
4. Check Valve

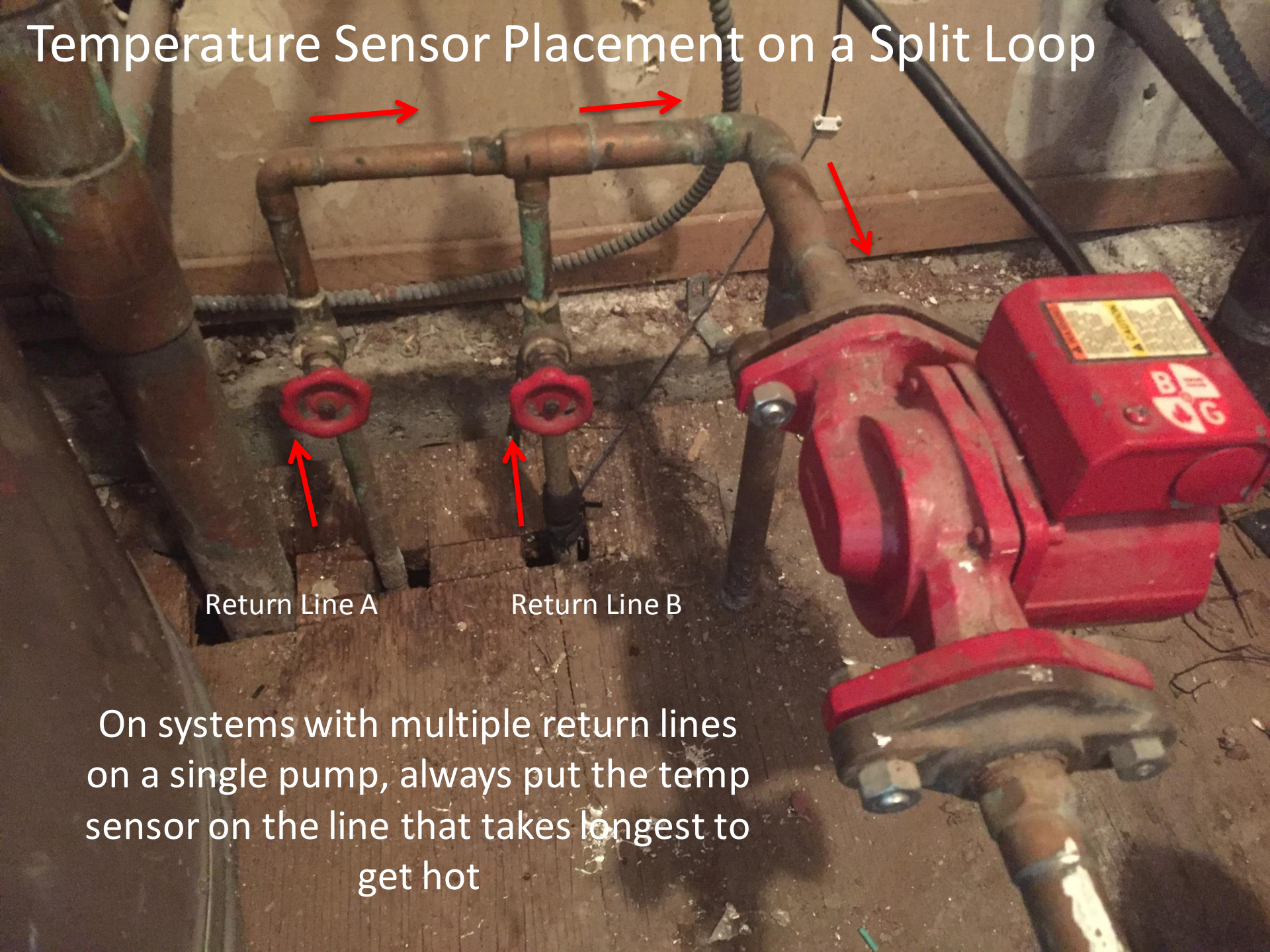


Demand Controlled Recirculation for Central DHW

- Automatically turns pump on and off based on building demand and water temperature
- Reduces distribution losses and increases water heating efficiency
- Aids in the reduction of pipe erosion and pinhole leaks

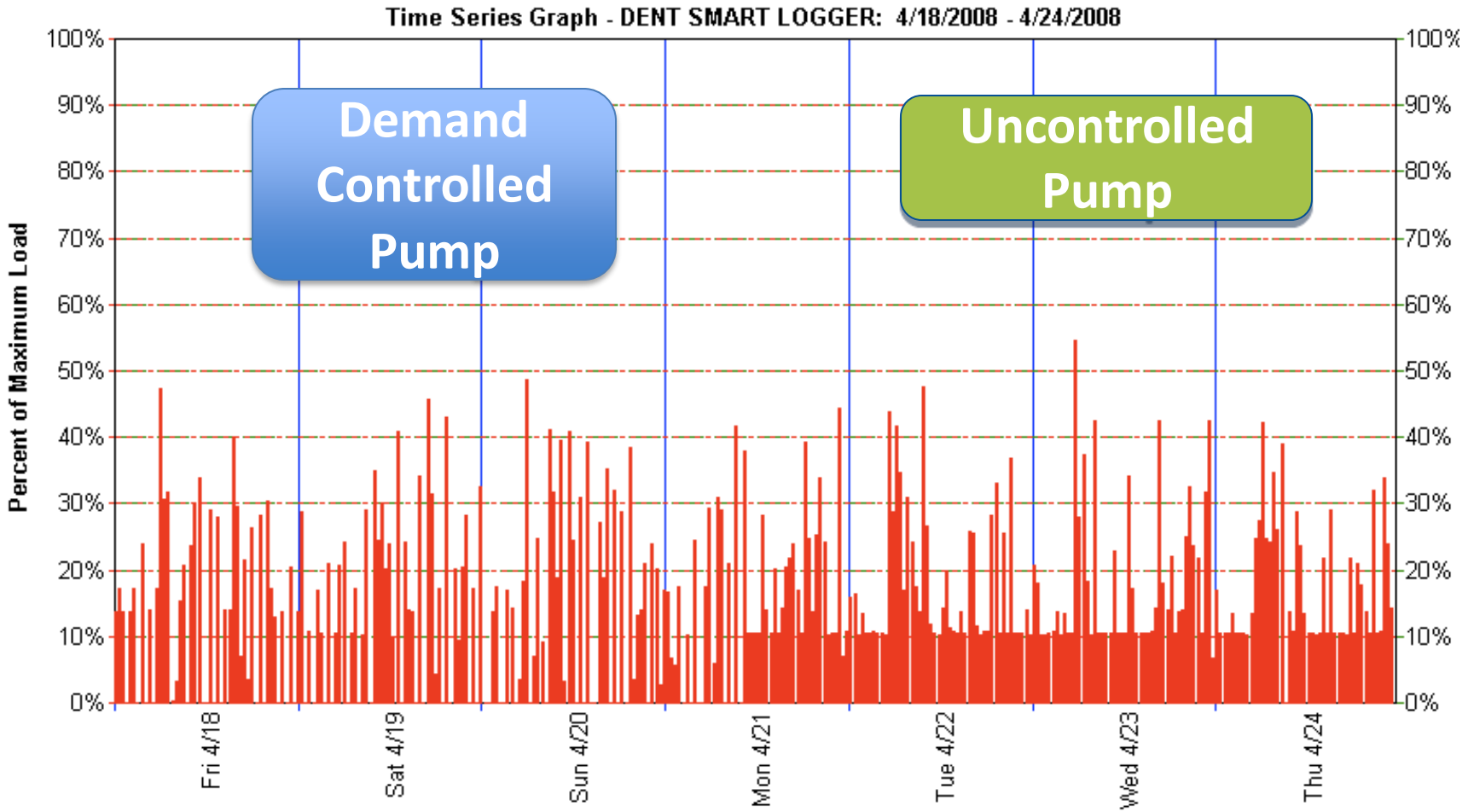

HW Supply
Flow Sensor installed on CW make up feed, using custom made T fitting provided
CW make-up
Pump, temp and flow sensors all connect to main control box
Temp sensor strapped to HW return line upstream of recirc pump
HW Return

Temperature Sensor Placement on a Split Loop

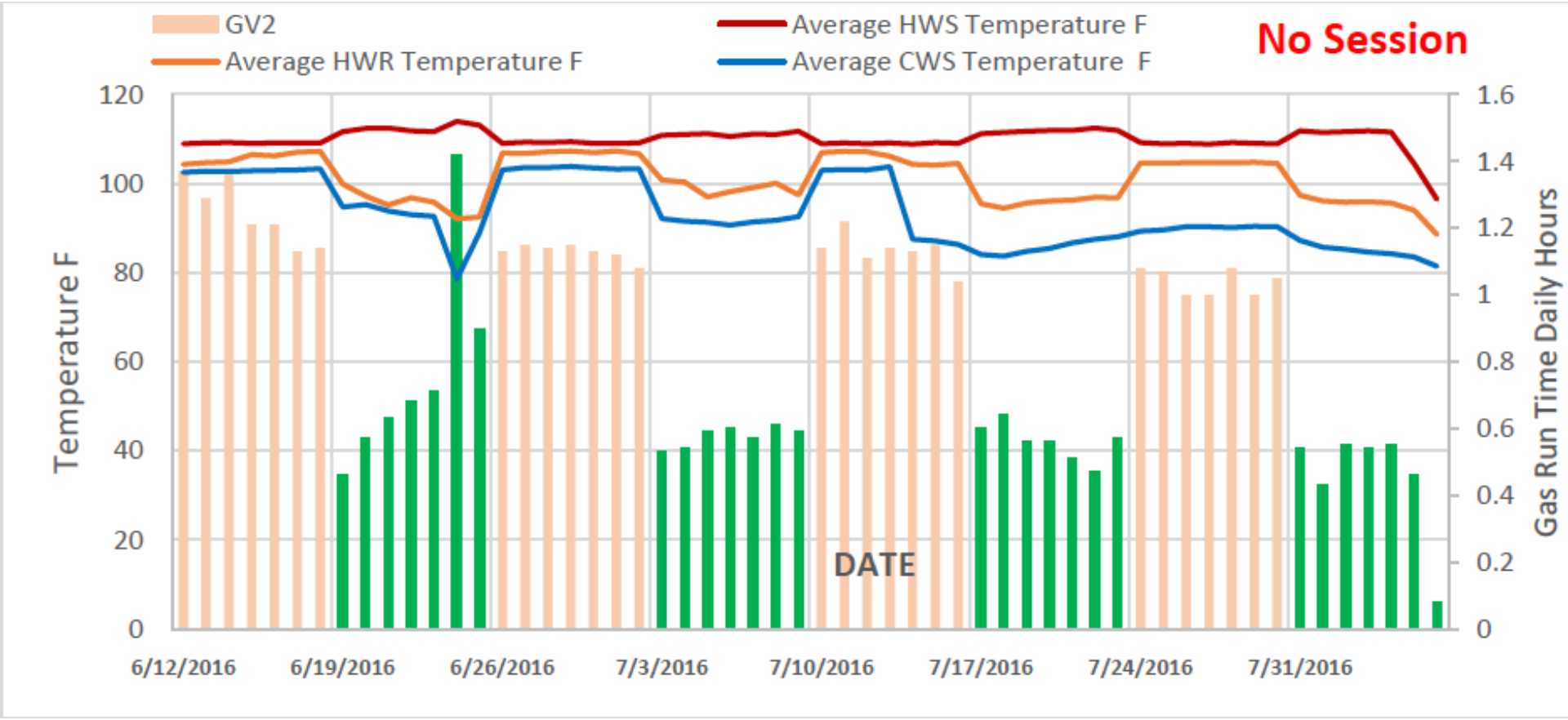


On systems with multiple return lines on a single pump, always put the temp sensor on the line that takes longest to get hot

Reduced Water Heater Cycling



UC-Riverside Falkirk Bldg. 3- No Session (Unoccupied)



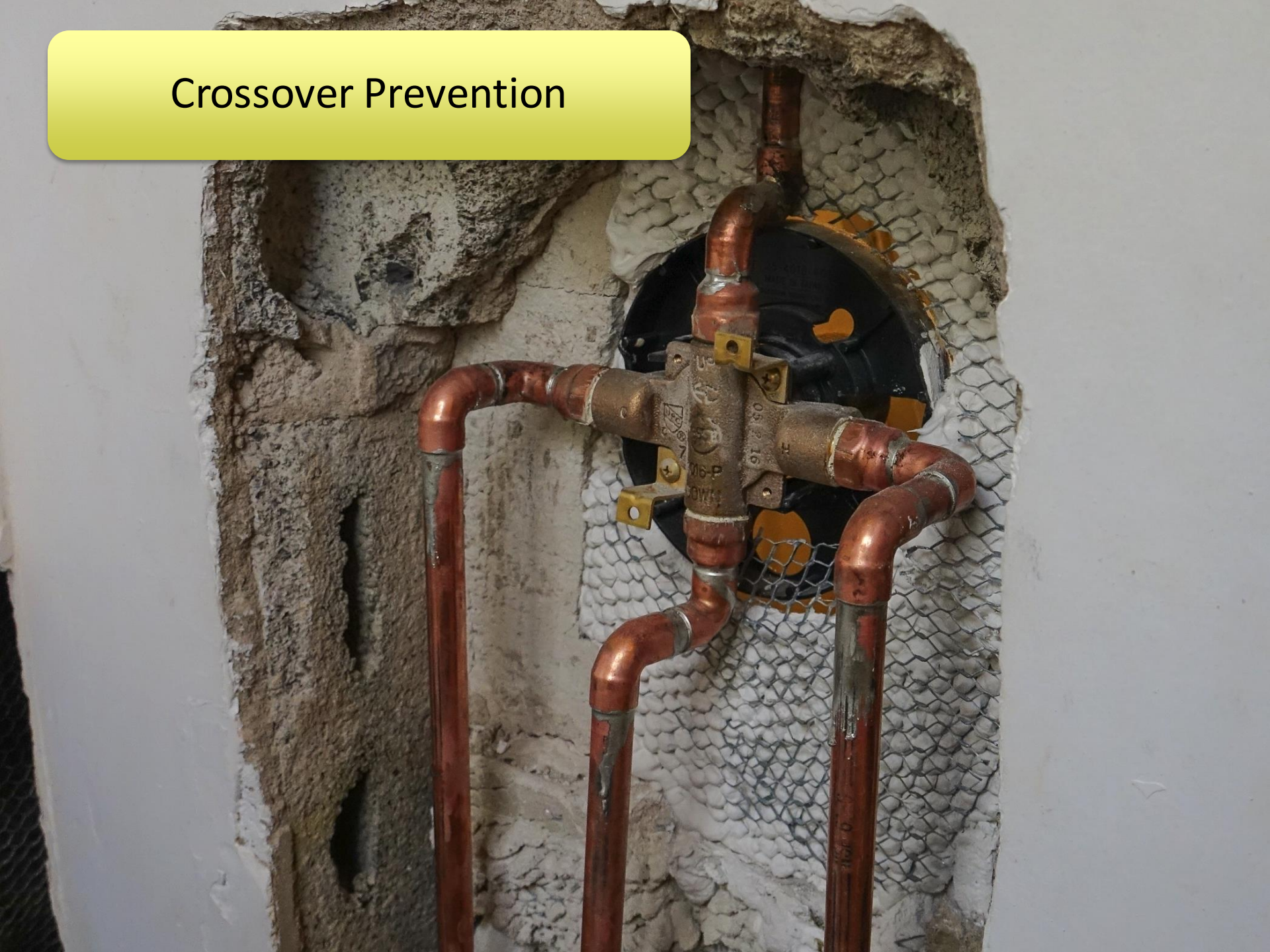
New Standards for CDHW Recirculation Controls

CA Title 24, Building Energy Codes (Prescriptive Requirement)

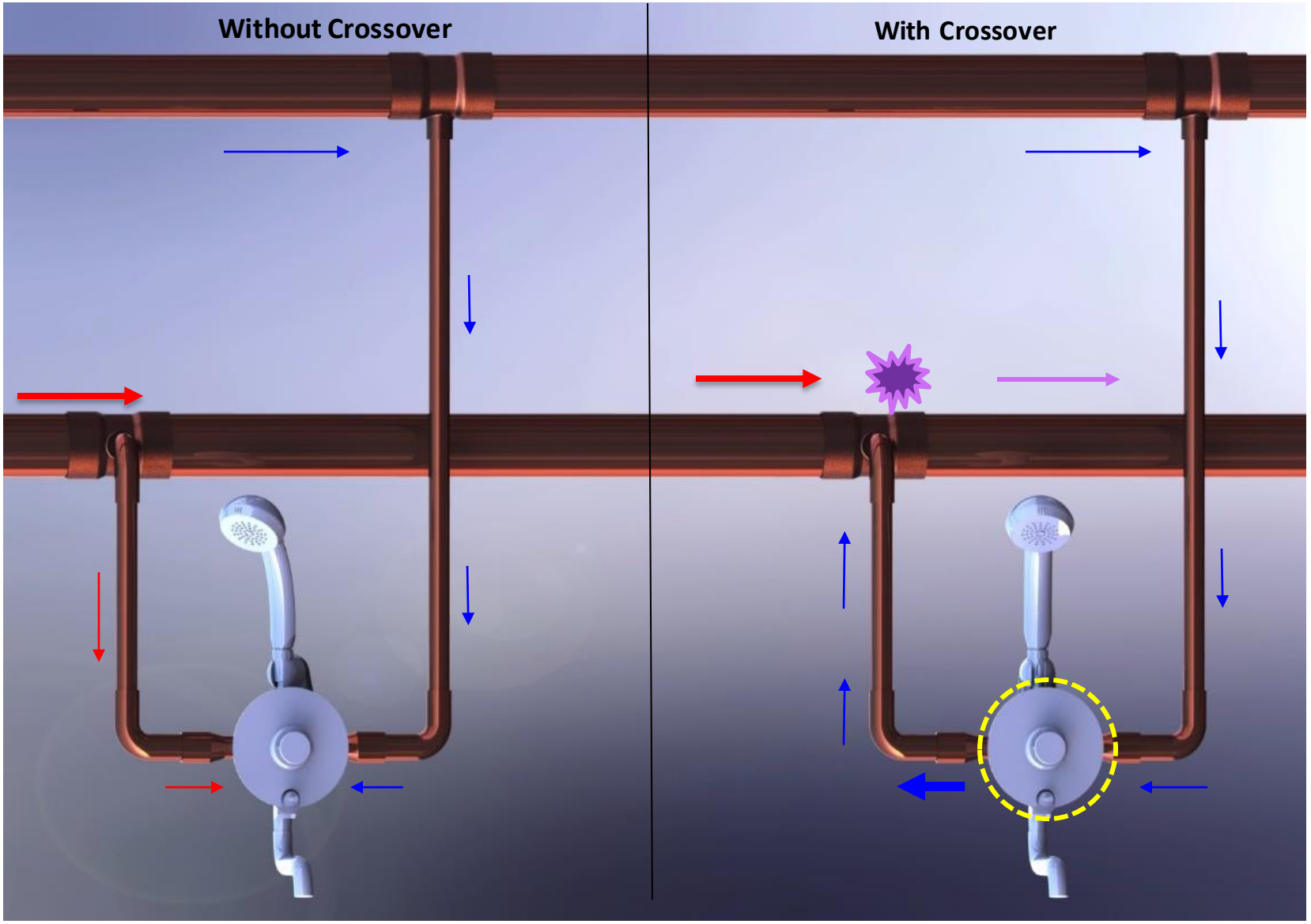
2015 International Energy Conservation Code (IECC), (Mandatory Requirement)

US Department of Energy – ZERH (Mandatory Requirement)

Crossover Prevention

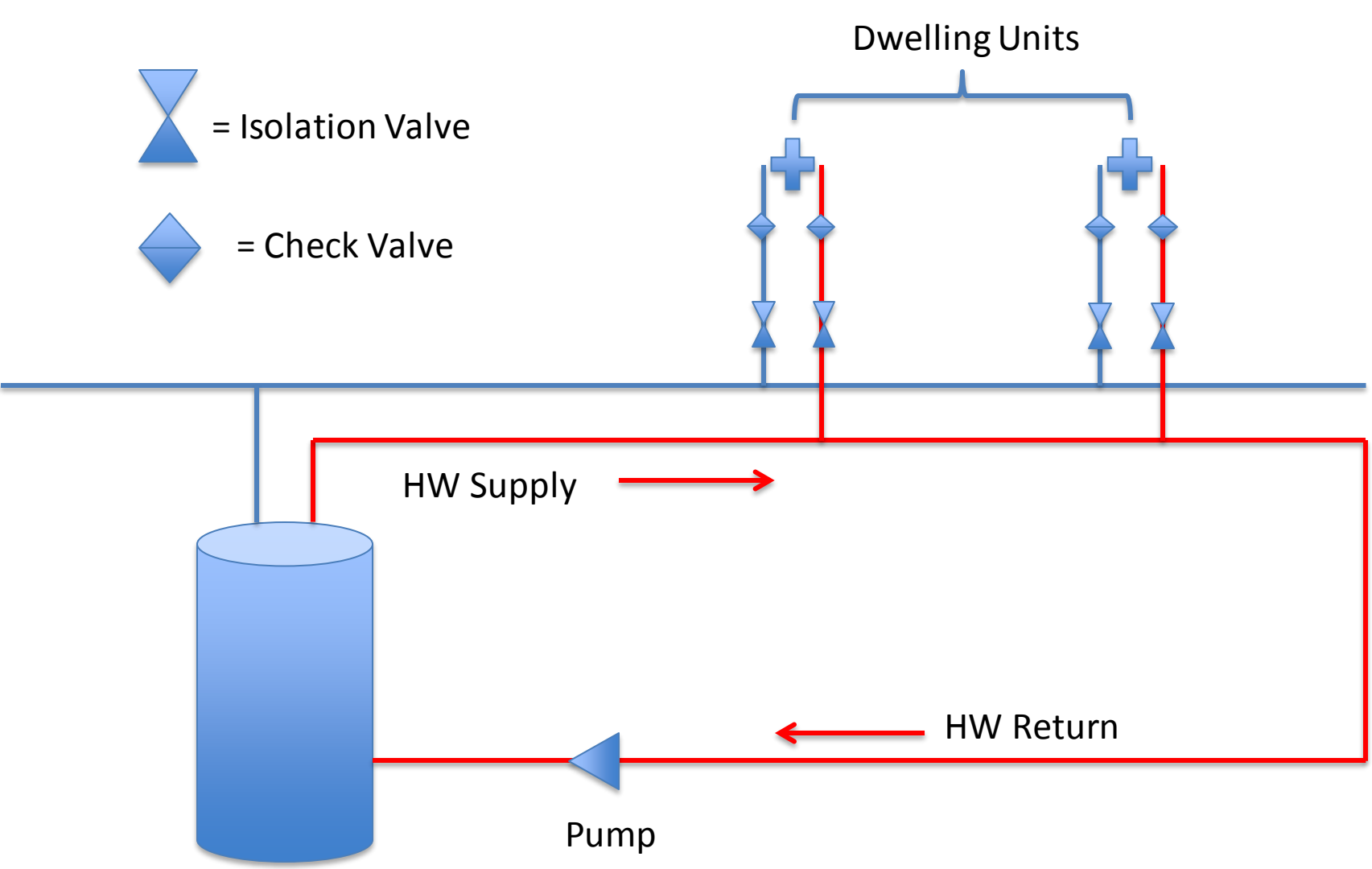


What is Crossover?



Crossover Prevention Methods

- Use only ASSE 1016 approved valves with integral check valves
- Add check valves to all incoming hot/cold pipes per unit
- Ensure check valves on cold water main, hot water return pipe
- Make access to shower valves easy, for cartridge or valve replacement


Dwelling Units
= Isolation Valve
= Check Valve
HW Supply
HW Return
Pump

Optimized Loop Design

Optimized Recirculation Loop Design

- Minimize distances from heating source to recirculation loop and from the loop to the fixtures
- Use dual loops, instead of one loop, serving same number of units
- Keep Mechanical Room in central part of the building, recirculation loop on middle floor
- Avoid 90˚ pipe turns, use sweeping or wide-radius elbows to minimize friction losses

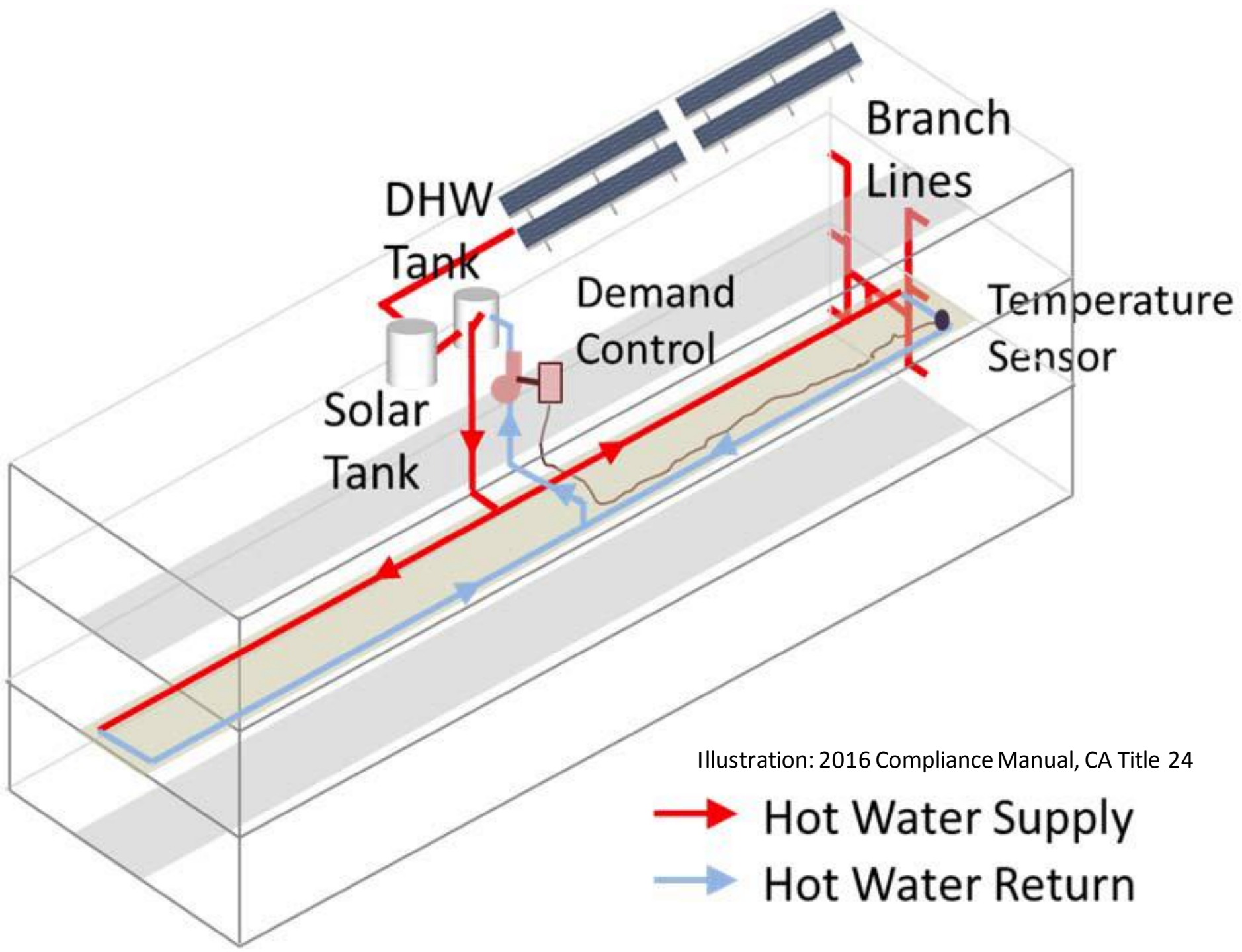


Illustration: 2016 Compliance Manual, CA Title 24

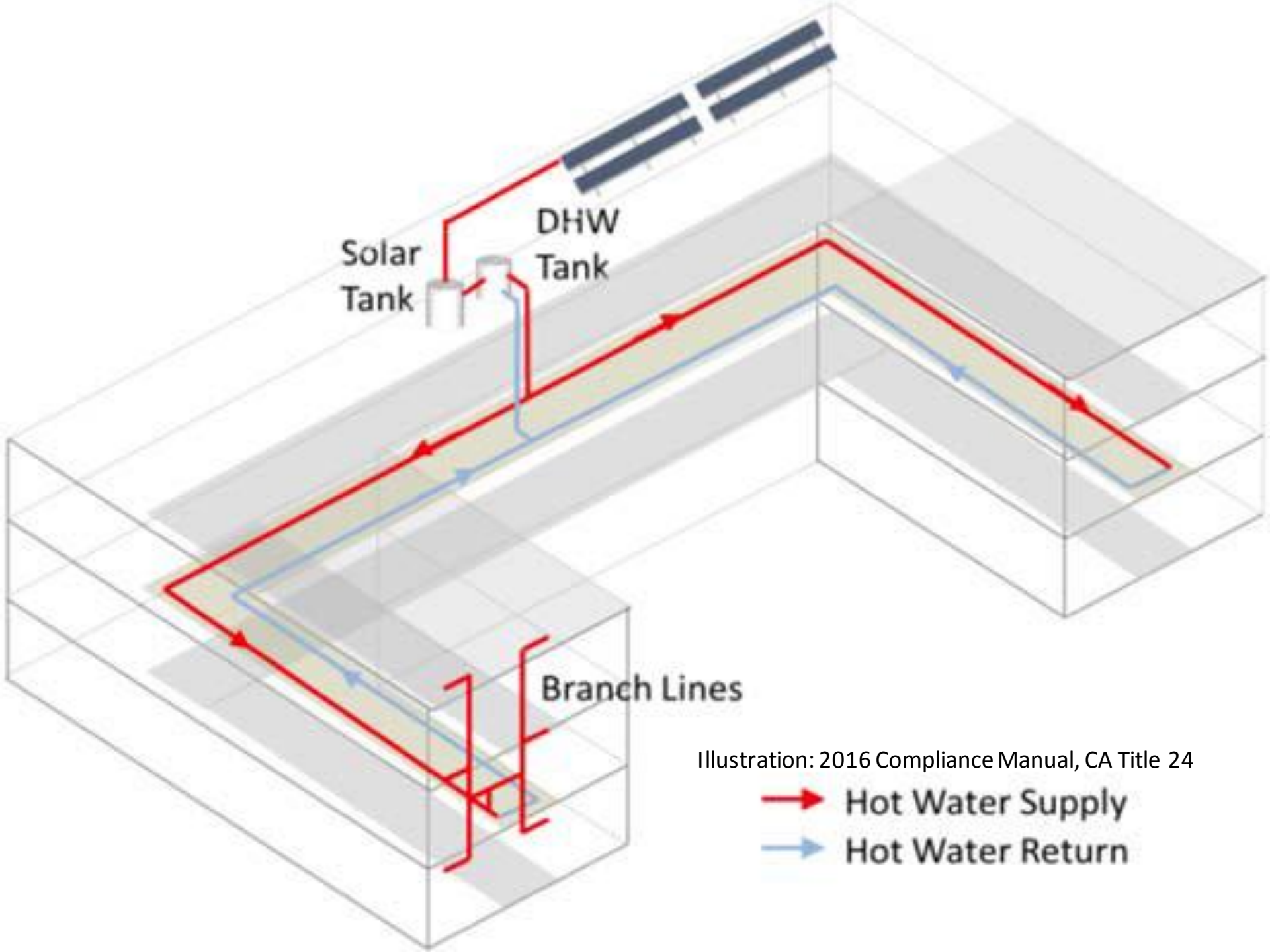
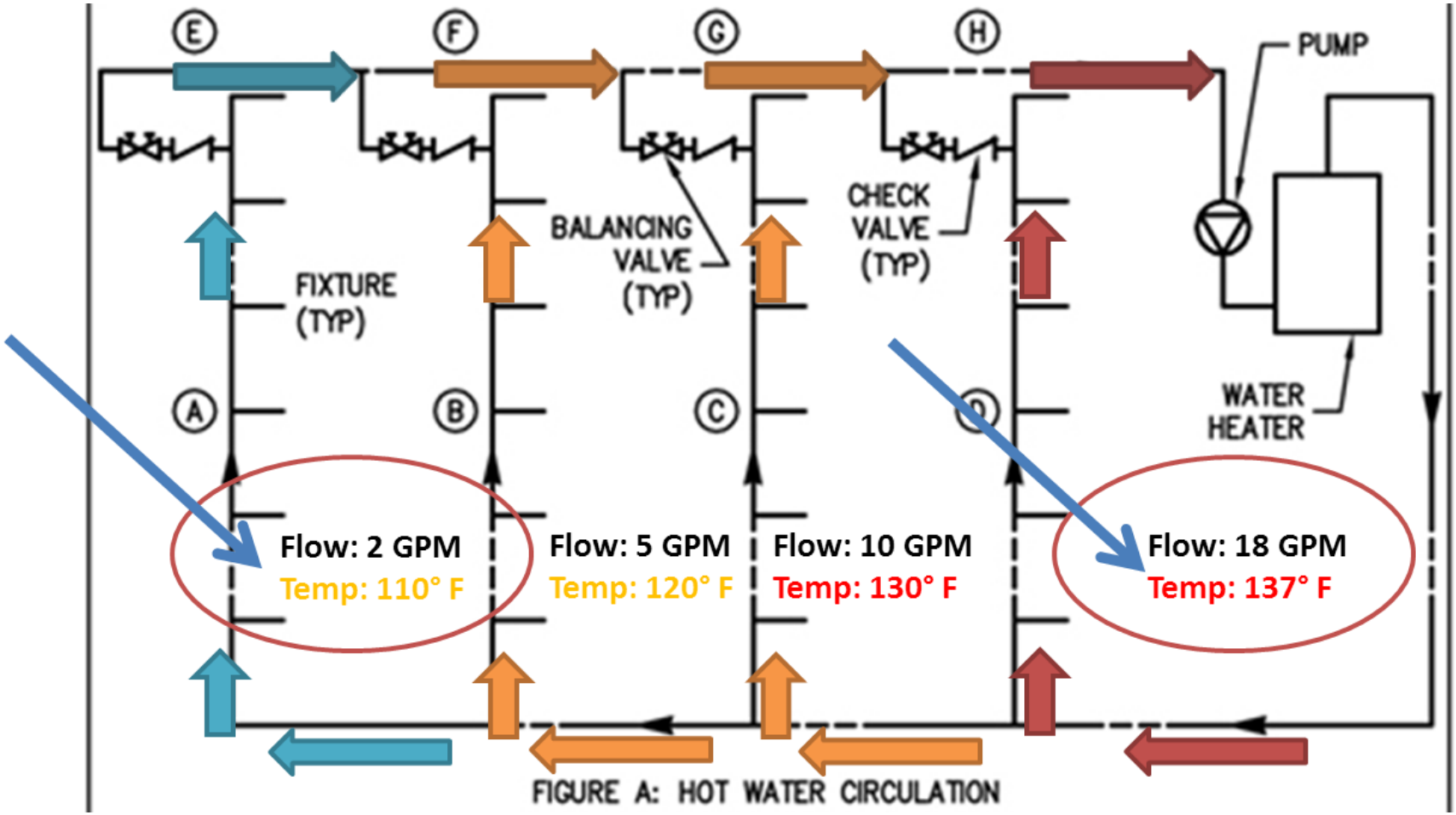


Illustration: 2016 Compliance Manual, CA Title 24

System Balancing

What is unbalanced Circulation?




“We shape our buildings;
thereafter, they shape us”
-Winston Churchill

ZERO ENERGY READY HOME
U.S. DEPARTMENT OF ENERGY
PARTNER

Thank You!

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