TITLE 24, PART 6 | 2028 CODE CYCLE

Circulator Pump Controls

Codes and Standards Enhancement (CASE) Proposal

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CALIFORNIA ENERGY CODES & STANDARDS
A STATEWIDE UTILITY PROGRAM

Proposal Description

- Code Change Proposal
- Benefits
- Background Information

Proposed Code Change

- **New prescriptive requirement** for **digital controls** for circulation pumps in service water heating systems in nonresidential buildings
- **Add NR Appendix** for guidance on **which control method** to use in Riser and Non-riser systems
- Required controls:
  - Constant return temperature
  - Demand control (in non-riser systems)
  - Differential or Constant pressure (in riser systems)

See Title24stakeholders.com for proposal description, justification, draft code language, and requested data

Benefits of the Proposed Change

- Utilize digital pump controls to reduce circulator pump energy consumption
- Reduce heat loss in pipes, reducing water heater energy use
- More consistent HW supply and return temperature
- Reduced destratification risk will mitigate HW runouts and may improve heat pump COP
- Digital controls are easier to set up and more persistent than analog controls

Background Information

- Currently no prescriptive requirements for nonresidential central water heating systems in Section 140.5
- NREL & NEEA research suggests adding controls to pumps has significant electricity savings
  - The research only evaluated pump savings not savings from water heater
  - Savings are from pumps running at less than 100% when not needed

Marked-up Code Language

See Title24stakeholders.com for marked-up code language

Title 24, Part 1	Title 24, Part 6	Reference Appendices
▪ No changes	▪ SECTION 110.3 – MANDATORY REQUIREMENTS FOR SERVICE WATER-HEATING SYSTEMS AND EQUIPMENT ▪ SECTION 140.5(a) Nonresidential Occupancies	▪ NA10 Circulating Pump Controls

Market and Technical Considerations

- Current Conditions and Trends
- Potential Barriers and Solutions
- Technical feasibility

Current Market Conditions

- Current market offerings are focused on controls in circulation pumps for hydronic systems
  - Differential pressure
  - Constant pressure
- There are some suitable for service hot water heating systems:
  - Bell & Gossett, ecocirc XL
  - Taco, 00e
  - Grundfos, MAGNA3
- Validated controls:
  - Constant return temperature
  - Demand control (in non-riser systems)
  - Differential or Constant pressure with balancing valve (in riser systems)
- Non-validated controls:
  - Adaptive or smart controls

Market Barriers and Solutions

Market Barriers	Potential Solutions
1. Not common industry practice 2. Design & installation experience 3. Product availability of pump controls in Service Water Heating circulation	1. Awareness or training 2. Training and best practices

Current Market Share

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Market share: percentage of buildings that already use the proposed technology or design practice (at or above the proposed stringency level)

Current Market Share

New Construction and Additions	**X%** ▪ Text ▪ Text
Alterations	**X%** ▪ Text ▪ Text

Poll

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Manufacturers: Are you planning on introduction more pumps for service water heating systems? **If yes, please elaborate**

Open ended response

Poll

Contractors or Designers:
Do you specify or install pump controls? If so which ones?

a. Aquastat
b. Timeclock
c. Both
d. Constant pressure
e. Other
f. I do not specify or install pump controls

Poll

When servicing controls, which ones are still working? Are controls bypassed or manually turned off? If so, which ones?

Open ended response

Technical Considerations

- Digital controls have several benefits compare to analog controls
  - Analog are often defeated:
    - Can be set in the always on position
    - Timers could desync from actual time (daylight savings time)
    - Aquastat can fail for unrelated system issues
    - Controls installed but never turned on or commissioned
- Riser distribution systems have poor compatibility with non-continuous recirculation controls
- Non-riser recirculation systems in large buildings have poor compatibility with purely demand controls, require pump cycling periodically to maintain desired minimum temperature in the distribution system (auto prime)
- Smaller NR, continuous and non-continuous controls are viable

Technical Barriers and Solutions

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Technical Barriers	Potential Solutions
	1. Training and best practices for designers 2. Training and best practices for installers

Poll

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When does an auto-adapt control method work?

Open ended response

Poll

What else should we know? Are there market or technical barriers or solutions that should be considered?

Open ended response

Per Unit Energy and Cost Impacts

Methodology and Assumptions

- Energy and Energy Cost Savings
- Incremental Costs

Energy and Energy Cost Savings Methodology

- Preliminary energy savings assuming a constant return temperature control strategy
- Nonresidential building type analyzed
- Baseline assumption is circulator pump with ECM and single speed operation
- Future analysis will include other advanced control strategies, will result in increased energy savings
- Data sources:
  - Literature review
  - Field testing (Code Readiness)

Preliminary Savings Estimates

ECM Circulator Pump with Controls	First Year Statewide Electricity Savings (GWh)	First Year Statewide Natural Gas Savings (Million Therms)	Confidence Level (low, medium, high)
NR new construction	5.7	0.3	Low

*per square foot for nonresidential buildings.

Preliminary field savings

- Non-riser system:
  - TBD
- Riser system:
  - TBD

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Energy Modeling Assumptions

- Simulating energy savings in custom spreadsheet calculation
- Simulating using the following prototypical buildings and climate zones
- Included existing and new construction

Prototypical Buildings

- Office (large, medium, small)
- School (large, small)
- Laboratory
- Restaurant
- Grocery

Climate Zones

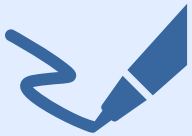
- CA Climate Zones 1 to 16

Key Modeling Assumptions

Prototypes: Large Office, Medium Office, Large School, Small School, Hospital, Assembly, Laboratory, Restaurant, Grocery, Manf, Misc

Standard Design

1. Circulation pump with ECM motor & no controls



Proposed Design

1. Pump with constant return temperature controls

Incremental Cost Framework

Prototype(s): Large Office, Medium Office, Large School, Small School, Hospital, Assembly, Laboratory, Restaurant, Grocery, Manf, Misc

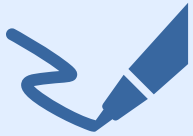
Baseline

First Cost

1. Installation of system and piping
2. Commissioning

30-Year Maintenance Costs

1. Equipment Replacement
2. Regular maintenance of system



Proposed

First Cost

1. Installation of system and piping
   - Including a pump with digital controls
2. Commissioning

30-Year Maintenance Costs

1. Equipment Replacement
2. Regular maintenance of system

Approach for Gathering Costs

- Develop Basis of Design and obtain cost data for baseline and measure case
- Collect cost data from:
  - **Contractors**
  - **Distributors**
  - **Installers**
  - **Consultants**
- Review published studies
- Review other codes and standards development efforts (ASHRAE & California Reach Codes)

Compliance Verification

- Key Aspects of Compliance Verification
- Barriers and Solutions
- Revisions to Compliance Software

Key Aspects of Compliance Verification

- Verification would be via self-attestation on the design (NRCC) and installation (NRCI) forms
  - Add single check box to NRCC-PLB Table H
  - Add line item to NRCI-PLB Table F
- Would include reference appendix with guidance based on application and control strategy

Compliance Barriers and Solutions

Compliance Verification Barriers	Potential Solutions
1. Added workload on form owners and plan checkers to understand, review, and verify additions	1. Explaining possible simple check box approach, and providing compliance manuals

Compliance Software Updates

- The Statewide CASE Team will document modifications needed in the compliance software to account for the new prescriptive requirements
  - User inputs to indicate the intended pump control method
  - Updates to the performance software to calculate the energy impact of the selected control method

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More information on
CEC's 2028 proceeding website.

We want to hear from you!

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Cost Effectiveness Results

Climate Zone	Benefits *30-year Energy Cost Savings + Other PV Savings* (2029 PV$)	Costs *Total Incremental PV Costs* (2029 PV$)	Benefit-to-Cost Ratio
1	$#,### – $#,###	$#,### – $#,###	#.# – #.#
2			
3			
4			
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16			

Results vary by prototypical building

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