

Commercial Boilers

CEC Staff Workshop

California Statewide Utility Codes and Standards Program

PECI
August 17, 2011

Boilers

Proposed code changes (mandatory)

- Combustion air positive shutoff
 - Combustion fan VFD
 - Parallel position control
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Boilers

Proposed language: Flue damper

SECTION 113 – MANDATORY REQUIREMENTS FOR SERVICE WATER-HEATING SYSTEMS AND EQUIPMENT

113(c) Installation.

7. Combustion air positive shut-off shall be provided on all natural draft and forced draft boilers as follows:

A. All boilers with an input capacity of 0.70 MMBtu/h (700,000 Btu/h) and above.

B. All boilers where one stack serves two or more boilers with a total combined input capacity per stack of 0.70 MMBtu/h (700,000 Btu/h).

C. All boilers when combustion air positive shut-off would significantly reduce air flow, and consequently boiler heat loss, during standby and shutdown periods.

Boilers

Proposed language: Fan VFD

8. Boiler combustion air fans with motors 10 horsepower or larger shall meet one of the following:

A. The fan motor shall be driven by a variable speed drive.

B. The fan motor shall include controls that limit the fan motor demand to no more than 30 percent of the total design wattage at 50 percent of design air volume.

Boilers

Proposed language: Parallel position

9. Boiler systems with input capacity 5 MMBtu/h (5,000,000 Btu/h) or larger shall maintain excess (stack-gas) oxygen concentrations at less than or equal to 5.0% by volume on a dry basis over the entire firing range. Combustion air volume shall be controlled with respect to firing rate or flue gas oxygen concentration. Use of a common gas and combustion air control linkage or jack shaft is prohibited.
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Boilers

Combustion air positive shutoff

- Energy Analysis

- Combustion air positive shut off saves 30% of total standby losses
 - Standby losses are 2% of rated fuel input.
 - 2722 hrs/year boiler operation per eQUEST models
 - Fuel is natural gas at \$1.27/therm
 - PV avg over measure lifetime excluding summer months
 - LCCA payback threshold is 11.94 years
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Boilers

Combustion air positive shutoff

- **Incremental Installed Cost**
 - Cost data provided by a flue damper manufacturer
 - Incremental cost to a boiler manufacturer for a flue damper is \$750
 - Their mark-up to end user was conservatively estimated to be 100%
 - Total incremental installed cost of \$1500
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Boilers

Combustion air positive shutoff

- **Maintenance Cost**
 - \$50 controller replacement every 10 years with 1 hour labor at \$100/hr.
 - Present value maintenance cost of \$112 at 3% discount rate.
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Boilers

Combustion air positive shutoff

- Life Cycle Cost Results
 - Input capacity 0.70 MMBtu/h

Incremental Installed Cost	\$1,500
Maintenance	\$150
PV of Maintenance (Year 10)	\$112
Total Incremental Cost	\$1,612
PV of Energy Savings	\$1,734
Lifecycle cost savings	\$122
Benefit/Cost Ratio	1.1

Boilers

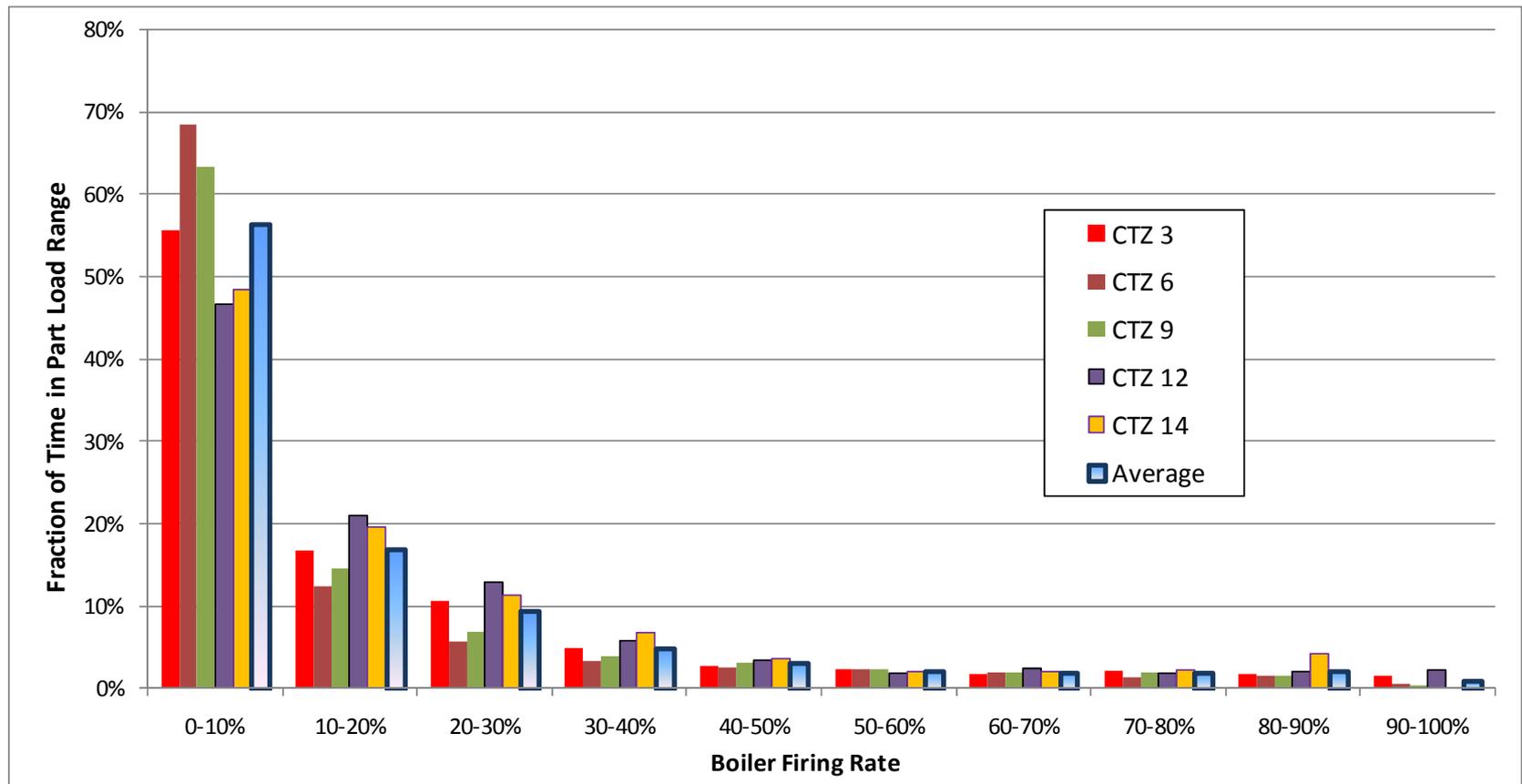
Combustion fan VFD

- Energy Analysis
 - 2722 hrs/year boiler operation
 - Motor load factor is 70%
 - Electricity cost is \$0.13/kWh
 - PV avg over measure lifetime excluding summer months
 - LCCA payback threshold is 11.94 years
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Boilers

Combustion fan VFD

- Energy Analysis
 - Boiler Run-Time Histogram



Boilers

Combustion fan VFD

- Incremental Installed Cost
 - Incremental cost data provided by RS Means and verified with cost data from PECCI's California RCx program data

Size (hp)	2013 Equipment Cost	Controls Programming: 8 hrs	Incremental Installed Cost	Cost/HP
3	\$2,753	\$800	\$3,553	\$1,184
5	\$2,898	\$800	\$3,698	\$740
7.5	\$3,449	\$800	\$4,249	\$567
10	\$3,449	\$800	\$4,249	\$425
15	\$4,318	\$800	\$5,118	\$341
20	\$5,738	\$800	\$6,538	\$327
25	\$6,898	\$800	\$7,698	\$308
30	\$7,999	\$800	\$8,799	\$293
40	\$10,839	\$800	\$11,639	\$291
50	\$12,172	\$800	\$12,972	\$259
60	\$13,795	\$800	\$14,595	\$243

Boilers

Combustion fan VFD

- **Maintenance Cost**
 - Incremental maintenance cost is a conservative estimate of 0.5 hr/yr at a labor rate of \$100/hr.
 - PV of the annual maintenance discounted by 3% over 15 years is \$597.
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Boilers

Combustion fan VFD

- Life Cycle Cost Results
 - 10 HP motor

Incremental Installed Cost	\$4,249
Incremental Annual Maintenance	\$50
PV of Annual Maintenance	\$597
Total Incremental Cost	\$4,846
PV of Energy Savings	\$6,333
Lifecycle cost savings	\$1,487
Benefit/Cost Ratio	1.3

Boilers

Parallel position control

- **Energy Analysis**
 - Parallel positioning control is standard with low- and ultra-low NOx burners
 - Base case is boiler with single-point control and without low- or ultra-low NOx burner
 - Measure case is parallel positioning control and without low- or ultra-low NOx burner
 - Base case excess air (oxygen) ranges from 40% (6.5%) at high fire to 80% (10%) at low fire
 - Measure case excess air (oxygen) is 28% (5%)
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Boilers

Parallel position control

- Energy Analysis
 - Net temperature difference (stack temp – intake temp) is 170°F
 - 2722 hrs/year boiler operation
 - Fuel is natural gas at \$1.27/therm
 - LCCA payback threshold is 11.94 years
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Boilers

Parallel position control

- **Incremental Installed Cost**
 - Incremental cost data was provided by 4 boiler controls reps
 - Total installed incremental costs from all 4 sources ranged from \$8,000 to \$9,000
 - Price does not vary with boiler capacity, at least between 50 HP (1.7 MMBtuh) and 1500 HP (50 MMBtuh)
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Boilers

Parallel position control

- **Maintenance Cost**

- A boiler's air/fuel ratio is adjusted during boiler tuning. This occurs for both the base case and the measure case but requires more time for the measure case.
 - The incremental maintenance cost is a conservative estimate of 4 hours per year at a labor rate of \$100/hr. The PV of the annual maintenance discounted by 3% over 15 years is \$4,775.
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Boilers

Parallel position control

- Life Cycle Cost Results
 - 150 HP (5 MMBtu/h) boiler:

Incremental Installed Cost	\$9,000
Incremental Annual Maintenance	\$400
PV of Annual Maintenance	\$4,775
Total Incremental Cost	\$13,775
PV of Energy Savings	\$15,984
Lifecycle cost savings	\$2,209
Benefit/Cost Ratio	1.2

Boilers

Contact

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