

Process Boilers CEC Staff Workshop

California Statewide Utility Codes and Standards Program

PECI
April 11, 2011

Process Boilers

Proposed code changes (mandatory)

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

Proposed language

Definitions:

PROCESS is an activity or treatment that is not related to the space conditioning, lighting, service water heating, or ventilating of a building as it relates to human occupancy.

PROCESS LOAD is a load resulting from a process.

PROCESS BOILER is a boiler serving a process load.

Process Boilers

Proposed language: Flue damper

SECTION 127 – REGULATED PROCESS EQUIPMENT

127(a) Process Boilers.

1. Combustion air positive shut-off shall be provided on all natural draft and forced draft process boilers as follows:
 - A. All process boilers with an input capacity of 0.70 MMBtu/h (700,000 Btu/h) and above.
 - B. All process 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 process boilers when combustion air positive shut-off would significantly reduce air flow, and consequently boiler heat loss, during standby and shutdown periods.
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Process Boilers

Proposed language: Fan VFD

2. Process 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.
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Process Boilers

Proposed language: Parallel position

3. Process 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.

Process 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.
 - 2920 hrs/year boiler operation (8-hour shift x 365 days/year)
 - Fuel is natural gas at \$1.22/therm
 - LCCA payback threshold is 11.94 years
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Process 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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Process 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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Process 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	\$1,791
Lifecycle cost savings	\$179
Benefit/Cost Ratio	1.1



Process Boilers

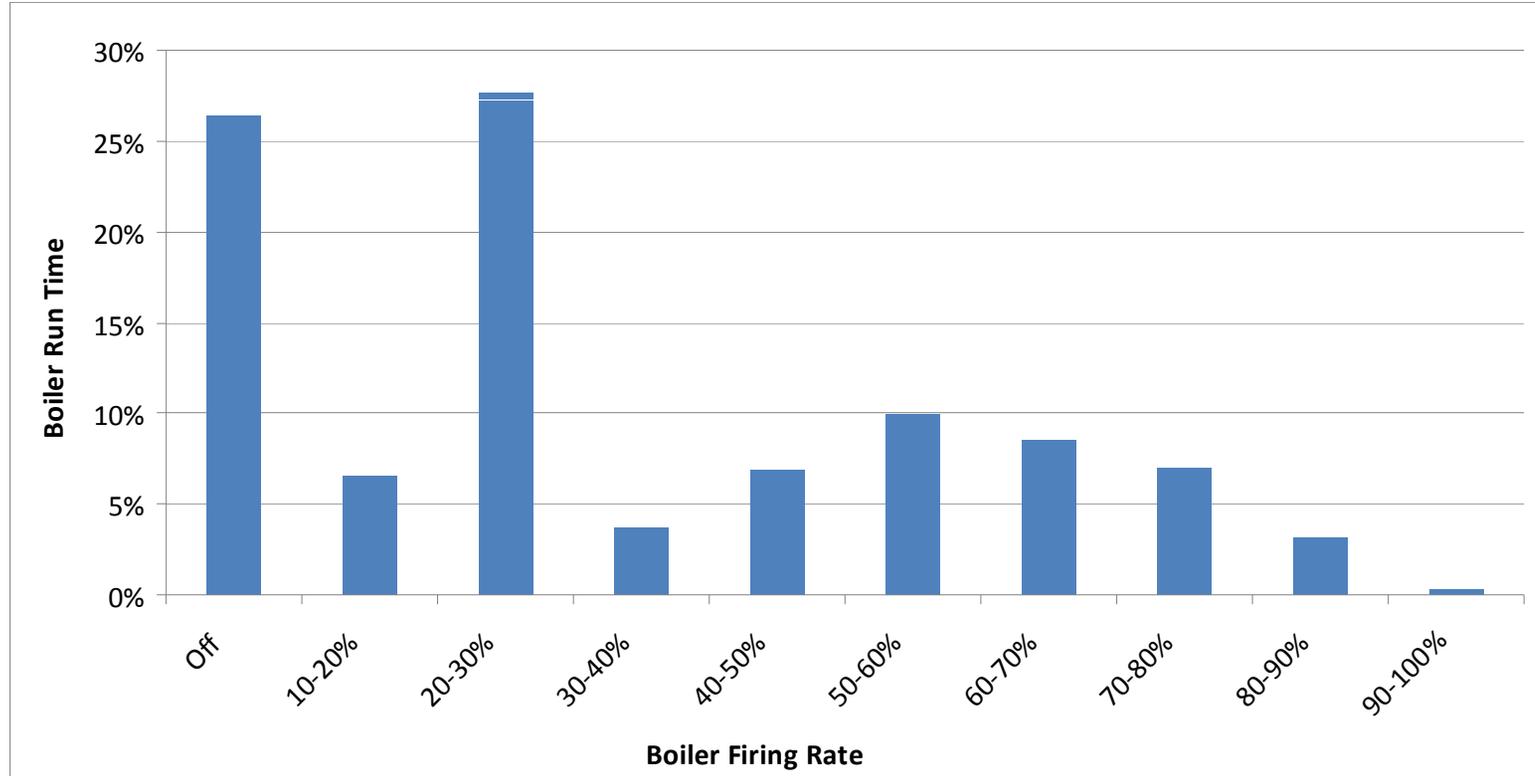
Combustion fan VFD

- Energy Analysis
 - 2920 hrs/year boiler operation
 - Motor load factor is 70%
 - Electricity cost is \$0.16/kWh
 - LCCA payback threshold is 11.94 years
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Process Boilers

Combustion fan VFD

- Energy Analysis
 - Boiler Run-Time Histogram



Process 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

Process 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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Process 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	\$13,264
Lifecycle cost savings	\$8,418
Benefit/Cost Ratio	2.7

Process Boilers

Parallel position control

- **Energy Analysis**

- Parallel positioning control is standard with low- and ultra-low NO_x burners
 - Base case is boiler with single-point control and without low- or ultra-low NO_x burner
 - Measure case is parallel positioning control and without low- or ultra-low NO_x 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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Parallel position control

- Energy Analysis
 - Net temperature difference (stack temp – intake temp) is 170 ° F
 - 2920 hrs/year boiler operation
 - Fuel is natural gas at \$1.22/therm
 - LCCA payback threshold is 11.94 years
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Process 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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Process 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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Process 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	\$24,756
Lifecycle cost savings	\$10,981
Benefit/Cost Ratio	1.8

Process Boilers

Contact

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