How Boiler O&M Strategies Save Energy

Proper operations and maintenance (O&M) practices will reduce fuel costs, increase safety and reliability, and lengthen equipment life. By periodically checking and testing boiler components and input and output streams, the operator can determine the operational efficiency of the boiler. Comparison to previous test results allows early detection and correction of system degradation.

Boiler O&M Energy-Saving Strategies

- *Maintenance logs* are a key part of a boiler maintenance program. They give vital information on typical boiler performance under differing loads as well as a record of maintenance and repairs. Kept in an orderly fashion, they remind maintenance staff when tests, inspections or servicing are due and allow staff to quickly compare recent and historical boiler performance.

- *Air-to-fuel ratios* compare the amount of air supplied to the combustion process to the amount of fuel. Each boiler has an optimum range of air-to-fuel ratios. For gas boilers, this should be from 5 to 10 percent more air (referred to as excess air) than required to provide exactly enough oxygen to combine with the fuel. Excess air is determined from analyzing oxygen or carbon dioxide concentrations in the flue gas. Too little results in unburned combustibles—carbon monoxide—and too much results in elevated stack temperatures. Carbon monoxide concentrations should always be checked following adjustment to ensure this poisonous gas is not being formed.

- *Diagnostics and inspections* should be done regularly to ensure subsequent adjustments are made to a sound boiler with full understanding of its operation. Otherwise, adjustments may be made based on inaccurate information. Boilers should be checked for air leaks before flue-gas testing—the only air entering should be controlled by the burner. Steam and water leaks should also be located and repaired before attempting to optimize boiler performance. In multiburner boilers, combustion uniformity should be checked.
• **Combustion uniformity** is essential if accurate air-to-fuel ratios are to be achieved in multiburner systems. One misadjusted burner can lead to erroneous excess air test results if combustion gases from that burner are sampled by the stack gas analyzer probe. The tendency is to adjust all burners according to the analysis when adjustment of just one burner would resolve the problem. Specialists are often hired to check for combustion uniformity.

• **Clean heat transfer surfaces** ensure the most efficient heat transfer. Natural gas burns clean, so fire-side surfaces tend not to foul in gas-fired boilers, but scale deposits on the water side act as insulation, reducing boiler efficiency by as much as 10 percent. Excess scaling can lead to boiler tube blistering and ultimately to tube failure.

• **Insulation** of the boiler, steam and condensate lines and all fittings reduces heat loss from the system. Wet or damaged insulation needs to be repaired after the source of moisture has been repaired.

• **Stack temperatures** more than 150°F above the saturation temperature of the steam indicate efficiency losses—too much heat is going up the stack, due to too much air delivered for combustion or to fouled heat transfer surfaces. If tests show excess air of 5 to 10 percent, the high temperatures are likely due to scale buildup on the water side of heat transfer surfaces. Excess air values greater than 10 percent indicate a need for burner adjustments. A combination of the two problems may also be the cause.

• **Oxygen (O\textsubscript{2}) analyzers** are often installed on large boilers to measure flue gas O\textsubscript{2} content and can provide highly useful ongoing combustion efficiency information. They are sometimes used along with burner controls to automatically adjust the air-to-fuel ratio. The analyzer probe must be placed to obtain a representative sample of the flue gas; even better is installing a grid of samplers to obtain an overall picture of combustion. It is also essential the analyzer be accurately calibrated using calibration gases of known concentration. If sample lines are plugged or leaking, even following manufacturer's procedures does not guarantee accuracy.

• **Steam pressure reduction** can provide some energy savings if existing steam pressures are greater than the highest-pressure load (including transmission losses). Savings are not likely to be more than 1 or 2 percent, but they can be obtained at little or no cost.

• **Blowdown management** is required to maintain acceptably low concentrations of solids in the boiler water without wasting energy. Blowdown is the necessary process of venting some of the heated boiler water to carry out unwanted high solids concentrations. This wastes some of the heated water, but failure to blow down the system leads to scale on heat transfer surfaces.

• **Load management** coordinates the operation of multiple boilers to ensure all loads are met in the most efficient manner. This often means shutting down some boilers during periods of low load so that the remaining boilers can operate at more efficient higher firing rates.
Benefits and Pitfalls

Proper boiler maintenance always provides benefits: operating efficiency, safety and avoided downtime. Pitfalls are due to inappropriately applied maintenance strategies.

Benefits

- Maintenance logs provide a history of problems, resolutions and maintenance on each boiler-personnel changes will not interrupt efficient system operation.
- Proper maintenance will keep boilers operating at optimum efficiency, avoiding increased fuel costs associated with inefficient operation.
- Regularly-scheduled maintenance and reference to historical boiler records will help identify developing problems so they can be addressed before they become significant.

Pitfalls

- Adjusting air-to-fuel ratios based on inaccurate excess air values leads to inefficient combustion. Such inaccuracies can arise from air leakage into the system or non-representative flue gas samples. High oxygen readings with normal or low stack temperatures indicate air leakage; high stack temperatures may result from too much combustion air, but may also be caused by scale buildup.
- Insufficient caution when cleaning heat transfer surfaces can directly damage the surfaces. Removed too quickly, loosened scale may plug water circulation passages.
- Not accounting for transmission losses when reducing steam pressure can lead to insufficient pressure at the load.
- Reducing air-to-fuel ratios to just before the point of producing carbon monoxide may result in later problems. A subsequent increase in humidity or drop in atmospheric pressure can result in deficient excess air and carbon monoxide formation. It is better to provide a conservative margin of 1 to 2 percent extra excess air above the point of carbon monoxide formation.

For More Information

Contact your PG&E representative or call 1-800-468-4743 for more information about PG&E's energy efficiency programs and other services.


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