Efficient Hospital Boilers Result in Financial, Environmental, and Safety Payoffs

Because of the high cost of an energy plant, boilers often are expected to last for the life of the facility for which they are purchased. Hospitals, therefore, benefit greatly by protecting this investment.

Boilers represent one of a hospital's largest facilities-related capital expenditures. They are costly to purchase and expensive to operate, particularly as the cost of energy continues to rise. Yet boilers, when properly sized, operated, and maintained, offer major opportunities for hospitals to save energy—resulting in financial and environmental benefits.

Boilers provide the hospital with steam or hot water for vital needs, such as space heating and a variety of process uses. Yet boilers can be dangerous, waste energy, and harm the environment. This fact sheet has been developed by the U.S. Department of Energy's Hospital Energy Alliance to highlight energy-efficient technologies and practices that reduce energy costs and address environmental and safety issues.

Operations and Maintenance is Vital

Almost two-thirds of the commercial-size hot-water boilers in the United States are more than 20 years old.[1] While proper operations and maintenance (O&M) is important to keep any system running at peak efficiency, O&M is especially important to older systems. Following are five essential O&M activities.

Optimize blowdown performance—Blowdown controls the buildup of solids in the boiler water; it protects the boiler's surfaces, enhances heat transfer, and ensures a safe chemical concentration. Unfortunately, blowdown often is either neglected or overused during routine maintenance. Optimizing blowdown performance reduces energy use.

- Make sure blowdown is at the appropriate rate, typically 4 percent to 8 percent of the boiler feedwater flow rate. The rate is determined by several factors, including boiler type, operating pressure, water treatment, and quality of makeup water.
- Install automatic blowdown controls that constantly monitor boiler water conductivity and adjust the blowdown rate accordingly. Such controls range in cost from $2,500 to $6,000 and typically have a one- to three-year payback.[2]

Maintain steam traps—Malfunctioning steam traps can waste thousands of dollars a year in energy costs and equipment damage. Leaks contribute to unstable boiler operating pressure and abnormally warm rooms. Oversized traps can lead to the release of live steam, reducing energy efficiency and causing safety hazards. Dirt can plug a valve or prevent it from closing, resulting in fuel loss. Steam traps should be checked regularly.

- Identify and correct steam leaks. Consider an automated steam trap monitor that allows for the monitoring of as many as 16 steam traps.
- Make sure that traps are correctly sized and located for easy maintenance.
- Keep traps clean.

Tune combustion air—Combustion efficiency is compromised by the accumulation of soot and other fouling in the combustion area and by excess combustion air. Tuning reduces accumulations and excess air. Every 15 percent reduction in excess air increases boiler efficiency by 1 percent.[3]

- Check for and repair air leaks and reduce excess air.
- Consider an automated oxygen trim system.
- Consider using an air economizer to preheat air and improve efficiency. Using heat recovery—drawing on the top stack hot air for the combustion air inlet—represents a low-cost option.

Keep equipment clean—As little as one-eighth inch of soot can decrease boiler efficiency by as much as 8 percent.[4]

- Clean combustion surface of accumulated combustion byproducts.
- Ensure that fire-side surfaces have adequate access to air to avoid soot buildup.

1. Boiler Retrofit vs. Replacement, HPAC Engineering, January 1, 2009. http://hpac.com/heating/boiler_retrofit_vs/.
2. http://www1.eere.energy.gov/industry/bestpractices/pdfs/steam23_control_system.pdf.
3. http://www.fypower.org/bpg/module.html?b=food__and_bev&m=Boilers.
4. Ibid.

Treat water impurities—Impurities such as scale, calcium, and other metals can reduce a boiler's efficiency by as much as 12 percent.[5] Ensuring that feedwater is treated correctly before being pumped into the boiler reduces the buildup of impurities.

- Add chemical treatments, clarifiers, and filters to help eliminate impurities.

Upgrading the Boiler System

Some hospitals may need major boiler renovations and upgrades. Large-scale improvements might involve the following:

Load matching—Over time, a facility's energy demand might change. For example, kitchen or laundry services might be added or outsourced. Hospitals should ensure that replacement boilers are the right sizes for the actual heating demand. Effective boiler load management techniques can save more than 7 percent of a hospital's energy use.[6]

- Consider modular boilers or multiple smaller units instead of redundant boilers.
- Consider point-of-use steam for hospitals with limited steam loads.

Combined heat and power systems (CHP)—Hospitals, because of their 24/7 nature, can be ideal facilities for CHP systems. CHP systems offer lower, more predictable energy costs, increased reliability, and sometimes the ability to generate revenue.

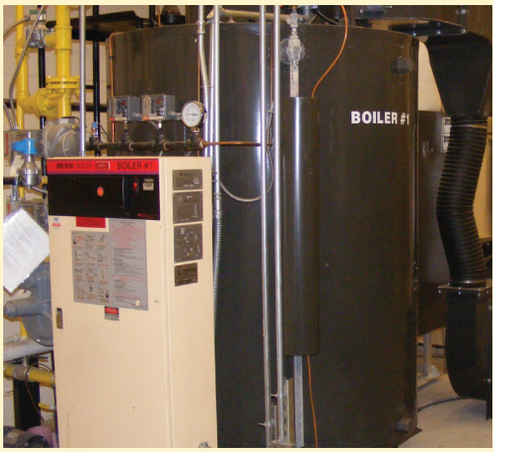
5. http://www.fypower.org/bpg/module.html?b=food__and_bev&m=Boilers.
6. http://www.uiof.org/best/steam/indexsteam.html.

Case Study

Duke Raleigh Hospital

Raleigh, North Carolina • Installations in 2005 and 2007

Duke Raleigh Hospital, which opened in 1978, is a 260,782-square-foot, 186-bed acute care facility that is part of the Duke University Health System. Faced with the challenge of high fuel costs, as well as limited water during periods of drought, the hospital's engineering staff recommended that the facility improve boiler efficiency to save energy and minimize water consumption. As a result of installing three new fuel-efficient and more environmentally friendly boilers, the hospital dramatically increased its energy efficiency—while conserving water at the same time.



Details

- Installed two dual-fuel 200 boiler horsepower (bhp) units at 6.7 MMBtu/hr.
- Installed one gas-fired 100 bhp unit at 3.35 MMBtu/hr two years after the original installation.
- Boilers produce steam for equipment sterilization and hot water for cooking, dishwashing, domestic hot water heating, and general heating.

Results

- Payback time for the boilers was about 13 months.
- The first two boilers saved between 1,200 and 1,600 decatherms per month, compared with the fire-tube boilers that they replaced; the third boiler saved an additional 200 to 300 decatherms per month.
- The energy savings resulted despite the hospital's approximately 6,000-square-foot addition.
- The system saves approximately $10,000 per month over the previous system.
- Each new boiler holds less than 100 gallons of water, compared with conventional boilers, which hold 500 to 600 gallons.
- Fewer chemicals are needed to treat fewer gallons of water.
- NO_x and CO_2 emissions were reduced.

Special Tip

- Rely on the advice of the manufacturer's representative for sizing pipes and blowdown; this will enable a smooth transition between the old and new boilers.

Hospital Energy Alliance

HEA is a forum in which healthcare leaders work together with DOE, its national laboratories, and national building organizations to accelerate market adoption of advanced energy strategies and technologies.

A Strong Energy Portfolio for a Strong America

Energy efficiency and clean, renewable energy will mean a stronger economy, a cleaner environment, and greater energy independence for America. Working with a wide array of state, community, industry, and university partners, the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy invests in a diverse portfolio of energy technologies.

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

EERE Information Center
1-877-EERE-INFO (1-877-337-3463)
www.eere.energy.gov/informationcenter

Commercial Building Initiative

For more information, contact:
Kristen Taddonio
Building Technologies Program
Energy Efficiency and Renewable Energy
U.S. Department of Energy
kristen.taddonio@ee.doe.gov
commercialbuildings.energy.gov/hospital

July 2011
Printed with a renewable-source ink on paper containing at least 50% wastepaper, including 10% post-consumer waste.