FACING THE NEED FOR Boiler Upgrades

By David Bohn

Upgrading or replacing a boiler system presents one of the most daunting and expensive challenges a large facility can undertake. When the time comes—whether the current system is outdated and inefficient or whether it fails outright—facility management must take the time to fully understand the process in order to set campus goals and make the right decisions to fulfill their energy and efficiency needs. Currently, a substantial number of colleges and universities, as well as over 1,200 Veteran's Administration (VA) medical center campuses, are undertaking system overhauls like this.

These system upgrades are driven primarily by environmental concerns. Most of these facilities will need to update their equipment, but some will require a full-system replacement. It's a huge undertaking—but most administrators believe that the long-term savings will make the effort worthwhile.

WHY MAKE THE CHANGE NOW?

One of the driving factors in making this change right away is regulatory. California, New Jersey, and Texas have implemented air-quality standards that will not be met by older boiler systems—boilers in these states must be upgraded or replaced.

These old systems often used technology that sacrificed environmental safety in favor of cost savings. Some systems incorporated metal mesh burners, which utilized filters that clog easily. The gradual clogging of air filters leads to less excess air, which leads to higher nitrogen oxide (NOx) emissions. NOx emissions are a combination of nitric oxide (NO) and oxygen. NO is the result of fuel combustion and alone is not considered hazardous; however, combined with oxygen, it is the source of fog, acid rain, and ground-level ozone, which has been linked to myriad health issues. And while some other systems might have utilized technology to reduce overall NOx, these systems had increased electricity costs.

A second reason for a system upgrade, therefore, is to address these cost concerns. Today's upgrades do not require air filters, which used to add to operation costs. Upgraded systems also offer quick-change, dual-fuel capabilities, switching between gas and oil firing in less than three minutes. This saves on service costs, since multiple people are no longer needed to make the changeover. The greatest cost reduction, however, is in the demand for electricity; upgrades can reduce electric consumption up to 60 percent.

One way to realize a cost savings is by employing a system that allows one to adjust the output according to the demand. This adjustment is achieved via what is called the unit's "boiler turndown ratio," which is the ratio of the maximum heat output to the minimum heat output at which the boiler will operate both efficiently and controllably. As the desired temperature/pressure point is reached, the heat source is turned down, and if the temperature/pressure falls, the heat is turned up.

In large campus applications, which require boilers to operate at a low proportion of their maximum output, a high turndown ratio is desired, and that can be achieved with modern upgrades. Traditional burners using fiber metal mesh provide a 3:1 turndown; however, with recent advancements in the field, there are now systems that can provide a 9:1 turndown or higher depending on NOx requirements. These systems can achieve ultralow NOx emissions without the use of flue gas recirculation (FGR).

Monitoring panels and new boiler at the VA Medical Center in Erie, Pennsylvania.

Photos courtesy of Preferred Utilites Manufacturing

In addition to the cost savings realized through a 9:1 turndown, there is another benefit to upgrading, which is the reduction in required maintenance. Not only are multiple people no longer needed for a dual-fuel changeover, but operating and monitoring the systems are also simplified. Older systems require constant maintenance to ensure fuel efficiency and emission control. For example, many older systems include jackshaft linkage. Due to the complexity of these systems, they require constant fine-tuning and maintenance by highly skilled operators. Maintenance of an upgraded or new system is far less complex.

Newer monitoring equipment also means fewer people are needed for hands-on examination of the system. Typically, with an older system, there was a boiler in each building—and that meant someone needed to be on location to monitor those systems. The ability to house the entire system in one location, or to upgrade the system to monitor it from one location, results in lower maintenance costs.

CAMPUSES MAKING THE CHANGES

Higher education is becoming a competitive industry and, honestly, who chooses a college or university because of how new the boiler equipment is? The utility plant is seen as a cost, and universities generally choose to invest in new buildings or facilities that will help them attract students. But with environmental awareness now a prominent part of the international discussion, universities continue to see and leverage the value (both economic and otherwise) in going green. Here are a few examples:

- A small, elite liberal arts college in Duchess County, New York, was working with old boilers that essentially could not fire. To fix the problem, the college chose new burners that were compatible with their old boilers, which saved a great deal of money, since they didn't need to replace the whole system. They also replaced their vacuum condensate system for further modernization and efficiency. They are now planning to buy a second burner and are interested in a solution that burns liquid wood.
- A prestigious medical school outside of Boston invested in new burners. Their solution provider helped them with reliable low life-cycle cost/best-value payback on their low-pressure steam boilers by providing three 800-horsepower (HP) burners and a feedwater system. The new burners use natural gas and No. 2 oil, and now the school is actively considering carbon-neutral fuels.
- The campus heating plant main boiler at a large public-college campus in upstate New York suffered from several crippling issues. Working with a vintage 600-HP steam boiler, the burner had a triplex-nozzle system that was an issue from day one. The burner was low-fire, disastrous and unrepeatable when cycled, and caused uneven fires from the three nozzles, which would not hold a tune-up and constantly needed cleaning and adjusting. Only one person in the boiler room could keep it running for more than a week. The college went with a proven installer who recommended a solution that holds a tune-up and remains stable with cycle repeatability in the lower firing ranges.
- A medium-sized Christian college in Providence, Rhode Island, was interested in going far beyond Environmental Protection Agency (EPA) requirements in order to reduce their emissions

and maintain their electrical and combustion efficiency. They selected a solution to achieve the best of both worlds: 22-ppm NOx on two 900-HP burners with natural gas and No. 2 oil, with new combustion controls on both burners/boilers.

- A small private college in central Massachusetts was provided a new 600-HP burner to replace an old boiler that was previously fired by a burner from a company that went out of business a few years ago. The college also selected new combustion controls. Before this, they had been shut down for a few years and faced an unreliable boiler plant. They chose fuels that were readily available and may consider other options as they continue to invest in infrastructure.

VA MEDICAL CENTER CASE STUDY

The boiler system at the VA Medical Center in Erie, Pennsylvania, had been in place for three decades and required a complete replacement. In order to achieve the most impact with this important project, the center built an entirely new boiler plant from the ground up.

The engineering team at the VA determined that the existing system had met its life span, and they wanted to replace it with the latest technology. Any short-term replacement would have simply been a bandage. They realized, however, that a project of this magnitude would take time to do properly. The team selected a project management firm to handle the entire project, based on their central-plant expertise and track record at other healthcare facilities.

Based on the campus steam load, the team determined that the replacement equipment would consist of two 400-HP boilers and one 200-HP boiler. Installation of the new boiler system took four months. From the ground up (including the new construction), the work on the project took 14 months to complete.

The center's new plant will deliver at least a 60 percent reduction in electricity consumption, which will be accomplished using a variable-frequency drive. This technology can run with the fan speed at a lower rate; for example, changing the power from 60 Hz to 30 Hz speed can cut the horsepower eightfold. Therefore, a 400-HP system would be cut to 60 HP. According to the project management firm, "Most systems can go from 60 Hz to 40 Hz easily. We chose a system that can efficiently go all the way from 60 Hz to 15 Hz for additional savings."

Fuel reduction provides cost savings over the life of the new system. Newer boiler systems can offer a savings of 2 to 5 percent. This means that one 400-HP boiler with a fuel cost of $500,000 annually can save between $10,000 and $25,000 a year. The new Erie VA plant, with its two 400-HP boilers and one 200-HP boiler, will save the hospital between $25,000 and $62,500 in fuel costs annually.

IS IT TIME FOR AN UPGRADE AT YOUR FACILITY?

A boiler-upgrade project like the one undertaken at the VA Erie Medical Center is clearly something that takes significant time and money to complete. But the center's management determined that the expense and effort would pay off in the long run. Could it be time for you to look at a similar project for your facility? Here are some points to consider when making your decision.

Sustainability

In large facilities, sustainability is sometimes neglected when considering boiler systems. Facilities like college campuses often rely on older boilers and choose the bandage approach of patching and maintaining them out of necessity—but this method is not sustainable. Upgrading to a new boiler is the best option for long-term, sustainable improvement.

Sustainability also refers to the environmental impact of a system. With ever-changing state requirements, it is important to choose a system with enough flexibility to face these new demands as well as future ones.

Fuel Efficiency

To adequately meet the heating- and energy-load demands of healthcare facilities, old boilers burn an inordinate amount of fuel. New boilers bring added efficiency and substantial fuel savings. There is also much being done in the realm of alternative fuels for boiler systems. Biofuels and liquid wood are two segments of the alternative fuel market that are making great strides.

Operation and Maintenance

New boilers are streamlined to operate more smoothly and efficiently than old boilers, which can be challenging to operate and maintain. The older boilers often take much longer to heat up, and they are often kept running to meet heating needs. New boilers are designed to heat up quickly and can be adjusted to handle variable loads in order to ensure less energy consumption.

When considering an upgrade or replacement, no matter what the reason may be, all factors of the operation need to be addressed in preparation for a system shutdown. A project of this magnitude, from the initial bid process to completion, will require a minimum of several months (for an upgrade) up to a year or more (for a complete boiler replacement). The impact of this change, and thus the importance of the decisions made during the process, are the reasons why so many campuses are carefully reviewing their future energy options.

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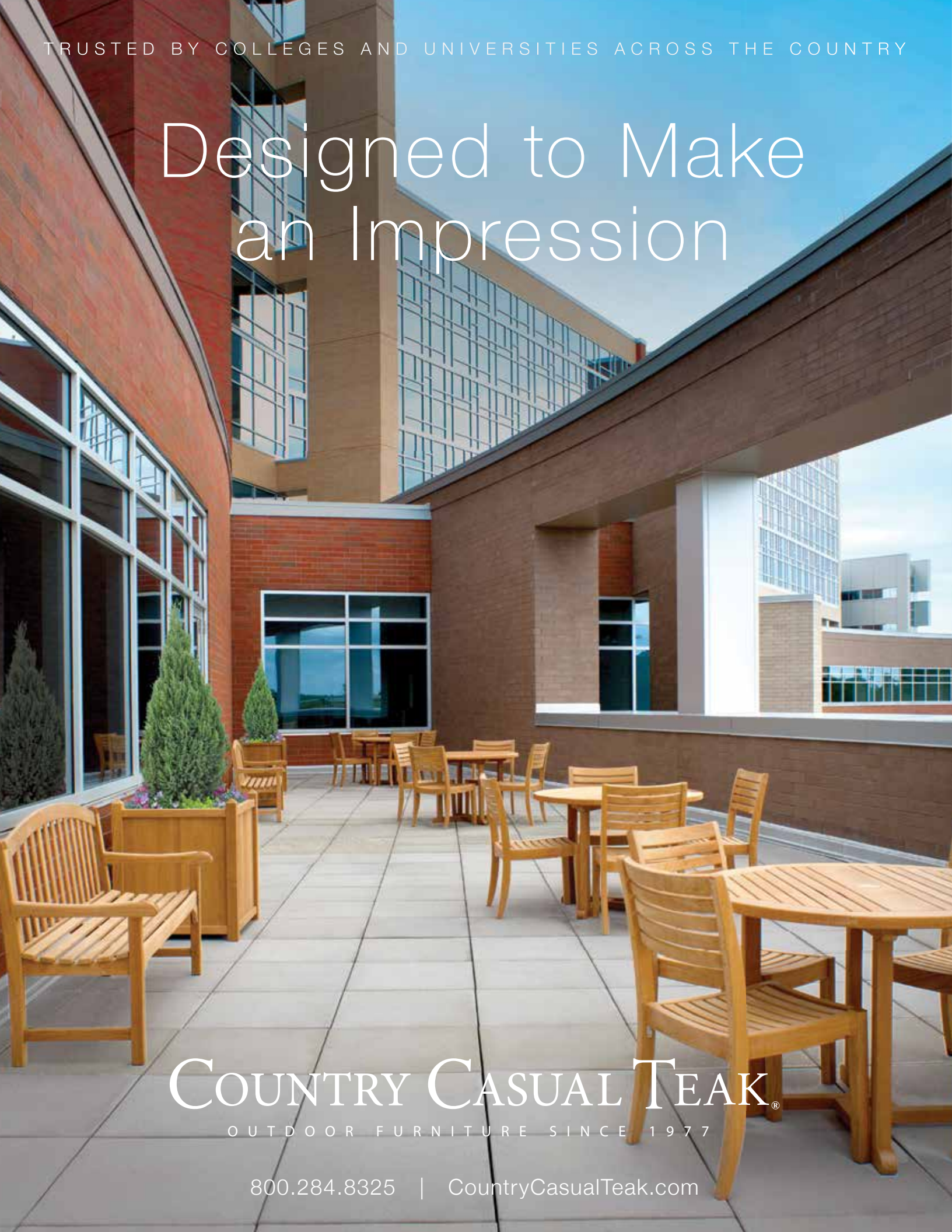
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