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Nationwide Boiler Inc. has been working with many customers who are choosing to replace their boiler systems with a natural gas-fired boiler system.

Boiler Upgrades and Conversions

BY JUSTIN MARTINO, ASSOCIATE EDITOR

The phrase "boiler upgrade" might call to mind images of increasing a boiler's efficiency or output. While that does make up a portion of the current boiler upgrade work, the main drivers for boiler upgrades currently are very different.

"The primary influence would probably be the cost of fuel, because that's always the long-term cost of a boiler system," said American Boiler Manufacturers Association President Randy Rawson. "For those users that are fueled by oil, they're looking to go to natural gas if they can in their localities. For those fueled by coal, they're probably looking to do the same thing."

The second driver for boiler upgrades is environmental regulations, Rawson said, especially for owners of industrial boilers looking to comply with the Industrial Boiler Maximum Achievable Control Technology Standard.

"The Industrial Boiler MACT is probably right now the largest driver in that segment simply because it's the newest," Rawson said. "There are other local rules and standards in various areas of the country that have provided challenges to boiler owners, but clearly not to the degree the Industrial Boiler MACT probably has."

The new Industrial Boiler MACT rules lean heavily on energy assessments and boiler tune-ups. Rawson said those are both good areas to look not only for meeting the standards of the rule, but also to ensure a boiler is running efficiently or effectively. The focus of the rules also means some operators may not need to make many changes in their boiler room.

"If you're lucky enough to have an up-to-date, state-of-the-art boiler room, you're not going to have to do much upgrading," he said. "If you haven't operated and maintained the boiler room in accordance with OEM (original equipment manufacturer) recommendations, then you may have to do some tweaking. And depending on the boiler's age, tweaking may be easy or difficult."

Some companies who find it difficult to tweak their boiler into compliance with the rule may find it easier to convert to a natural-gas fired boiler.

While an oil-fired burner may be able to be converted to fire natural-gas, a boiler that fires solid fuel, such as coal, may need to be replaced completely.

"If you're burning coal, and I think the boiler MACT gets to the coal user more than anyone else, you're going to have to take a good, hard look at what you need to do to upgrade," Rawson said.

Joe Baranski, lead engineer at Day & Zimmermann, said the company is working with many customers that have already made the decision to switch from their current fuel to natural gas. Switching to a natural gas-fired boiler can involve many changes in the boiler and the facility itself, he said.

Plants that are running boilers using solid fuels such as coal currently have to offload the fuel in bulk, Baranski said. The coal could be delivered by truck, although large boilers might have coal delivered by train.

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"The bulk unloading of coal would be removed from the equation," he said. That includes the storage where coal is held in inventory, the system used to convey coal to the boiler and bunkers that hold a supply of coal above a pulverizer, if that is being used in the boiler.

"All of these components need to be abandoned in place after they're made safe, or they can be removed from service entirely and either sold for scrap or sold on the open market, depending on the condition of the component," he said.

In addition, the windboxes and

Tennessee Valley Authority will be adding scrubbers and selective catalytic reduction systems to its Gallatin coal-fired power plant by the end of 2017 to reduce emissions.

Nationwide Boiler has worked with many clients seeking to replace their current boiler system with a natural gas-fired boiler, including this boiler that was installed at Duke University.

burners would also need modification, Baranski said, and may be removed entirely and rebuilt. Depending on the size and complexity of the burners, as well as what is available from the original equipment manufacturer, certain portions or components could be rebuilt and replaced.

Flame scanners in the boiler would need to be removed and replaced for natural gas. When that is done, the owner has the option to upgrade the boiler to lower nitrogen oxide (NOx) emissions.

"The OEMs and the burner subsuppliers have made great advances in low NOx burner technology," Baranski said. "These can be accommodated in the new windbox."

On the downstream side of the system, Baranski said there are a few changes that can be made. The scrubber, precipitator, fabric filter (or baghouse) and carbon injection system for mercury removal can be removed from service or isolated. In addition, the gas pass to the stack can possibly be readjusted to reduce pressure losses in the gas side, which would result in a cost savings.

It's also possible that some of the components within the heat transfer surfaces of the boiler would have to be changed, he added. The characteristics of the combustion of natural gas are different from coal, especially with the pulverized coal often used by the boilers Day & Zimmermann work with. More of the heat release and heat recovery with coal occurs inside the furnace, where water walls will take up a large portion of the radiant energy, while in natural gas combustion, more of the radiant energy occurs in the back end of the boiler.

"There are a lot of elements to be considered in making the transition," Baranski said.

Those elements can become more complex when dealing with larger boilers, such as those that might be used by a utility power station. While most small boilers may only use one or two burners, large boilers may use multiple burners.

"Once you get to multiple burners, there are lots of permutations on how you would fire those burners to meet a given steam demand," he said. "And if you have multiple burners that need to be fired, the fuel-air ratio control system is also increased in complexity."

> "The choice is to clean up the coal or make the transition over to a natural gas fuel."
> - Joe Baranski, Day & Zimmermann

The downtime to convert a boiler to natural gas can vary depending on the size of the boiler, though the general rule of thumb is six months to a year. Baranski said one client the company worked with had excellent controls on an integrated engineering and construction schedule and was able to trim time off that.

The key to reducing the amount of time a boiler would need to be down is doing as much work ahead of the shutdown as possible, he added.

Another method to prevention disruption to the facility is to arrange for a different source of power to avoid a shutdown.

"Our clients who have smaller installations or smaller developed sites are able to use rental boilers to complement their infrastructure so the interruption for steam generation is minimalized," Baranski said. "In that case, what I loosely refer to as prework can be included prior to the shutdown of the rental boiler. You wouldn't notice the difference because the steam would keep coming."

Despite the complexity and the possible need for a shutdown, there are many reasons companies may choose to convert their current boiler system to firing natural gas. The price of natural gas is attractive to many of Day & Zimmermann's clients, Baranski said. Other factors include the ease of using gas compared to a fuel like coal and environmental regulations that put more of a burden

on coal-fired power generation than gas-fired power generation.

"The choice is to clean up the coal or make the transition over to a natural gas fuel," he said.

Tim McBride, sales engineer at Nationwide Boiler Inc., said emission controls are less of an issue for companies with natural gas-fired burners. Although some states such as California may require more stringent environmental controls, most new natural gas-fired boilers are able to meet environmental regulations without major upgrades.

> "A lot of people are running to gas for a lot of reasons. Coal is going away."
> - Tim Martin, Nationwide Boiler

Like Baranski, McBride said he has seen many companies choosing to convert to a natural gas-fired boiler.

"A lot of people are running to gas for a lot of reasons," he said. "Coal is going away."

For some operators, however, switching to natural gas may not be the best option. Mark Minniti, NAES Corp. director of business development for the maintenance and construction group, said there are a variety of factors to consider before making a switch.

"I believe it is a mix based on many factors, such as geographic location, number of other plants in the generator's system, the generator's current fuel diversity, anticipated capacity requirement, age and size of the units, the cost to add control, whether the generator is regulated or unregulated and politics in the state, region or locale," he said.

A number of different controls can be fitted onto a boiler system in order to reduce the emissions of the unit. Flue-gas desulfurization, selective catalytic reduction, active carbon injection and dry sorbent injection technology can all be added to a plant's emission system. Other options include a new fabric filter or adding or upgrading electrostatic precipitators.

All of these options are used to help control the amount of emissions from a boiler, including sulfur oxides, nitrogen oxides, carbon dioxide, mercury and particulate matter. Deciding which options are needed may make the situation more complicated, however. Minniti said many companies are waiting for government agencies to finalize the regulations, then researching the available options and comparing the effectiveness and costs relative to other options.

Regardless of what a boiler owner chooses to do to upgrade their boiler, Rawson said it's important companies make decisions quickly in order to help control cost and the time it would take to do the necessary work.

"Regardless of what is motivating you to retrofit, upgrade or replace, the longer you wait, the more expensive it's going to be," he said. "I don't think anybody can make that determination easily, but they need to be very careful because sooner or later when they knock on our doors there are going to be delays and the costs will have gone up farther than they are today." pe

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