

TODAY'S BOILER

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Pump selection can bring out (or hold back) hydronic boiler performance. Assess the several variables in play to make sure your system delivers.

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Converting To Natural Gas: ARE YOU READY?

REGULATIONS AND LEAD TIMES, NEW VERSUS RECONDITIONED ... THERE'S NOTHING SIMPLE ABOUT GETTING YOUR SYSTEM UP TO PAR (OFTEN BY A DEADLINE), AND REFUELING AN EXISTING UNIT COULD BE THE WAY TO GO. SURVEY THE FACTORS INVOLVED, FROM RENTAL BOILER PLANNING TO EMISSIONS-REDUCTION STRATEGIES.

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Today, coal is still a primary source of energy in the United States, fueling 50% of America's power needs. However, low natural gas prices, increased shale gas production, and increasingly stringent environment regulations from Boiler MACT have created new opportunities for business. Coal-fired plant owners have a variety of options to consider as costs of operating plants continue to rise: retiring units, converting coal-fired boilers with new or reconditioned natural gas-fired package boilers, or refueling existing boiler equipment. These decisions are influenced by many factors, including plant integration, capital costs, maintenance costs, operational time requirements, and emissions control requirements.

Overall, the number of coal-fired conversion projects is small relative to the number of expected unit retirements. Deciding on the appropriate path to take is a major issue many plant owners face in a time of uncertainty. However, essential planning and preparation will help minimize the challenges associated with a successful conversion project.

STEAM PLANT FUEL SUPPLY

A major component in the evaluation of converting to natural-gas fired boilers is the supply of natural gas. The cost of bringing natural gas to a site is significant and includes items such as connecting in to an existing gas pipeline, construction of a new pipeline to a facility, and installation of a metering station. Local building codes or insurance requirements may limit the pressure of the natural gas brought in to an existing facility, and design standards such as NFPA 54 and ASME B31 are needed to ensure that a new system is properly designed. Once a natural gas system is put into place and is operational, areas around potential leak points would be classified as hazardous areas. Periodic testing of the natural gas piping, safety valves, and burner management systems would be necessary maintenance items to be implemented as part of a safety program in order to prevent boiler explosions and to detect possible leaks in the boiler room.

In some instances, the installation of a natural gas supply line and auxiliary equipment would be too costly of a solution. An alternative option would be to mothball an existing steam plant in favor of a new-build scenario that could easily be designed to facilitate the fuel supply source and piping requirements. However, the process to acquire permits for a new facility would be cost and time prohibitive.

NEW OR RECONDITIONED BOILER OPTIONS

The boiler industry as a whole is experiencing long lead times due to increased boiler demand over the last several years and a skilled boiler labor shortage. According to major industrial package boiler OEMs, current production of new boilers is being quoted with up to 42 weeks until final delivery. This can be a costly option if plant owners delay in decision making and must meet certain state or local emission deadlines. The option to buy an in stock, new, or reconditioned boiler at a significantly lower cost can be advantageous and may significantly decrease the length of time needed for a conversion project. There are several major companies that specialize in supplying new and reconditioned stock package boilers that are readily available for delivery and can provide up to 200,000 lb/hrs of steam output. Although reconditioned boilers may require minor upgrades and modifications, they do normally include a warranty similar to a new boiler if offered by a respected boiler supply company. In general, boilers have a long service life and many can be used for over 30 years if properly maintained.

REFUELING CONSIDERATIONS

Refueling a boiler from burning coal to natural-gas dramatically affects the original performance of a boiler. Furnace exit gas temperature (FEGT) typically increases and will affect final steam temperature, requiring greater steam temperature control. The boiler tubes will also need to be evaluated to ensure that material temperature limits are maintained at an acceptable level.

Compared to coal, natural gas has a much higher Btu and specific energy content when compared on a weight basis. This equates to less natural gas fuel requirements, but greater dry air requirements per pound of fuel for ideal combustion. In addition, excess air is typically maintained no more than 15% when firing natural gas, compared to at least 20% when firing coal.

Overall, many other components of a boiler are effected when a coal-fired boiler is refueled for natural gas. A comprehensive study that evaluates the impacts of boiler/burner modifications effecting burner performance, emissions, and efficiency is critical when considering a refueling project. Computational fluid dynamics (CFD) modeling is also an important tool to determine furnace thermal conditions and feasibility of gas burner performance.

CONTROL SYSTEM UPGRADES

A steam plant's burner management system (BMS) is dedicated to the safe and proper operation in the starting and stopping of a boiler's combustion system. A fuel conversion project will require an update to the combustion controls and BMS according to National Fire Protection Association (NFPA) hazard codes.

EMISSIONS

Natural gas firing will require meeting stringent NOx limits, and there are several technologies that can control NOx formation in natural gas-fired boilers: Flue gas recirculation (FGR), low NOx burners, overfire air/burners out of service (BOOS), water injection, low excess air, selective catalytic reduction (SCR), and non-selective catalytic reduction. Several of these technologies can be used together to achieve an optimal level of NOx reduction required. However, SCR technology is the most effective method and can provide approximately 90% reduction of NOx compared to conventional gas burners.

SCR technology uses catalyst and ammonia as a reducing agent to convert NOx into nitrogen and water. Today's SCR systems can perform efficiently across a flue gas temperature range of 325°F to 750°F for package boilers and can also minimize fan requirements by eliminating or greatly reducing the need for FGR. When an SCR system is combined with extended surface finned tube economizers and standard burners, both the benefits of low emissions and high efficiency can be achieved, accomplishing significant decreases in operating costs along with the operational benefits of improved flame stability, higher turndown, and faster response to load swings. Both urea and



RENTAL BOILERS SIMILAR TO THESE 70,000 LB/HR UNITS WITH CATASTAK™ SCR SYSTEMS MUST BE CONSIDERED DURING THE PLANNING PROCESS OF A COAL TO NATURAL GAS-FIRED CONVERSION PROJECT.

ammonia-based SCR systems are available.

UNINTERRUPTED STEAM SUPPLY

Utilizing rental boiler equipment during a conversion project is critical to ensure that the loss of a steady supply of steam is minimized. Duke University recently included rental boilers as part of the university's West Campus Steam Plant conversion project. In February 2009, the university ended an 80-year tradition of coal delivery by rail

car, and after a two year plant renovation and boiler upgrade project, the plant converted to natural gas.

During the renovation process, an 82,500 lb/hr trailer-mounted rental boiler was used as a "base plant" to augment steam supplied by Duke's east campus steam plant. The rental boiler was kept on site for the final phase of the coal-to-gas construction process while coal-fired boilers were replaced with three new high-capacity, natural-gas fired package boilers.

When renting boiler equipment, upfront planning is the most important stage in the contingency planning process. This includes determining the total capacity and operating characteristics of a boiler system. Often, multiple boilers can be arranged in parallel to increase plant capacity to any desired level and may involve renting one or multiple mobile steam plants or trailer-mounted boilers. When possible, mobile equipment is preferable to skid-mounted equipment and is less costly due to fast delivery and no special foundation or footing requirements needed to support the boiler equipment. When compared to skid-mounted boilers, trailer-mounted boilers (with capacities up to 120,000 lbs/hr) are the most economical to rent, as they avoid the need for new foundations, crane handling, or special rigging.

When evaluating the opportunity to convert a coal-fired boiler to natural gas, many factors are involved and need to be considered. With a thorough understanding of the options available and how those options affect the entire performance of the boiler, combustion system, and the layout of the existing facility, success can be achieved for all involved. **TB**

SOURCES:

- Schindler N. and Berry L., *Practical Considerations for Converting Boilers to Burn Gas*. Power [Online] 2013.
- Black S. and Bielunis D., *Challenges when Converting Coal-Fired Boilers to Natural Gas*. Technical Publication Presented at Council of Industrial Boilers (CIBO) [Online] 2013.
- Schindler N. and Adriani A., *Practical Considerations for Converting Boilers to Burn Natural Gas*. PEERS Conference [Online] 2012.