Today, Brigham Young University-Idaho (BYU-Idaho) in Rexburg, Idaho, educates its 19,400 students in more than 40 buildings around campus with a total of about three million square feet of conditioned building space.

Founded in 1888 as a junior college, BYU-Idaho grew rapidly in the 1950s, as did the number of buildings on campus. The college needed an economical way to heat the buildings, so it built a central boiler plant with one coal-fired boiler. In the 1960s, the college added two more coal-fired boilers, and a fourth coal-fired boiler was added in the mid-1970s.

In 2001, BYU-Idaho transitioned from a two-year college to a four-year university and remodeled its central heating facility, installing a natural gas-fired boiler and removing the smallest coal-fired boiler. The central heating facility remained the same until a few years ago when the coal-fired boilers had become aged, inefficient, and it was becoming difficult to find replacement parts for them.

At the same time, the United States Environmental Protection Agency and Idaho Department of Environmental Quality (DEQ) were putting in place more stringent emissions regulations, forcing BYU-Idaho to install emission control scrubbers and other control equipment.

“We came to the conclusion that we should make some changes,” said Sam Merrick, supervisor of HVAC Services, Facilities Management for BYU-Idaho. “We needed to improve the facility and the equipment. Efficiency and emissions were a concern, and we wanted to make sure we were being good stewards of the environment.”

The university’s design team set forth the following goals:

1. **Become more energy efficient.** The university strives to deliver education that is affordable for students, so it’s important to reduce costs wherever possible. Installing more efficient equipment would help to reduce ongoing operational costs.

2. **Eliminate dependence on coal.** BYU-Idaho was paying significantly less for natural gas compared to coal. In addition, natural gas had become the industry standard.

3. **Reduce emissions.** BYU-Idaho wanted to proactively reduce its NOx emissions and maintain compliance with the DEQ.
4. **Minimize reliance on the electrical grid.** BYU-Idaho had experienced interruptions in its power supply from the local grid during times of severe Idaho weather when demand was most critical. In addition, BYU-Idaho had learned from the local power company that the university’s electric costs were projected to nearly double within 10 years.

**Equipment Selection**

In 2012, the design team at BYU-Idaho began researching natural gas-fired boiler equipment that exhibited cutting-edge technology, had low NOx capability, could last 40-50 years, and required minimal maintenance. Merrick said the university recognized that, “Switching to natural gas was better for both the environment and our finances.”

The team ultimately selected Cleaver-Brooks to provide the new boiler system equipment, including:

- CBEX Elite Firetube Boiler (25,000 lb/hr)
- Two O-Type Watertube Boilers with 30 ppm NOx burners (both 45,000 lb/hr units)
- Max-Fire® Heat Recovery Steam Generator (HRSG) (50,000 lb/hr)

Although BYU-Idaho did not have any Cleaver-Brooks equipment on site, many of the team members had experience with the equipment at other campuses and institutions.

“We knew Cleaver-Brooks manufactured quality equipment, and we specifically liked the burner options from Natcom,” said Merrick.

As for the boiler design, Merrick added, “We liked the water wall with welded tubes rather than the refractory. It was a big selling point for us on Cleaver-Brooks. There is only a small amount of refractory on the two ends of the steam and mud drums.”

**System Design**

Throughout the design phase of the project, BYU-Idaho worked closely with Heath Engineering in Salt Lake City, Utah, and Jason Hansen, new equipment sales manager for Holbrook Servco in Salt Lake City, Utah.

The design team knew it had to be more energy efficient on the electrical side, and they saw a significant advantage in pursuing independence from the local electrical grid. For this reason, they explored the idea of cogeneration, thus generating a majority of their campus electrical needs while also supplying an efficient, reliable steam supply. The administration resisted the idea at first but changed their mind when they learned the university could construct a new facility, including a space for the cogen at the same cost as it would be to remodel the old facility. A reduced upfront cost enabled BYU-Idaho to purchase the cogen system.
Working with the design team, which included RMH Group, Cleaver-Brooks proposed an HRSG system based on a Max-Fire® boiler design. This “water wall” HRSG boiler design along with the Cleaver-Brooks supplied duct burner and a fresh air fan gave BYU-Idaho the greatest level of flexibility in how the system could be operated. With these components, the university not only maximizes its steam production but also has the ability to generate steam from the HRSG.

The university also selected Cleaver-Brooks to supply two auxiliary boilers that provide backup steam for the cogeneration system. O-type boilers were chosen due to their small footprint. Despite this, the original boiler design was 1½ to 2-feet too long to fit into BYU-Idaho’s ideal building layout.

The engineering staff at Cleaver-Brooks modified the design to fit the space without affecting system performance or equipment reliability. As a result, there is more critical operator access room in front of the boilers in BYU-Idaho’s facility.

Another piece of equipment that had to be custom designed was the stainless steel stack, which had to be 80 feet tall for dispersion of emissions. BYU-Idaho is approximately 50 miles from pristine Yellowstone Park, and the university’s emissions are closely monitored by the DEQ.

Finally, BYU-Idaho had planned to retrofit its existing natural gas fired watertube boiler with a Cleaver-Brooks burner and controls to match the other new boilers instead of purchasing a new one. When the project started, this old boiler was in operation for the heating season. After it was shut down, the team saw that repairs had to be made to the boiler’s front wall based on internal conditions. There were also concerns about the complexity of moving the boiler.

Based on the condition of the existing boiler and apprehension about moving it, Hansen recommended the university instead purchase a CBEX Elite firetube boiler. The new firetube could meet the same load demand for around the same cost of the burner retrofit and the repairs/modifications that were necessary. The new boiler, though a firetube, was provided with a similar Cleaver-Brooks PLC advanced control system for communication with the facility’s SCADA system and integration into their system’s lead-lag control strategy for boiler operation.

Construction of the new boiler facility began at BYU-Idaho in 2012, and the last boiler was installed in 2015.

**Results**

Replacing the old coal boilers with natural gas ones increased boiler efficiency by approximately 10 percent and decreased operational costs by 17 percent in 2017 compared to 2014.

According to Merrick, the operators really like the responsiveness of the new boilers. For ongoing monitoring, the boilers tie into BYU-Idaho’s building SCADA, which provides the operators the information they need on a continuous basis.

“It’s definitely a safer environment,” said Merrick. “There is less physical maintenance compared to the old coal system and fewer moving components and parts.”

The operators also appreciate the cleaner environment. Merrick explained that in the old coal facility, if there was any dust in the shakers, it would become airborne inside the boilers, resulting in an explosion risk.

Most notably, this project added electric generation to the campus, which was previously unavailable with the coal-fired system. Prior to adding the gas turbine and HRSG unit, the university would lose power on the coldest day of the year for four to six hours and in Idaho, the temperature can be frigid! The university is now self sustaining during disasters or any interruption in power.
Providing energy-efficient, environmentally friendly boiler room solutions

Cleaver-Brooks is one of only a few boiler room solution providers in the world to operate a dedicated research and development facility. Having pioneered several industry-leading technologies, we remain just as committed today to introducing technology and products that enable a more energy-efficient and environmentally friendly generation of steam and hot water.

We distribute our products through the Cleaver-Brooks Representatives Association, or CBRA, an alliance of independently owned and operated companies that provide boiler room products and service. CBRA companies can be counted on to provide Cleaver-Brooks products and parts, engineering support, customer training, technical service and system maintenance. To find a CBRA representative near you, please visit cleaverbrooks.com/reps.