BALLARD ENGINEERING INC.

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CULVER EDUCATION FOUNDATION
Culver, IN

Culver Academy is a college prep residential high school located in rural Indiana. To combat rising energy costs, update its boiler system, and provide greater reliability in its electrical generation, Culver Academy with Ballard Engineering Designed and installed a cogeneration system. The 1.1 MW system consists of two 525 kW Waukesha natural gas fired engines that are capable of producing 5,200 lbs./hr of low-pressure steam. Steam is used for campus heating in the winter and for a 400 ton absorption chiller in the cooling season. The system is designed for parallel and stand alone operation.

ENERGY USER NEWS NOVEMBER, 1998 VOL. 23, NO. 11

Academy Pulls Plug on High-Cost Electricity

A cogeneration system provides campus with electricity and heat, and pays for itself in energy savings.

By KENNETH W. BETZ

CULVER, IND.—The more things change, them ore they stay the same. Around the turn of the century, the Culver Academies boasted a "state-of-the-art" power plant that supplied steam and electricity to campus buildings. That plant functioned until the 1960s, when it was replaced by natural-gas fired boilers and electricity supplied by a local utility company.

But by the winter of 1996-97, history had repeated itself insofar as the power plant was concerned. Culver pulled the plug on the bulk of power supplied by the utility company, replacing that dependency with a 1,050-kilowatt cogeneration facility. This cogeneration system displaces about 94 percent of the electrical power previously purchased from the utility company, and it displaces about 20 percent of the total steam production of the old, natural gas-fired boilers. The remainders of the steam requirements come from two new 400-horsepower boilers.

Though it may seem to some that the cogeneration system is a step back in time, the arrangement is more efficient and economical, given today's economic realities.

Ballard Engineering, the Rockford, Ill., firm that designed the system, estimates a savings in energy costs of $262,915 a year. The utility had been charging The Academies an average of eight cents per kilowatt hour for electricity. By generating its own power, Culver has reduced that cost to three and one-half cents per kilowatt-hour.

TAX-EXEMPT BONDS

The $1.8 million facility was financed by tax-exempt bonds issued by the Indiana Development Finance Authority. The bonds mature in ten years, with an annual interest of 5.25 percent paid semi-annually. The entire principal will be repaid in ten years. The whole issue was privately placed with members of Culver's board of trustees. Each year about $200,000 of the annual savings in utility costs will be directed toward building a fund to repay the $1.8 million to the bondholders.

In the cogeneration plant, the boilers (fired by natural gas) generate high-pressure steam, which is reduced to seven pounds per square inch and piped across campus. Steam is used to heat the first floor administrative offices in North and East barracks and Linden Hall. The rest of campus is heated by steam-heated water. Heat from the steam is transferred to water in a heat exchanger.

The move to a cogeneration system was prompted by a desire to conserve energy as well as costs, explains Culver Academies treasurer Peter McCone.

LEAKY STEAM LINES

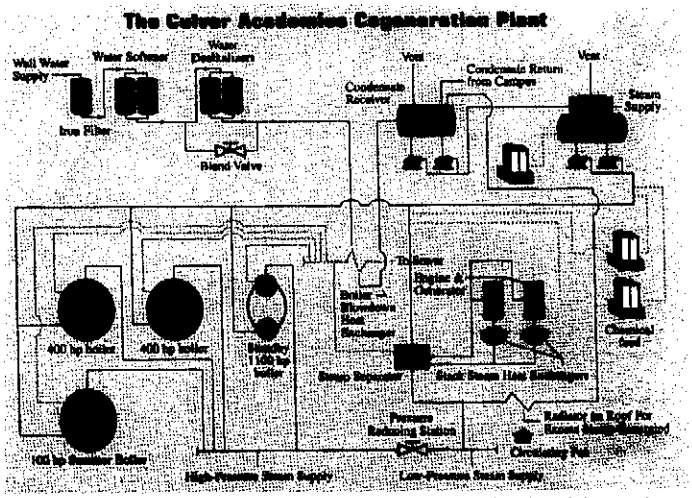
"We were continually digging up leaky steam lines in the winter and having condensation problems in the summer," says McCone. "All of this stimulated discussions about what we could do for the long haul. This was a big problem for us, and there had to be a way to turn this to our advantage."

Among the alternatives was scrapping the existing underground steam and condensate return lines. But about half of the mile and a half of steam lines already had been replaced, so scrapping the system was "counter conservatory,' explains facilities director Hal Weitgenant.

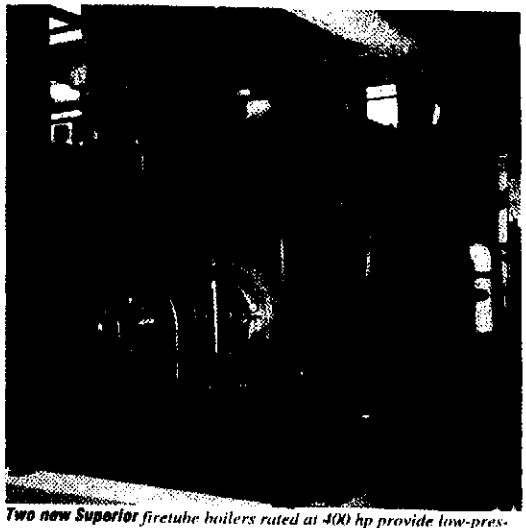
The problem was that the old coal-fired Erie City boiler installed in 1939 and later converted to oil, then natural gas, was grossly inefficient. Likewise, the Nebraska boiler installed in 1964 was about 50 percent efficient.

BETTER RATES SOUGHT

In the meantime, the school also was looking for a better electric



***In addition to** two engine-generator sets rated at a combined 1,050 kW, the Culver physical plant contains two new 400 hp boilers. The system is expected to save the school more than $250,000 in energy costs per year.*



***Two new Superior** firetube boilers rated at 400 hp provide low-pressure steam for heating and other services on the campus of The Culver Academies.*

rate from the utility company. Culver proposed a demand side limiting program to the local utility, but the power provider wasn't interested. The Academies also made inquiries about becoming a demonstration project site for fuel cell technology. Again, there was no interest.

"We were exploring ways to upgrade without spending the foundation's money and struck out," McCone says.

As a quid pro quo for not building a cogeneration facility, the next alternative was requesting a rate reduction. After many months and several negotiating sessions, the utility offered a ten percent across-the-board reduction in electric rates. Weitgenant and McCone were thinking along the lines of a thirty- percent reduction.

At that point, talks began with the utility's unregulated division about the feasibility of building a cogeneration plant. McCone had been involved with a similar project at the Dana Hall School in Wellesley, Mass., where he served as chief financial officer, business manager, and facilities director before coming to Culver in 1992. McCone and Weitgenant are members of the Association of Physical Plant Administrators, and McCone is a senior member of the Association of Energy Engineers.

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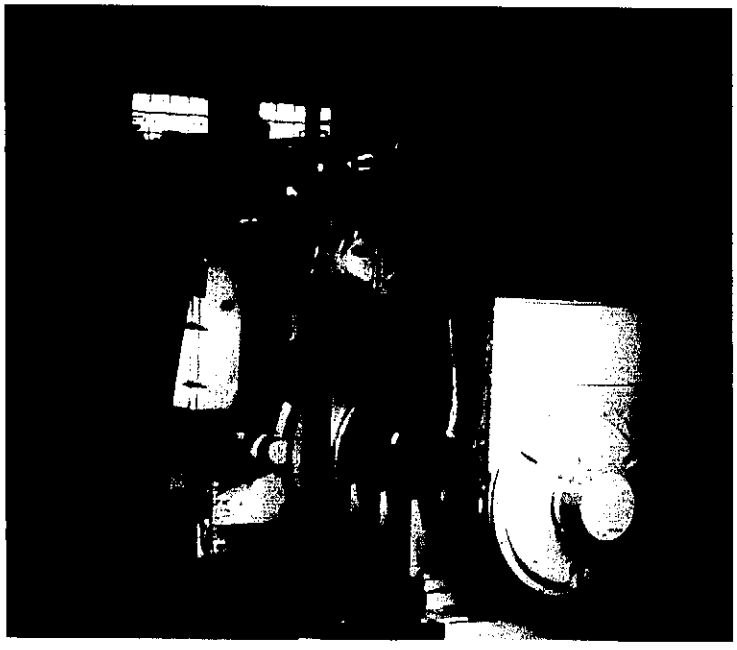
Shown is one *of two Waukesha diesel generators, modified to operate on natural gas, that were installed as part of The Culver Academies cogeneration plant. Each engine produces 825 hp and each generator is rated at 525 kW.*



SMALLER, MORE EFFICIENT

Inside the powerhouse, the two new four hundred horsepower fire-tube boilers take up one-quarter of the space previously occupied by the old boiler and are more efficient. Fired by natural gas, each boiler generates 13,000 pounds of steam per hour. The old Nebraska boiler cranked out 49,000 pounds an hour.

"We're getting by with 26,000 pounds an hour. Therefore, we were wasting a lot of energy before," Weitgenant says. But those days are over.

In addition, two diesel generator sets, modified to operate on natural gas, were installed. The engines produce 825 hp @ 1,200 rpm, and each generator is rated at 525 kW. The system is designed to allow parallel operation with supplied utility power.

The entire system is computerized, with displays that tell shift supervisors when everything is running smoothly and when it is not. The computer has a twin in Rockford, Ill., monitored by Ballard engineers.

HEALTH AND SAFETY

Besides the environmental (the new system outputs less greenhouse gases) and cost considerations, there is a health and safety issue. We need to have the capability to generate our own heat and electricity. We have boarding students here. We have to worry about their safety and keeping them warm," Weitgenant adds.

In addition to heat and lights, there are other basic needs. Without electricity, for instance, sewage cannot he pumped from campus to the town treatment plant.

Also, maintaining energy efficiency and costs savings "will keep us competitive in the private school market," says Weitgenant. Keeping utility costs down will help keep tuition increases in check.

The added benefit, of course, is that if there is a widespread power outage, Culver has its own system. It stands alone providing light and heat to buildings and electrical power for food preparation. On the other hand, if one or both of the school's generators were to fail, the Academies would be able to buy electricity from the utility. "They're in the business of selling power, " says Weitgenant. "They don't care if the circumstances warrant our going back to their system for back-up power at a moment's notice."

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