

CASE STUDY

Barlow Projects Waste-to-Energy System – Perham, MN

Relay’s “Intelligence” Slashes Time and Costs on Retrofit of Generator for Advanced Waste-to-Energy System

Barlow Projects WTE site recycles trash into electric power and steam heat via advanced system that employs “recycled” turbine generator.

Fort Collins, CO—With its sights on looming energy shortages and ever-mounting waste disposal needs throughout the U.S., Barlow Projects, Inc. was eager to prove that its proprietary waste-to-energy (WTE) system could generate maximum energy production from the incineration of nonorganic waste at a lower production cost than conventional means. The challenge was to build a highly efficient, reliable trash-burning and steam WTE facility utilizing a “recycled” turbine generator to help lower capital investment requirements.

WTE facilities, like those built by Barlow Projects, produce steam from the combustion of trash heating a boiler. This steam can be used to push turbine generators to produce electricity, or it can be sold as steam to nearby industry, schools, hospitals and the like. Modern WTE technology has proven environmentally friendly and economical. Burning trash effectively destroys waste stream bacteria, pathogens and other harmful elements. Efficient WTE processes, such as Barlow’s, can reduce the incoming volume of waste by about 90 percent.

The proprietary combustion system employed by Barlow Projects, known as Aireal™ Combustion Technology, was developed in collaboration with its subsidiary company, The Barlow Group, also located in Ft. Collins. The Barlow Aireal combustion system can be scaled to accommodate as little as 100 tons or as

much as 1,000 tons of trash daily, based on local needs. Multiple combustion units (“trains”) can be added for redundancy or increased processing capacity for even larger units.

For its second WTE project, in August 2002 Barlow undertook the conversion of an existing trash-burning facility in Perham, Minnesota to a Barlow Aireal-based steam-and-electricity generating plant. The EPA had shut down the Perham facility in 1998 for environmental violations.

“We spent close to \$9 million in the re-engineering and construction of the facility,” explains Marty Anderson, Barlow Projects Vice President of Operations. “We kept the buildings but completely retubed the boiler, put in an all new combustion unit, all new pollution control devices, all new transformers and switchgear.”



Figure 1—For its second WTE project, in August 2002, Barlow undertook the conversion of an existing trash-burning facility in Perham, Minnesota to a Barlow Aireal-based steam-and-electricity generating plant.

In order to make the transformation as cost-efficient as possible, Barlow decided to incorporate a used turbine generator system, which was purchased from a utility in Bermuda. The owner of the generator, a mid-1980s Peter Brotherhood (Peterborough, UK) brush model, simply sawed it off at the connections and shipped the disjoined unit to its new home in Perham.



Figure 2—In order to make the transformation as cost-effective as possible, Barlow decided to incorporate a used turbine generator system, which was purchased from a utility in Bermuda.

Once at the new WTE site, Barlow had to see that the generator was refurbished, retrofitted to the combustion system, connected to the on-site substation and interfaced with the local utility, Otter Tail Power. The new facility had waste contracts with the city of Perham and four surrounding counties, and is a source of “Green Power” for Otter Tail Power.

Among the main concerns about integrating the Peter Brotherhood generator with the rest of the WTE system were the protection, monitoring, and interfacing issues. Barlow Projects had successfully incorporated a retrofit system into its initial WTE site at Alexandria, MN, and intended to use retrofit systems as part of its plans to maximize ROI (return on investment) whenever possible. Although Barlow Projects and its subsidiary organization are highly experienced in providing engineering services for power systems—including waste systems, turbines and retrofits—they also have close relationships with outside power systems specialists.

Barlow outsourced the relay work, turning to Exponential Engineering, a high-voltage specialist located just a few miles away in Fort Collins. Exponential works on utilities, substations, transmission and distribution lines, as well as distributed generation and interconnects.

“We had to deal with the generator as it came. It had literally been cut off from its original moorings, so we had a very unusual situation on our hands,” explains Tom Ghidossi, Exponential Engineering president. “We were confident that the generator was a good one, but we didn’t have much reference available, either in books or documentation.”

Interfacing the relay with the CTs (current transformers) presented unusual problems, because it was literally sawed off at the busbars. “Some of the CTs had been cut from the generator and left behind in Bermuda,” says Ghidossi. “So we had to come up with some CTs to match those that were left on the unit. Also, we had no information about the direction of rotation as far as the terminals were concerned. Somehow the terminals got swapped when the generator was shipped from Bermuda. We had to go through a lot of testing to determine which way the generator should be connected, and which way it would turn.”



Figure 3—Among the main concerns about integrating the Peter Brotherhood generator with the rest of the waste-to-energy system were the protection, monitoring, and interfacing issues. SEL-300G Generator Relays were purchased to provide the necessary protection for the refurbished generator.

Exponential Engineering was convinced that the SEL-300G Generator Relay from

Schweitzer Engineering Laboratories, Inc. (SEL) would provide the necessary protection for the refurbished generator. Based on extensive experience with “utility-grade” SEL relays, Ghidossi knew that the SEL-300G would also provide critical system configuration information. The local utility, Otter Tail Power, is also an experienced user of SEL relays.

The SEL-300G, the first microprocessor-based technology to comply with IEEE turbine protection standards, includes several unique features designed for unsurpassed protection, monitoring, and control of electrical generators. SEL designed the SEL-300G to meet the needs of a variety of users, including utility and industrial power plants and generator set manufacturers. In addition to comprehensive metering and reporting capabilities, the SEL-300G features include 100 percent stator ground fault protection, out-of-step protection, over excitation protection, directional power element protection, and RTD-based protection.

“The SEL-300G was really useful because we had to swap several different terminals and different connections as we were doing startup, to get to the point where we knew the unit was functioning the way it should,” Ghidossi explains.



Figure 4—The SEL-300G Relay (shown here installed), the first microprocessor-based technology to comply with IEEE turbine protection standards, includes several unique features designed for unsurpassed protection, monitoring, and control of electrical generators in utility and industrial applications.

“The ability to diagnose and see which currents were flowing via the relay’s

metering and reporting functions really let us know what was going on. Those features made the troubleshooting task a lot easier.”

This unusual retrofit also presented other problems. Exponential Engineering had to redo a lot of cabling. The existing substation at the Perham site required refurbishing. The generator’s resistive grounding had been left behind in the Bahamas and had to be replaced.

“This was a challenging project because it was a retrofit involving old equipment that came from a number of different places,” Ghidossi says. “As we progressed with refitting the equipment, we needed a tool that would help us understand the system. With the metering and reporting capabilities of Schweitzer relays, you can find out what’s going on. You are able to better assess situations more quickly and accurately. For instance: Why was the system showing a differential trip? Well, it was because the leads were the same as we thought they were, but the CT connections were not. So, the relay’s features helped us a lot in diagnosing problems like those. We accomplished in a single day what might have cost a week—without the intelligence that the relay gave us. And that time savings translated into very significant cost savings.”

Ghidossi says Barlow sent the generator to a GE shop in Minneapolis for testing and a checkout prior to undertaking its retrofit. “We wanted to be certain about what we were dealing with. The shop found some shorted turns in the field winding, which had evidently prevented the generator from operating at full power in its original installation. After the winding was repaired and we got the connections reconfigured, the system was operating at fully-rated power,” he says.

In order to eliminate the possibility of occasional downtime due to power grid problems, Barlow Projects and Exponential Engineering recently engineered the Perham site to operate in an “island” mode. “Since we generate electricity for the power grid, if the grid shuts down for some reason, we

would have to shut down, too,” Anderson explains. “Now we can avoid shutting down by disconnecting from the grid and operating in island mode, simply generating power for our own operation.”

Anderson says the Perham site is designed to burn 116 tons of trash daily, and has a 90 percent burn rate of carbon materials contained in the waste.

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About Barlow Projects, Inc.

Most of Barlow Projects facilities are engineered to produce electricity that can be used internally or sold back to the national power grid. Barlow Projects maximizes electric generating capacity and steam production capacity on a project-by-project basis based on local electricity rates and steam needs. Appropriate equipment would be installed to maximize efficiency based on those rates and the overall return on investment for the project.

About The Barlow Group

The Barlow Group has provided engineering services to a broad range of clients since 1990. Barlow Group clients have included cities, counties, construction firms, utilities, and the U.S. Department of Energy. The

firm has demonstrated expertise in all major areas of power generation, including boilers that utilize various types of fuel and all major models of gas turbines.

About Exponential Engineering

Founded in 1993, Exponential Engineering specializes in high-voltage electrical engineering, power substations, and transmission and distribution lines. One of Exponential Engineering’s principal strengths is protective relaying. In recent years the firm has been highly involved with distributed generation, including generators and substation interconnections.

About SEL

Schweitzer Engineering Laboratories, Inc. (SEL) has been making electric power safer, more reliable, and more economical since 1984. This ISO 9001:2000-certified company serves the electric power industry worldwide through the design, manufacture, supply, and support of products and services for power system protection, control, and monitoring. For more information, contact SEL, 2350 NE Hopkins Court, Pullman, WA 99163-5603; phone: (509) 332-1890; fax: (509) 332-7990; email: info@selinc.com; website: www.selinc.com.

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