

## Discovering the Benefits of Microturbines

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They were called to the site to disconnect the station from the power grid run by United Electric Cooperative, the distributor that operates an electric system in northern Pennsylvania that spans 7,000 square miles, including the overhead power lines running to the Ardell transmission station.

The electricians didn't know that the Elk County, PA, station, built and operated by Clarksburg, WV – based Dominion Transmission, was far from going quiet. Instead, it was taking its first steps toward generating its own onsite power, and ending its reliance on United Electric Cooperative or any other power provider.



"Those electricians couldn't believe that we were disconnecting from the grid," says Bob Pastorik, project manager for Dominion, a provider of natural gas transportation and storage systems.

"But we were. We had found a more efficient,

more reliable way to provide power to our station. Why wouldn't we go with it?"

The Ardell transmission station, tucked deep into the woods of northern Pennsylvania, officially began generating its own electricity in December 2001. Since then, the facility has run on the power generated by three 60-kW microturbines manufactured by Chatsworth, CA – based Capstone Turbine Corp. The turbines provide more than enough electricity to power the station, which draws gas from the southern part of Pennsylvania to the northern half of the state. In fact, the third of the station's turbines serves only as a backup.

Why did Dominion make this move? The company wanted the most reliable power source possible, and the best way to do this was to generate its own electricity at Ardell. This

way the station could continue to operate without a hiccup even if United Electric suffered a brownout.

And reliability isn't the only benefit Dominion receives from its microturbines. By using the turbines, Dominion officials saved a significant amount of money. United Electric agreed to install a three-phase power line at Ardell. Problem was, in doing so – thanks to complicated legal reasons – United Electric would have run power lines from a station located 15 miles away. United Electric then planned to charge Dominion \$1.35 million to install the three-phase power line and a rate of \$0.116 per kilowatt-hour. That didn't sit well with Dominion officials, who, by instead going with Capstone's microturbines, saved more than \$1 million while providing Ardell with its own power source. In even more good news, the turbines – because they emit such low levels of nitrogen oxides and nearly no sulfur dioxide – allowed Dominion to easily pass its air-quality tests, a critical hurdle considering that the station sits on the boundary of a state forest and thus had to meet more stringent emissions requirements.

Since installing the turbines, Dominion officials have had to spend virtually nothing on maintenance, thanks in large part to the fact that the microturbines feature just one moving part. It's no surprise that, since that day in 2001, Dominion engineers have become devoted fans of microturbines. The company now operates 22 Capstone microturbines in seven different stations, and plans to install yet another seven in a new transmission station being built later this year. In September 2004, Dominion even installed its first combined heat-and-power microturbine from Capstone, using the waste heat of three ICHP units to provide the Crayne Compressor Station with hot water. At the plant, located in Waynesburg, PA, exhaust-heated water raises the temperature of the natural gas chilled during one of the processes at the station. That "free heat" eliminates the need for an otherwise required boiler and boiler fuel. The system of three C60-ICHP Capstone microturbines running at Waynesburg, then, acts as a zero-fuel, zero-emission 1-million-Btu boiler.

The continuing relationship between Dominion and Capstone is just one of the many success stories in the growing business of microturbine-produced power. Highlighting it gives Distributed Energy magazine the opportunity to provide yet more evidence that microturbines are changing the onsite generation industry. Here is a look at how Capstone and Dominion formed their partnership.

**A Booming Business**

This story actually began in 1998, when Capstone shipped its first three commercial microturbines. At that time, no one could have predicted the future popularity of these machines. Today, a growing number of commercial and industrial firms, and public and government facilities are turning to microturbines to generate onsite power. Capstone’s success itself proves just how popular microturbines have become. Since 1988 the company has shipped more than 3,000 across the world.

These turbines hum in office buildings, hotels, apartment buildings, schools, industrial parks, and small industrial buildings. The reasons for their popularity are many. Microturbines come with low setup costs. They are flexible,



able to run on either gaseous fuels – natural gas, propane, or biogases; or liquid fuels – diesel or kerosene. They are extremely reliable, too, and boast low emission rates.

For all these reasons, microturbines made sense for Dominion.



“We compared different types of generated electricity,” Pastorik says. “We tried fuel cells. We considered having the local power company run three-phase power lines up the road to our substation. We tried reciprocating horsepower. But nothing

made as much sense as did the microturbines. Capstone turned out to be the most cost-effective option for us because the turbines allow us to move gas through our system using less energy on a daily basis.”

Keith Field, director of communications with Capstone Turbine Corp., isn’t surprised. Electric power rates aren’t

going down, and sit at sky-high levels in some of the most populous parts of the country. Microturbines give companies a weapon with which to battle this trend, and the ability to gain control over the electric rates they are forced to pay.

“The primary reason to use our equipment is to lower the cost of doing business, particularly here in California, in New York, in most of the northeastern states where rates are very high,” Field says. “Our microturbines are also very popular in Europe, Japan, and a number of other nations where electric power rates are extremely high. In those regions it is economically advantageous to create some of your energy onsite to reduce your draw from a high-priced utility’s power.”

Microturbines are also easy to maintain, a plus for busy companies and firms. The turbines are about the size of a beer keg, and they feature just one moving part. The odds are high that little will go wrong with a microturbine.

Officials with Dominion Transmission are far from the only ones who have turned to microturbines for their onsite power needs, something that has been reflected in Capstone’s quick growth.

“Our business took a dip down a few years ago when, around the nation and abroad, we had a recession. That triggered a slowdown in capital spending by businesses,” Field says. “That had an impact. But we are seeing a very dramatic growth in our business now. In fact, earlier in our fiscal year, about a year ago now, our CEO was predicting that we would be in the neighborhood of doubling our growth this fiscal year over last fiscal year.”

**Meeting a Company’s Needs**

Dominion Transmission is no small fry in the business of gas transportation and storage services. As part of its mission of storing and transporting large quantities of natural gas for customers such as major utilities and power plants, Dominion operates the world’s largest underground natural gas system and boasts links to major pipelines and markets in the Midwest, Mid-Atlantic and Northeast regions of the US.

The company is responsible for some 10,000 miles of pipeline in six states – Maryland, New York, Ohio, Pennsylvania, Virginia, and West Virginia.

Clearly, Dominion is an experienced firm. The company, though, faced some unique challenges in Pennsylvania’s Elk County.

The Ardell transmission station had long run on single-

phase power provided by United Electric Cooperative. An Add-A-Phase device was used to create three-phase 480-V power. A Cummins generator backed up this arrangement.

The system proved unreliable. Ardell sits deep in a wooded area, and the transmission station suffered frequent brownouts, especially during hunting season. The reason? Scores of cabins and hunting camps would switch on their power, overloading the system.

The Add-A-Phase lines were also a problem. Jerry Todd, project engineer with Dominion, says that the lines wore out fast, usually after just a single year. With both the Add-A-Phase devices and the utility being unreliable, Ardell was often running on the Cummins generator. The generator only had a 500-hour air permit, and during several years Ardell maxed out those hours.

Dominion officials knew they needed a new system. The solution, at least at first, seemed obvious. The Tennessee Gas Pipeline Co. ran its own substation just a few miles from Ardell. Dominion officials decided to run a three-phase power line through the woods to the Tennessee Gas station. Unfortunately, those plans were scuttled when United Electric forbade Dominion from going directly to Allegheny Power, the utility that provides the power to distributor United Electric.

United Electric agreed to install a three-phase line at Ardell, but would only run it from their closest substation, a station that sat 15 miles away.

“That was going to be a significant cost, approximately \$90,000 per mile,” Todd says. “It didn’t make sense to go with that arrangement.”



That’s when Dominion made the decision to somehow generate its power onsite. Its research eventually led the company to Capstone and its 60-kW microturbines, the company’s C60 model. At the time, 2001, Capstone had only been selling its microturbines for about three years. Dominion officials, though, were willing to take a risk on the new products for one



reason: It offered the best and most economical solution to the problems at Ardell.

“We were excited that the theories behind the microturbines were correct,” Pastorik says. “The company at that time was still a bit in design mode. They still needed people to test their microturbines, so to speak.”

The turbines worked well, although there were some problems. At one point, the shaft of one of the microturbine systems went out, for instance. But Capstone overnighted a replacement engine and the system was back online a few hours after its arrival. Today the microturbines run smoothly, and require little attention from Dominion officials. To date the three microturbines at Ardell have in excess of 30,000 hours of operation combined.

Dominion now runs Capstone microturbines in seven of its transmission stations. Last year, the company took the extra step of installing its first three C60-ICHP microturbines in its Crayne Compress Station in Waynesburg, PA. That model is Capstone’s combined-heat-and-power microturbine, a machine that allows facility managers to run their water loop through its integrated heat exchanger and use the exhaust to heat the water that’s used for building and process heating. Dominion officials use the captured waste heat, then, to provide hot water, free of charge, to the facility – which makes the microturbines about 86% efficient.

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