



RE: Capstone Turbine Microgrid References

To whom it may concern,

Please find here within a list of Microgrid reference installations in which Capstone Microturbines have been installed and operate in parallel with other distributed generation technologies.

OATI Microgrid - Bloomington, Minnesota

Open Access Technology International (OATI) – A 600kW Signature Series MicroTurbine package forms the backbone of the OATI Microgrid at their new headquarters and data center building in Bloomington, MN, commissioned in 2017. Integrated in a state-of-the-art Microgrid with solar PV, small wind, energy storage and diesel backup, the C600S provides power, heating and cooling in a CCHP application 24/7/365. Not only is this project the centerpiece of OATI's new Microgrid business that the company intends to develop for other customers going forward, but it powers critical functions of the Midwest Independent System Operator (MISO) grid operator.



Sierra Nevada Brewery – Chico, California

Two Capstone C1000 microturbine systems fueled by Low Pressure Natural Gas (LPNG). Replaced aging fuel cells that were previously installed at the property. The system provides steam to the brewery process via two Steam Generators. With 2MW of installed solar, the microturbines complement this existing on site electrical generation. With multiple sources of onsite generation, Sierra Nevada is now operating as a Microgrid.



Monhegan Island – Maine

This remote island off the coast of Maine wanted a dramatic change from its existing reciprocating engine-based power plant, so in 2016 the power district installed four stand alone liquid fueled C65 units. Capstone technology was selected, and was funded by the U.S. Government, by virtue of its ability to meet EPA Tier 4 emissions and its low maintenance requirements. The microturbine plant provides all of the power on the island, and hot water from two of the units is piped to a nearby archival building for dehumidification. The C65 units operate as a Microgrid in conjunction with a 20kW solar array.



Southern California Edison Co. at Catalina Island

The remote island of Santa Catalina, which sits off the Southern California coast, in the United States, commonly known as Catalina Island, is renowned for its scenic ocean views, distinctive Mediterranean charm, and picturesque island paradise. Fortunately, absent from this popular tourist destination are California's frequent "brown outs" thanks to Southern California Edison and 23 C65 Capstone Microturbines.

With an isolated power grid that relied on dirty diesel internal combustion engines for electricity, Catalina Island needed to upgrade its outdated grid to meet California's strict air quality standards. In addition, the utility needed to improve system voltage and frequency to accommodate large shifts in energy consumption.

Located approximately 22 miles (35 kilometers) off the coast, the island is home to 4,000 full-time residents. Primarily a tourist destination, the island's population swells to over 10,000 energy consumers on weekends and throughout the summer. The stunning island has served as the backdrop to over 500 motion pictures, documentaries, television programs, and commercials.

"What the Capstone microturbines do for Southern California Edison on Catalina Island is allow us to meet the island's electrical demand and frequency moment by moment perfectly," said Ronald Hite, Southern California Edison's District Manager.

Southern California Edison, the largest subsidiary of Edison International (NYSE: EIX), is the primary electricity supplier for much of Southern California. The utility operates the island's Edison Pebbly Beach power station near Avalon where the Capstone C65s supplement the utility's electrical power supplied by a few diesel engines and help offset peak power loads.



At a glance

Location

Catalina Island, California, USA

Commissioned

December 2011

Fuel

Liquid Propane

Technologies

- 23 C65 Capstone microturbines

Results

- The C65 microturbines supply approximately 1.5MW supplement electricity produced by the diesel engines to help provide prime power to the island's 25,000 electrical meters
- Power can be dispatched in increments from 65kW up to 1.5MW
- C65 microturbines reduce diesel fuel usage by about 10%, or 200,000 gallons, annually
- The Island's overall emissions profile improved with annual reductions of smog-forming nitrogen oxide emissions by about 8% and diesel particulates by about 9.5%

For decades, the island's 25,000 electrical meters were powered by diesel internal combustion engines when California's tightening air quality standards required a fresh approach. When selective catalytic reduction (SCR) units were installed on the engines to reduce nitrogen oxides (NOx) emissions, power output from the engines dropped.

"The fact that this is an isolated microgrid on an island means I have to meet demand continuously, 24/7, with voltage and frequency," Hite added.

He added that because of the island's fluctuating power demand and inability of the SRC-equipped diesel engines to consistently meet demand, the island required an additional form of generation that is quickly and easily dispatched in small increments. "The Capstone microturbines were able to do that, and at the same time displace how much diesel emissions we were emitting, so it improved our overall emissions profile on the island," Hite added.

Fueled by vaporized liquid propane, the microturbines power a diverse marketplace year-round, that includes a full complement of tourist activities like shopping, dining, hiking, fishing, and camping.

"I have the variability of being able to dispatch power in increments from 65 kilowatts up to 1.5 megawatts of cleaner propane powered generation," Hite said.

"The addition of the microturbines to Southern California Edison's electrical system on Catalina Island increases power capacity to approximately 1.5 megawatts, and reduces the consumption of diesel fuel by 200,000 gallons annually", said Caroline Choi, Southern California Edison's Vice President for Regulatory Policy.

In their first year of operation, the microturbines generated 2.5 million kilowatt-hours of energy, or roughly nine percent of total power produced on the island. This in turn reduced smog-forming nitrogen oxide emissions from the facility by about eight percent and diesel particulate matter by about 9.5 percent.

Training was critical to the success of the installation. "This site's island location is two hours from Long Beach by ferry, which means our service-response time is impacted," said Mark Parriott, Vice President of Customer Service for Capstone distributor Regatta Solutions, which installed the system. "We minimized the chance of service issues by training onsite facility operators to provide first-responder service if a rare unscheduled outage occurs. As a result, we expect this site to provide the clean, secure and round-the-clock power the island needs."

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23 Capstone C65 microturbines provide prime power to Southern California Edison's Avalon site on Catalina Island.

In addition to working with Capstone's Regatta Solutions to train technicians and operators for the project, Southern California Edison worked closely with the Southern California Air Quality Management District (AQMD), which is the air pollution control agency for Orange County and major portions of Los Angeles, San Bernardino, and Riverside counties.

"These microturbines are helping to reduce smog-forming pollutants and diesel particulates from Catalina's power plant," said William A. Burke, Ed.D., AQMD's Chairman. "This will help improve air quality not only on Catalina but also on the mainland as prevailing winds can carry pollutants onshore." ■

At a glance

Location

Lancaster, Texas, USA

Commissioned

December 2014

Fuel

Commercial Propane (HD-10)

Technologies

- Capstone C65 Microturbine for Grid Connect
- Inverter based microgrid application with various other technologies for education and demonstration purposes

Customer

- Oncor Electric Delivery Company
- A 150,000-square-foot (13,935-square-meter) complex consisting of five buildings

Results

- Microturbine is able to parallel load with all technologies on site
- Microgrid system is fully operational
- Solar panels are effectively charging batteries
- Laboratory building is operating on 200kW inverters

Oncor Electric Delivery Company

Operating the largest distribution and transmission system in Texas, Oncor is a regulated electric delivery business that delivers power to more than three million homes and businesses, and operates approximately 119,000 miles (191,512 km) of transmission and distribution lines statewide. Oncor also works with distributed generation customers to ensure safe and reliable interconnection with the state's power grid.

Establishing Onsite Generation in a Microgrid Application

As an advocate for clean energy technologies, Oncor wanted to establish a resilient and innovative microgrid based at their facility in Lancaster, Texas. The system would serve to promote the adoption of alternative power generation capabilities within a microgrid application. Oncor also wanted to implement a technology that could easily parallel with their existing generators as well as future technologies.

With a plant design in place, Oncor turned to Horizon Power Systems, the Capstone distributor for the state of Texas, for a reliable and efficient Capstone microturbine. The propane-fueled 65kW microturbine was able to parallel load with all other technologies on site, including solar, wind and renewable power.



“Oncor selected a propane-fueled Capstone microturbine as one of the primary sources for our advanced microgrid project. The microturbine integrated easily into the microgrid and has performed beyond our expectations,” commented Lance Spross, P.E., Director of Engineering Standards and Maintenance Strategy at Oncor. “Horizon Power Systems has been very responsive and supportive and has been a key partner in the construction, integration and testing of the Oncor advanced microgrid.”

A Showcase for Clean Energy Education

Commissioned in December 2014, the grid-tied system consists of nine different distributed generation resources, including a 65kW Capstone microturbine, two solar PV arrays, two energy storage units and four generators. The microgrid has a total peak capacity of 900kW; however, it is scalable to meet any load requirements. The system can operate at its peak capacity for two hours before dropping to a baseload of 550kW as solar generation falls off at night and the batteries deplete.

“Of all the components included in Oncor’s advanced microgrid, the Capstone propane-fueled microturbine was the simplest to integrate and has consistently operated as designed. The advanced controls and technologies associated with the Capstone microturbine have enabled demonstration of important capabilities like peak shaving and load shifting with very low emissions,” added Spross.

Along with commissioning the microgrid, Oncor completed its Technology Demonstration and Education Center at the company’s onsite System Operations and Services Facility. This facility showcases the role that distributed energy resources will play in the electric grid of the near future by providing reliable power to homes, businesses and schools. These transformative technologies are integrated into a larger system of four interconnected microgrids that allow for continuous site operation during extended storm outages and other critical events.

Oncor now offers public facility tours to showcase their clean energy generation sources, including the Capstone microturbine. Facility guests are able to visit three specific areas during the tour. First, a multimedia immersion room provides a high-level overview of questions Oncor is answering with their microgrid. Next, the demonstration room displays state-of-the-art

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control and monitoring technology to integrate and synchronize the diverse sources. Finally, guests head outside to see the battery system, solar arrays, Capstone microturbine and the distribution equipment that ties it all together. This firsthand view of how microgrid technologies work should serve as a foundation to enhance reliability for Oncor customers and promote microgrid technology.

“The selection of Capstone Turbine as an example of reliable onsite power generation, by an entity of Oncor’s reach, will open new conversations concerning distributed generation and fault-tolerant grid improvement for years,” commented Bryan Hensley, Vice President of Sales and Marketing at Horizon Power Systems. “We are pleased to be part of these exciting conversations.” ■

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