Dakota Station
Cooling, Heating, and Power Facility

Site Description

The Dakota Station, located in Burnsville, Minnesota, 10 miles south of Minneapolis, is a natural-gas peak-demand- shaving facility that is part of the Minnegasco gas distribution system, and is owned by Reliant Energy. In the spring and summer months, when natural gas prices are lower and there is lower gas demand, the facility cools natural gas to -260 °F to liquefy it and then stores it in a 12 million gallon holding tank for use in the winter months when the demand for natural gas is higher. The liquefaction process draws about 500-kW_e. The stored gas is equivalent to approximately 1 billion cubic feet of natural gas. By storing natural gas like this, Minnegasco can maintain lower costs to its customers and offset the need to provide additional expensive pipeline capacity to meet peak natural gas demands in the winter.

Dakota Station applies the exhaust heat from a 30 kW_e microturbine, used to reduce the peak energy demand during the liquefaction process, to provide dehumidification in the summer and heating in the winter to the facility.

While the Dakota Station is not a typical commercial installation, it clearly exemplifies the benefits of CHP to:

- Meet and offset seasonally cyclic demands (both electricity and gas),
- Reduce energy use and costs through efficiency,
- Save on energy costs by balancing energy demand; storing energy (liquefying gas) when it is less expensive (summer) and then making it more readily available when it is more expensive (winter), and
- Providing dehumidification/cooling and heating to the building.

According to Todd Lind, the Dakota Station Plant Manager, "The 30 kW_e microturbine was set up for customers to view in order to promote the use of microturbines among our customers."

Cooling, Heating, and Power (CHP) Configuration

Minnegasco currently uses two Capstone microturbines:

- The exhaust from the 30 kW_e microturbine is directed to a Unifin Heat Recovery unit to either provide heat or dehumidification/cooling via a liquid desiccant.
- A second Capstone microturbine, 60 kW_e, was added in November 2000 to meet the backup load of their liquid propane gas (LPG) plant along with an existing 40 year old gas reciprocating engine-generator. They also run the 60 kW_e unit in a "peak-shaving mode" during the day in the summer when local electric utility rates are higher.

A feasibility study is being done on the 60 kW_e microturbine to determine if it would be economical to use the exhaust heat to run an absorption-cycle refrigeration system.

Financial Statistics

30 kW_e Installation:	
Microturbine:	~ $35,000
Heat Recovery Unit:	~ $6,000
Desiccant Unit:	Already Owned
Electric Connection:	~ $4,000
TOTAL	**~ $45,000**
Highest Monthly Savings	~ $1,500
Simple Payback	~ 2½ years

Energy Overview

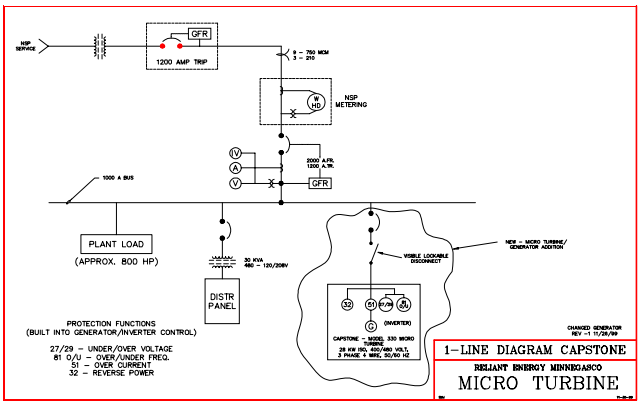
On average, the natural gas liquefaction process runs for two to three months during the spring and early summer and draws a load of approximately 500 kW_e. If natural gas usage has been high during a particular winter it may take as long as six months to replenish the liquid supplies.

Supplemental and back-up power is purchased under a uniform general services rate from a local electrical supplier. (All of Reliant Energy's electric generating plants are located out of state.) The purchase contract is somewhat typical in that it consists of an energy usage component and an energy demand component. The demand component includes a fee for the peak usage during the month plus an additional fee based on its peak usage during the previous 12-month period. Demand charges are higher during the day.

When the liquefaction process is not operating, the plant load is 15 to 30 kW_e. Therefore for 6 to 10 months of the year, the 30 kW_e microturbine can serve the entire load of the facility, with power primarily going to lights, air compressors and security systems.

Using the microturbine has reduced both the energy usage and the demand charges. Also, by using the exhaust energy from the 30 kW_e microturbine, the electric demands of the facility are further reduced. Minnegasco can generate a kilowatt-hour with as little as 4,500 Btu's of incremental gas use. According to Capstone data, generation efficiency is about 26 percent without heat recovery. When heat is recovered, the efficiency of the system increases to about 75 percent.

The 30 kW_e unit requires 50 psi natural gas. Because the Dakota Station is a gas storage facility, natural gas is available at high pressure that is reduced to supply the microturbines. Therefore there are no parasitic energy losses to consider due to running a gas compressor.



Fuel consumption and exhaust rates found in table below:

Capstone Microturbines	30 kW_e	60 kW_e
Heat Rate (LHV)	13,300 kj/kWh *(12,600 Btu/kWh)*	12,900 kj/kWh *(12,200 Btu/kWh)*
Fuel Flow	440,000 kj/h *(420,000 Btu/h)*	885,000 kj/h *(811,000 Btu/h)*
Exhaust Gas Temperatures	261°C *(500°F)*	305°C *(580°F)*
Total Exhaust Energy	305,000 kj/h *(290,000 Btu/h)*	571,000 kj/h *(541,000 Btu/h)*

Maintenance and Reliability Overview

As of March 2002, the 30 kWe unit had been operating very reliably for 16,244 hours. Very low maintenance costs have been incurred to date. There was an electronics failure in the digital power controller (DPC) during the first 100 hours, which was replaced within a couple of hours, once the part arrived. The only other maintenance or repair activity has been cleaning and changing the air filter. There have been no other forced outages. Minnegasco has been very satisfied with the service provided by the Capstone distributor from whom it purchased the units. The unit has run through winter temperatures dropping to –20°F and summer temperatures reaching 99°F.

As of March 2002 the 30 kWe unit has 16,244 hours of operation and has operated very reliably. The 60 kWe unit had operated reliably for 5,762 hours as of March 2002.

Results

- Reduced energy costs by offsetting grid usage, approximately $1,500 per month (season dependent).
- Provides further energy savings through use of exhaust heat for plant cooling and heating.
- Highest efficiency when exhaust heat is recovered for use in heating or cooling applications.
- Reduced maintenance costs versus other electric generator technology.
- Highly reliable operation experienced.
- Reduced emissions versus other electric generator technology.
- Provides showcase for Minnegasco customers.
- Contributes to utility customers' education of advanced energy technology.

For further information contact:

MIDWEST CHP APPLICATION CENTER

Address:
University of Illinois at Chicago
Energy Resource Center
M/C 156
851 S. Morgan Street
Chicago, IL 60607-7054

Phone: (312) 413-5448
Fax: (312) 996-5620

*www.***CHPCenterMW***.org*