The Power of New Technology: Microturbines

With the deregulation of the power industry, new opportunities are being created for customers to seek alternate, on-site energy sources. Customers are looking for improved power quality, reliability, and energy sources that can have a positive impact on the environment and their economic well-being. Microturbine technology can meet these demands. The CANMET Energy Technology Centre's Community Energy Systems group is working with Canadian gas and electric utilities and Canadian distributors of microturbines to develop high-performance, high-efficiency systems and to harness the potential of low-grade waste fuels.

Mariah CHP Unit at CETC

What are Microturbines?

Microturbines are small, high-speed gas turbines ranging in size from 30kW to 500kW. Like larger turbines, microturbines can be run on a variety of fuels. Microturbines are currently undergoing trials in commercial applications and have the potential to supply electricity to customers in a reliable, cost-effective way. Microturbine systems are suitable for applications ranging from remote locations to city centres, delivering clean, high quality power from a wide variety of fuels, with superior safety and low emissions.

Benefits from the use of Microturbines:

Microturbines can offer customers many benefits, including those of an economic and environmental nature. Some of these benefits include:

Fuel flexibility: These small power plants can operate on multiple fuels including natural gas, diesel, propane and other similar high-energy fossil fuels. R&D efforts are underway to modify microturbines so that they can be run on biogases or waste gases such as oilfield flare gas and landfill gas.

Low emission levels: A microturbine produces very low levels of NO_x (<9 parts per million). This is particularly important when siting units in urban areas.

Reduced maintenance costs: A typical microturbine has only one moving part, uses air bearings and needs no lubricating oil or cooling water. With only one moving part, the opportunities for failure are therefore minimized. With features such as built-in protective and diagnostic protocols constantly monitoring system operation, problems can be pre-empted.

Compact size: Little room is required to house a microturbine. The dimensions of a typical commercial 60kW microturbine are 0.76m wide x 1.93m long x 2.08m high.

Low levels of noise and low vibrations: Microturbines currently emit approximately 65 db at 10 metres and the noise can be further reduced through readily available control technologies. Microturbines produce almost no vibrations and thus do not require heavy foundations.

Efficiency and reliability: Microturbine manufacturers promote efficiencies of 25-30% and high reliability. With heat recovery, these systems can achieve efficiencies of 70-75%. The exhaust gas from the turbine passes through a heat exchanger or recuperator that heats the compressed air before it enters the combustion chamber. This preheating reduces the fuel used by the turbine thereby increasing efficiency.

Honeywell Microturbine with an Unifin Heat Recovery Unit at Health Canada Building, Toronto, Canada

Outage Protection: Microturbines can be operated in parallel with a utility grid, utilizing built-in control algorithms for load following, peak shaving, or time of use operation or completely separate from the utility grid in stand-alone mode. In the event of grid failure, the optional dual mode controller (DMC) senses the power interruption, disconnects the microturbine from the grid, and reconfigures the system for stand-alone operation, automatically bringing the local loads back up. When grid power returns, the process is reversed and the loads reconnect to the utility. All of this occurs without end-user intervention.

Issues to be Considered

- When planning to connect the microturbine to the grid, it is important to fully understand the code requirements of both the electrical distribution utility and the gas utility.
- Projects with multiple values have the most potential to gain from microturbine technology, ie., peak shaving and heat recovery for space or hot water heating.
- Gas turbines are significantly affected by increases in air temperature and altitude, which decreases air density. It is therefore important to calculate the impact of these factors on power output and efficiency.
- Since the sales distribution channels are currently in a state of development, it is important to understand the technical and warranty support systems, and their terms and conditions.

Honeywell Microturbine at Trail Road Landfill Site, Ottawa, Canada

Community Energy Systems Group - Microburbine Heat Recovery Systems

Since 1997, the Community Energy Systems group (CES) of the CANMET Energy Technology Centre has been managing a program on distributed generation that concentrates on microturbines.

One of CES' primary focuses is on advancing the development of flexible heat recovery systems. Recuperated microturbine exhaust is approximately 250° C and can be captured to heat water.

This process can increase the overall efficiency of the system from approximately 25% to 70-75%.

A Canadian company, Unifin International, has developed a heat recovery system that uses an exhaust gas diverter. When heat recovery is required, the diverter flap will open, allowing the hot turbine gas to circulate through the heat exchanger. When heat recovery is not required, the diverter closes, allowing the hot gas to bypass the unit. Supply and return water temperature and gas inlet temperatures are used in the heat recovery unit to control the position of the diverter. This design enables full power to be produced at times when there may not be a need for heat. This heat recovery concept, which is currently being marketed under the name of MicoGen, is designed to be used with any supplier of microturbines.

In addition, the Canadian company Mariah Energy Corporation has developed an integrated CHP (combined heat and power) system using the Capstone 30kW and 60kW microturbines. The integrated system has a smaller footprint which is easier to fit into crowded boiler rooms.

Landfill Gas

Another market niche that CES has identified is the use of landfill gas (LFG) from small landfills as a fuel. CES has been running tests with a Honeywell 75 kW unit at the Trail Road landfill site in Ottawa. The system runs on LFG with a methane content of approximately 35-41% and uses propane as a fuel addition.

Building Integration

CES has also developed a number of relationships with both gas and electrical utilities to explore the concept of integrating microturbine units into buildings. A number of demonstration projects are currently underway which aim at finding ways to reduce installed project costs and operating and maintenance costs.

Useful Web Sites:

CANMET Energy Technology Centre
www.cetc-ctec.gc.ca

Unifin's Heat Recovery System for Microturbines
www.unifin.com/micogen.htm

Secure Power Systems Microturbine Technology Overview
www.securepower.com/html/product.html

Mercury Electric Corporation
www.mercuryelectric.com

Greenhouse Gas Technology Center
www.sri-rtp.com

DOE/CETC/CANDRA Workshop on Microturbine Applications
www.nrcan.gc.ca/es/etb/cetc/cetc01/htmldocs/ces_rbrandon_e.html

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