United States Environmental Protection Agency | Air and Radiation 6202J | Revised Draft March 2004

EPA Coalbed Methane Outreach Program Technical Options Series

GENERATING ELECTRICITY WITH COAL MINE METHANE-FUELED MICRO TURBINES

Five Capstones Micro Turbines Operating at abandoned Akabira Mine in Japan
(Photo courtesy of Raven Ridge Resources)

APPLICATIONS AND BENEFITS INCLUDE…

- Off-grid self-generation of electricity at remote gas production sites
- Available in 30 kW to 2000 kW systems using cogeneration technologies such as discharge heat recovery
- Low air and noise emissions
- Low installation and maintenance costs
- Ideal for gob gas use operating on gas with a heating value as low as 350 Btu
- Recovery and use of methane reduces greenhouse gas emissions

Micro turbines have only one moving part, which drastically reduces maintenance

Why Consider Using Micro Turbines To Generate Electricity With Coal Mine Methane?

A large portion of the methane emitted from coal mines comes from gob areas (collapsed rock over mined-out coal), where methane concentrations may vary from 30 to 80%. Coal mines frequently do not use medium-quality gas from gob wells and instead vent the gas to the atmosphere, contributing to global warming. However, gas with a methane concentration exceeding 35% can in fact be used as a fuel for on-site power generation. Given their large energy requirements, coal mines can recover methane and generate electricity with micro turbines to realize significant economic savings and reduce greenhouse gas emissions.

The micro turbine is advanced technology developed from the defense industry that may be an ideal option for on-site electricity generation at coal mines. The micro turbine consists of a small, air-cooled gas turbine connected to a high- speed generator and compressor on a single shaft. This simple design results in a system with a high power output, minimal noise generation, and efficient operation. Diesel, gasoline or kerosene can be used as alternate fuels to insure continuous electricity production in the event that the methane supply is disrupted.

Micro turbines use air-bearing technology that eliminates the need for lubricants

Micro turbines are a compact, quiet, clean, and reliable power source. Their compact size allows them to be located at remote gob well sites or inside mine buildings, and can reduce the level of investment and maintenance typically associated with conventional generators. Because the generating capacity can be sized from 30 kW to 2000 kW, by integrating multiple-unit systems a mine can easily scale the project according to its needs. The micro turbine's 22-30% efficiency rating improves with the use of exhaust heat for pre-heating and adsorptive cooling.

Micro turbines have a high power-to-weight and volume ratio compared to diesel generators

Micro Turbine Case Study:

In 2001, Sumitomo Coal Mining commissioned five Capstone C30 Micro Turbines at the abandoned Akabira Mine near Hokkaido, Japan. This configuration uses approximately 30% of the mine's total methane discharge. The mine ceased mining operations in 1994, but while operating emitted nearly 125 billion cubic feet of methane to the atmosphere. The electricity generated is used on-site to power facility loads while the surplus is sold to a nearby factory. Exhaust from the system is sequestered back into the mine, eliminating greenhouse gas emissions and liberating more methane to power the micro turbine array.

Facts About Micro Turbine Power Plants…

- Provide off-grid power to remote areas
- Exhaust temperatures for a single 30 kW system exceed 500° F with an air flow of 204.0 lb (93.0 kg) per minute;
- Mines can recover exhaust energy over 250,000 Btu/hr for heating or drying
- Quiet operation (at least one model is less than 60 decibels @ 33 feet)
- Multi-unit systems can be designed according to site-specific power demands

Natural gas, diesel, gasoline or fuel oil can be used as a backup fuel

In today's changing power market, the trend toward distributed generation will allow consumers to determine their own power generation sources. At coal mines, these compact? power plants can help shift the source of power from centralized power stations to on-site units, satisfying a portion of the mine's power-generating needs. Micro turbines are both a short and long term solution to meeting a coal mine's electricity needs, while reducing greenhouse gas emissions.

Rapidly changing electricity markets are creating new opportunities for on-site power generation using coal mine methane. Micro turbines may be a cost-effective power generation option for gassy underground coal mines.

For More Information…

To obtain more information about generating electricity using micro turbines contact:

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