Chiquita Water Reclamation Plant

120 kW microturbine CHP system

Project Profile

combined heat & power in waste water treatment

Quick Facts

Location: Santa Margarita, CA

Capacity: Four Capstone C30 Biogas 30kW microturbines and one Microgen™ hot water generator

Fuel: Anaerobic digester gas

CHP system: Digester heating

System Online: December 2001 (Phase 1), 60 kW upgrade in October 2003 (Phase 2)

System Efficiency: Electric efficiency is around 20% to 22%

Total Project Cost: Phase 1 installation costs of $114,020 plus South Coast Air Quality Management District (SCAQMD) support; Phase 2 installation costs of $160,582

Energy Cost Savings: Estimated $60,000/year (for Phase 1)

Expected Payback Time: 2 years for Phase 1 with the SCAQMD support

Funding Sources: Santa Margarita Water District and SCAQMD donation

Project Overview

Two Capstone 30 kW microturbines integrated with one Microgen™ hot water generator (HWG) were commissioned at the Santa Margarita Water District (SMWD) Chiquita Water Reclamation Plant in December 2001.

Two additional 30 kW microturbines were commissioned and the HWG was modified in October 2003. The original two Microturbines (Phase 1) were donated by the South Coast Air Quality Management District (SCAQMD) as part of their program to provide clean auxiliary power during periods of peak demand on the grid.

The microturbines are fueled by anaerobic digester gas from the reclamation plant. Waste heat from the microturbines is used to heat the anaerobic digesters. SMWD chose to operate their original microturbines full time, realized significant monthly cost savings and thus decided to independently acquire its second two microturbines (Phase 2).

The systems are all base loaded at full electrical power and typically deliver 26-30 kW each. Waste heat from the first two microturbines was sufficient to allow shutting down the two boilers that originally fed hot water to the digesters, although one boiler is kept in standby mode. Additional heat provided by the newer microturbines may be used to dry sludge in order to lower shipping costs and/or heat future anaerobic digesters.

Costs & Financial Incentives

The SCAQMD program supporting the original installation began in April 2001. The Chiquita Water Reclamation Plant microturbines were actually commissioned in December 2001. Phase 1 construction costs added up to $83,666, not including change order costs. Other costs included interconnection ($1,400 for four turbines), SCAQMD permits ($1,611 for two turbines) and emissions source testing ($9,520 to test one representative turbine). Total Phase 1 installation costs ultimately added up to $114,020, excluding the cost of the equipment donated by SCAQMD.

In March 2003 SMWD was granted a location specific permit exemption by SCAQMD. SMWD pointed out that burning digester gas in microturbines is more environmentally friendly than the alternatives, including fueling boilers, reciprocating internal combustion engines or

simply flaring the gas. It took 16 weeks to finalize an interconnection agreement with San Diego Gas and Electric.

The Phase 2 microturbines and modified Microgen™ hot water generator were commissioned in October 2003. Total installation costs for Phase 2 were $160,582.

Picture below: Microturbines

Picture above: Microturbine disconnection switches

Performance Summary

The Phase 1 installation generated net operating cost savings of $4,000-$5,000 per month. As of May 2003, after 11 months of continuous operation, SMWD estimated total operating savings due to the microturbines to be approximately $58,300. Also as of May 2003 these two microturbines had each logged approximately 10,800 operating hours.

As of December 18th, 2003, the Phase 1 and Phase 2 microturbines had logged approximately 12,800 and 1,500 operating hours, respectively. SMWD operators estimate 99% availability for the microturbines. The most common reliability problems are centered around the fuel cleanup and delivery system.

Efficiency can be difficult to measure as anaerobic digester gas composition and heat utilization can fluctuate. However, based on a typical digester gas heating value of 60% of natural gas the electric efficiency is approximately 20-22%. Fuel compression requirements represent significant parasitic power loss. Up to 1 MMBTU/hr (293 kW) of heat is utilized. Emissions tests performed in 2002 indicated emissions levels of 1.25 ppmv NO_X and 138.5 ppmv CO, corrected to 15% O_2, from one microturbine operating at full power.

Lessons Learned

Lessons learned from both project phases include: (1) Installation costs for these systems were very significant in relation to the cost of the generators themselves; (2) Placing a robust fuel treatment system upstream of the microturbines was important (the new installation includes a refrigerated dryer and SAG™ filter system for cleaning and drying the digester gas - landfill gas can contain siloxanes and burning converts them to silica particles, which are abrasive and clog conventional combustion engines); (3) Integration of the heat exchanger with the microturbines was not trivial.

Further information can be found at

Santa Margarita Water District:
http://www.smwd.com/ Ron Meyer (949) 459-6594
South Coast Air Quality Management District:
http://www.aqmd.gov/
Methane (Biogas) from Anaerobic Digesters:
http://web.archive.org/web/20041124201613/www.eere.energy.gov/consumerinfo/factsheets/ab5.html?print
PRAC: www.chpcenterpr.org Version 1.2 12/19/06

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To be able to produce digester gas from cool waste water the digester has to be heated. The necessary heat is captured from the microturbines, which increases the overall energy efficiency of the system.

Important for a well functioning system is a H_2S scrubber (filter) which reduces the corrosive hydrogen sulfide content in the biogas. Failure to scrub H_2S could reduce the engine lifetime considerably.