

## Self-Sustaining Energy Production Using Microturbines

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### Abstract

The East LA oil and gas lease is located in an industrial area within the City of Commerce in Los Angeles, CA. Bentley-Simonson, Inc. (BSI) has installed gas treating equipment to process the produced gas from the field to pipeline specifications. A byproduct of the gas processing, a high vapor pressure component of the stabilized overhead vapors (OHV), is used as fuel in an Ingersoll-Rand 70 kW microturbine system to generate electricity.

Even though these overhead vapor components have a high Btu content (~1600 Btu/scf) they can be difficult to burn, marginally economic to store and sell, and the energy they contain is infrequently recovered in the form of electricity. The Ingersoll-Rand microturbine, installed in February of 2003, has logged approximately 3600 hours, generating 216,000 kWh of electricity that was used in the production facility. The success of the installation has led to the sale and future installation of additional Ingersoll-Rand microturbines at other BSI production sites.

### Introduction

Bentley-Simonson, Inc. (BSI), headquartered in Ventura, California, is an independent oil and gas producer in the State of California. With over 50 employees, BSI operates oil and gas producing wells in seven fields across Los Angeles and Ventura counties. Led by a team of industry professionals with domestic and international experience, BSI was founded in 1986 by Ted and Jim Bentley, Clif Simonson and later, in 1998, joined by Petter Romming. BSI has pursued a selective acquisition and development program to become one of the top 15 oil and gas producers in California.

Given the electrical energy situation in California, BSI is installing microturbine generation systems in its fields. These systems consist of small gas turbine generators to supply electricity for the production facility. Fuel gas is supplied by BSI's own wells, thereby providing a self-sustaining energy source.

### Microturbine Technology

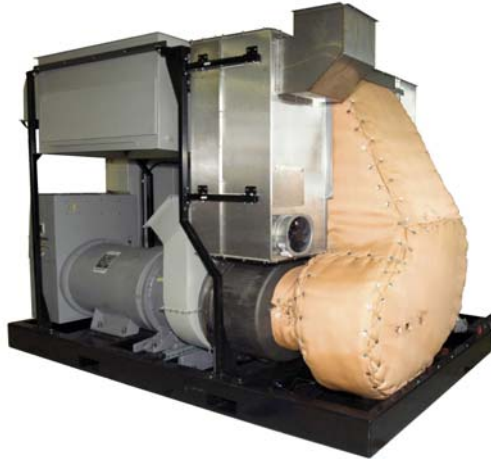
Microturbine systems are small gas turbine generation packages designed to provide onsite power and thermal energy, with low emissions and low maintenance requirements. Two sizes are currently available from Ingersoll-Rand, with rated outputs of 70 kilowatts (kW) and 250 kW at ISO conditions (59°F ambient temperature at sea level).

The turbines use lean premix combustion systems for low NO<sub>x</sub> and CO emissions (less than 9 parts per million by volume in the turbine exhaust, at an adjusted oxygen content of 15%). Actual turbine exhaust oxygen content is 18%. The turbine engines are recuperated, which results in an efficiency of 29% for the 70 kW unit and 32% for the 250 kW unit (LHV basis, not accounting for the parasitic load of gas compression). Exhaust leaves the recuperator at 450-500°F.



**Ingersoll-Rand MT70** features a patented recuperator, dry low NO<sub>x</sub> combustor and on-board heat recovery (optional).

Thermal energy can be captured and used onsite in several ways, depending on the site details. Hot exhaust can be ducted directly into a boiler as combustion air, which transfers all of the heat in the exhaust to the boiler and reduces the boiler fuel input accordingly. Or, Ingersoll-Rand provides an optional heat exchanger inside the microturbine package to generate hot water from the exhaust for a variety of possible uses.



**Ingersoll-Rand MT250** features a patented recuperator, dry low NOx combustor, conventional synchronous generator, single shaft design and integrated heat recovery (optional).

The electric generators provided by Ingersoll-Rand as part of these microturbine systems are standard industrial generators rotating at a fixed speed of 1800 rpm. Either induction generators or synchronous generators can be provided, for grid-parallel or grid-isolated electrical generation. Ingersoll-Rand provides the switchgear, braking resistors, and other electrical components necessary to meet the site and utility requirements. The electrical output is at 480 volts and 60 cycles/second.

The microturbines were originally designed to burn natural gas and to be used in commercial and industrial cogeneration applications. They have now been adapted for use with flare gases, biogas, and other waste fuels. This provides the opportunity to recover valuable energy from associated gas streams in oil and gas production operations such as those operated by BSI. Of the three basic types of systems (export, parallel, and island), the microturbines utilized by BSI operate parallel to the power grid.

### **East LA Site**

The East LA and Bandini/Southside leases, with 32 oil and gas wells, are located in an industrial area within the City of Commerce in Los Angeles. The fields were developed by Atlantic Richfield Company in the 1950s. BSI acquired the fields in 1998 with liens on title, expired permits and an infrastructure that was incapable of handling production. Since then BSI has cleared title, obtained permits, and updated the infrastructure including installation of a new gas treatment facility and returning ten wells to production. Several of the wells have been successfully recompleted and most of the wells have additional potential.

At the East LA site, BSI separates natural gas from the crude oil. Overhead vapors (OHV) are separated from the natural gas and used as fuel for the microturbine. This makes use of an energy resource that would otherwise be wasted. It is not economic to upgrade the OHV to natural gas at this site. The vapor flows through a gas/liquid separator and is compressed to about 80 psig. The compressed gas flows into a small receiver tank, and then into the microturbine. The microturbine software controls the flow rate of the fuel into the turbine.

The 70 kW induction generator operates in parallel with the Southern California Edison (SCE) grid. A capacitor bank was installed to correct the power factor to 0.8. Initial results are:

	Before	After	
	<u>Microturbine</u>	<u>Microturbine</u>	<u>Savings</u>
kW (avg)	63	4	
\$/month	\$4,200	\$1,100	\$3,100

This generates a savings on the monthly power bill of approximately \$3,100. The cost of the microturbine was about \$75,000. At current electric rates, the system should pay for itself in just over 2 years.



**Ingersoll-Rand MT70** operating at the BSI East LA site.

BSI installed the Ingersoll-Rand microturbine in February of 2003. As of early September, the unit has logged approximately 3600 hours, generating 216,000 kWh of electricity that was used in the production facility. Because of the success of this installation, BSI has decided to install additional Ingersoll-Rand microturbines at other production sites:

	<u>70 kW</u>	<u>250 kW</u>
East L.A.	1	
Sansinena	2 (3 more optional)	1 (with waste heat recovery)
Murphy (Las Cienegas)	5 (1 more optional)	
Paxton (Pacoima)	1	

### **Sansinena Site**

The Sansinena Field is located in the City of La Habra Heights (SCE territory). BSI acquired the field from Crimson Resources Management in late 2002. The field was originally discovered by Unocal in the late 1940s and currently produces both oil and gas from 100 of the 155 wells. The Sansinena Field produces approximately 1.1 MMcf/d of natural gas and this is currently being delivered to Black Sand's (formerly Nuevo Energy and Unocal) Brea Lease via pipeline. BSI receives no remuneration for this gas transfer and therefore BSI plans to market this gas by installing several pieces of processing equipment to convert this gas stream to merchantable specifications. This equipment should produce approximately 121,000 cf/day of overhead vapors (OHV) with a heating value of 1814 Btu/scf (gross). These OHV can then be used to generate electricity.

In order to convert these OHV to electricity, BSI plans to install one 250 kW and two 70 kW microturbines, for a total rated capacity of about 390 kW. The 250 kW unit will be equipped with a waste heat recovery unit (WHRU) that will supply thermal energy to the amine (DEA) unit. The WHRU should exempt the site from "spikes" in electricity demand charges when this equipment is taken off-line for service.

At the same time, BSI is converting the KOBE hydraulic lift system over to HRP's. The net effect will be to increase electrical requirements from 294 kW to 399 kW. The cost of the three microturbines (including installation) is less than \$500,000. This equipment should produce 390 kW of the 399 kW required and reduce the annual electrical expense by about \$500,000 (payout <1 year).



BSI is converting the KOBE hydraulic lift system to HRP's at Sansinena Site 5.



Microturbines will be installed downhill from a residential neighborhood at Sansinena Site 3.

### **Murphy Site (Las Cienegas)**

Located five miles southwest of downtown Los Angeles, the Las Cienegas Field was acquired by BSI in May 2000. This site is in Los Angeles Department of Water and Power (LADWP) territory. Developed in the early 1960s, the field produces oil and gas from over 40 wells and three drill sites: Jefferson, Murphy, and 4<sup>th</sup> Avenue.

BSI purchased the Las Cienegas field from Nuevo Energy Company who bought it from Unocal in 1995. The field had been poorly maintained for several years when BSI took over operations and production was the lowest it had been since the field's inception. By reinvesting considerable funds back into the property, BSI has been successful in turning around a steep production decline by reducing well downtime, returning idle wells to production and making modifications to the waterflood.

Currently, the produced gas from Jefferson and Murphy is processed at Murphy and sold to SoCalGas at the Pacific Electric site, stranding 4<sup>th</sup> Avenue gas. BSI plans to bring 4<sup>th</sup> Avenue gas back to Murphy and sell gas from all three sites (Jefferson, Murphy and 4<sup>th</sup> Avenue) at this location. Because the Murphy site impacts a natural gas refueling station, all gas sold at this site must comply with CARB MN80 specifications (a detailed discussion of CARB MN80 is beyond the scope of this paper).

The existing Low Temperature Separator (LTS) is not capable of supplying MN80 gas and therefore a new LTS must be installed. Based on the HYSIM runs done for BSI by Vanson Engineering, this unit should produce approximately 80,300 cf/day of OHV with a heating value of 1746 Btu/scf. The OHV will be used to generate electricity. BSI plans to install five 70 kW

microturbines to consume about 60 Mcf/D of OHV. No gas will be vented during normal operation of this system. The total microturbine capacity that BSI can install at Murphy is presently limited by the site's electrical equipment (amp service).



**BSI** will install a new LTS at the Murphy site to supply MN80 gas.

The five 70 kW microturbines will generate about 350 kW of electrical power. BSI's cost for these five machines is about \$350,000. Based on the last 12 months of electrical expenses, BSI believes this equipment should reduce LOE by \$250,000 per year (payout <1.5 years).

#### **Paxton Site (Pacoima)**

Chevron discovered the Pacoima Field in 1975, with development starting in early 1981. The Paxton drillsite (in LADWP territory) is a 2.7 acre fee surface site located within a residential community with a high block wall enclosing the facility. Located on the north side of the San Fernando Valley, the field has four producing wells and one injector. Though the Paxton drillsite was designed for 20,000 Mcf/D, the Pacoima Field reached its peak production in July 1987, when the gas production averaged 7,644 Mcf/D. BSI acquired 100% working interest in the Pacoima Field in late 2002 from Crimson Resource Management and the site was shut in until August 2003 awaiting the installation of SoCalGas meter equipment.



SoCalGas meter equipment was installed at the Paxton site.

The wells at Paxton were historically produced with gas lift, but some wells were converted to HRP by Crimson in 2001. BSI has undertaken a facility reconfiguration that includes:

1. Returning idle wells to production and performing well recompletion
2. Glycol reboiler relocation and reconfiguration
3. Installing one 70 kW microturbine

BSI's cost for the microturbine is about \$80,000 and the anticipated electrical savings is estimated to be about \$3,000 per month (payout <2.5 years).

### **Conclusion**

Microturbines from Ingersoll-Rand are providing environmental energy solutions to BSI oil and gas production sites in Southern California. Integrated into reconfigurations of these recently acquired operating sites, microturbine generators use stabilized overhead vapors to generate electricity and in some cases, thermal energy as well. Evaluated on a simple payout basis, the microturbine systems at four BSI sites are projected to pay for themselves in less than one year to less than 2.5 years.