

Business Park Opts for Cogeneration

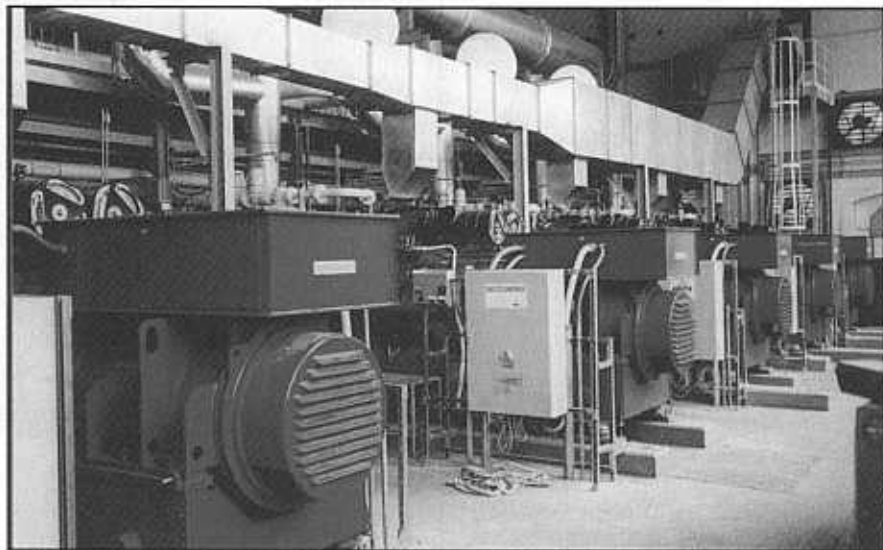
Southbridge Business Center uses Deutz gas engines for thermal and electric energy

by Mark McNeely

Any mid-size facilities that demonstrate balanced thermal and electric energy loads are ideal candidates for cogeneration. Sure, there will be shoulder seasons where production and demand don't match perfectly, but if the peak summer and winter demands can be easily identified, the reciprocating natural gas engine with heat recovery stands as one of the most efficient systems for fulfilling those primary energy requirements.

In Southbridge, Massachusetts, U.S.A., what was once the boiler plant for a large industrial complex has now been transformed into a high efficiency energy plant generating electricity, thermal energy, chilled water and compressed air for more than 13 companies. The Southbridge Energy Center is a descendant of an optical company's original oil-fired boiler plant, commissioned around 1904. Although demand at the optical manufacturing site had gradually dwindled in recent years, the plant continued to supply steam and electricity to other businesses. It became evident, however, that switching to natural gas was a more economically and environmentally sound option.

With a gas infrastructure in place, the power plant's owner, Nations Energy, began removing the old steam-powered turbines and replacing them with high-efficiency Deutz Energy natural gas-fired engines. "Years ago, there was a tremendous load for process steam," explained Gene Morrill, facilities manager for the Southbridge Energy Center. "Through the years demand has gone down and then the local gas utility gave us a couple of good incentives to take down the number 6 fuel oil tank farm.



A view inside the engine room of the Southbridge Energy Center shows the five Deutz TBG-620-V16k gas engines. The combined electrical output of the plant is around 6.0 MW. The high efficiency energy plant generates electricity, thermal energy, chilled water and compressed air for more than 13 companies in the Southbridge Business Center.

"We struck up a good deal with Deutz," Morrill continued. "They were able to meet our emissions and efficiency targets, as well as cost." The overall plant conversion project, which was commissioned in June 2001, was US\$14 million.

The Southbridge Energy Center is one of several power plants owned and operated by Nations Energy, based in Chicago, Illinois, U.S.A. The company's cogeneration facilities are built around the concept of distributed power, according to Tom Shepard, vice president of operations for Nations Energy. "Our focus is to build dedicated on-site cogeneration facilities providing an 'inside the fence' supply of utilities to industrial and commercial end users. This is the dedicated on-site power market where our host provides the majority of the load for both thermal energy and electricity," he said.

The power plant consists of five Deutz TBG-620-V16k gas engines rated 1358

kW at 1800 r/min driving 4160 V Leroy Somer generators. The engines feature Heinzmann step-up governors and ABB turbochargers. With a compression ratio of 12:1, the Deutz 620 engines have a bore x stroke of 170 x 195 mm, for a total displacement of 70.8 liters. The engines have an electric efficiency of 40% and a thermal efficiency of 45.9% for a total efficiency of 85.9%.

Power plant engineering was provided by Waldron Engineering Inc. of Exeter, New Hampshire.

Exhaust energy from the engines is recovered via five Engineering Controls Vaporphase model ECXSV-5410V-1.5 waste heat recovery silencers equipped with internal exhaust bypass circuits. Each unit is rated to produce 1020 kg/h of steam at 3.45 bar from 104°C feed water. The waste heat recovery silencers are designed for 10.4 bar steam.

Other peripheral equipment to the



The power plant's paralleling switchgear allows for both power import and export. The switchgear was manufactured by Prime Automation and features several Basler generator monitoring components. Engine monitoring and control is via a Deutz total electronic management (TEM) system.

generator sets includes Alfa Laval plate frame heat exchangers for intercooler and auxiliary water cooling and SENS Stored Energy Systems battery chargers. Engine condition monitoring is via Deutz's total electronic management (TEM) system.

Phase I of the project called for three engines to produce roughly 3.5 to 4.0 MW of power, along with steam. Phase II, now nearing completion, calls for the remaining two engines to come online, along with activation of the facility's chiller. Total electrical output will be 5.5 to 6.0 MW. Part of the steam generated is directed to an 800 ton York absorption chiller, while the remainder is utilized for both hot water and steam heating. Aside from the engine-produced thermal energy, the plant also contains

two packaged boilers to supplement the winter heating demands. Peak demand months run from November to April.

Power is also utilized by three air compressors, two Worthingtons and one Ingersoll-Rand, that were part of the existing steam-driven plant. Another existing structure that came in handy was the original exhaust stack. Although internal modifications were extensive to allow the fitting of both the boiler and engine exhaust liners, the stack's sound attenuation properties are excellent, according to Morrill.

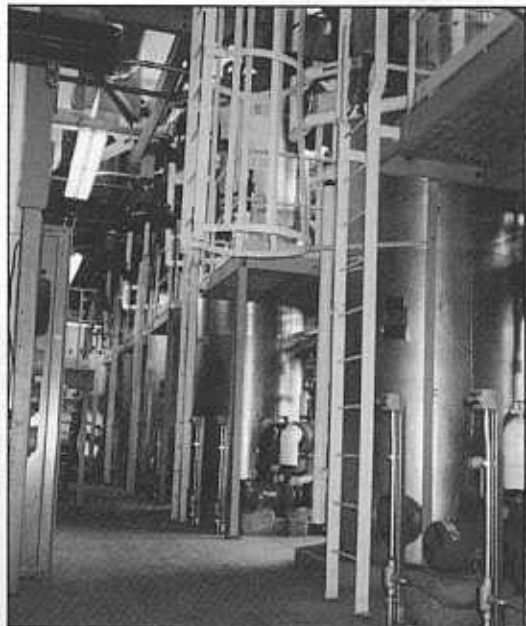
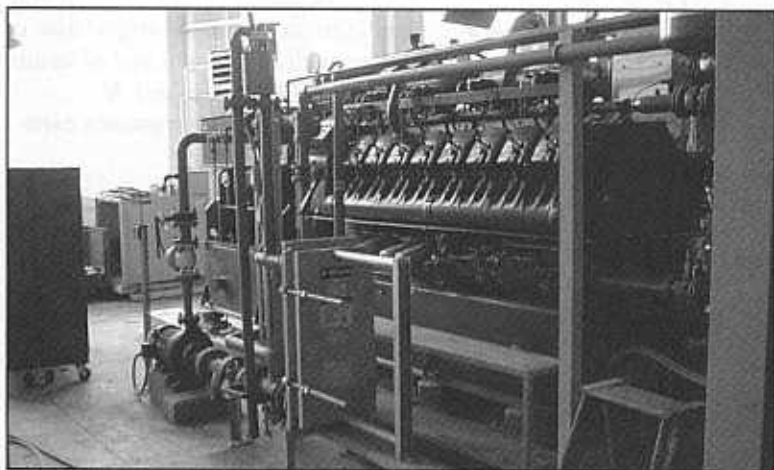
Much of the plant's thermal energy and electricity is needed for a new United States Department of Defense (DoD) training center, adjacent conference center and hotel, the opening of which has coincid-

ed with the completion of Phase II. Morrill noted the re-powered plant was critical in the DoD's decision to build in the Southbridge Business Center.

From the control room the facility has the ability to both import and export power, according to Morrill. The paralleling switchgear equipment was supplied by Prime Automation, located in Plymouth, Massachusetts. The switchgear incorporates several Basler generator monitoring devices, including a BEI-GPS generator protection system, digital voltage regulation, overcurrent relays and DECS power module. Other equipment includes a GE Fanuc PLC and SATEC power metering. Engine monitoring is tied in through the Deutz TEM system.

Each of Nations Energy's Energy Centers is designed to benefit the grid by providing voltage and frequency support, reduction of line losses, reactive power control, transmission capacity release and reduction of overall emissions. Shepard said these sites play an important role in meeting peak power demands, supplying critical customer loads, improving power quality and providing low cost energy in combined heat and power applications.

"We are looking quite extensively at the power, quality and reliability (PQR) market," Shepard said. "We believe this is an opportune time for us in the market and we're very optimistic about our business planning going forward." ▀



(Left) One of the Deutz gas engines. Each engine uses an Alfa Laval plate frame heat exchanger for intercooler and auxiliary water circuit cooling. (Right) A view from behind the engines shows five Vaporphase exhaust heat recovery silencers supplied by Engineering Controls. Each unit is rated to produce 1020 kg/h of steam at 3.45 bar from 104°C feed water.