Declaring Independence from Grid Power Uncertainties

Generating Onsite Power with Capstone Benefits Production, the Environment and the Bottom Line

THE ISSUE:

Eliminate grid power uncertainties that threaten production and profits for a continuous process manufacturer.

THE SOLUTION:

The Capstone MicroTurbine creates clean, economical, onsite electricity along with thermal energy for climate control.

Harbec Plastics President Bob Bechtold, an innovative businessman with an innovative technology.

SOLUTION SUCCESSES:

- Yields 36% net energy cost reduction
- Ensures production continuity
- Uses microturbine heat exhaust for climate control: absorption chiller air conditioning and desiccant drying in summer; radiant floor and circulated air heating in winter
- Delivers excellent return-on-investment, yielding production protection, low O&M needs, and high energy efficiency through CHP
- Lowers environmental impact compared to conventionally generated power and heat
- Eliminates need for paralleling switchgear and other costly arraying hardware
- Interconnection requires no additional hardware, thanks to UL 2200 and UL 1741 certification, as well as built-in protective relays and other direct-to-grid interfacing functions

Continuous Process Manufacturing Depends on Continuous Power

At Harbec Plastics, the waste produced at each step becomes the input for the next step. Even the scraps swept off the floor become raw material used to create fresh new products. Electric power keeps Harbec moving, but a power interruption can create disaster, ruining raw materials and work in-process. Complex CNC processes drop offline, resulting in extensive downtime. A grid outage, spike, sag or frequency variation of minutes or even a split-second can translate into long recovery times and huge economic losses.

Harbec Plastics' founder Bob Bechtold has, for more than 20 years, walked a tightrope balancing power cost and quality against his corporate livelihood.

Located outside Rochester, NY, Harbec (www.harbec.com) produces highly engineered, precision plastic parts for customers in medical, automotive, consumer goods and other industries. Every aspect of Bechtold's ISO 9002/Q2 9000/ISO 14001-certified operation is designed to maximize sustainability and efficiency while minimizing waste through re-use and recycling.

Overlooking the Capstone MicroTurbine installation at Harbec Plastics.

Power Problems Lead to a Capstone Solution

Years of increasingly frequent power problems culminated in a string of grid outages and other power events that hit Harbec hard in 1999. Clearly the power outlook for Harbec was uncertain and something had to be done.

Today, Bechtold's facility has a state-of-the-art array of 25 ultra-low-emission 30-kW Capstone MicroTurbines producing high-quality uninterrupted power. Heat from the array is used for both warming and cooling.

Bechtold's search for the optimal energy system began with several objectives in mind:

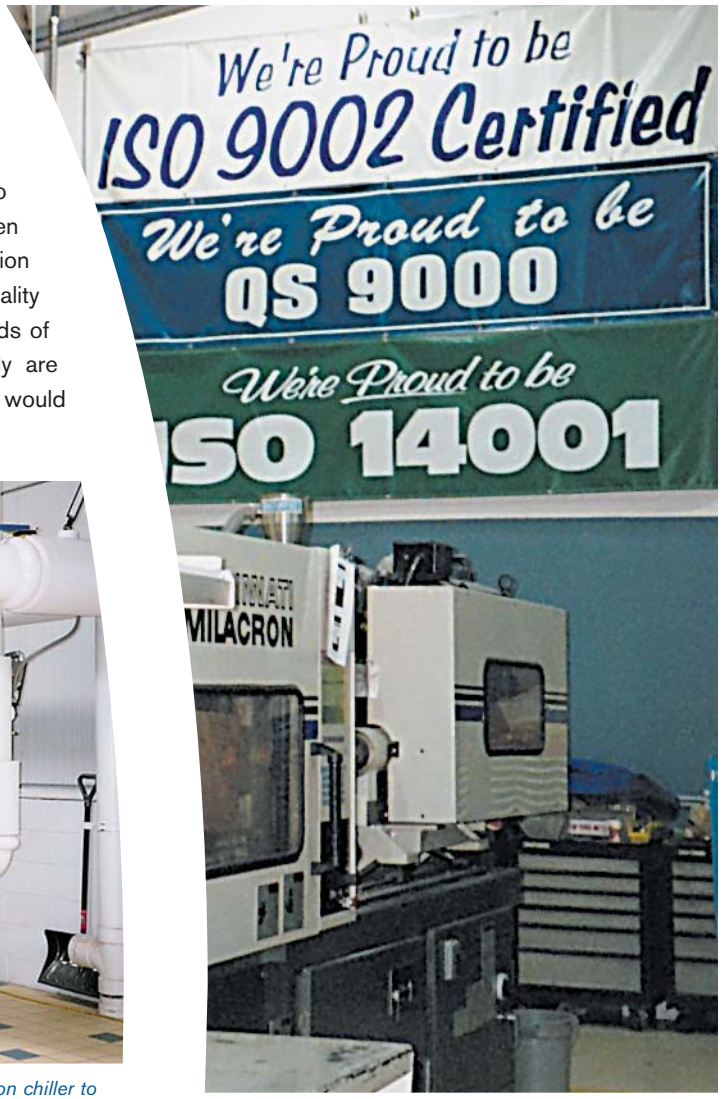
The system must be the facility's primary source of power. Since even a momentary outage was as damaging as a lengthy one, standby generation alone was not an adequate solution. A battery UPS may have improved power reliability but would have increased the already high electric costs. The solution also needed to instantaneously load-follow the facility's needs, which often swing 30 percent several times a minute during full production phases. The onsite system must be a continuous source of quality power to the facility, with some level of redundancy. The odds of multiple primary and redundant units failing simultaneously are extremely low, but, if such a case were to arise, the utility grid would serve as the final backup source.

Hot exhaust from the Capstone MicroTurbines fires this Carrier absorption chiller to air condition the Harbec facility using near-zero electrical load.

The system must have extremely low emissions. Since Harbec is an ISO 14001-certified facility, Bechtold was committed to designing an environmentally benign onsite system. This commitment led away from reciprocating engine technologies, even those fired by natural gas, as NOx emissions from natural gas engines are many times higher than the best-in-class generating technologies. Thus, he began investigating wind power, fuel cells and microturbines.

The system must be efficient. Bechtold wanted a solution that recovered as much of the input energy as possible. He envisioned a system that would capture exhaust heat and put it to valuable use for space heating, process drying and even "power-free" air conditioning via absorption chilling.

The system must be economically feasible. While attracted to the renewable energy supply represented by wind, and the potential high efficiency and low emissions of fuel cell prototypes, economic analysis clearly revealed that microturbines offered the best up-front and ongoing value for clean, continuous onsite power. Further evaluation of microturbine options led Bechtold to a simple conclusion, "For fully functional, proven technology that met all our criteria, there's only one company… Capstone Turbine."



As an ISO-certified company, Harbec demanded–and received–the utmost quality from Capstone, an ISO-9001 company.

A **New Way** of Looking at **Electric Power** and **Climate Control**

The electrical loads of Harbec's building were evaluated, and the microturbine configuration identified. Twenty of the 25 Capstone MicroTurbines were mated to five heat recovery boilers. Each boiler uses exhaust heat from four microturbines to heat water to 210°F. Total system efficiency exceeds 70%.

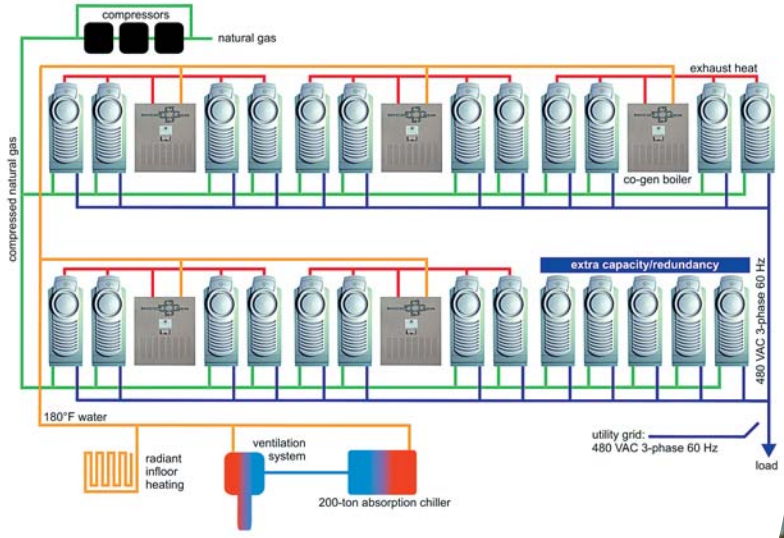
In the winter, this hot water is routed to the ventilation system as well as radiant floor heating built into the concrete slab of Harbec's warehouse area. In warm and humid weather, the heated water fires a 200-ton absorption chiller to air-condition and dehumidify Harbec's warehouse and production areas without adding any appreciable electrical load (the facility had no air conditioning prior to this installation). The desiccant effect also eliminates the cost of drying raw materials in humid weather.

Like all other continuous process manufacturers, Harbec Plastics needs continuous power to protect production and prevent costly downtime.

Assessing System Performance

The Harbec system went into full operation during the summer of 2001, the season historically most plagued by power outages. The microturbine array provided full-time operating power to all facility loads, including the starting and stopping of several motors as large as 60 horsepower, while the exhaust heat fired the Carrier chiller, delivering a constant supply of dry chilled air to the facility.

Uninterrupted power has load-followed Harbec's many processes and machines, eliminating power outage costs and downtime, enabling Harbec to meet its own and its customers' demanding lead times. The Capstone MicroTurbines provided this power while emitting ultra-clean exhaust with less than 9 ppm NOx , a level less than half that per kWh emitted by generators of the local utility (according to EPA data). Maintenance on the systems is expected to be minimal: after a full year of constant operation, the only scheduled maintenance is an air filter change and a quick visual inspection of key system components.



Anatomy of a Solution: A diagram of the system at Harbec Plastics.

The built-in multipacking capabilities of Capstone MicroTurbines allow units to be taken down for maintenance while remaining units instantly and automatically pick up the displaced load. Up to 20 stand-alone units (unlimited number for grid-connected units) can be arrayed without the need for paralleling switchgear or other hardware beyond common computer cables. Up to 100 units can be multipacked via Capstone's affordable PowerServer™ option.

Dispatching, monitoring and diagnostics can be accomplished via Capstone Remote™, the company's Windows-based software that operates via a single modem or direct connection through RS232 (serial) cable or TCP/IP (Internet). This is essentially a "set-it-and-forget-it" combined heat-power-drying-chilling system that needs no end-user involvement. To Bechtold and his staff of more than 100, there's no before-and-after difference other than power certainty and lower energy costs.

The "Green" Room: In keeping with the company's practices, Harbec's warehouse is designed for low environmental impact and high energy efficiency.

Uninterruptible Power at a Profit

Harbec secured a natural gas contract with TXU that delivers fuel to the facility at an average cost of $6.85/MCF. At this rate, the value of the hot water recovered from the microturbines equates to over $0.03/kWh. Factoring in this recaptured heat value, electric power is generated for approximately $0.07/kWh, lower than the averaged local grid price of approximately $0.105/kWh. In the final analysis, total gas and electric utility bills are reduced 36 percent. At a capital cost of $1,100 per kW for the microturbine CHP hardware and Harbec's effective utilization rate of over 5,000 operational hours per year, this equates to a payback period of less than two and one-half years. At the time of this writing, natural gas is available in many parts of the nation for $4/MCF. At that rate, the utility bill savings would be over 50 percent and payback on the hardware investment closer to two years. These calculations do not include the positive added value of outage cost avoidance.

At Capstone's Los Angeles-area headquarters, microturbine arrays undergo extensive pre-shipment testing.

Why **Capstone** Makes Sense for **Continuous Process Manufacturers**

Capstone's 30-kW and 60-kW microturbines provide a continuous source of high-quality power with near-zero emissions and extremely minimal maintenance requirements. Coupling them with heat recovery systems to provide thermal energy for space and process heating, cooling and/or drying makes these systems extremely energy efficient.

The economics of onsite power with heat recovery allow businesses to achieve an extremely reliable power supply. It's a system whose energy economics create payback in three years or less in many parts of the country. In these times of volatile electricity prices, onsite generation enables companies to budget exactly what their electricity will cost. The systems that can do this are here today, creating a productive and positive working environment at businesses like Harbec Plastics.

Quick Facts:

Number of Units:
25 Capstone Model C30s

Electrical Output: 750 kW

Heat Recovery:
1.5 MW or 5,128,500 Btu/hr

Additional Equipment:
Capstone PowerServer™

Unifin micoGen™ heat exchangers

Carrier™ absorption chiller

Installation Purpose:

- To provide reliable electric power and eliminate outage costs
- To provide thermal output to drive heating and cooling systems
- To deliver better total fuel efficiency than conventional options
- To reduce environmental impact compared to utility power and gas heating

Side view of the Capstone Model C30 MicroTurbine

Capstone

The microturbine generator for power on or beyond the grid:

- Ultra-Low Emissions
- Designed for Ultra-Low Maintenance
- Fuel-Flexible
- Air-Cooled
- One Moving Part
- No Lubricants or Coolants

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