ELECTRIC POWER RESEARCH INSTITUTE

Strategic Intelligence Update: DER

Program 101 — **Emerging Distributed Generation Technologies and Infrastructure**

www.epri.com

August 2006

EPSI Integrates Emission Control Technology with DER

Combustion Turbine Genset Destroys VOCs While Providing Distributed CHP

More than 100 types of businesses representing as many as 100,000 commercial and industrial facilities use materials that produce air emissions regulated by federal, state, and local agencies. The U.S. EPA regulates volatile organic compounds (VOCs) under Title III of the Clean Air Act of 1990, and those regulations are tightening. Environment and Power Systems International (EPSI) of Tucson, Arizona (www.epsipower.com) has developed an alternative to traditional VOC abatement technologies that also offers end users the benefits of distributed generation and cogeneration. EPSI founder Steve Sexton met with EPRI's **David Thimsen** and said he believes his technology will provide an appealing value proposition to thousands of customers within a few years.

Ground-level ozone is created by the chemical combination of VOCs and NOx in the presence of heat and light, and is a major constituent of smog. Major man-made sources of VOCs are automobile exhaust and industrial processes, where they are widely used as solvents. VOC emissions can be reduced to meet EPA limitations by thermal oxidation, catalytic oxidation, adsorption, condensation/refrigeration, and biological oxidation. Regenerative thermal oxidation (RTO) is the most common method, passing post-combustion gases through heated beds of ceramic material to achieve removal efficiencies of 98% to 99%.

GTO Technology

EPSI is staking its strategy on a different thermal technique using gas turbine oxidation (GTO). A GTO consists of a gas turbine with a secondary combustion chamber designed to efficiently destroy VOCs and other hazardous air pollutants, including biochemical contaminants. At the same time, GTOs generate electricity and produce thermal energy that can be used for process heat and steam, space conditioning and cooling, and other industrial applications.

"Gas turbines have a limited number of applications: standby power, emergency power, primary power, peaking power," explained Sexton. "With this device, we can justify placing combined-heat-and-power (CHP) onsite for production and manufacturing facilities while we're abating VOCs. This is obviously a niche, but the number of potential applications makes it very exciting."

EPSI's system is built around the Vericor ASE8™ combustion turbine, which is rated for 525 kW continuous power. The added GTO technology is patented can-type combustion chamber that increases residence time at VOC destruct temperatures in the range of 1600°F to 2200°F (870°C to 1200°C) (see Figure 1, next page). The genset uses 7.8 million Btu/hr; caloric value not supplied by the VOCs is made up by natural gas. NOx control is provided by water injection, with expected raw emissions of 30 ppmv at 15% O_2.

EPSI's target market is thousands of facilities already using RTO or alternative technologies looking to expand, replace existing equipment, or provide redundancy.

"Why would somebody want to switch technologies, when

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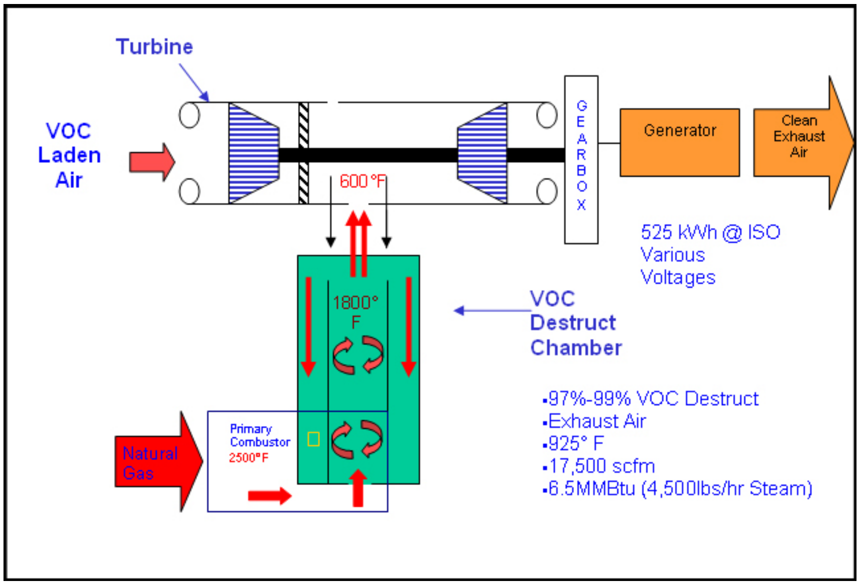

Figure 1: Schematic of the EPSI GTO

most companies and personnel are already comfortable with what they've worked so hard to put in place?" Sexton asked rhetorically. "That's a tough question we must address.

"The answer is economics," he continued. "When you switch technologies, you eliminate the capital cost of the thermal oxidizer and the natural gas needed to fire it, and over time you eliminate the related life-cycle costs. Instead, now you have a capital investment in a CHP device that also destroys VOCs and provides at least two new revenue streams: waste heat and ... an engine that provides around 500 kW of electricity."

Because a GTO can be ramped up and down very quickly—"ours can be turned on and off like a truck motor," said Sexton—it would use significantly less natural gas than an RTO, which takes a long time to ramp up and down, and as a result is often run continuously.

Table 1 provides EPSI cost and performance estimates for RTO versus GTO, showing a payback period of less than two years plus the potential for hundreds of thousands of dollars in energy savings for GTO.

Table 1: Cost/Benefit Comparison of RTO and GTO Technology

	RTO System	EPSI GTO System
Total Capital and Project Costs	$1,800,000	$3,200,000
Total Annual Costs	$618,000	$262,000
Fuel and Electricity	$227,000	$122,000
Maintenance	$35,000	$10,000
Administration	$94,000	$90,000
Refurbishment Fund	$261,000	$40,000
Total Annual Credits	$0	$475,000
Electricity Generation	$0	$125,000
Heat Recovery	$0	$350,000
Simple Payback Period	None	1.6 years
Return on Investment		60%

"My thrust is to do this on a very large scale, replacing thousands of thermal oxidizers in a very short period of time," Sexton said. "I think there's also financing we can put together so that if the customer doesn't want to buy it, we can buy it for them, put it in place, and share the savings."

Business Strategy

EPSI emerged from the environmental controls business; in fact, Sexton still works as an environmental engineer. It is an early stage company that Sexton began in 1997 to advance GTO technology he first saw used by Allied Signal at a polystyrene plant, where a similar system removed pentane from an air stream and waste heat was used to power a steam generator. When Allied Signal and Honeywell merged, the original intellectual property passed through them to Vericor Power Systems, with whom EPSI has an exclusive license to develop derivative products and which will provide the combustion turbine engines used in EPSI's GTO package.

"Our technology is not a breakthrough technology, it's all off-the-shelf," Sexton said. "There's no magic. It's just a larger combustion chamber that works on a nice industrial gas turbine." Sexton believes that familiarity will ease investors' and potential customers' concerns about risk. He has worked to build alliances, line up suppliers and vendors and, in 2003, secure investors and form a corporate board of managers. The company now has a private-placement offering that Sexton hopes will raise $3 million to support EPSI's efforts for about two years. He later plans to secure another $5 million for the third year in which production is initiated. At the present, EPSI is essentially a one-man operation advised by a board of managers but without employees, inventory, or physical plant.

Sexton singles out the contributions of the Gas Technology Institute (GTI), which performed a technical assessment of EPSI's system in 2003 (available in PDF format at www.epsipower.com/documents/GTITechnologyAssessmentEPSIGTO2003.pdf). EPSI has a technology development agreement with GTI under which GTI will share its DER test facilities, advise on performance and safety, and provide a host site for the first prototype, due to be delivered to GTI in Des Plaines, Illinois in early 2007. Because local regulations prevent GTI from injecting VOC contaminants, that test will assess only overall performance, maintenance, and reliability. A second prototype will be installed in Arizona specifically to test for VOC destruction. EPSI plans to begin producing units for commercial customers in 2008 with the objective of placing 10 units by 2009.

Looking ahead, Sexton hopes that EPSI can take advantage of alternative energy programs in states such as New York, Pennsylvania, New Jersey, Connecticut, California and others. As more regulators encourage innovative forms of distributed energy, emission control, cogeneration, and energy efficiency, Sexton believes that his GTO technology will be an increasingly attractive option.

EPSI would welcome demonstrations and partnerships with interested utilities and energy companies. For example, Sexton described a potential customer in California that is interested in deploying several GTO systems onsite that the local utility might want to buy. He added that demonstration gensets are available to interested customers until EPSI begins production and commercialization of its final genset design.

"We have a long road ahead of us," Sexton said. "But if we can get recognized, we may fit into a niche by satisfying demands on utilities" to provide distributed energy, emissions controls, and cogeneration. "EPSI could manage the environmental side and sell off the generating assets to the utilities because that's the business they're in. I think it might be a very good fit. We should be very flexible when imagining what we can do."

EPRI Perspective: DER installations generate operating benefits from electricity production. CHP installations add a revenue stream from thermal energy production. The GTO application that EPSI is developing adds a third revenue stream: that associated with destroying pollutants. An associated benefit is that the calorific value of the pollutants can reduce gas turbine fuel purchases.

Incumbent technologies that clean contaminated air can be sorted into three types:

- Technologies that simply destroy VOCs and have no other useful purpose. These yield no benefit streams, only costs.
- Technologies that incinerate VOCs and recover useful thermal energy, usually in the form of steam. They provide a modest revenue stream via the fuel displaced by the recovered thermal energy. These applications are rare.
- GTO technologies, which provide a benefit stream in the form of electricity purchases displaced by the combustion turbine and, where it fits, heating appliance fuel purchases displaced by recovered thermal output.

GTO technology will not be applicable for all VOC destruction needs. It can be more expensive than alternative methods. However, the potential economic advantages and other benefits such as quick start and stop, opportunities to market excess generating capacity to utilities, shortened mean time to repair and replace, and others could make GTO attractive for some customers. How "real" any of these advantages and benefits are must be assessed through field installations.

Electric utilities should be interested in this technology/application for two reasons: 1) if successfully demonstrated, GTO is likely to be widely deployed to clean air contaminated with VOCs from a variety of industrial processes, and, 2) if redundant GTO units are installed to maintain standby VOC destruction capability, these standby units may be available for dispatch during peak electrical demand periods.

EPRI is monitoring the progress of EPSI's marketing and deployment activities. Contact **David Thimsen** for more information on opportunities to monitor performance and costs of the technology.