Technology advancements make GT-based generation more compelling than ever

Planning for the annual Pacesetter Plants issue is ongoing. The editors routinely track announcements of new domestic gas-turbine-based generating facilities and significant retrofit/upgrade projects through various news sources and company press releases. Additional resources include the many loyal readers associated with GT user groups who call with leads; plus Chris Bergesen of Platts' Washington office and Chris Kels of EVA Inc, Arlington, Va, both of whom share appropriate data from their new-plant surveys.

By July 2007 the editors had started files on more than 50 projects that they believed qualified for coverage in the 4Q/2007 issue. It looked like a banner year. First step was Google searches on all projects to get more detail, an effort that was marginally successful at best. Then there were seemingly countless calls to owners, engineering firms, equipment suppliers, etc—essentially anyone who might possess knowledge on a given project. This phase was time-consuming and the results did not meet expectations. But the editors were able to identify about 30 plants that were indeed scheduled for start-up in 2007—one of the acceptance criteria at the time. The others had been pushed off into the future or canceled.

In December, phoning began to arrange site visits—as late in the year as possible to get the early operating experience that would be of interest to readers. What the editors found was a severe case of schedule flu—commercial start of project after project had slipped to 2008. So they made a decision to publish 4Q/2007 after 1Q/2008 to include projects starting up in the first quarter. Only conclusion one can draw is that the personnel shortages so many have been talking about for so long are undeniably true.

In the last State *of* the Industry report (4Q/2006, available at www.combinedcyclejournal.com/archives.html) the editors observed that "given the current political climate, public concerns, and the industry's intolerance for risk-taking, installing gas-turbine-based generation in load centers is a difficult option to beat in many areas of the country."

That certainly remains true today. A report posted by Industrial Info Resources Inc (IIR), Sugar Land, Tex, in June, concluded that "market forces have pushed natural-gas-unit construction activity in the US to a three-year high in 2008" with 210 units totaling 18,000 MW under construction. Further, that an additional 22,000 MW is scheduled to begin construction in the next 18 months.

You could condemn what appears to be an over-reliance on GTs as foolish—especially considering the decline in domestic gas reserves and fuel prices stoked by increasing global trade in LNG. Not many would argue the point. However, it is difficult to overlook the advantages of gas turbines compared to the "big power" coal and nuclear options:

- Virtually no stack emissions.
- Minimal water consumption.
- Small footprint.

Regarding the big disadvantage—fuel cost—the public doesn't appear too concerned at the moment. It may just be resigned to higher energy costs, conditioned by the huge run-up in the price of gasoline in the last year. There are choices, of course: More judicious use of the family vehicle and reducing energy waste in the home. News reports have chronicled the recent drop in miles driven; perhaps turning off lights, TVs, and computers when not in use will be next.

Nuclear. There is considerable debate regarding the future of nuclear power. Mention often is made of two or three dozen plants "at the licensing stage," whatever that means. Nuclear's promoters talk about the reliability of the existing fleet and the very favorable average busbar cost of electricity in 2007 of 2.2 cents/kWh. All true. However, don't forget that it took about a quarter of a century to get to the "good numbers," aided by increasing costs for everything new.

As Editor Len Hyman pointed out in Black & Veatch's *Energy Strategies Report* on March 31, "The nuclear renaissance (people talk of it as if it were happening) continues to depend on an array of federal subsidies." These include:

- A payment of 1.8 cents/kWh for eight years for 6000 MW of capacity (which works out to about $6.8 billion at the industry's current 90% capacity factor).
- Debt insurance for six plants in case they are delayed (a total of $2 billion).
- Loan guarantees for 80% of project cost (maximum of $18.5 billion, which might cover four or five plants).

A back-of-the-envelope calculation by Hyman says power from a new nuclear plant probably will fall somewhere between 10 and 15 cents/kWh. "Where's the beef?" as Clara Peller used to ask in the TV commercial.

Forget about the numbers for a moment and reflect on some of the other factors that could adversely impact a near-term nuclear renaissance:

- There's a presidential election in the fall and the nuclear-waste

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issue probably is further from resolution today than any time in the recent past.

- Water use/consumption is a major issue nationwide. Nuclear plants require more water than coal-fired steam stations and much more than GT-based generation—unless, of course, once-through cooling is possible.
- Where do the engineers and crafts come from to design and build the new nuclear fleet? At a recent GT user group meeting one plant manager told the editors that the OEM called a week before a planned outage to say, "Can't make it; we don't have the people now." A couple of phone calls later the editors knew others have experienced such delays as well.

And what happens to the whole plan when the anti-nuke faction injects itself into the picture? Perhaps they don't believe in a nuclear renaissance: Not a peep out of them—yet.

The promise of coal has been seriously compromised in the near term by potential CO_2 liabilities. It is doubtful that much new coal capacity will be built, beyond that already started, until there is some resolution of the CO_2 issue. That could take years years. In this arena, the climate-change activists are hard at work. Witness the recent blockade of a North Carolina coal-plant construction project on April 1—dubbed Fossil Fool's Day. Activists went as far to lock themselves to construction equipment. Globally, more than 150 such actions were carried out that day.

The GT-based generation sector of the electric power industry is not idling while the nuclear and coal-fired sectors are "in irons." Rather, it is advancing the state of materials, controls, and other technologies, steadily improving performance—including starting reliability, unit availability, and efficiency—while reducing emissions.

In the last year, GT user groups have chronicled progress in the welding of sophisticated alloys required to survive the Brayton cycle's high temperatures, extending parts life and the time between inspections to reduce outage time, advancements in lube-oil conditioning technology, GT rotor life extension, materials inspection techniques, etc. Many of these advancements undoubtedly will be transferable to future coal-fired and nuclear stations.

It is an industry sector "on a mission" of continual improvement, both at the deck-plates level, and at the OEMs and third-party services providers challenged as never before to do better tomorrow than they did today—at an even lower price.

Technology advancements highlight several articles in the Portfolio of Pacesetting Plants. An outstanding example is Portland General Electric Co's 407-MW, M501G1-powered 1 × 1 Port Westward combined cycle in Clatskanie, Ore—one of the most efficient powerplants on the West Coast (p 45).

The utility, in "partnership" with EPC contractor Black & Veatch, Kansas City, and Emerson Process Management's Power & Water Solutions division, Pittsburgh, took the industry's first step in the application of digital bus technology to powerplants. The project was a success from the get-go: Cost and schedule were about the same as for traditional I/O wiring—the additional engineering and startup time required to implement the new technology being offset by reductions in conduit and wire. In the first year of operation, no specific plant issues could be attributed to fieldbus.

Enhancements to extend the lifetimes of mature frames have been particularly impressive. To illustrate: PSM, Jupiter, Fla, essentially remade Altura Cogen LLC's (Channelview, Tex) five 7E diffusion-flame GTs into new engines with its LEC III combustion system, installation of an inlet bleed heat system, redesigned exhaust end, and other modifications (p 59).

Testing verified that NO_x emissions were reduced by about 90% to less than 4 ppm and CO emissions to typically less than 5 ppm across all ambient conditions and premix load ranges. Plus, turndown to 55% of the full-load rating without exceeding 4-ppm NO_x was verified with the IBH system in service. Power augmentation steam flows of up to 80,000 lb/hr also are possible without exceeding 4-ppm NO_x. These results were achieved "right out of the box," with no engine disassembly or retuning required.

Combined heat and power (CHP) has taken New England institutions—and other East Coast facilities requiring both electrical and thermal energy—by storm as several articles in the Portfolio attest. There are good reasons for the paradigm shift: Ageing steam plants that dominated the landscape were showing their wear and tear, stack emissions were well off today's regulatory requirements for new facilities, efficiency was not what it could be in a time of spiraling fuel cost, transmission constraints and reliability issues would only get worse as campus enrollments continued to climb, student and personnel safety would be compromised if "must run" energy infrastructure didn't perform as intended, etc.

Reading through all seven CHP profiles offers a quick education on the many options available to users faced with superannuated steam systems. The simplest solution is Fairfield University's installation of a Solar Turbines Inc (San Diego) Mercury® 50 engine, modulating bypass damper, and hot-water generator (p 85). The low-emissions, highly efficient machine precludes the need for downstream emissions control and significantly improves the reliability of electric supply.

At the other end of the spectrum is the award-winning CHP facility installed by UMass at its Amherst (Mass) campus (p 21). This plant is different from the others in many respects—architecture to begin with. It looks more like an athletic fieldhouse than a powerplant; one outstanding visual attribute is that stacks and supporting infrastructure (oil and water tanks, for example) do not poke you in the eye.

Noteworthy, too, is the plant's fired boilers that make up the difference in thermal demand when the heat-recovery steam generator on the back end of the 10-MW Solar Mars® 100 GT is maxed out or unavailable. The innovative units from Rentech Boiler Systems Inc, Abilene, incorporate the latest emissions control technology from Peerless Mfg Co, Dallas, to restrict NO_x emissions to 2 ppm with 2 ppm ammonia slip over a wide range of boiler loads while holding CO emissions in the single digits.

Earlier, mention was made of the relentless march forward of technology development in the GT-based generation sector. One idea aimed at extracting more power at higher efficiency and lower emissions from simple-cycle machines in particular is the simplified combined cycle described on p 92.

Rights to the Chen cycle technology, developed by Dr Dah Yu Cheng and proven commercially, recently were acquired by Advanced Power Projects Inc, Fremont, Calif—a new company formed by Peter Cartwright and Tom Mason, two long-time industry veterans. Experience to date has been with GE gas turbines—specifically the LM2500, LM6000, 6B, and 7EA—and that's where the company is focusing its initial efforts. **CCJ**