The Best Defense? A California Muni Fights Back with an Advanced 50 MW Combined Cycle Power Plant

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Redding's Generating Unit No. 5: The Pioneer Combined Cycle installation in the U.S. of the Alstom GTX100 combustion turbine

Introduction

The Redding Electric Utility (REU) is the municipal utility for the City of Redding, California. In 2002, REU completed a major capacity addition project, the City of Redding Generating Unit #5 Plant Installation. This plant provides a nominal 43 MW baseload capacity addition. The steam generated by exhaust heat recovery from the new plant displaces steam currently generated by natural-gas-fired boilers and is used for an additional 11 to 13 MW of power generation capacity from an existing steam turbine.

The new plant is built around an ALSTOM GTX100 industrial gas turbine engine, the second of its type to be installed in the U.S. ALSTOM intended and designed the GTX100 to be a high-efficiency industrial machine that would compete favorably in a size and application field largely

dominated by aero-derivative combustion turbine engines. The new plant also includes the largest application of SCONOx™ emission control technology for NOx, CO and VOC reduction to date.

The project was executed by APComPower, a subsidiary of ALSTOM, with POWER Engineers providing detailed design as ALSTOM's engineer.

REU – A California Utility in an Enviable Position

In the midst of the California energy crisis, the Redding City Council approved construction of this new project to fulfill an energy need starting in 2005 due to expiring supply contracts and as a hedge against the failing market design in California. REU is now a California utility in an enviable position: it has access to more power than it needs at this time, and can sell the excess to other entities who need it. Counting the output of its own power generation facilities (136 MW including the new generation plant) and existing contracts with the Western Area Power Administration and others, REU has access to approximately 330 MW of capacity, while its own peak demand is 227 MW.

REU's current position is a result of an accurate strategic decision by REU's management in the 1990s, to make costly expenditures in power plant infrastructure and long-term supply contracts in order to be able to contain future power prices by being energy-independent. REU's current position is also the result of the participation and support of REU ratepayers, who shared personally in the decision by REU's management to invest up front in the expectation of future reward. REU funded the energy independence program in the 1990s by a then-controversial 23 percent surcharge on customer bills: rates went from 8¢ to 10¢ per kilowatt hour, with the surcharge originally planned to expire in 2004.

Recently, in part because of revenues from excess power sales, REU ended the surcharge effective July 1, 2002, with customer's rates dropping back to 1997 levels. This pleasant electrical situation has been a strong factor in economic development in Redding, which offers manufacturers and businesses a refuge where the power infrastructure is already in place and prices are predictable.

Diversification as A Defense Against Price and Availability Instability

The new Redding combined cycle plant has innovative features: a new high-efficiency gas turbine engine, and a high-performance NOx reduction system. But in many ways, the new plant is a continuation of an existing REU and City of Redding strategy to defend its citizens from potential depredations from outsiders.

REU's resource manager recently observed, "Forecasting can be difficult, especially when it pertains to the existing energy market." Such forecasting difficulty has been most evident in California's recently deregulated electric utility industry where market trends of the past are no indication of what the future may hold in store. The REU resource manager explained, "For example, we have seen wholesale market prices for electricity go from 4 cents per kWh on average to spikes of $1.50 per kWh and with averages in 2001 around 18 cents per kWh. That translates to a 350% wholesale price increase. If such an increase were passed on to a typical household in Redding that uses about 1,000 kWh per month, the electric bill would soar from $100 to $240."

To hedge Redding's ratepayers against vulnerability to this kind of volatility, REU has deliberately planned a diversified inventory of power sources. According to the Resource Manager, "REU's electric resources consist of a balance of various fuel sources that include hydro, coal, and natural gas. Electric supply reliability is maintained by not having all REU generation resources located at any one site. REU has generation resources located within the city limits, in and around Northern California, and outside the state. By diversifying both fuel source and generation resource location, REU is able to maintain a highly reliable and cost effective power supply."

In 2001, REU's determination to protect the interests of ratepayers became most evident in the utility's reaction to a threat levied by California's governor to seize surplus power from California municipalities for use elsewhere in the state. REU Director James Feider's reaction was an assertion – remarkable for its vigor in the normally staid electrical utility industry – of REU's and the City's historic concern for the soundness of its electrical supply: "The Governor needs to understand that when we have excess generation to sell, it is usually at the highest incremental cost to produce, and these costs must be passed on to protect those who invested in the system: the Redding community."

He continued: "We will continue to work with the Governor and his staff to find the right avenue and make our excess generation available to them as long as the City of Redding is compensated on a fair return and a guaranteed payment. Additionally, we will make sales to the State, as long as we have the right to stop the flow of electrons and return this energy supply back to the City, if there is a need here at home." He noted that REU could not justify selling power to the state at cost if it meant using up permitted run hours and then later having to buy power at the market price. "We have no intentions of selling low today, and having to buy high tomorrow."

The Repowering Debut of an Advanced High-Efficiency Combustion Turbine Equipped with State of the Art Emission Controls

Since the new turbine's conception in 1995, several ALSTOM GTX100s have been installed and operated throughout Europe. The Redding installation represents the second U.S. installation of the GTX100. The GTX100 is intended to serve in a medium-sized CT market niche hitherto dominated by aeroderivative combustion turbines. The new Redding turbine, fired with natural gas, is fitted with an ATS/Express Heat Recovery Steam Generator (HRSG), which provides steam to drive an existing steam turbine at the REU plant to generate additional energy and achieve higher thermal efficiency.

The plant utilizes state-of-the-art SCONOx™ technology to reduce NOx and CO emissions without the use of ammonia, as opposed to conventional SCR and CO catalyst technology. The SCONOx™ catalyst oxidizes CO to CO_2 and NO to NO_2. The NO_2 is then absorbed on the surface of the SCONOx™ catalyst which is coated with potassium carbonate and platinum. The resulting potassium nitrites and nitrates are then reconverted to potassium carbonate through a regeneration process that involves passing a mixture of natural gas and steam across a steam reforming catalyst to produce H_2 and CO_2. The concentration of H_2 in this gas is typically 2-4%.

The regeneration cycle of the SCONOx™ catalyst is achieved by passing a controlled mixture of the regeneration gases (H_2 and CO_2) across the surface of the catalyst in the absence of oxygen. Sets of dampers are located upstream and downstream of ten catalyst sections. Each section is regenerated individually to achieve the required oxygen-free environment. The regeneration gases react with the nitrites and nitrates to form water vapor, elemental nitrogen and potassium carbonate. There is no net gain or loss of potassium carbonate after both oxidation/absorption and the regeneration cycle have been completed.

Construction of the plant began in March 2001. Extensive site work consisting of dynamic and vibratory compaction was required as the site is located over an area that was extensively dredged for gold in the late 1800s. The combustion turbine, SCONOx™ and HRSG were delivered to the project site during October-December 2001. First fire of the turbine was achieved on 4/8/02, and the unit began steam production to the Unit #4 steam turbine on 4/30/02. The SCONOx™ system was compliance tested and achieved average NOx and CO values of 1.55 ppm and 0.15 ppm respectively, well within the permitted values of 2.5 ppm and 6 ppm.

The plant was released for operation June 7, 2002. Since that time it has provided power to the REU with few forced outages. REU plans to operate the GTX100 powered combined cycle at or near base-load for the majority of time over the next several years and then base-load the unit as the City of Redding's energy needs increase. The site has also been designed for the addition of a second unit at some future date.■