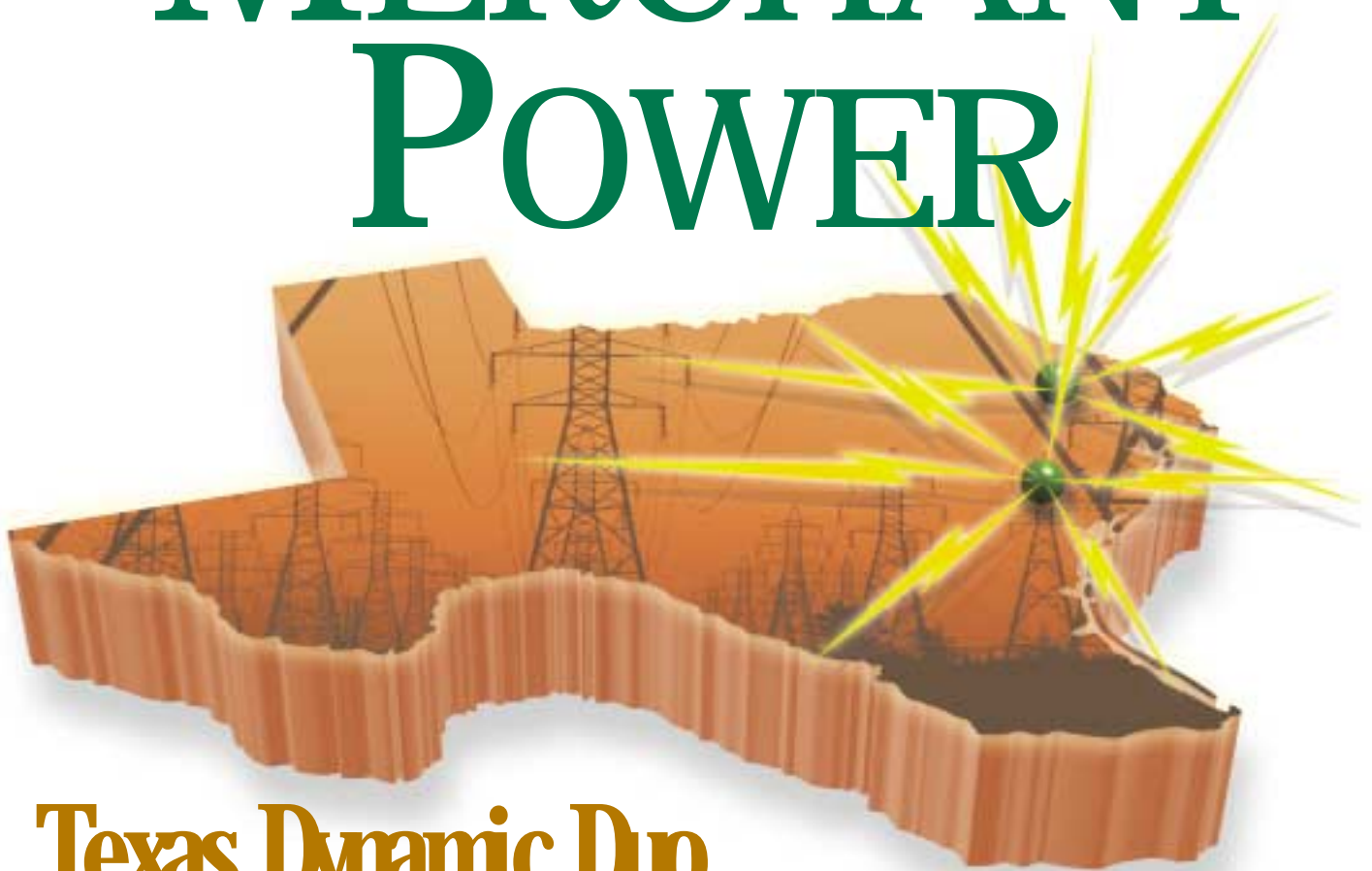



# POWER Engineering

July 2001 *the magazine of power generation*

## MERCHANT POWER



### Texas Dynamic Duo Serves Two Grids At Once



# TENASKA'S *DYNAMIC DUO* SCORES IN TWO NERC GRIDS AT ONCE

BY STEVE BLANKINSHIP, ASSOCIATE EDITOR

WITH SOME "OUTSIDE THE BOX" THINKING AND A HEAPING HELPING OF CREATIVE ENGINEERING TO MATCH, INDEPENDENT POWER PRODUCER TENASKA HAS CREATED A PAIR OF TEXAS POWER PLANTS THAT DO WHAT NO OTHER POWER PLANTS IN THE U.S. CAN.

As the old real estate adage goes, the three most important things are location, location, and location. It applies to the merchant power business too.

A convergence of power grids, ready availability of water and fuel, and a steady demand for electricity in one of the nation's most economically vibrant vicinities has produced Tenaska's Frontier Generation Station in Grimes County, Texas, 50 miles northwest of Houston's city limits. Frontier's nearly identical twin, Gateway, goes into service later this year in Rusk County, east Texas. Both can send all or part of their power into two grids. In fact, both Tenaska plants can send power into two grids at the same time – into the Electric Reliability Council of Texas (ERCOT) and into the eastern grid through interconnection with Southeastern Electric Reliability Council (Frontier) or Southwest Power Pool (Gateway).

The idea for a plant that could be dispatched to either the Electric Reliability

Council of Texas (ERCOT) grid or the Eastern interconnection came to Tenaska Vice President Dave Fiorelli while attending an ERCOT operations subcommittee meeting in 1996. At the meeting, one of the subcommittee members mentioned that a part of CSW's black start plan for ERCOT involved temporarily connecting a West Texas Utilities' plant, normally connected to the Southwest Power Pool, to ERCOT. It occurred to Fiorelli that if it is possible to do it on an emergency basis, why couldn't it be done routinely. To put it another way: Would it be possible to design and build a plant to feed into more than one grid, perhaps even simultaneously? The advantage for a merchant plant could be substantial by providing an independent power facility greater flexibility in reaching the most lucrative markets.

Fiorelli worked on a few ideas and proposed to his bosses at Tenaska the possibilities of developing such a plant. Since Tenaska was building plants in Texas, an ideal location was close to the

boundaries of Texas island grid ERCOT and the Eastern grid. Located near the Texas/Louisiana gulf coasts, the area is one of the fastest growing, most power hungry in the nation and several companies in the region, including AEP/CSW, operate on both grids.

Pennsylvania-based Exelon Power Team has purchased and will market Frontier's total output within ERCOT and all of the Eastern interconnection. The entire power output of the Gateway plant will be purchased at wholesale by an affiliate of Houston-based Coral Energy, LLC. The affiliate will sell the power on a merchant basis within ERCOT and to markets in the eastern power grid such as the Southwest Power Pool (SPP), and the Southeastern Electric Reliability Council (SERC).

## INNOVATIONS ON THE POWER SIDE TOO

Frontier, which went into commercial operation in September, has a few somewhat unique elements on the power block side of the equation as well. The Tenaska engineering team chose a 3 x 1 combined cycle configuration. Three GE 7FA gas turbines drive three electric generators with heat sent on to three heat recovery steam generators. Frontier's total output is a nominal 830 MW. Total output at Gateway will be 845 MW. The outputs differ because of differing site conditions including elevation and average ambient temperatures. "Our engineering team looked at a number of configurations including 2 x 1 and the newer G class," says Tenaska Operations and Maintenance Program Manager Todd Jonas. "Tenaska chose the 3 x 1 based on cost. The larger steam turbine also gives us a better heat rate."

Jonas says some consideration was given to the new G class, but the engineering team wasn't yet ready to commit to the G class. "We wanted to stay with the F

Class because it's proven and more conventional," he says. Frontier's steam turbine is one of the first GE steam turbines with a low-pressure section containing 40-inch last stage buckets made of titanium. The longer last-stage buckets allow the steam to expand further and improve the steam turbine's efficiency.

Both the Frontier and Gateway plants are able to put their total output onto one grid and within less than two hours, transfer total output of one, two, three or four generating units to another grid. The plants can also send the output from any combination of their four generating units to ERCOT and into the Eastern grid simultaneously. "Controlling output individually to two grids requires some additional management because when the combustion turbine's output varies, the steam turbine's output changes as well," says Frank Carelli, Frontier plant manager. "The CT output can be varied from approximately 55 percent base load through base load," he explains.

Supplemental firing gives Frontier about 40 MW additional output per CT train. "The ramp rate is much slower than that for increasing the load via a CT. Supplemental firing is not used in combination with raising load via a CT, since the CT must be at baseload before firing the duct burners, explains Carelli.

There are four possible configurations in dual grid operation: The steam turbine by itself on one grid, the steam turbine with one combustion turbine, the steam turbine with two combustion turbines, or the steam turbine with three combustion turbines. "At times, there are multiple ways to reach desired load requirements on each grid," says Carelli. "At other times we have to choose between optimal efficiency and load flexibility."

Frontier is one of only three only plants based on the 7FA capable of running on fuel oil. The plant can run multiple days at full power on fuel oil if necessary, and has on-site fuel storage capability to accomplish this.



Tenaska Vice President Dave Fiorelli (left) visits with Frontier Plant Manager Frank Carelli.

## STATE-OF-THE-ART EMISSION CONTROLS

When firing on gas, emissions are controlled by GE's Dry Low NO<sub>x</sub> (DLN) combustion technology. Permitted emission levels are 16 ppm on gas and 42 ppm on oil. The DLN combustion system is recognized as current BACT. Selective catalytic reduction was not necessary to meet NO<sub>x</sub> emission requirements, although space is available in the HRSGs to add SCRs if required at a later date. When operating on fuel oil, water injection from an on-site water storage tank is used to lower NO<sub>x</sub>.

Frontier gets its water from the Trinity River Authority via Lake Livingston through an agreement with the city of Huntsville. Gateway's water comes from the Sabine River Authority's Toledo Bend reservoir northeast of Houston. The cycle heat rejection system at each plant consists of mechanical draft cooling towers made of fiberglass.

Rather than the more traditional chemical demineralization, HRSG feedwater at Frontier is purified using a relatively new technology employing reverse osmosis and electrolysis (E-cell), manufactured by GE Glegg. "We also capture and re-use waste streams from the system as cooling water make-up," says Carelli. "Waste

streams include boiler blowdown and demineralizer regeneration/reject waters. "It's a good thing to do for both economical and environmental reasons."

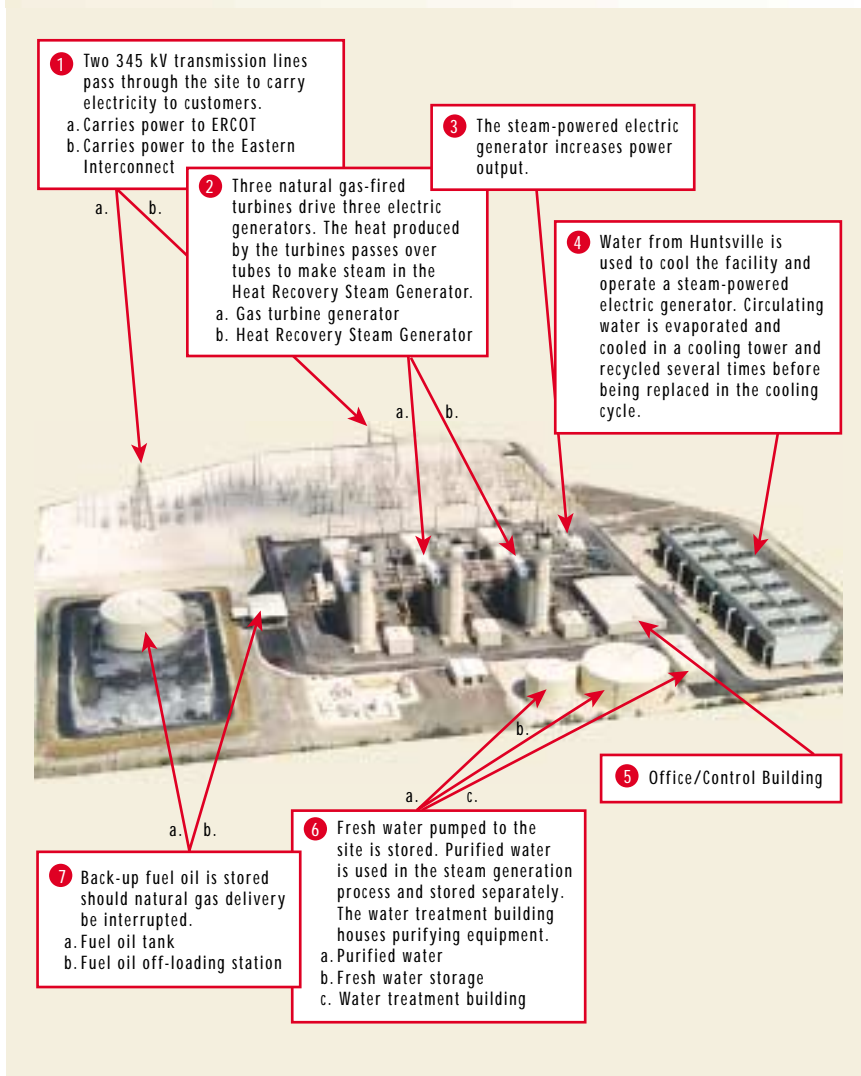
To improve overall efficiency, the gas is heated to 360 F. before being sent to the turbines. There is no on-site compression. Tenaska Gas Co. is responsible for securing the natural gas supplies for the Frontier project. Natural gas may be delivered to the project from a number of pipelines in the area including Lone Star, Aquila, Tejas and Texas Eastern. Gateway's natural gas supplier is Coral, since Gateway is a joint venture with Coral, a division of Shell.

Frontier and Gateway's connection to both ERCOT and SPP/SERC are in each plant's switchyard where transmission lines connect each of the plants to ERCOT and SPP/SERC. ERCOT manages the transmission over multiple control areas from the generators to the load entities through an Independent System Operator. ERCOT has set up the ISO as the rule maker for generation facilities, transmission providers, and load entities. The concept is to create a truly even playing field with equal access to the transmission for the generators and loads. In a similar manner, SPP is also now operating an ISO based transmission system where the Gateway plant is connected, while management of the SERC transmission system is delegated to each of the various transmission provider control areas where Frontier is connected. Entergy, as a member of SERC, manages the flow of power from Frontier into the SERC system and owns the transmission line that connects the plant to Entergy.

Tenaska developed both of these projects, and remains the managing partner. An affiliate of Tenaska operates both facilities. Members of Tenaska Frontier Partners, Ltd., own and operate the Tenaska Frontier Generation Station and include affiliates of Tenaska, Inc.; Diamond Generating Corp.; Continental Energy Services, Inc.; and Dynegy, Inc. Members of the Tenaska Gateway Partners, Ltd., which owns and operates the Tenaska Gateway Generating Station, include affiliates of Tenaska, Inc., Coral Energy, L.L.C. and Diamond Generating Corp.

Commenting on the innovation displayed in the two strategically planned and executed plants, Fiorelli says, "Tenaska is always looking for innovative ways to develop strategic market locations that uniquely meet customer needs." 

Figure 1  
TENASKA FRONTIER GENERATION STATION



A bird's eye view of the Frontier campus shows the switchyard with connections to both ERCOT and the Eastern grid.