CHP Case Studies in the Pacific Northwest

SP Newsprint Co.

130 MW Gas Turbine Combined Cycle Power Plant

Aerial View of SP Newsprint Gas Turbine CHP Plant

Site Description

SP Newsprint in Newberg, Oregon is a pulp and paper mill with an annual capacity in excess of 430,000 tons using a 55% recycled old newsprint (ONP) and 45% wood fiber mix.

In November 1999, Southeast Paper Manufacturing Company, headquartered in Atlanta, Georgia, acquired the Newberg mill and then changed its corporate name to SP Newsprint Co. The company immediately embarked on an $80 million quality improvement project at the mill site. This project was completed in October 2001.

On Oct. 1, 2001, electricity rates charged to most of the state's industrial customers, including SP Newsprint, jumped in excess of 50%.

"When you have a facility that is as dependent on energy as ours, that is a huge impact to your business," said Dennis Lakey, SP Newsprint manager of power and utilities in Newberg. The company realized the Newberg facility wouldn't remain financially viable under the new rate. At that time SP Newsprint Co. made the decision to invest $75 million for a 92 MW gas-fired power plant consisting of two natural gas-fired turbines with heat recovery steam generators (HRSG) to generate electricity and steam to supply the mill's power and steam requirements. With increases in power output from the existing steam turbines, the total electrical output from the mill increases from 20 MW to 130MW. After the needs of the mill are met, the CHP plant sells up to 20-25 MW of power on the wholesale market.

The plant became fully operational in June 2003.

CHP Plant from Ground Level

Plant Configuration

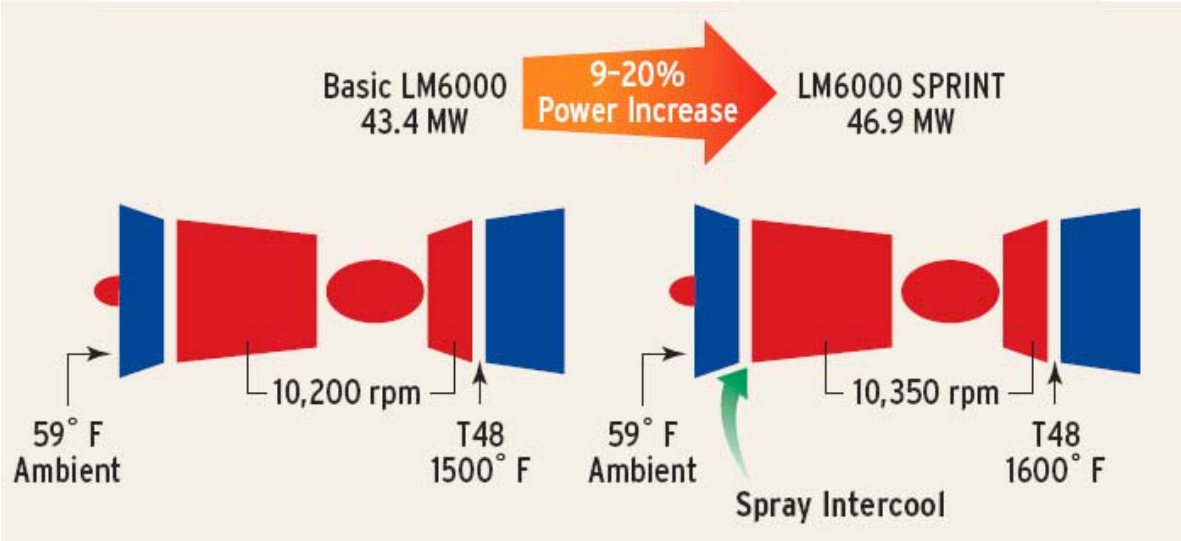
Before the addition of the new generating capacity, the mill generated steam from two solid fuel boilers that were fired with a mixture of hog fuel, sludge, and natural gas. Two smaller natural gas packaged boilers were also used at the mill. Two steam turbine generators produced 20 MW of power. On average, the mill purchased 84 MW of power.

The state-of-the-art gas turbine power plant and HRSG's that were installed had to be integrated with the existing 330 KPPH, 900 psig and 900 deg F hog fuel boiler and two existing steam turbines. The integrated facility provides 100% of the mill's power and steam requirements plus a variable quantity of export power. The power output from the existing steam turbine generators was increased to 36 MW due to the added steam capacity of the overall system. The plant consists of the following equipment:

- There are 2 LM6000 aero-derivative industrial gas turbine generators with the SPRINT package which increases generator output. As fitted with inlet air filters and heat recovery steam generators, the output from each generator varies from 38.5 MW on a 90^{o} F summer day to 48.5 MW at an ambient temperature of 45^{o} F. The ISO rated output as configured for each gas turbine is 46.4 MW.

- At full ISO rated output, 825 ^{o} exhaust gas is ducted from each of the gas turbines to Heat Recovery Steam Generators (HRSG) that produce 900 psig steam for mill process use. The steam generated is dependent upon the gas turbine firing rate. Supplemental firing duct burners serve as a back-up source of additional steam in case the

LM6000 SPRINT™ Technology Increases Output



Spray Inter-cooling (SPRINT) increases mass airflow by cooling the air inlet during the compression process. The power increase effect is ranges from 9% at ISO conditions (59o F) to 17% on hot summer days.

hog fuel boiler is down. Peak steam generating capacity with supplemental firing is in excess of 230,000 lbs/hr per HRSG. During full ISO rated output, without supplemental firing, steam output from each HRSG is 88,000 lbs/hr.

- A 6 ½ mile natural gas distribution pipeline was built by Northwest Natural to supply fuel to the facility.
- Gas compression brings the natural gas pressure up from a delivery pressure of 300-400 psig to the required 675 psig for the gas turbine inlet.
- Turbine enclosures provide noise reduction and weather protection.
- The distributive control system for the new facility was integrated with the control system for the existing plant.
- Each HRSG includes an integral deaerator. Separate feed-water pumps supply feed-water to the low pressure and high pressure sections of the HRSG.
- There is no provision for bypassing the HRSG and operating in simple cycle.
- Each turbine-HRSG pair has a 150' stack.
- Power output feeds into the 13.8kV generator bus to two step-up transformers which feed the 115kv mill primary feed and the tie breakerto the utility system
- The existing equipment, that remained in service, included a 330 KPPH, 900 psig and 900 deg F hog fuel boiler; a 5 MW back pressure turbine and a 36 MW condensing turbine.

Energy/Financial Analysis

The mill requires an average of 200-235 MMBtu/hr of steam and 92-108 MW of electricity. In the old mill configuration, 410 MMBtu/hr of steam was generated from hog

fuel, sludge, and natural gas to meet the process steam requirements and to produce 20 MW of electricity.

With the new CHP plant, the mill produces up to 89 MW from the gas turbines and 41 MW from the two existing steam turbines. The higher power output from the steam turbines is the result of the additional steam available. Power production meets 100% of the mill's needs with 20-25 MW available for export.

The CHP plant cuts SP Newsprint's energy costs by 25 percent, stabilizes their operating expenses, and generates additional revenue by marketing excess power. During a period of weak pricing for newsprint, the power sales have helped the operating profit for the company.

The mill sells 20-25 MW of excess power from the CHP system to PGE and other customers based on short term agreements typically from a day to a month's duration. The power sales depend on the wholesale price and the needs of the mill. The mill has shifted some power demands to off-peak hours to maximize their ability to sell power. These sales may be suspended during brief periods of excess hydroelectric capacity in the region such as during the Spring snow melt. Backup power is provided to the mill by PGE according to a special tariff.

Rated electric efficiency of the LM6000 gas turbines are very high at 40% on a lower heating value basis (heat rate 8451 Btu/kWh).

SP's monthly gas consumption has increased significantly from approximately 90 MMBtu/hour to over 800 MMBtu/hour. Gas is provided to the facility by Northwest Natural Gas through a special 10-year contract approved by the Oregon Public Utility Commission. SP Newsprint is now Northwest Natural's largest customer.

Operating Experience and Results

The gas turbines have operated comparatively trouble free. Availability is in the 95+% range. One of the GTs had an inlet gearbox failure that required a 5-week change out and rebuild in early 2004.

Northwest Construction magazine listed the CHP plant as one of the top ten construction projects in Oregon for 2003 and presented the *Award of Excellence* to The Industrial Company (TIC) as the mechanical contractor for the erection of the HRSGs. The HRSG erection project was complicated due to the small site in which crews had to erect the 123' long and 60' tall system with a 150' stack/silencer. Crews coined the phrase, "construction in a bottle" to describe the project.

With the addition of the new power plant, SP Newsprint needed to train the operating staff. Stewart & Stevenson contracted to provide onsite staff training for the LM6000 systems. Performance Improvement for Industry (PII) contracted to provide onsite Balance of Plant and controls system training. The Oregon Economic and Community Development Department's Old Growth Diversification Fund provided a $100,000 grant to partially offset the training costs.

Environmental Profile

The gas turbines can be rated as low as 25ppm for NOx, based on water injection. Annual measurements are taken and control is maintained by adjusting the water injection rates.

With the conversion of one of the existing hog fuel boilers to standby, there was no increase in emissions for the site.

Open View of the Multi-stage Compressor Section of the LM6000

Lessons Learned

SP Newsprint's development of its own combined heat and power facility is a dramatic example of strategies by Oregon manufacturers to deal with increased power rates and an unpredictable energy market.

The plant has enabled the mill to stay open in the face much higher energy costs and a general industry downturn.

Power and Utilities Department Manager, Dennis Lakey offers two important lessons related to implementing a project of this type. First, with everyone at the mill involved in mill operations, there is a real need to hire the best outside consulting support to focus exclusively on the power plant design, procurement and installation issues. This was not a turn key project. A mill project team was formed to work with the outside consultants and direct all phases of design, construction and start-up. The project team spent two years negotiating with the electric utility over interconnection, standby charges, wheeling, and power rates.

The second lesson learned was that the time and expense spent on staff training was critical to the project's success and greatly reduced the start-up time. The staff worked with the start-up team both during checkout and start-up.

Future Plans

SP Newsprint would like to develop a longer-term contract for its power sales. Currently, excess power is sold based on short-term agreements.

Organizational Profile

Equipment: GE Power Systems
Engineering Design: Jacobs Engineering
Technical and Operations Consulting: Dale Fields Enterprises, Inc.
Construction Manager, General Contractor: DPR Construction
Gas Contract: Northwest Natural Gas Company
Local Electric Utility: Portland General Electric Company
Staff Training: Stewart & Stevenson and Performance Improvement for Industry

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