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Making CHP Work in the Real World

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Combined Heat and Power (CHP) can be more difficult to execute than a traditional combined cycle plant. After all, a combined cycle plant just needs the acceptance of the local area and a utility or independent power producer (IPP) willing to build it and sell its output. With CHP, things are a little different. As well as selling its power, the facility has to find a partner (ideally adjoining or at least nearby) that wants steam for use in district heating or industrial processes.

Take the case of the Eight Flags CHP Plant in Florida. Eight Flags Energy LLC is a subsidiary of Chesapeake Utilities, as is Florida Public Utilities (FPU). Low-cost steam is provided to a cellulose products manufacturing facility RYAM (Rayonier Advanced Materials Inc.). Eight Flags leases land within RYAM facility in Fernandina Beach on Florida's Amelia Island. FPU obtains the power for its retail customers under a power purchase agreement with Eight Flags. Building the plant improved flexibility at the cellulose facility and supported its production capability.

Solar Titan 250 Gas Turbine

The facility is powered by a Solar Titan 250 gas turbine that produces between 20 MW and 23.5 MW, depending on conditions and the time of year. A long-term service agreement (LTSA) entitles Eight Flags to the latest version of the Solar Titan 250 after 30,000 hours of operation if a new or modified version has been released. The facility received the Titan 250E 3.5 years ago, increasing steam production from the unit by an additional 62,000 lb/hr. The latest upgrade introduced new actuators from Solar for the inlet guide vanes (IGV). The LTSA also provides Solar Turbines with two maintenance windows each year to service the turbine. For example, every 30,000 operating hours, Solar removes and replaces the entire cold section (compressor).

The semi-annual outage lasts two days and the annual outage lasts four days. Solar sends technicians on site for each outage to inspect and maintain its turbine, as well as taking care of anything else needed in the interim. Solar monitors the turbine 24/7 remotely and sends advice and alerts. They can look at the data from our turbine and predict the trends that are occurring. Additionally, Solar also does offline water washing during outages and whenever needed.

The turbine includes Solar's SoloNOx system to regulate the combustion process. It closely controls the combustion temperature to keep thermal NOx levels down. As a result, no SCR system is needed. NOx is maintained at less than 15 ppm and CO2 at less than 25 ppm at 15% O2. In almost ten years, the facility has always passed stack tests by local air quality regulators. The plant manager said the plant has maintained compliance in accordance with its FDEP air permit over the nearly 10 years of operation without exception.

Eight Flags has six employees, runs 24/7 and has a capacity factor of 97% over almost ten years average. It is quite common for the plant to have a 100% capacity factor for several months in a row. The number drops during the scheduled semi-annual and annual outages.

HRSG Operations & Maintenance

The Rentech HRSG feeds steam to RYAM at 160 psi. The HRSG recovers around 70-75,000 pounds of steam per hour and has the capability to increase that amount using duct burners that add 125,000 pounds per hour of process steam for a grand total of 200,000 pounds per hour if needed.

The key to smooth HRSG operation is to have a reliable vendor, good service and maintenance practices, and maintain water quality at a high level. A visual inspection of the HRSG is done every outage to check the diverter, make sure there are no hot spots, and confirm that there is no loss of insulation. According to the plant manager at Eight Flags, the tubes on the HRSG have held up well despite 10 years of constant use.

The boiler at Eight Flags was intentionally oversized. Most of the time it operates at 75,000 lbs per hour. When the duct burners are running, it hits 200,000. As a best practice, it is best to oversize the HRSG as you run into fewer maintenance issues and have the option of adding more steam if you need it.

The HRSG was built and assembled in Abilene, Texas at the Rentech headquarters and shipped in a couple of large modules. This reduced overall cost compared to a stick-built unit which would have had to have been built onsite. This would also have added onsite construction complexity and lengthened the construction process.

Eight Flags operates in a salt marsh and beside a manufacturing plant where there is a lot of dust from woodchips and debris. Thus, another best practice is the use of non-corrosion coatings on the equipment and HRSG.

The plant manager added that standard preventive maintenance work is everything. He checks vibration levels, inspects the air and water side of the HRSG and checks the integrity of the tubes to see if they are losing any material. In 10 years, he said Eight Flags has hardly lost any tubes.

The efficiency of this CHP plant is 80%. How is it so much higher than combined cycle plants that typically provide 60% to 64% efficiency? This is achieved by smart reuse of waste heat. As well as using waste heat to produce more power, it is utilized in the economizer to heat up feedwater for the HRSG. In addition, de-mineralized water provided by Rayonier is channeled through the hot water economizer in the HRSG to increase the water temperature by approximately 70F. This hot water is returned to RYAM for use in production processes. This helps RYAM to gain additional saving on energy.

Further, the superheater dries out steam for the process needs of RYAM. If you get a lot of water in the steam, it is harder to use. The exhaust temperature is around 990°F, steam is produced in the HRSG around 370°F and the superheater raises that to 430°F. The steam produced by RYAM's boilers is stepped down to the pressure needed for its processes. Any steam provided by the Rentech HRSG is fed at the specified pressure.





The Rentech HRSG at Eight Flags.

CHP Economics

According to the plant manager, everyone is happy with the contract as the economics have worked out well for all concerned. Power, steam and hot water are always available. If the mill has a hiccup on power or steam production, Eight Flags allows RYAM to continue to make more cellulose products. If it needs more steam, the duct burners in the HRSG can be up and running within 10 mins to boost steam from 75,000 to 200,000 pounds per hour of process steam.

FPU is interested in adding more facilities like Eight Flags in the future due to its success. There are several potential sites identified however, the economics are also contingent on the presence of subsidies like the Investment Tax Credit (ITC).

The ITC provided us with a 30% funding credit for Eight Flags. That was an essential element in making the financial side of Eight Flags more attractive and feasible to the various parties involved.

About Rentech Boiler Systems:

Rentech specializes in custom-designed boilers for a wide range of industries. Our product portfolio includes heat recovery steam generators (HRSGs), fired packaged watertube boilers, waste heat and specialty boilers, selective catalytic reduction (SCR) and catalytic oxidation systems, and hot water boilers. We also provide field service and repair to support ongoing system performance and reliability.

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