

CALPINE CORPORATION

CLEAR LAKE POWER PLANT



PROJECT FACTS

System Benefit:

Over 51 net MW added
3.5% improvement in heat rate

Gas Turbine Information:

3 x W 501DS at 105.6 MW each

Hybrid Refrigeration System:

5 x 60 Hz ABSC-16C Plants, 8,300 TR
1 x 60 Hz CVHF-1280 Chiller, 1,200 TR
1 x 6.5 mil gals Thermal Energy Storage (TES) Tank

Ambient Design Conditions:

95°F dry bulb
80°F wet bulb

THE CHALLENGE

The cogeneration plant operated with three (3) W501D's combustion turbines with a total rated capacity of 316.8 MW before the plant was retrofitted in 1999. More than ever, Independent Power Producers (IPPs) are becoming more aggressive due to their plan to increase their share of the power generation market. This has resulted in IPPs looking for solutions that can make up for the decrease in power output when ambient temperatures increase – allowing them to sell more electric energy when demand increases.

THE SOLUTION

Management decided to evaluate various solutions for increasing plant capacity for the sale of electric energy during on-peak periods. These various solutions included evaporative cooling, fogging, electric chillers, absorption chillers and hybrid systems. When comparing solutions, the turbine inlet chilling (TIC) systems with chillers achieved a greater increase in power capacity because chillers can reduce the inlet temperature to 50°F while evaporative cooling and fogging can only reduce inlet air temperature to 81.5°F, respectively. In addition, the parasitic power need of a direct-fired double-effect absorption chiller is the lowest while that for an electric chiller is the highest.

With the evaluation of various solutions, TAS Energy designed a package for the retrofit that included installation of a hybrid refrigeration system including a combination of absorption chillers, an electric chiller and a Thermal Energy Storage (TES) tank, custom built filter houses with cooling coils and a heat recovery coil retrofit.

The gas combustion turbine inlet air cooling system was designed to cool the ambient air from 95°F dry bulb/80°F wet bulb temperature to a 50°F combustion turbine inlet air temperature. The TIC system utilizes TES and is designed to produce and store chilled water energy during 14 “nighttime, off-peak” hours and discharge the energy to cool the air during 10 “on-peak” hours of the day in order to supplement the chillers during on-peak periods. This “partial storage” design not only reduces the amount of chillers needed but also reduces the on-peak power consumption and heat exhausted required.

THE RESULTS

- Enhanced power capacity by cooling the inlet air to 50°F, the gas turbines output increased from 86% to 104% of the rated capacity.
- Enhanced steam production.
- Increased effective capital cost per MW and lowered total plant costs.
- Use of TES allowed Calpine management to take advantage of increasing power capacity while using chilled water at the most affordable peak power costs when power is also the most scarce.

ABOUT TAS ENERGY

TAS Energy provides clean and highly efficient solutions through the design and manufacturing of modular energy conversion and cooling systems for the power generation industry; district, commercial and industrial process cooling; mission critical; and the renewable energy sectors.

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