Black and Veatch—Lihue, Kauai, Hawaii, USA

Kauai Island Utility Co-operative, Kapaia Power Station

Once Through Steam Generators (OTSGs) were chosen to provide Gas Turbine steam Injection (GTI) / (STIG) for their simple cycle peaking plant located in Kauai, Hawaii. The project, completed in 2002, involved adding a GTI retrofit and installation of an OTSG on one (1) LM2500 28 MW gas turbine so that power could be augmented and NOx levels reduced.

Project Description

The Kauai facility was constructed in 2002 to provide power for the island of Kauai. The single simple cycle LM2500 was retrofitted to permit steam injection and one GTI OTSG was installed in the turbine's exhaust path. The GTI cycle significantly increased the gas turbine's mass flow, which resulted in an increase in efficiency and power output plus a reduction in NOx emissions. GTI OTSG applications can reduce NOx emissions by 85%, lower fuel consumption and increase the gas turbine output by more than 15%.

During the installation phase, the gas turbine was out of service for less than one week. The GTI OTSG was designed, fabricated and ready to ship in less than 6 months.

The absence of drums and the modular design and manufacture of the OTSG facilitates easy and rapid shipment and erection of the unit. The unit at Kauai was mechanically installed on site in approximately three weeks and required 2750 installation man-hours.

Tremendous flexibility is afforded by the GTI OTSG due to its full dry run capability. The gas turbine can continue to operate while the steam process is not required or is out of service.

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GTI OTSG Process (STIG)

This process consists of injecting steam into the head end of the combustor (for NOx reduction) and into the compressor discharge, increasing mass flow, lowering fuel consumption and increasing power output. Gas turbines are typically designed to allow 5% steam injection of the compressor airflow with flows of as high as 10% allowed on some gas turbines. The injected steam must contain at least 50 °F (28 °C) superheat and be at a pressure comparable to the fuel gas pressure. A steam injection flow of 5% of total flow will increase power output by approximately 17.5% for all ambient conditions (independent of temperature, humidity etc.) and also reduce NOx levels.

The main advantages of the steam injection process are:

a) Increased power. The power augmentation process will increase power in all climates and at all times of the year.
b) Reduced NOx. The injected steam reduces the flame temperature thereby reducing thermal NOx.
c) Reduced fuel consumption. Current power levels can be maintained while reducing current fuel consumption.
d) No additional capital investment. Large utilities can upgrade their GT fleet with GTI and add 17.5% more power without adding any new bricks and mortar.

CONTRACT SUMMARY

Gas Turbine	Turbine Output (MW)	Exhaust Weight (lbs/hr)	Fuel	Exhaust Temp. (°F)	Firing Temp. (°F)	Feedwater Temp. (°F)
LM2500PH	28	601,200	Naptha	926	NA	70

HP Steam Flow (lbs/hr)	HP System Pressure (psia)	HP Temp. (°F)	LP Steam Flow (lbs/hr)	LP Steam Pressure (psia)	LP Temp. (°F)	OTSG Total Heating Surface (sq ft)
75,000	382	875	NA	NA	NA	83,751