Case Study of Energy Audit of Gas Based Power Plant

About Installation

The Power plant is 330 MW combined cycle Gas Turbine Power Project. The plant consists of two gas turbine of 104 MW each and one steam turbine of 122 MW based on in HRSG. Due to paucity of water this plant has been designed to operate on treated sewage water, which is being supplied from Sewage Treatment plants. Average total electricity generated by the plant is about 196.02 MU per month; where as power exported to SEB is 190.7 MU per month and auxiliary consumption is about 4.97 MU per month. Natural Gas consumption is about 42.7 MMSCM per month, which, leads to specific fuel consumption of 0.217 SCM/KWh.

About Assignment

Detail energy audit has been carried out at the plant, which has resulted in identification and recommendation of total energy cost savings to the tune of 21.43% (Rs 27,349,529 per annum) in internal consumption. Total Investment required to invest to implement the energy cost saving measures is about Rs. 72, 12,000. Annual Savings in Electricity Consumption are about 12780154 KWH/Annum. Internal consumption is 2.54% of gross electricity generation.

How we Approach?

Energy audit is carried in 2 phases. First is Preliminary Energy Audit (PEA) and the second is Detail Energy Audit (DEA). Focus during PEA & DEA has been as follows:

1. Preliminary Audit:

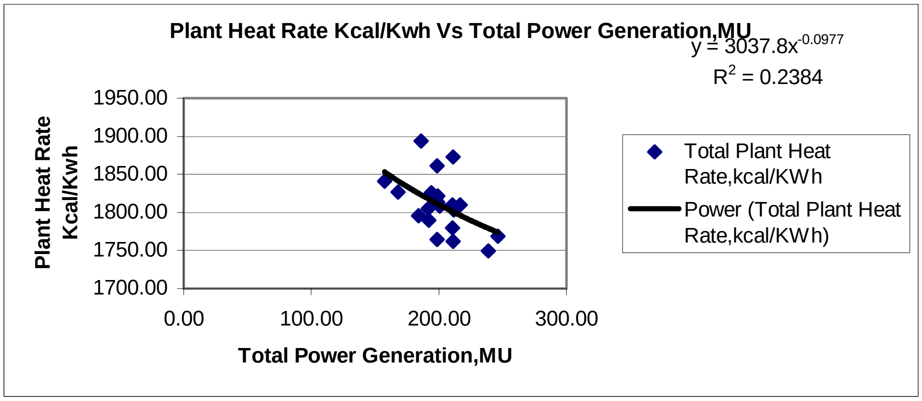
   (i) Collect all required data and benchmarks from control room and analyze.
   (ii) Correlating every energy input to production.

2. Detail Audit:

   In this portion the scope of audit is pursued and focused in detail. This involves performance evaluation of systems like Boilers, Gas and Steam Turbines, Transformers, Motors, Air conditioning, Cooling towers, Compressors, etc and also detail study of steam distribution network, feed water system , water treatment plant and energy conservation measures are identified for optimizing end use energy efficiency and/or cost. The recommendations include annual savings in energy cost, approximate investment and payback period.

Observations

Following graph indicates impact of Total Power Generation on Plant Heat Rate



Comment: Though regression coefficient is low, still the trend is qualitatively valid for analyzing reduction in plant heat rate with increase in Total Power Generation.

Findings & Recommendation

i. In Cooling Tower fan power consumption, energy saving potential by installing Automatic Temperature Controller (ATC), which will switch ON/OFF cooling tower fan is about 15%.

ii. In Fin-Fan cooler, there is significant energy saving potential by replacement of existing Fin-Fan coolers by water-cooled Plate Heat Energy. These savings are due to low pumping power requirement of water based cooling, which involves latent heat transfer at CT as compared to total sensible heat transfer in existing Fin-Fan Cooler.

iii. At Low Pressure Boiler Feed Pump significant energy saving are possible by Reduction of stages In Multistage Pump or by Installing VFD or by Installing New Pump of proposed specification. This saving potential is primarily due to difference in design duty point (head & flow) of the existing pump as compared to the operating head & flow; which is causing the pump the operate at far off point than the design duty point; thus causing reduction in operating efficiency.

iv. High Pressure Boiler Feed Pump significant energy saving are possible by Reduction of stages In Multistage Pump or by Installing New Pump of proposed specification. This saving potential is primarily due to difference in design duty point (head & flow) of the existing pump as compared to the operating head & flow; which is causing the pump the operate at far off point than the design duty point; thus causing reduction in operating efficiency.

v. Osmotic filtration is practiced on fairly large scale at Gas Turbine plants. Reverse osmosis requires high pressure pumping. Even in the best-practiced system in the last effect (stage) of separation there is a reject stream to be maintained at 10 Kg/cm^2 artificially to have significant permeate rate. Normally this resistance is created by control valve. Finally, reject stream leaves to drain or to other point of use.

Modern day trend is to replace artificial throttling by pressure recovery turbine. Turbine offers equivalent resistance but the flows passing through it generate power before going to drain. About 15% of feed water leaves Reverse Osmosis system at 105 m of WC. Total recovery potential = 2.861 Kw.

vi. Gravity Feeding of Cooling Tower Makeup Water.
Water can be made flow through gravity from source to Cooling Tower basin.