B.02.06.02 Techniques for improvement of energy efficiency

FSU and LNG regasification compound

The FSU and LNG receiving terminal and regasification compound have been designed so as to minimize heat ingress within the systems maximizing energy efficiency.

Measures to optimize the energy efficiency of the LNG and related process have been established in the design principles and implemented. These include the following:

1. The FSU has been retrofitted with new LNG pumps for the ship-to-shore LNG transfer. These new pumps are considerably more efficient, smaller than the original pumps and are sized for optimum send out, thus reducing the need for recirculation.

2. LNG tanks and pipe connections have been designed with appropriate heat insulation so as to prevent heat ingress from the environment. This way BOG production will be managed and minimised; thereby reducing the potential for system pressurization which could otherwise lead to BOG flaring under emergency conditions.

3. The water glycol system recovers valuable cooling power from the LNG regasification process which is then transferred to the GTs air intake coolers. The GT air intake temperature is reduced within these coolers enhancing the performance of the CCGT plant. Similarly, the heat taken from the GT air inlets is transferred to the IFV equipment and used as heat to regasify the LNG. Thus, eliminating additional cooling in the CCGT and reducing additional heating in the regasification plant and increasing the efficiency of both.

4. The BOG compressors are also cooled using the glycol loop thus recovering waste heat from these machines to input energy to the glycol loop for LNG regasification.

5. To reduce wear on the BOG compressors caused by running with warm gas at start-up, they are run constantly. An LNG spray attemperator will be installed to the BOG line to allow the compressors to be stopped and the LNG onboard the FSU can then be consolidated to reduce boil off. This will save on electrical consumption as well as improving the overall efficiency of plant by regasifying liquid rather than compressing gas.

6. The current Glycol pumps were found to be over sized, requiring excessive throttling and power losses. New pumps that are smaller and more efficient will be installed saving on electrical consumption.

CCGT Power plant

The SCC-800 type gas turbine combined cycle plant has been designed with a reliable and efficient technology which maximizes the energy efficiency of the plant. Some of these systems and design principles are outlined below:

1. The CCGT power generation technology itself is highly efficient as it recovers a considerable proportion of heat developed during the combustion process of the natural gas within the burners via a direct expansion of the flue gases in the GTGs and subsequently in the HRSG by raising steam at two levels of pressure which will be expanded in a steam turbine.

2. The gas turbine (GT) combustion system and transition ducts is lined with a proprietary thermal barrier coating to minimize heat losses to the environment. This way, most of the heat developed during the combustion process is converted into shaft work in the turbine gas expansion optimizing the efficiency.

3. The exhaust diffuser and the HRSG section are coated with thermal insulator material which will prevent heat leakage into the environment. This way, exhaust gas energy content is recovered to the extent possible with current state of the art technology in the heat exchangers within the HRSG enhancing the efficiency.

4. The CCGT includes gas fuel performance heaters. These heaters will preheat the gas fuel intake before being injected in the combustion chambers. HRSG hot feed-water is used as the heating medium, thus increasing efficiency of the system.

5. The GTs are equipped with annular-type Dry Low Emission (DLE) burners. A fuel-lean, staged combustion process is developed within the DLE burners accomplishing low level of NOx and CO emissions. The combustion process will be complete so as to increase the heat released during the combustion process and increase the energy efficiency.

6. The new CCGT offers high operational flexibility which allows operating the plant at a wide range of loads so as to meet different power output demands. In combined cycle mode, the power plant can operate with one, two or three GTs in combined cycle mode so that the efficiency is optimized during part load operation.

7. The Balance of Plant (BOP) pumps are equipped with variable frequency drives so that pump speed is adjusted to flow demand requirements thereby decreasing the necessity to throttle flow through control valves. This reduces house load and hence increases efficiency.

8. The steam system is equipped with full flow steam turbine bypass valves. These divert the steam to the condenser during boiler start-up and during ST trip. In this way, the steam condenses and is recovered instead of being vented it into the environment. Water consumption is therefore reduced.

9. In addition to operation maintenance, Gas Turbines follow a planned maintenance programme that include a number of inspections as shown in the timeline below. The B and C inspections include visual inspections, non-destructive testing, and the replacement of elements. During B and C inspections some of the power and efficiency degradation is recovered.

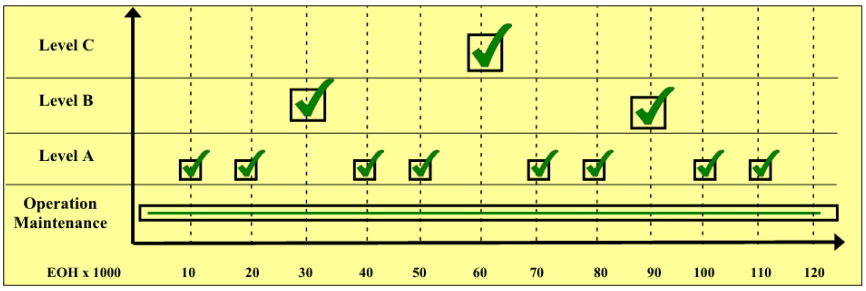

Figure 1 - GT maintenance schedule.