A Review on Paras Thermal Power Plant

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***Abstract*- Paras Thermal Power Plant is oldest power plant of Maharashtra State Power Generation Company (Mahagenco) located at Paras, Akola district of Maharashtra. The power plant is one of the coal based power plants of Mahagenco. The station has witnessed the third generation technology. The station had 30 MW installed capacity in 1961 with a stroke boiler. The same unit was abandoned in 1993 due to ageing**

Index Terms- Coal fired power plant, rankine cycle, boiler efficiency, turbine efficiency, condenser efficiency, heat rate.

I. INTRODUCTION

M/s MAHAGENCO proposed to setup 1×250 MW thermal power plant at Paras by replacing the existing two units of 1×30 MW and 1×62.5 MW respectively. The present capacity of the existing power plant is 500 MW (2×250 MW) which with the addition of 1×250 MW unit will become 750 MW. The land requirement for the proposed unit is estimated as 110.92 ha which MAHAGENCO has already acquired. The water requirement of 6.5 million m³ per annum will be met from the Mun barrage constructed on the river Mun. The coal requirement for the proposed plant would be 1.3 MTPA and will be met from the Mahanadi coal block.

The ash bund area (30 ha) of the existing unit will be used for the proposed unit also. Besides an additional land of 60 ha area is earmarked for the proposed plant. It is also proposed to provide one RCC chimney of 220 m height as per the prevailing regulatory norms so that suspended particular matter and SO2 emission remain well within the permissible limit. The existing power plant is located near the village Paras in Balapur tehsil of Akola district in Maharashtra at Latitude: 20O43'40"N and Longitude: 76O48'50"E. The site is almost equidistant (2 km) from Paras village and Paras railway station and is connected by all-weather tar road to National Highway No. 6, which is about 6kms from the power plant site.

The land available with the existing power plant is 110.92 ha. The site of proposed plant is located at 220 44 '53.56" N Latitude and 760 48' 04.30" E Longitude. Infrastructure facilities viz. roads, railway siding, communication system, administrative blocks, security office, time office, canteen already available for the existing power plant would be used for proposed expansion and as such MAHAGENCO would not need to acquire any additional land. In view of the availability of these infrastructure facilities at the existing power station, installation of the proposed unit is considered to be techno-economically viable and the project would be taken up for execution soon after necessary clearances/approvals.

II. BRIEF INFORMATION REGARDING PARAS POWER PLANT

2.1 Power Plant

Paras Thermal Power Station is the oldest of all Mahagenco Power plants. The station has witnessed the third generation technology. The station had 30 MW installed capacity in 1961 with a stroke boiler. The same unit was abandoned in 1993 due to ageing.

2.2 Transport

It is on the Nagpur–Bhusawal section of Central Railway. Coal-based thermal power stations consume large quantities of coal. For example, the Paras Thermal Power Station consumed 351,000 tonnes of coal in 2006-07. Around 80 per cent of the domestic coal supplies in India are meant for coal based thermal power plants and coal transportation forms 42 per cent of the total freight earnings of Indian railways

2.3 Installed Capacity

Stage	Unit No.	Installed Capacity(MW)	Date of Commissioning	Status
Stage I	1	30	1961	Abandoned
Stage I	2	62.5	1967	Abandoned
Stage II	3	250	2008 March	Running
Stage II	4	250	2010 August	Running

III. ADVANTAGES OF COAL BASED THERMAL POWER PLANT WORKING OF THERMAL POWER STATION

Among several systems required in a thermal power plant the key ones are a boiler, a turbine and a generator.

3.1 Boiler

A boiler, as the name suggests, is a place where water is boiled to make steam. It is made up of about 100 miles of pipes, all welded together for better heat flow from the fire to the water. A big furnace, 14 storeys high provides the required heat to the water. The reservoir at the top collects steam for delivery to a high pressure turbine.

Well, after all the energy from steam is used up by the turbine, it is sent to a condenser. The condenser turns the leftover steam to water and a pump sends it back to the boiler. This completes the boiler cycle.

The condenser is a big heat exchanger that works like a radiator in your car. The engine in the car gets hot when it is running and a radiator is used to cool it. The same thing happens in a thermal power plant. The leftover steam is hot and has to be liquefied before the pump can send it back to the boiler. Generally, a natural water body comes in handy to cool a thermal power plant.

3.2 Turbine

The steam made in the boiler feeds the turbine arriving first at a nozzle block, which is made of thick steel. Remember that it has to hold the pressure and heat that comes from the steam. The steam exits the nozzle block from about 100 small holes, approximately one inch high and one-quarter inch wide.

The high pressure steam generated in the boiler is fed by pipe to a turbine. The turbine uses the kinetic and/or reactionary energy from the steam to spin a shaft. The figure 1 below will give you a clear view. See the cup-shape of the blades.

They quickly capture the steam and move rapidly. The turbine has many stages. Can you count them all? Yes, there are three stages to this turbine, a high pressure on the left, an intermediate pressure in the middle, and a low pressure on the right. The turbine has tremendous torque and is connected to a generator by a shaft. The shaft can be 18 to 24 inches thick. This brings us to the next part which is a generator.

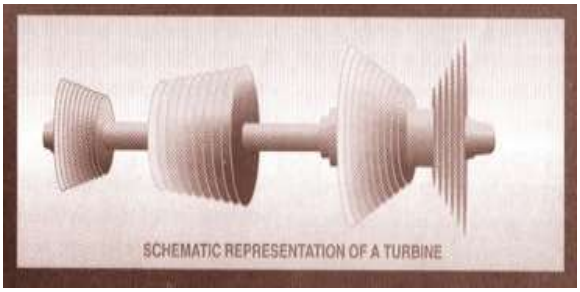

Figure 1.Schematic of Turbine

Face to face with the generator

What is a generator? It is simply a big electric motor. The generator pins at 3600 rpm and provides the electricity that comes to your home. There are four main parts to a generator, a stator, rotor, brushes, and a shaft. The generator makes electricity at a specific voltage and phase so that an electrical grid may use it. What is a grid? You must be indeed so familiar with the World Wide Web. Well, the grid is somewhat like that! How? In the World Wide Web many computers are all connected together and they can talk to each other. In the electrical grid, the electrical generators are all connected by wire.

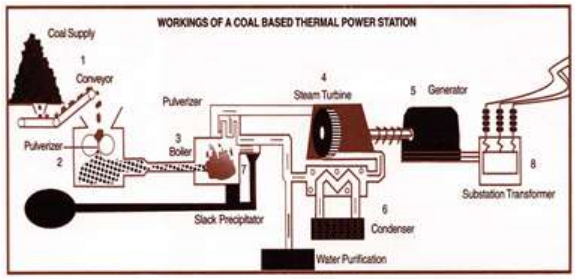

Figure 2. Working of Coal based TPS

They all have a physical connection to each other. But whether they can converse with each other is still unknown! Figure 2 below shows a pictorial representation of how a generator works.

A generator is online when it is connected to the grid and is providing electricity to the customers. It is said to be offline when it is not providing electrical power to the grid. A generator may be taken offline for repairs or because your city is not using a lot of power. For example, during the night, a generator may be taken offline because your city is using less power than it does during the day. Combustion of coal for power generation lead to production

IV ADVANTAGES OF COAL BASED THERMAL POWER PLANT

1. They can respond to rapidly changing loads without difficulty
2. A portion of the steam generated can be used as a process steam in different industries
3. Steam engines and turbines can work under 25 % of overload continuously
4. Fuel used is cheaper
5. Cheaper in production cost in comparison with that of diesel power stations.

V. DISADVANTAGES OF COAL BASED THERMAL POWER PLANT

1. Maintenance and operating costs are high
2. Long time required for erection and putting into action
3. A large quantity of water is required
4. Great difficulty experienced in coal handling
5. Presence of troubles due to smoke and heat in the plant
6. Unavailability of good quality coal
7. Maximum of heat energy lost
8. Problem of ash removing

VI. APPLICATION

Fly ash, siliceous powdery residue product obtained after mechanical and thermal weathering of metamorphic rock i.e. Coal. Worldwide coal is the prime and cheapest source of energy for mankind. India has vast reserves of coal is about 174 billion tones to fulfill the energy demand for next 200 years. Annually 225 million tones coal has been mine for fueling coal based thermal power plants in the country and generated about 160 million tones fly ash (2009 – 10).

Combustion of coal for power generation lead to production of fly ash, it is predicted that, generation of fly ash will reach to 185 million tones by 2012 and 900 million tones by 2031-32. Properties of fly ash are dependent on coals geological origin, combustion process, efficiency of particulate removal, its storage and handling. Handling of such huge quantum of fly ash stored nearby to power plants occupied about 60 thousand acres of land (ash ponds), not only attending national priority but also essential for sustainable ecological balance. Field demonstration and training project for bulk utilization of fly ash on 120 farmers field in the 41 villages surrounding to four MAHAGENCO thermal power plants in Maharashtra was implemented during 2006-07 to 2010-11 by Department of Soil Science and Agril. Chemistry, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola. As per the recommendation of Fly Ash Mission, TIFAC, DST, single dose of fly ash @ 50 t ha-1 was applied to farmers field only once before start of experiment. There were two treatments viz. Control (without fly ash) and Treated (fly ash @ 50 t ha-1), replicated 30 times in different villages surrounding to each TPS. The freedom was given to farmer for cultivation of crops including use of package of practices as per their aspiration and requirement. The demonstration trials on farmer's field were monitored continuously for four years i.e. for eight cropping seasons

VII. CONCLUSION

In this study, combined cycle power plants were investigated by energy, exergy and thermo economic analysis. General methodologies of these methods were discussed and also applied to case studies. The operating parameters of combined cycle power plants were chosen to study their effect on overall thermal efficiency and exergy destruction in different components. An empirical correlation was determined for different set of operating variables and assessment parameters. Cost analysis was applied to a four stage intercooling, four stage reheating and three stage regenerating combined cycle by using software, cycle pad. Five different configurations were made and analyzed on cost basis.

Cost of electricity production per MWh was calculated for each configuration. In chapter-3 "Effect of operating variables on overall efficiency of

combined cycle power plant" an empirical correlation was established among the different variables and overall thermal efficiency (eq. 3.24). The effect of variables like air inlet temperature of compressor, gas turbine inlet temperature, pinch point, temperature and pressure of steam in steam turbine on overall thermal efficiency were discussed. In gas turbine plant if air inlet temperature in compressor increases, the efficiency of gas turbine plant decreases. Because increasing the air temperature reduces the density of air and there by reduces the air mass flow rate. The power consumed by the compressor increases in proportion to the inlet temperature without their being a corresponding increase in the output of the turbine. In combined cycle plant, as air inlet temperature in compressor increases it shows some positive effect on thermal efficiency since the increase temperature in the gas turbine exhaust raises the efficiency of the steam process enough to more than compensate for the reduce efficiency of the gas turbine unit. An increase in the inlet temperature of the gas turbine, the overall efficiency of combined cycle power plant increases because gas turbine efficiency and steam turbine efficiency increases. By reducing the pinch point, the rate of energy utilization in the HRSG can be influenced within certain limit.

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