

## 1.2 LAYOUT OF MODERN COAL POWER PLANT

### Layout of steam power plant:

Steam is an important medium for producing mechanical energy. Steam is used to drive steam engines and steam turbines. Steam has the following advantages.

1. Steam can be raised quickly from water which is available in plenty.
2. It does not react much with materials of the equipment used in power plants.
3. It is stable at temperatures required in the plant.

### Equipment of a Steam Power Plant:

A steam power plant must have the following equipment.

1. A furnace for burning the fuel.
2. A steam generator or boiler for steam generation.
3. A power unit like an engine or turbine to convert heat energy into mechanical energy.
4. A generator to convert mechanical energy into electrical energy.
5. Piping system to carry steam and water.

The development of power in any country depends upon the available resources in that country. The hydel power totally depends upon the natural sites available and hydrological cycle in that country. New sites cannot be humanly created for hydel power plants.

The development of nuclear power in a country requires advanced technological developments and fuel resources. This source of power generation is not much desirable for the developing countries as it is dependent on high technology and they are highly capital based systems.

Many times, hydel power suffers if draught comes even once during a decade and the complete progress of the nation stops. The calamity of rain draught on power industry has been experienced by many states of this country.

To overcome this difficulty, it is absolutely necessary to develop thermal plants in the country which are very much suitable for base load plants. The general layout of the thermal power plant consists of mainly four circuits as shown in Figure the four main circuits are:

1. Coal and ash circuit
2. Air and gas circuit
3. Feed water and steam flow circuit
4. Cooling water circuit.

1. Coal and ash circuit

This includes coal delivery, preparation, coal handling, boiler furnace, ash handling and ash storage. The coal from coal mines is delivered by ships, rail or by trucks to the power station. This coal is sized by crushers, breakers etc. The sized coal is then stored in coal storage (stock yard). From the stock yard, the coal is transferred to the boiler furnace by means of conveyors, elevators etc.

The coal is burnt in the boiler furnace and ash is formed by burning of coal, Ash coming out of the furnace will be too hot, dusty and accompanied by some poisonous gases. The ash is transferred to ash storage. Usually, the ash is quenched to reduced temperature corrosion and dust content.

There are different methods employed for the disposal of ash. They are hydraulic system, water jetting, ash sluice ways, pneumatic system etc. In large power plants hydraulic system is used

## 2.Air and Gas circuit

It consists of forced draught fan, air pre heater, boiler furnace, super heater, economizer, dust collector, induced draught fan, chimney etc. Air is taken from the atmosphere by the action of a forced draught fan. It is passed through an air pre-heater. The air is pre-heated by the flue gases in the pre-heater. This pre-heated air is supplied to the furnace to aid the combustion of fuel. Due to combustion of fuel, hot gases (flue gases) are formed.

The flue gases from the furnace pass over boiler tubes and super heater tubes. (In boiler, wet steam is generated and in super heater the wet steam is superheated by the flue gases.) Then the flue gases pass through economizer to heat the feed water. After that, it passes through the air pre-heater to pre-heat the incoming air. It is then passed through a

dust catching device (dust collector). Finally, it is exhausted to the atmosphere through chimney

### Feed water and Steam circuit

The steam generated in the boiler is fed to the steam prime mover to develop the power. The steam coming out of prime mover is condensed in the condenser and then fed to the boiler with the help of the pump.

The condensate is heated in the feed-heaters using the steam tapped from different points of the turbine. The feed heaters may be of mixed type or indirect heating type.

Some of the steam and water is lost passing through different components of the system; therefore, feed water is supplied from external source to compensate this loss. The feed water supplied from external sourced is passed through the purifying plant to reduce the dissolved salts to an acceptable level. The purification is necessary to avoid the scaling of the boiler tubes.

### 4.Cooling water circuit

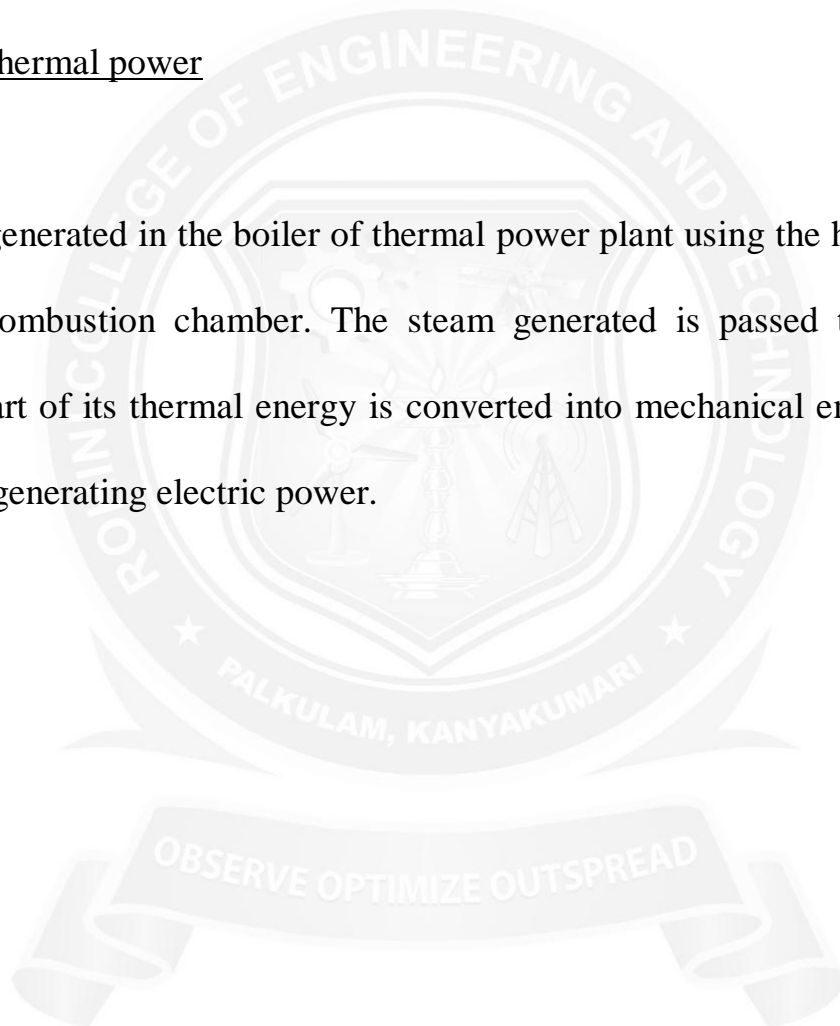
The circuit includes a pump, condenser, cooling tower etc. the exhaust steam from the turbine is condensed in condenser. In the condenser, cold water is circulated to condense the steam into water. The steam is condensed by losing its latent heat to the circulating cold water.

Thus the circulating water is heated. This hot water is then taken to a cooling tower, In cooling tower, the water is sprayed in the form of droplets through nozzles. The atmospheric air enters the cooling tower from the openings provided at the bottom of the

tower. This air removes heat from water. Cooled water is collected in a pond (known as cooling pond). This cold water is again circulated through the pump, condenser and cooling tower. Thus the cycle is repeated again and again. Some amount of water may be lost during the circulation due to vaporization etc. Hence, make up water is added to the pond by means of a pump. This water is obtained from a river or lake. A line diagram of cooling water circuit is shown in figure separately.

### Working of the thermal power

Steam is generated in the boiler of thermal power plant using the heat of the fuel burned in the combustion chamber. The steam generated is passed through steam turbine where part of its thermal energy is converted into mechanical energy which is further used for generating electric power.



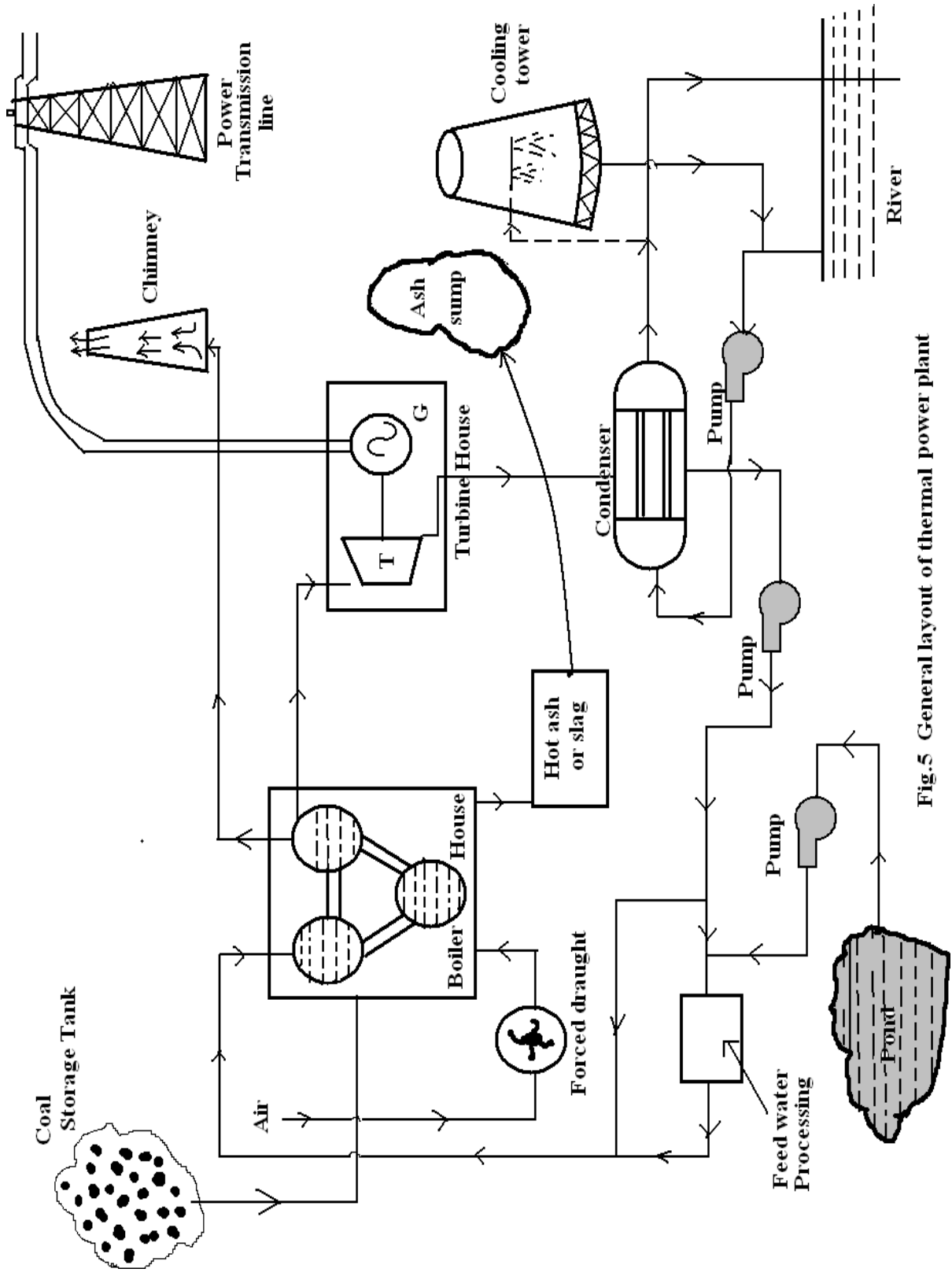


Fig.5 General layout of thermal power plant

**Figure 1.2.1 Layout of Thermal power plant**

[Source: "power plant Engineering" by Anup Goel ,Laxmikant D.jathar,Siddu :13]

**Merits (Advantages) of a Thermal Power Plant**

1. The unit capacity of a thermal power plant is more. The cost of unit decreases with the increase in unit capacity.
2. Life of the plant is more (25-30 years) as compared to diesel plant (2-5 years).
3. Repair and maintenance cost is low when compared with diesel plant.
4. Initial cost of the plant is less than nuclear plants.
5. Suitable for varying load conditions.
6. No harmful radioactive wastes are produced as in the case of nuclear plant.
7. Unskilled operators can operate the plant.
8. The power generation does not depend on water storage.
9. There are no transmission losses since they are located near load centres.

**Demerits of thermal power plants**

1. Thermal plant are less efficient than diesel plants
2. Starting up the plant and bringing into service takes more time.
3. Cooling water required is more.
4. Space required is more
5. Storage required for the fuel is more
6. Ash handling is a big problem.
7. Not economical in areas which are remote from coal fields
8. Fuel transportation, handling and storage charges are more
9. Number of persons for operating the plant is more than that of nuclear plants. This increases operation cost.

10. For large units, the capital cost is more. Initial expenditure on structural materials, piping, storage mechanisms is more.

