

⇒ * STEAM / THERMAL POWER STATION

A generating station which converts heat energy of coal combustion into electrical energy is known as steam power station. It works basically on the principle of rankine cycle.

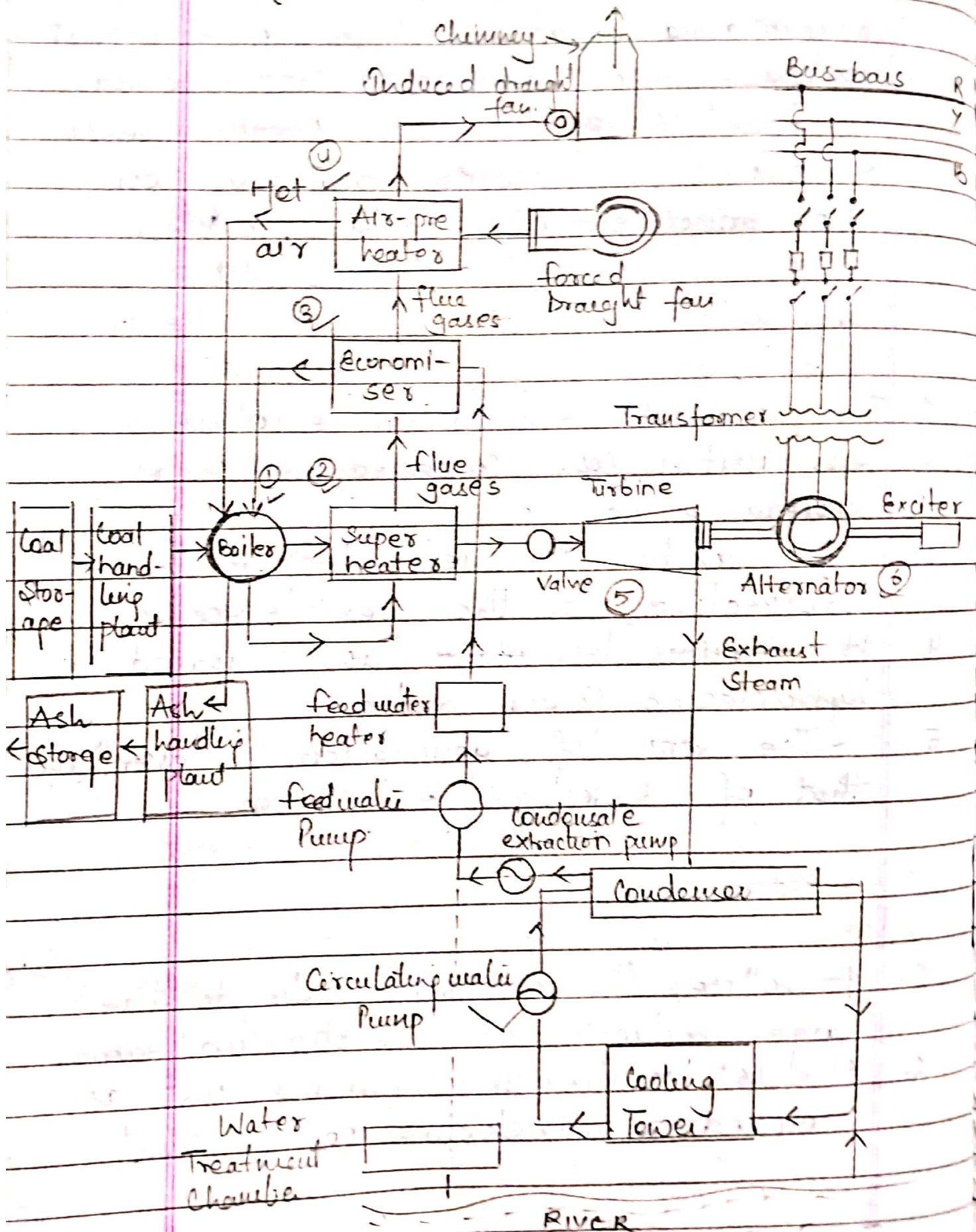
Advantages:

1. The fuel (Coal) used is quite cheap
2. Less initial cost compared to other generating station
3. It can be installed at any place irrespective of the existence of coal.
4. It requires less ^{space} place as compared to hydroelectric power station.
5. The cost of generation is less than that of Diesel power station.

Disadvantages

1. It pollutes the atmosphere due to the large production of smoke and fumes.
2. It is costlier in running cost as compared to hydroelectric power plant

Schematic arrangement of Steam Power Station



BOILER

The heat of combustion of coal in the boiler is utilised to convert water into steam at high temp. and pressure.

SUPERHEATER

The steam produced in the boiler is wet and is passed through a superheater where it is dried and superheated.

ECONOMISER

An economiser is essentially a feedwater heater which derives heat from the flue gases to heat the water which is feeding to the boiler.

AIR PREHEATER

An air preheater decreases the temp. of air supplied by coal.

Air is drawn from the atmosphere by the forced draught fan and is passed through air preheater before supplying to the boiler furnace.

STEAM TURBINE

The heat energy of steam when passes over the blade of the turbine

is converted into the mechanical energy after giving heat energy to the tur the heat energy is exhausted

ALTERNATOR

The alternator converts mechanical energy of a turbine into electrical energy.

Cylindrical Synchronous generator

EFFICIENCY OF STEAM POWER STATION.

Thermal efficiency

$$\eta_{\text{thermal}} = \frac{\text{Heat equivalent of Mech. Energy transmitted to turbine (shaft)}}{\text{Heat of Coal combustion}}$$

⇒ * HYDRO-ELECTRIC POWER STATION (Dams)

A generating station which utilizes the P.E of water at a high level of generation of electrical energy is known as hydroelectric power station.

Advantages

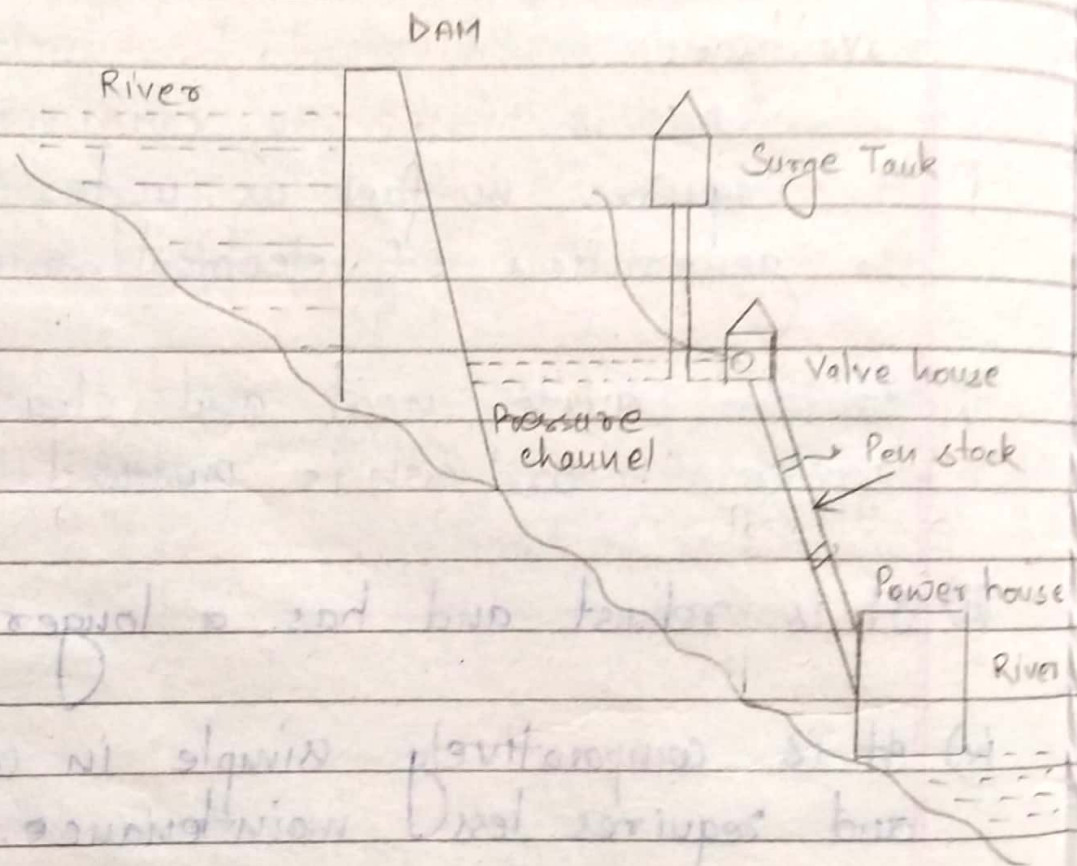
- i) It requires no fuel as water is used for generation of electrical energy
- ii) It is quite neat and clean as no smoke or ash is produced.
- iii) It is robust and has a longer life
- iv) It is comparatively simple in construction and requires less maintenance.
- v) It requires very small running charges as compared to T.P.P.

Disadvantages

- i) It involves high capital cost due to construction of dam.

ii) Skilled and experienced hands are required to build the plant

iii) It requires high cost of transmission line. because plant is located away from the consumer.



1. Dam

A dam is a barrier which stores water and creates waterheads. Dams are built of concrete or stone masonry, earth or rock fill.

2. Spill ways

There are time when the river flow exceeds the storage capacity of the reservoir. Such a situation arises during heavy rainfall. Therefore spill ways are used to discharge the surplus water.

3. Head works

It consists of a divergent structure at the head of an intake.

4. Surge tank

A surge tank is located near the beginning of the conduit. When the turbine is running at a steady load there are no surges in the flow of water through the conduit. Hence surge tank overcomes the abnormal pressure in the conduit.

5. Penstocks

Penstocks are open or close conduits which carry water to the turbine.

6. Water Turbines

They are used to convert energy of

falling water into mechanical energy i.e. p.e of water into rotational energy (K.E). Turbines are of two types:

- i) Impulse Turbine $\rightarrow$ Pelton Turbine (High heads)
- ii) Reaction Turbine - Is a horizontal or vertical wheel
 - $\rightarrow$ Kaplan Turbine (low heads)
 - $\rightarrow$ Francis Turbine (middle heads)

$\Rightarrow$ ELECTRICITY TARIFF * (Done)

The rate at which electrical energy is supplied to the consumers is known as tariff

Types

i) Simple Tariff

When there is a fixed rate per unit of energy consumed is called as simple tariff or uniform rate tariff

ii) Flat rate tariff

When diff. types of consumers are charged at different per unit rates

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iii) Block rate tariff

When a given block of energy is charged at a specific rate and the succeeding blocks of energy are charged at progressively reduced rate it is called as block rate tariff.

iv) Two part tariff

When the rate of electrical energy is charged on the basis of maximum demand of the consumer and the unit consumed it is called as two part tariff.

v) Maximum demand tariff

It is similar to two part tariff with the only diff that the max. demand is actually measured by installing maximum demand meter.

vi) Power factor tariff

The tariff in which power factor of the consumer's load is taken into consideration.

vii) Three part tariff

When a total charge to be made

from the consumer is split into three parts i.e. fixed charge, semi fixed charge and running charge is known as three part tariff.

POWER FACTOR IMPROVEMENT * Done

Power factor

the cosine of angle b/w the voltage and the current in an ac circuit is known as power factor.

Power factor improvement equipment are:

- i) Static capacitor
- ii) Synchronous condenser
- iii) Phase advancers.

DISADVANTAGE OF LOW POWER FACTOR *

1) Large copper losses

$$P = V_L I_L \cos \phi$$

$$I_L = \frac{P}{V_L \cos \phi}$$

from the above relation it is clear that if power factor is low then the current withdrawn by

the power system is very high and hence large i^2R losses. (Copper loss)

1. Large KVA Rating of Equipment

KVA $\rightarrow$ Kilo Volt Ampere.

$$KVA = VI$$

~~Power~~ $\cos \phi$ inversely $\propto$ to KVA

$$P = \underbrace{VI}_{KVA} \cdot \underbrace{\cos \phi}_{\text{Power factor}}$$

$$KW = KVA \cos \phi$$

$$KVA = \frac{KW}{\cos \phi}$$

$$\Rightarrow \cos \phi = \frac{KW}{KVA}$$

from the above eqn it is observed that if the $\cos \phi$ is increased then the KVA requirement is reduced.

2. Greater Conductor Size

To transmit or distribute a fixed amount of power at const voltage the conductor will have to carry more current at low power factor.

POWER FACTOR IMPROVEMENT

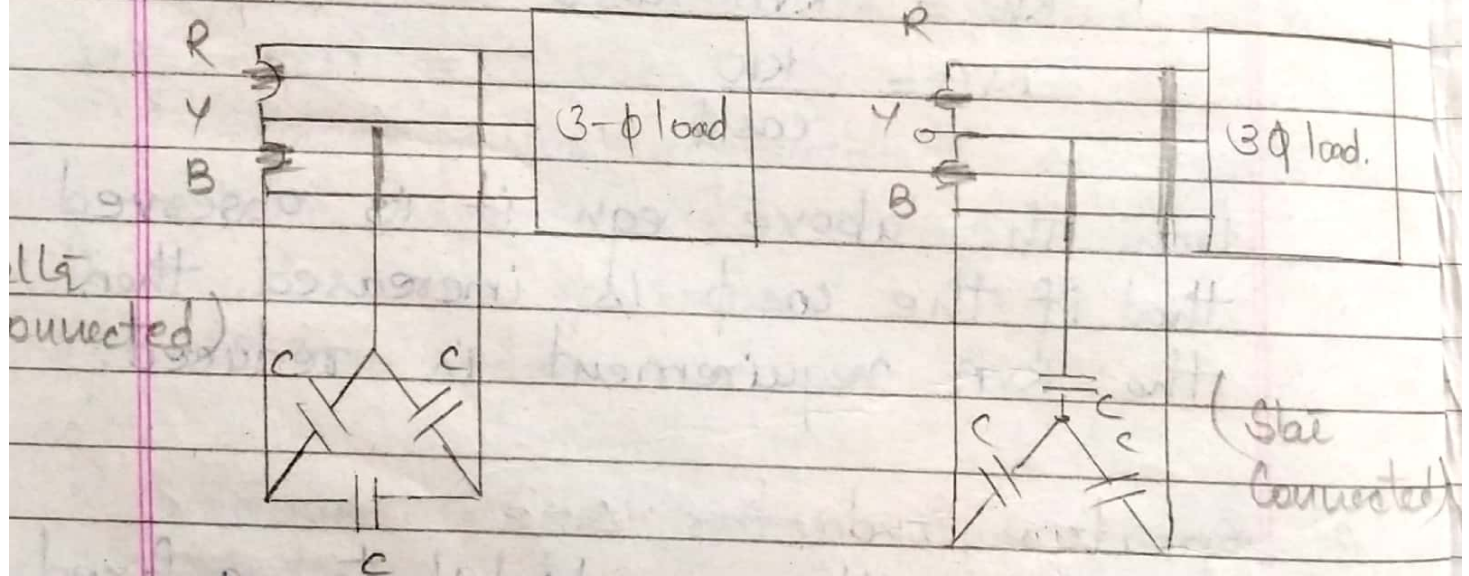
So as to avoid the losses in the

transmission line or to maintain the power factor should be low. So we use following device to improve the $\cos \phi$ power factor.

1. Static Capacitor

The $\cos \phi$ can be improved by connecting the capacitor in parallel to the equivalent load operating at low $\cos \phi$.

A static capacitor installed in // with 3 ϕ



Advantage

1. losses are low in static capacitors.
2. There is no moving part, therefore need low maintenance.
3. They are light weight so it can be easy to install.

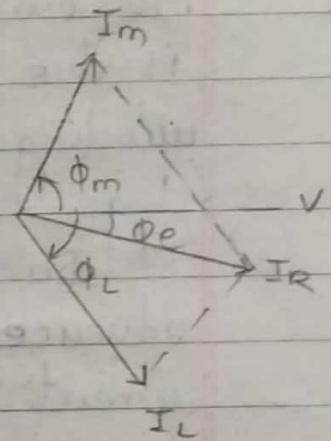
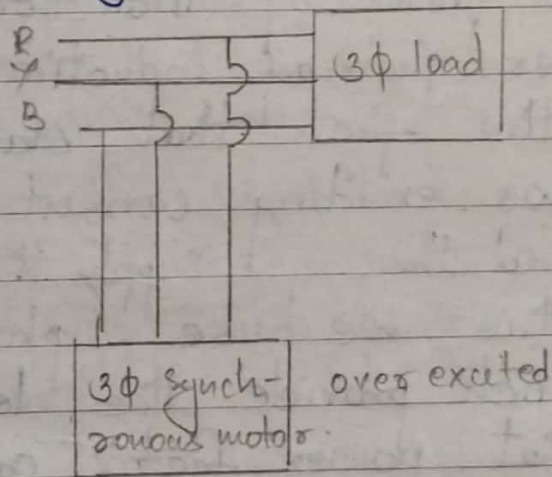
Disadvantage: The age of static capacitor is low (5-10 yrs)
→ If rated voltage ↑, then it causes damage.

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2. Synchronous Condenser

A synchronous motor takes a leading current when over excited and $\therefore$ behaves as a capacitor. An overexcited synchronous motor running on no load is known as synchronous condenser.



Advantage almost
long life (25 yrs).

1. By varying the field excitation, the magnitude of current drawn can be changed by any amount.

2. The fault can be removed easily.

Require low maintenance.

Disadvantage

1. It produces noise

2. The maintenance cost is high.
3. There are considerable losses in the motor.

3- Phase Advancer

Phase Advancers are used to improve the power factor of induction motor. The low power factor of induction motor is due to the fact that stator winding draws exciting current which lags behind the supply voltage.

So, in this we use phase advancers which provide the leading current so that power factor can be improved.

Advantage

- It can be used where the ^{area} synchronous motor is unacceptable.

Disadvantage

- Using P.A is not economical for motors below 200 H.P.