

GENERATION TRANSMISSION AND DISTRIBUTION

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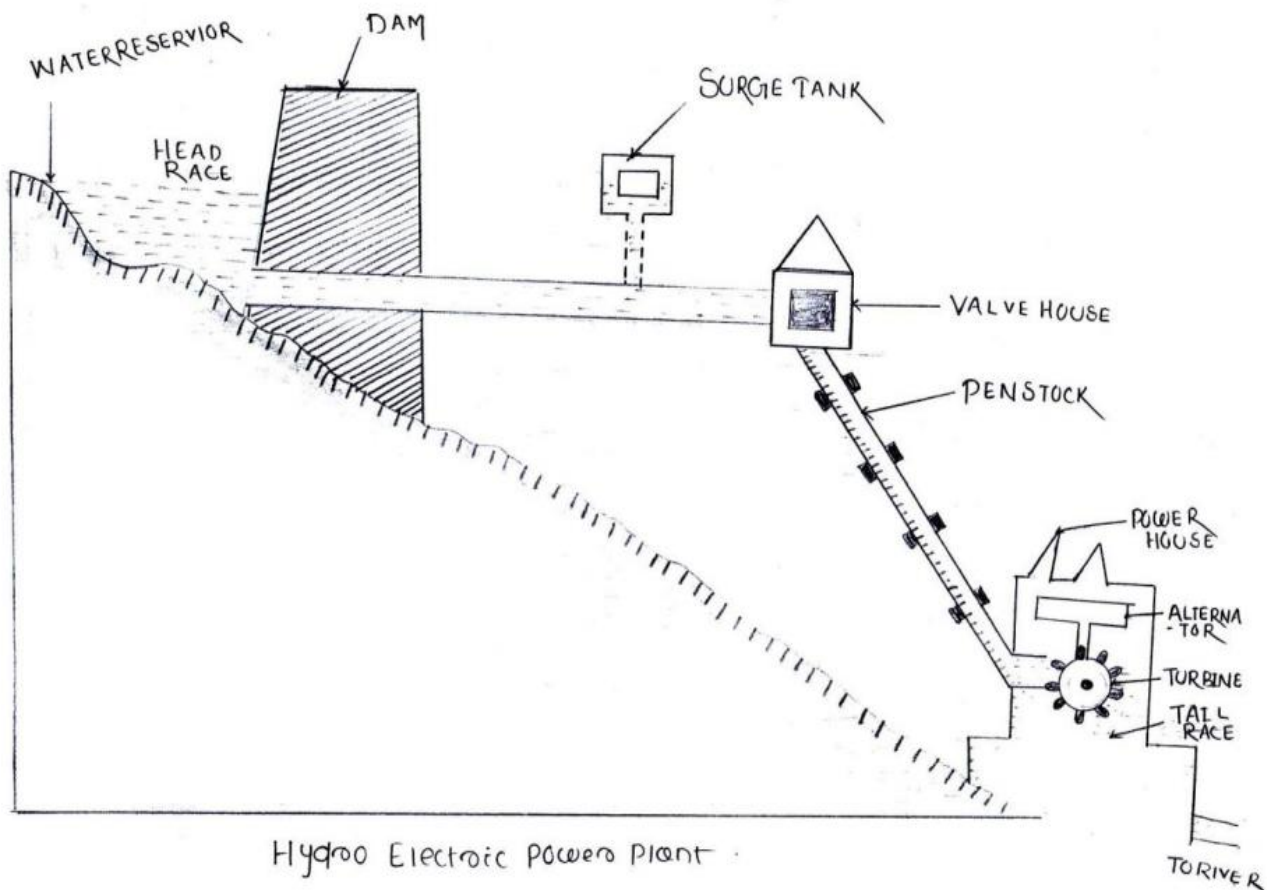
CHAPTER-1

GENERATION OF ELECTRICITY

HYDRO ELECTRIC POWER

The power obtained from Energy of Falling water is known as hydro Electric Power.

HYDRO ELECTRIC POWER STATION-The power station which convert the kinetic energy of water in electrical energy are called hydro electric power station.



ELEMENTS OF HYDRO ELECTRIC POWER PLANT:

- a. **Storage reservoir**:-It stores water during excess flow periods (Rainy Seasons) & supplied the same during least flow of periods i.e. (dry seasons) It can be either natural i.e. lake or artificial made by construction dam across the river.
- b. **Dam**:- It is the most expensive & important part which is built up concrete or stone masonry earth or rock fill. It is not only raise the water surface by creating artificial head but provide pondage or storage.
- c. **Fore bay**:-It serves as regulating reservoir storing water temporary during light load period & providing same during increased load period i.e. it is either a pond behind the diversion dam or an enlarge section of canal spread out to accommodate required with of intake.
- d. **Spillway**:-These are constructed to discharge the over flow water to the downstream. When the reservoir is full. Generally it acts as safety valve during flood situation.

e. **Intake:-** Generally intake includes head works i.e. Structure at the intake the conduits & tunnel or flumes which are res possible for diverting & preventing entry of debris & ice into the turbines. These structures include booms, screams, rocks or sluices.

SURGE TANK: Surge tank regulates & maintains required pressure in the penstock. Because during light load pressure in the penstock becomes more even if which can burst the penstock but surge tank reduces the pressure by raising water level inside it. Similarly during the low pressure additional water flows provided by it. So search tank stabilize the velocity & pressure in the penstock.

VALVE & GATES:- Generally these are fitted at Entrance to the turbine during in section & repairing these are shut off.

TAIL RACE:- The water from turbine is discharged to the tail race generally tail race may be same stream or another one but design & size of tail race should be search that water are free exist.

PRIME MOVERS / WATER TURBINES:- In hydro power plant water turbines are used as prime movers which convert kinetic Energy of water into mechanical energy which is further utilized to drive the alternators generating electric at energy.

SELECTION OF SIDE FOR HYDRO ELECTRIC POWER PLANT:- These are some factors which are taken in to consideration for the selection of site for hydro electric power plant i.e.

Availability of water:- Hydro electric power plant should be built where there adequate water available at goof head or huge quantity of water is flowing across a given point

WATER STORAGE:- For continuous supply of water. The water storage in suitable reservoir at height or building of dam across the river is essential so convent accommodation for the erection of a dam per Reservoir must be available.

WATER HEAD:- It has a considerable effect on the cost & economy of power generation i.e. an increasing effective head reduces the quantity of storage water & handle by pen stock screens & turbine resulting reduction in cost.

DISTANCE FROM LOAD CENTRE:- Generally these plant locate far away from load center so roots & distances affects on economical transmission.

ACCESSIBILITY OF SIZE:- It requires adequate transportation facilities for easy transportation required equipment & machine

AVAILABILITY OF LAND:- The land available most be cheap & rocky to with stand large building & machinery.

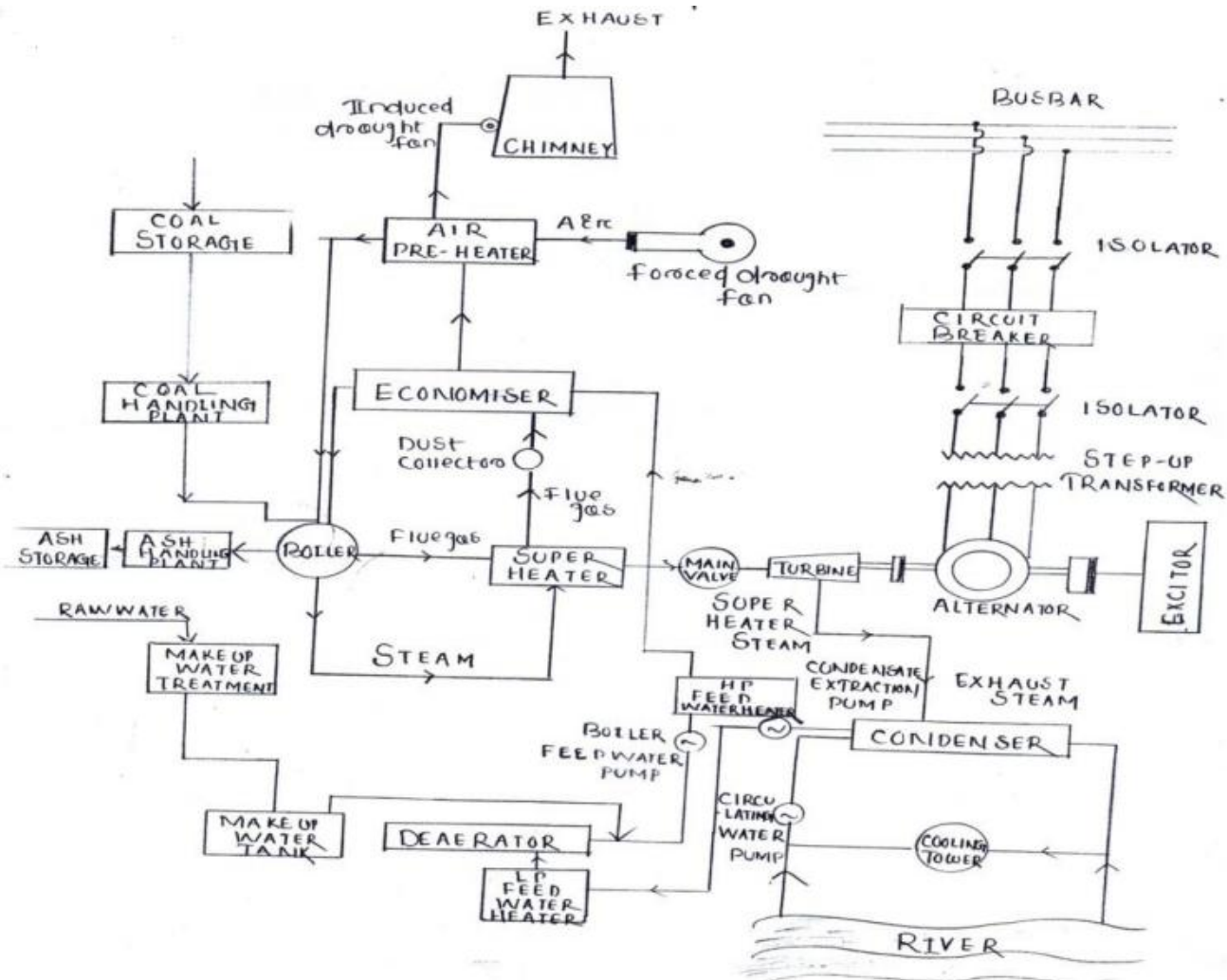
MERITS:-

1. No fuel is required by such plant because water is the source of energy.
2. It is highly reliable & cheapest & operation & maintenance
3. No. Stand by loss & variable load demand can meet easily
4. Good longer life & robust.
5. Efficiency does not fall with age & it has neat & clean environment due to absence of smoke & ask.
6. In addition to generation of provides irrigation flood control on navigation.

DEMERITS:-

1. It covers large area.
2. Constructional cost is very high along with it requires long transmission line as it far away from load centre.
3. Its O/P is uncertain

STEAM POWER PLANT OR THERMAL POWER PLANT:-The power plant which generates electrical energy from the combustion of coal called steam power plant

**ELEMENTS OF THERMAL POWER PLANT:-****1) STEAM GENERATING EQUIPMENT:-**

- Boiler:**-It is a major part of thermal power plant which converts water into steam. It is of two types fire tube boilers & water tube boilers in fire tube boilers the tubes containing hot gasses of combustion surrounded with water while in water tubes water inside the tube while hot gasses outside.
- Boiler furnace:** - Boiler furnace is a chamber in which fuel is burnt to liberate the heat energy it also provides support & enclosures for combustion equipment i.e. burner.
- Super heater:**- A superheater is a device which removes the last traces of moisture from saturated steam leaving a boiler tubes & also increase its temp. Above the saturation temp.
- Re-heater:**-It re-super heat the partly expanded steam from the turbine resulting dryness of steam up to last stage of turbine

e) **Economizer & Air pre-heater** :-Those are such devices which recover the heat from the flue gases on their way to chimney & raise the temp. of feed water. & air supplied for combustion

2) **CONDENSER**:-Steam after explanation through prime movers goes through condenser which condenses the exhaust steam & also removes air & other unwanted gases from steam while passing through them. It is up two types

1. Jet or contact condenser

2. Surface condenser

3) **EVAPORATOR**:-These are employed for feeding pure water to steam power plant by evaporating raw water.

4) **FEED WATER HEATER**:-These heat the feed water by means of bled steam before supply to the boiler which dissolves improve efficiency.

5) **PRIME MOVER**:-It converts the stored energy in steam into rotational mechanical energy. It is either reciprocating or turbines. Now rises only steam turbine is use as prime movers.

WORKING PRINCIPLE OF STEAM POWER PLANT:-The working of thermal power plant can be summarized as be follows.

1. **FUEL & ASH CKT**:-Generally heavy amount of fuel i.e. coal is stored in coal storage his again transfer to boiler furnace through coal handling plant. Where gates pulverization. After combustion the resulting ash get transfer to ash storage to ash handling plant.
2. **AIR & FLUE GAS CKT** :-Here, atmospheric air is drawn by forced draught fan or induced draught fan through air preheated in which air is heated by heat of flue gases passing to chimney & finally air is passed to furnace. Similarly, flue gas after passing through boiler & super heater drawn by induced draught fan via dust collector (Precipitator). Economizer & Air preheated finally Exhausted to the atmosphere to the chimney.
3. **FEEDWATER & STEAM CKT**:-Generally steam coming from boiler is wet & having high pressure, which again dried & further super heated by super heater & supply to steam turbine through main valve where it gives heat energy & passes through condenser. Now, the condensate steam is extracted from the condenser to the low pressure feed water by condensate extraction pump. Where is gets heats up at low pressure & pump to high pressure water heater through deaerator & finally to boiler through economizer where it get again heat of by heats of flue gas passing it on the way of chimney. Here the function deaerator reduces dissolved oxygen in the condensate steam. Generally a small part of steam & water is passing through different components are loosed. So water is added to feed water as make up water by makeup water treatment.
4. **COOLING WATER CIRCUIT** :-The cooling water is supply from the natural source of supply i.e. river, lake canal etc through screens to remove the matter that might choke condenser tube. The circulation of cooling water maintenance low pressure in condenser.

SELECTION OF SITE FOR THERMAL POWER PLANT:-There are different factors which govern the site selection.

1. **Near to the load center**:-It locates near the load center resulting low transmissions cost & loss.
2. **Supply of water**:-Large quantity of water is required
 - a. To raise steam in boilers.
 - b. For cooling
 - c. For carrying disposal of Ash.
 - d. For drinking
3. **Availability of coal**:-It required huge amount of coal so plants are located near the coal mines to avoid the transport of coal & ash.

4. **Load requirement**:-Land is required not only for setting of plant but also other purposes for staff colony, coal storage ash disposal etc.

TRANSPORTATION FACILITIES:-These facilities must be available for transportation of heavy equipment & fuels i.e. near railway station.

MERITS:-

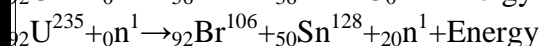
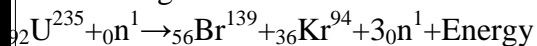
1. The fuel (i.e. coal) used is quite cheap.
2. Cheaper in initial cost in comparison to the other plant.
3. Less space is required in comparison to hydropower plant.
4. Such plant can be installed at any place whereas hydro electric plants can only be developed at source of water.
5. A portion of steam raised can be used as process steam in various industries like paper mill, sugar mill, chemical or etc.

DEMERITS:-

1. High maintenance & operating cost.
2. Pollution of atmosphere due to fumes & residues.
3. Consumption of huge amount of water.
4. Handling of coal & disposal of ash is quite difficult
5. Troubles from smoke & heat from the plant.

NUCLEAR POWER PLANT:-The power plant which generates electricity by utilizing the vast energy released from nuclear fission reaction is known as nuclear power.

NUCLEAR FISSION:-The nuclear reaction in which a heavy nucleus is split into small nuclei with liberation of vast energy by bombardment of neutron is known as Nuclear Fission Reaction. Eg- Chemical reaction



Note:-1 kg of natural uranium gives energy equivalent to combustion of 10.500 kg of coal i.e.

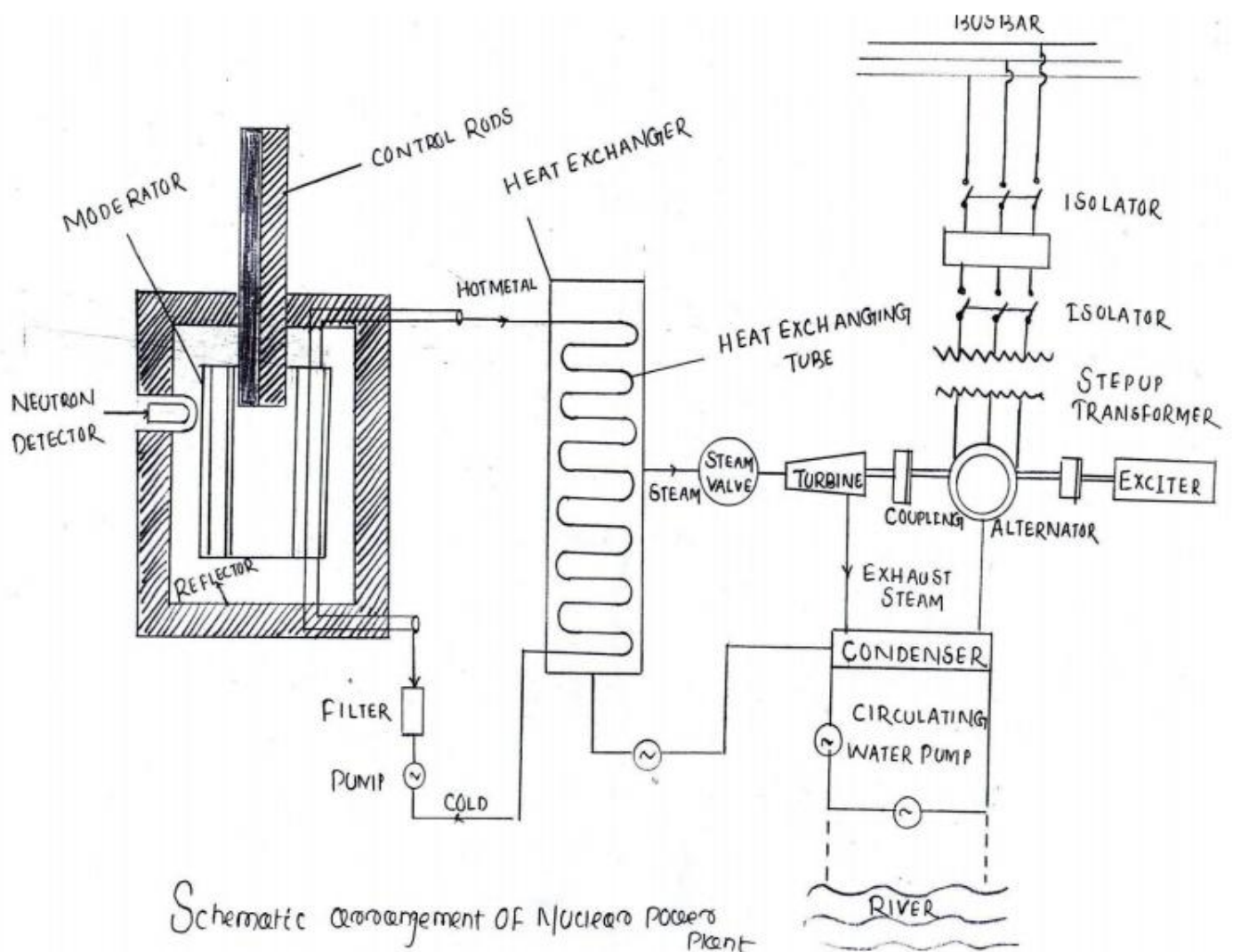
$$0.7/100 \times 3 \times 10^6 \times 0.5 \text{ Joule}$$

NUCLEAR CHAIN REACTION:-It may be defined as a fission reaction where the neutrons from previous step continuously propagate & repeat the reaction i.e.

Components of the nuclear power plant:-

Nuclear Reactor:-It is the main part of nuclear power plant which is very similar to boiler of thermal power plant it has following component.

1. **Reactor core**:-It contains a number of fuel rods made of U etc. as uranium gets oxidised rapidly so fuel rods clad with aluminum stainless steel or zirconium.
2. **Moderator**:-The moderator moderates or reduces the neutrons speed to a value that increases the probability of fission reaction. The elements which are used as moderator in nuclear reactor are hydrogen deuterium He, Li, oxygen, carbon heavy water etc.
3. **Control Rods**:- The control rods which are made of Boron-10 cadmium or Hafnium are inserted into nuclear reactor from the top of reactor vessels. The control rods control rate of the nuclear fission reaction by absorbing neutrons. It can be inserted or taken out as according to requirement i.e. if we need increased rate of reaction we have to take out & vice versa.
4. **Coolant**:-It is the medium through which heat generated in the reactor is transferred to the heat exchanger & it also keeps the reactor at desired temp.



- a. The material like air He, H & CO₂ amongst the gases light or heavy water amongst the liquid or molten sodium or lithium amongst the metal used as coolant.
- b. **Heat Exchanger**:- In heat Exchanger the gas is heated or steam is generated by utilizing heat from nuclear reactor, here heat is connected by heat exchanger tube by circulation.
- c. **Steam turbine**:- The Steam produce in heat exchanger is transferred to steam turbines through steam valve where heat energy is converted in to mechanical energy.
- d. **Condenser**:- The exhausted steam from steam turbine is condensed by condenser & again feed to heat exchanger by feed water pump.
- e. **Alternator**:- It is coupled to steam turbine & it generate electricity by converting mechanical energy to convert in to electrical energy.

SELECTION OF SITE FOR NUCLEAR POWER PLANT:- The factor to be considered while selecting a site for nuclear power plant for economical deficient generation.

Availability of water supply:-

1. It requires more water i.e. two times of thermal power plant of same rating. So it located near the river, sea side or lake.
2. Distance from populated area:- Generally these are located for away from populated area due to danger of radio activity.

3. Nearness to load center:-Those plants can be located near the load center because of absence of transportation.
4. Availability of space for disposal of water:-There should have adequate space & arrangement for the disposal of radio activity waste.
5. Types of land :The land should be strong enough to support the heavy reactor i.e. 10,000 tones weight with imposed boarding pressure around 50 tones.

MERITS:-

- 1.It requires very small fuel.
- 2.It requires less area as compared to in other plant
- 3.In addition to generating power it powder variable Fissel material.
- 4.It can be located at load center resulting reduction in primary distribution cost.
- 5.It has most economical & flexible O/P.
- 6.The operating cost quite low after installation.

DISMERITS:-

- 1.The initial cost is very high as compared to any other plant.
- 2.It required greater technical known – how forits irrection & commissioning of the plant.
- 3.It bi-product is also radio activity causing dangerous pollution.
- 4.The fuel is used is very expensive & difficult to recover.
- 5.High maintenance charges
- 6.Heavy amount of water is needed.