

FLUID MACHINE LAB MANUALS

EXPERIMENT NO 4

Aim: - To study the working & constructional details of Hydro-power plant (H.P.P)

Apparatus Used: - Model of Hydro-power plant.

Theory: - Hydro-power Plant can be classified as follows:-

- 1. Based on Utilization of water:-
  - (a). Run-of-River plants (R.P.P) : are low head plant
    - (i) Run of River plants with pondage
    - (ii) Run of River plants without pondage
  - (b). Storage Reservoir Plants (S.R.P): - are made for generating power and also for controlling the floods, irrigation purpose and for fishing etc. They are called multipurpose projects, e.g. Bhakra Nangal, Damoder Valley projects.
  - (c). Pump Storage Plants (P.S.P): - Also called reservoir turbine with high efficiency used for power head race level.
  - (d). Peak Load Plants (P.L.P): - Work during peak load hours.

Based on availability of Head:

- (a). Low Head Plant (L.H.P.): - Head <45 m, Kaplan & Propeller type turbine are used
- (b). Medium Head Plant (M.H.P): - Head =45-250m, fore bays, surge tanks are used to avoid the effect of water hammer (W.H).
- (c). High Head plant (H.P.P).

Constructional details or components of hydro power plant are: -

- 1. Water reservoir (W.R): - May be either (i) Natural that can be found in high mountains from where the water is through down through tunnels. (ii). artificial: - Are made by Dams across the river.
- 2. Head Works: - Equipment used to control the flow of water into the water ways on the head race side (H.R.S) is called head works. It has (i) Gates: - types are plain, sliding gates, roller & wheeled gates etc. (ii). Valves: - Used are butterfly & needle type valves. (iii). Fish type & Trash racks: - These are nets used to keep the fish away from the debris from going into the water ways. And made of rectangular cross-sectional steel bars, some sort of cleaning device is also provided to remove the debris from the trash racks. (iv). Heating arrangements to melt the ice of the mountains at the inlet.
- 3. Water ways (W.W): - (Tunnel, power channels or penstock with for bay & necessary apparatuses such as intake structure, air vent valve, surge tanks. These are the passage through which water is brought from reservoir to the power house.



- (a). A tunnel has to be cut through a hill if it comes between the reservoir & power house.
- (b). Open channel: - Are to be provided when the distance of the water storage & the power house is considerable.
- (c) Penstock are the steel or reinforced concrete pipes used in the last stage of the water travel from reservoir to the power house.

4. For bays Or Surge Tanks: - For bays is just a small water storage to meet the load fluctuations. For small periods, as for a day. These are made at the end of the tunnel or the open channel as the case may be. In case of open channel, a fore bay can be made by enlarging the channel just before the penstock starts. When the distance between the reservoir and the power house is less and only penstock to be used, the reservoir itself is a fore bay. Fore bays is used case of medium & low head plants where length of the penstock is small.

Surge Tanks: - Also act as a small reservoir for the water to the turbine. When the load on the turbine is reduced, water has to be restarted but it takes time to do so; the excess flow of water is temporarily stored in the surge tank & the level of the water in the surge tank becomes higher than the average. When the load on turbine increases, the increased supply of water is made partially by the direct flow of water and partially by the surge tank containing the water. It also avoids the water hammer effects. They are must for high and medium head plants and should be located as close to the turbine as possible. It is a cylindrical open topped tank and the normal level of water in it. To be at the level of reservoir minus the head losses in transition from the reservoir to the surge tank. To reduce the height of the surge tank, it is usually located at the junction of penstock and the pressure channel.

- 5. Power House: - It contains turbines, generators, governing mechanism and other equipment.
- 6. Tail Race: - It is a water way which carries the water from the turbine out let into some reservoir, river or channel.

#### **Viva Questions:-**

- 1. What is the function of surge tank?
- 2. What is meant by water hammer?
- 3. How are hydro power plants classified?
- 4. Name the major parts of a hydro power plant?