

Basic Features of Hydro Power Plants :-

The essential features of a hydro power plant are as below -

- ① Catchement area
- ② Reservoir
- ③ Dam and intake house
- ④ water way
- ⑤ Power house - or outlet water way.

① Catchement area :-

The Catchement area of a hydro plant is the whole area behind the dam, draining into a stream or river across which the dam has been built at a suitable place.

② water Reservoir :-

In a reservoir, the water collected from the catchement area is stored behind a dam.

→ Catchement area gets its water from rains and streams.

③ Dam :-

* The purpose of the dam is to store the water and to regulate the outgoing flow of water.

* The dam helps to store all the incoming water. It also helps to increase the head of the water.

④ water ways :

water ways are the passages, through which the water is conveyed to the turbines from the dam. These may include tunnels, canals, flumes, forebays, and penstocks and also surge tanks.

A forebay is an enlarged passage for drawing the water from the reservoir or the river and giving it to the pipelines or canals.

⑤ Power House : -

⑥ Tail Race or Tail water level :-

Tail water level is the water level after the discharge from the turbine. The discharge water is sent to the river, thus the level of the river is the tail water level.

Pumped Storage Plants :-

A pumped storage plant generates power or energy during peak hours, but during the off-peak hours, water is pumped back from the tail water pool and head water pool for the future use.

During peak hours, the water flows from the reservoir to the turbine and electricity is generated.

During off-peak hours, the excess power available from some other plant is utilized for pumping water back from the tail pool to the head pool.

In such a scheme, the same water is utilized again and again and no water is wasted.

Types of Pumped Storage Plant -

Pumped storage plant is suitable where -

- 1. The natural annual run-off is sufficient to justify a conventional hydroelectric installation.
- 2. It is possible to have reservoir at head and tail water location.

Types of pumped storage plants -

Various arrangements are possible for higher and lower reservoir. These are -

- i) Both Reservoirs in a single river.
- ii) Two reservoirs on two separate rivers close to each other and flowing at different elevations.
- iii) Higher reservoir an artificially constructed pool and the lower reservoir on natural river.
- iv) The lower reservoir in a natural lake while the higher is artificial.

Advantages :-

- * As compared to other plants, pumped storage plants require relatively low capital cost.
- * Pumped storage plants can pick up load rapidly within a few minutes.
- * Such power stations can be available to automation as well as a remote control.
- * It does not cause any kind of environmental pollution and thus they do not contribute to air and water pollution.
- * The power required for pumping is available at a cheaper rate.
- * Flood waters are stored to be utilized during slack monsoon years.

Efficiency of P_s plants :-

For every 3 kW input we may expect 2 kW output in pumped storage plants. The normally attainable overall plant efficiency (η_o) is around 70%.

It could be worked out as below, for a closed cycle operation.

$\eta_o = \frac{\text{Energy generated during one cycle, } E_g}{\text{Energy consumed during the same cycle, } E_p}$

Now, if Q is the discharge and H is the gross head.
Then

$$E_g = \frac{\omega Q (H - h_f) \times 0.736 \times \eta_e}{85}$$

where

$\eta_e = \text{overall efficiency of generation.}$

and

$$E_p = \frac{\omega Q (H + h_f) \times 0.736}{85 \eta_p}$$

$\eta_p = \text{overall efficiency of pumping operation.}$

then, the overall efficiency, $\eta_o =$

$$\frac{E_g}{E_p} = \frac{(H - h_f)}{(H + h_f)} \times \eta_e \times \eta_p$$

Since $h_f = 12 \text{ H}$

then

$$\eta_0 = \frac{1-k}{1+k} \times \eta_f \times \eta_p$$

Average values of η_f and η_p are respectively 0.88, 0.85 and 0.02 to 0.03. With these values, the overall efficiency comes out to be 82%.

Reversible Turbines :-

The term 'Reversible turbine' as it applies to the area of energy can be defined as: A hydraulic turbine normally installed in a pumped storage plant, which can be used alternatively as a pump or as an engine, turbine, water wheel or other apparatus that drives an electrical generator.