

## UNIT-1 PART-1

### HYDROELECTRIC POWER STATIONS

#### Site selection and Factors Affecting the Location of Dam of Hydroelectric Power Plants

Before discussing the hydro-electric power stations we need to know the where we should locate our hydro-electric power station. What factors we should keep in our mind while building a hydro-electric power station. So we going to discuss few factors which are considered the most important.

##### Availability of water:

Since water is the primary requirement of the hydro-electric power station. Water availability must be in huge quantity. Such power plants must be built at a place where the water is available in a huge amount at a good head as well.

##### Storage of water:

There is wide variation in water availability from rivers throughout the year. This makes it necessary to store the available water. In order to store water for constant generation of electrical power, we must build dams. In certain days of the year, the water quantity decreases up to a low level which can affect the generation of electrical power as well.

##### Cost and type of land:

Another most important point is the initial cost and type of land. The land on which the powerhouse is going to be built must be at a reasonable price and secondly the bearing capacity of the land. The ground should be good to withstand the weight of heavy types of equipment.

##### Transportation facilities:

The site selected for the hydro-electric plant must be accessible on transport facility. So that heavy machinery could be easily transported to the station.

##### Constituents of a hydro-electric plant

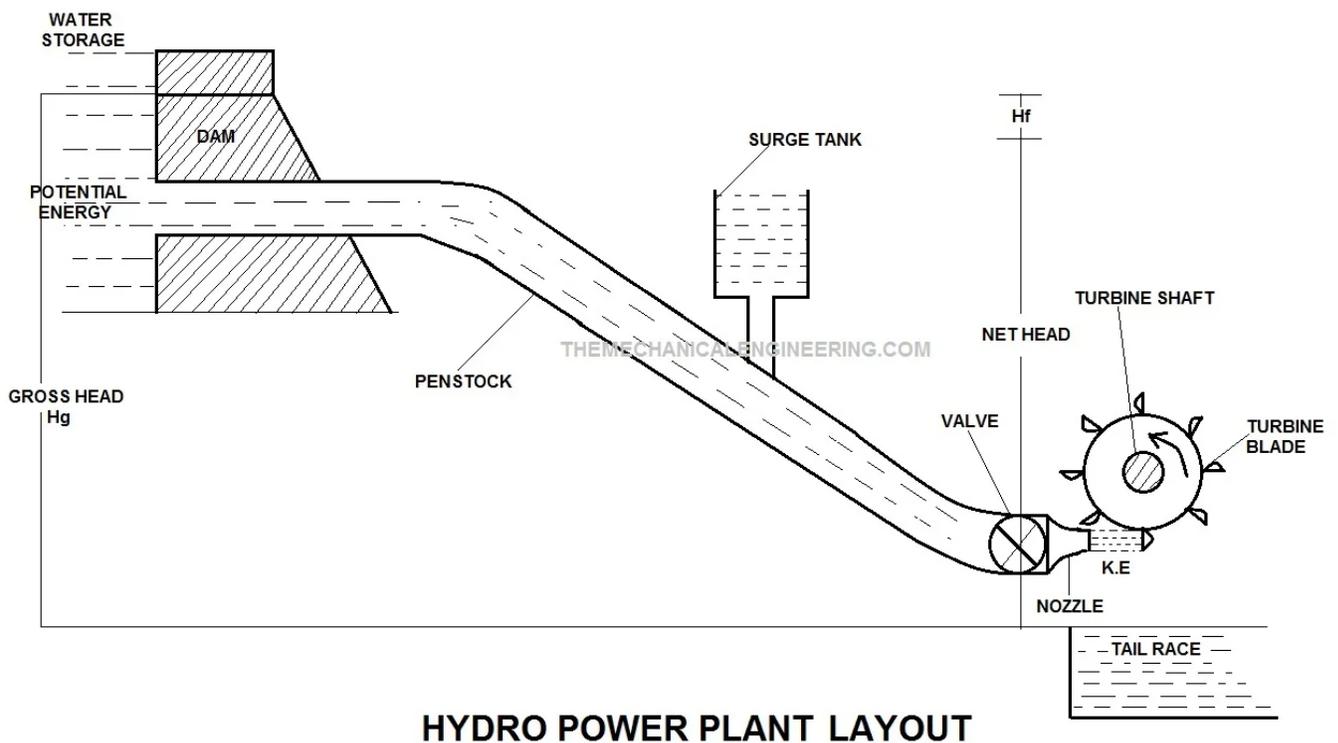
The constituents of hydro-electric power station can be divided mainly into three categories 1) hydraulic structure 2) water turbines 3) electrical equipment. We are going to discuss each item in turn.

## Types of Power Generating Plants

### 1. Hydro Power Plant:

Hydro Power Plant is an electricity-producing plant in which the water is an essential fuel, the potential energy is being converted into kinetic energy and kinetic energy is further converted into mechanical and into electrical energy with the help of a turbine and motor.

### Hydro Power Plant Layout and Working:



[Potential Energy to Kinetic Energy to Mechanical Energy to Electrical Energy]

### **The following Construction or Layout of Hydro Power Plant:**

1. Headpond or Reservoir
2. Control gate
3. Penstock
4. Valve and Nozzle
5. Surge tank
6. Turbine
7. Draft Tube

8. Tail Race
9. Transmission Line
10. Generator
11. Transformer
12. PowerHouse

### **1.Headpond:**

There is one reservoir which is having a large area in which A huge amount of water is being stored here. So the energy here is in the form of Potential energy.

*We Know Potential Energy is  $mgh$  [Mass\*Gravitational force\* Height]*

### **2.Control Gate:**

There are having multiple control gates in a single hydro power plant. The work of control gate is to regulate the flow of water. When the control gate is fully opened the speed of water flowing is maximum.

### **3.Penstock:**

The penstock is also called [Pipe](#). The water stored at the dam or head pond is being released by the control gate, the water starts moving to the turbine. The Head pond is having high heights and the Turbine is situated below.

So the speed of water gets increased because of [gravitational force](#). The material of the penstock is hard steel being used.

### **4.Valve and Nozzle:**

The [valve](#) work is similar to the control gate and Nozzle work is striking water in a specific direction [Pressure is high] that is a turbine blade.

### **5.Surge tank:**

Surge tank is an additional and essential component which is used to accumulate the water which is in pipe when we want to close the turbine working. Or you can say it is used for avoiding the pipe burst.

### **6.Turbine:**

Turbine is a device which is used for generation of electricity. Turbine work is, the fluid having kinetic energy is being converted into rotational energy.

The high kinetic energy water comes through the penstock to the nozzle and strikes the turbine blades. The turbine blades start rotating. So the rotational energy can also be called mechanical energy.

### **7.Draft Tube:**

Draft tube is mechanical component which is used for enlarging the area of pipe for sending maximum fluid to the other side.

**8.Tail Race:**

Tailrace carries water away from the plant. Hence the water is sent to the river.

**9.Transmission Line:**

The transmission line carries power from the power unit or transformer and transfers or supplies from one source to another. It is made up of conductor.

**10.Generator:**

When the turbine buckets starts rotating, the turbine shafts also rotating. the motors are attached to the turbine shafts which is also rotating and generator is attached to them which generates electricity.

**11.Transformer:**

The transformer is attached to the generator. The electricity generated is now controlled by the transformer. The work of transformer is to set up or set down the voltage.

**12.Power House:**

The name power house means there is a house in which the power is being stored and released to the transformer and so on.

**Hydro Power Plant Working:**

In a large amount of water is available or you can say a river. The water is being stored in the reservoir which is in the form of potential energy. With the use of the control gate, the water is being released and water starts flowing into the penstock. Here two components are attached 1. Surge tank, Valve, and Nozzle.

Initially, the valve is closed. But when the water reaches up to the max level that can create high pressure then we open the valves. The water with high pressure starts flowing and strikes to the turbine blades through the nozzle.

The turbine blades start rotating. So till now, we observed the water which is having PE is now converting into KE.

In the turbine blade, an electric motor is attached to the turbine shafts. So rotation of turbine blades also rotates the turbine shafts, which also rotates the electric motor. Hence Kinematic energy into mechanical energy and then further it is converted into electric energy.

The energy generated is sent to the powerhouse, [Transformer](#), and Transmission line. The water which is rotating the turbine blades is now sent to the river via a tailrace.

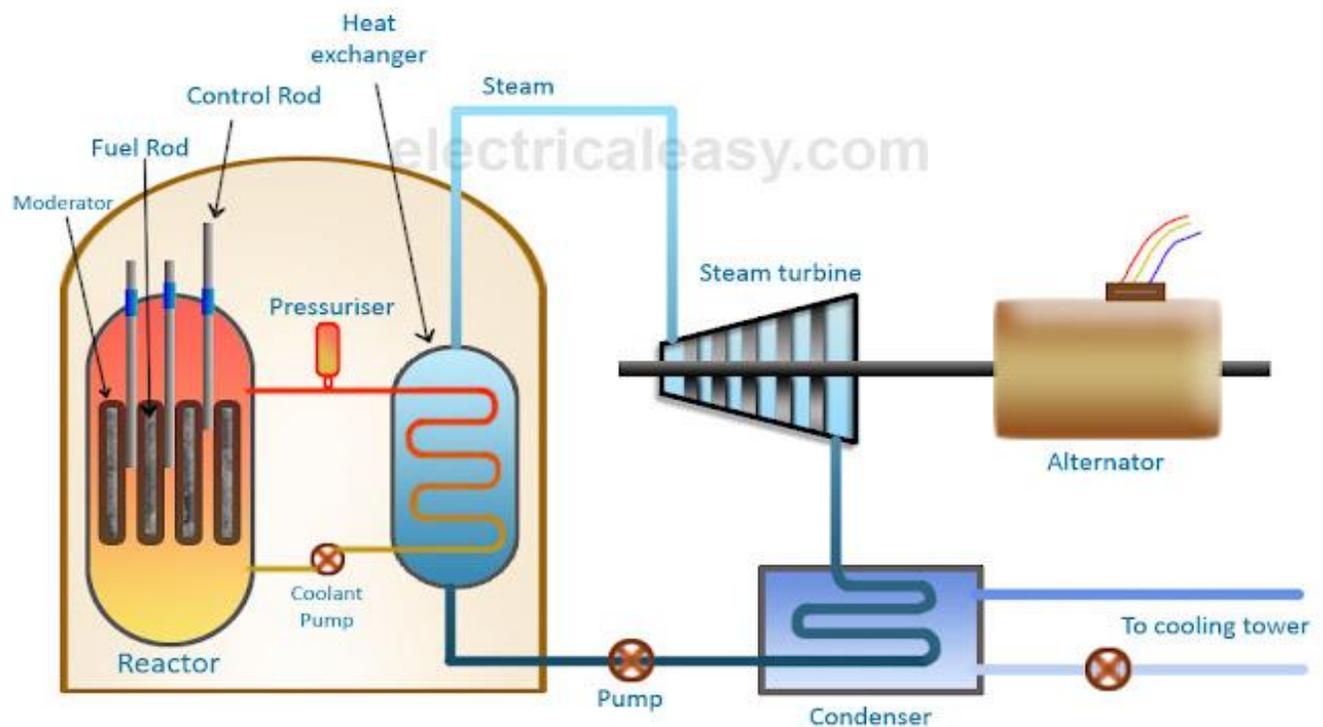
The hydropower plant is constructed to store the water in a large amount. When the water reaches up to the max level then it is being released which also causes the flood in some area (due to sudden release of water).

## 2.Nuclear Power Plant

A **nuclear power plant** is a type of power station that generates electricity using heat from nuclear reactions.

A **nuclear power plant (NPP)** is a thermal power station in which the heat source is a nuclear reactor. As is typical of thermal power stations, heat is used to generate steam that drives a steam turbine connected to a generator that produces electricity.

### Nuclear Power Plant Layout and Working:



The Nuclear Power Plant consists of 7 Main Parts

- 1.Nuclear Reactor
- 2.Coolant circulating pump
- 3.Heat Exchanger
- 4.Feed pump
- 5.Condenser
- 6.Turbine
- 7.Generator

**1.Nuclear Reactor:**

**Nuclear reactors** are used at nuclear power plants for the generation of electricity and in nuclear marine propulsion. The Heat generated from nuclear fission is passed to a working fluid which is (water or gas), which in turn runs through steam turbines. These either drive a ship's propellers or turn electrical generators' shafts. Nuclear-generated steam can be used for industrial process heat and some reactors are used to produce isotopes for medical and industrial use or the production of weapons-grade plutonium.

**2.Coolant Circulating Pump:**

Coolant circulating pump circulates the water which is further going to be heated and used for turbine blade rotating.

**3.Heat Exchanger:**

The name itself indicates the **Heat exchanger** which works to exchange heat from lower to higher.

**4.Feed Pump:**

Send the water from the condenser to the heat exchanger and from there by the use of a circulating pump it sends to the concrete shield system.

**5.Condenser:**

The **condenser** is the component that is used for extracting the heat from the working fluid or simple you can say it cools the working fluid because it is having a low temperature.

**6.Turbine:**

The **turbine** is a device that is used for power generation. Here The fluid strikes to turbine blade which is further converted Kinetic energy into mechanical energy and the generator converts that mechanical energy into electrical energy.

**7.Generator:**

The **generator** is further used for converting into Electrical energy and the output we got is Power.

**Nuclear Power Plant Working:**

Nuclear Plant consists of the Nuclear Reactor, Coolant circulating pump, Heat Exchanger, Feed Pump, Condenser, Turbine, and Generator. The Heat is generated in a reactor by the fission reaction. The coolant in the primary circuit gets heated by observing the heat and enters the Heat Exchanger.

Here, In the Heat Exchanger, the feed water is heated and converted into steam by the hot coolant using heat transfer. The steam from the Heat Exchanger will enter the turbine to rotate the turbine blades and generates power.

The steam after doing the work enters the condenser and is converted into water which is pumped again to the Heat Exchanger by the feed pump. The hot coolant gets cold in the Heat Exchanger and is recirculated into the reactor by the coolant circulating pump. The cycle is repeated continuously for the generation of power.

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