5. Explain in detail about various types of condenser used in thermal power plant. (May/June 2016)

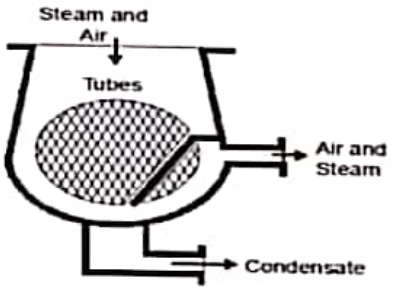
A condenser is a device in which the steam is condensed by cooling it with water. The condensed steam is known as condensate. The following are the advantages of installing a condenser in a steam power plant.

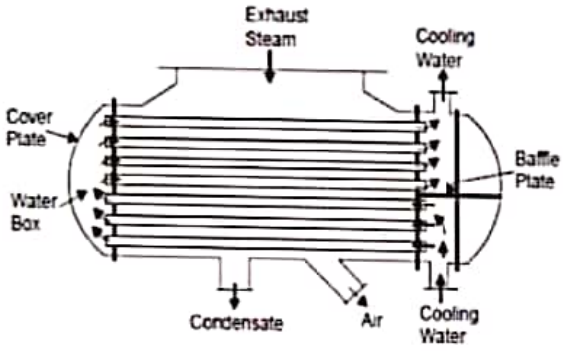
1. More work is done by the given amount of steam than could be obtained without a condenser. Thus, the efficiency of the power plant is increased.
2. Steam consumption is reduced for the given output.
3. The condensate is recovered for the boiler feed water.

Surface condensers

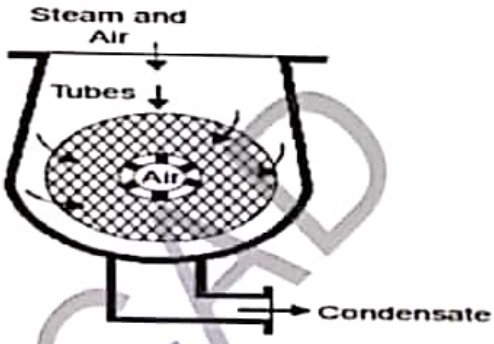
In surface condensers there is no direct contact between the steam and cooling water and the condensate can be re-used in the boiler: In such condenser even impure water can be used for cooling purpose whereas the cooling water must be pure in jet condensers. Although the capital cost and the space needed is more in surface condensers but it is justified by the saving in running cost and increase in efficiency of plant achieved by using this condenser. Depending upon the position of condensate extraction pump, flow of condensate and arrangement of tubes the surface condensers may be classified as follows:

(i) **Down flow type.** Fig shows a sectional view of dawn flow condenser. Steam enters at the top and flows downward. The water flowing through the tubes in one direction lower half comes out the opposite direction in the upper half

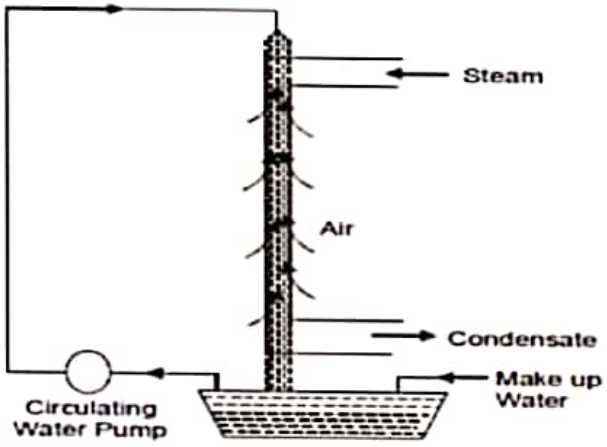




Central flow condenser. Fig shows a central flow condenser. In this condenser the steam passages are all around the periphery of the shell. Air is pumped away from the centre of the condenser. The condensate moves radially towards the centre of tube nest. Some of the exhaust moving towards the centre meets the under cooled condensate and pre-heats it thus reducing under cooling.



(*iii*) **Evaporation condenser.** In this condenser (Fig.) steam to be condensed is passed through a series of tubes and the cooling waterfalls over these tubes in the form of spray. A steam of air flows over the tubes to increase evaporation of cooling water, which further increases the condensation of steam.



The various advantages of a surface condenser are as follows:

1. The condensate can be used as boiler feed water.

2. Cooling water of even poor quality can be used because the cooling water does not come in direct contact with steam.

3. High vacuum (about 73.5 cm of Hg) can be obtained in the surface condenser. This increases the thermal efficiency of the plant.

The various disadvantages of' the surface condenser is as follows:

1. The capital cost is more.

2. The maintenance cost and running cost of this condenser is high.

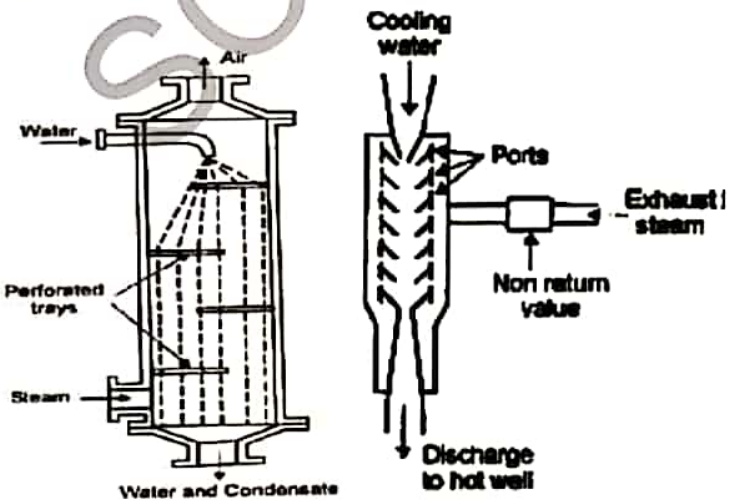
3. It is bulky and requires more space.

Jet condenser

In a jet condenser, the steam to be condensed and the cooling water come in direct contact and the temperature of the condensate is the same as that of the cooling water leaving the condenser. For jet condensers the recovery of the condensate for reuse as boiler feed water is not possible.

Low level jet condenser

In this condenser, the cooling water enters at the top and sprayed through jets. The steam enters at the bottom and mixes with the fine spray of cooling water. The condensate is removed by a separate pump. The air is removed by an air pump separately from the top.



High level jet condenser

This is similar to a low level condenser, except that the condenser shell is placed at a height of 10.36 m [barometric height] above the hot well. The column of water in the tail pipe forces the condensate into the hot well by gravity. Hence condensate extraction pump is not required.

1. Draw and explain block diagram of Nuclear power plant and write few advantages and disadvantages? (Nov/Dec2015,May/June2016 &Novc/Dec 2016)

Nuclear Power plants has various components,

Nuclear fuel

Fuel of a nuclear reactor should be fissionable material which can be defined as an element or isotope whose nuclei can be caused to undergo nuclear fission by nuclear bombardment and to produce a fission chain reaction. It can be one or all of the following,

U233, U235 and Pu239.

Natural uranium found in earth crust contains three isotopes namely U234, U235 and U238 and their average percentage is as follows :

U238 — 99.3%,U235 — 0.7%,U234

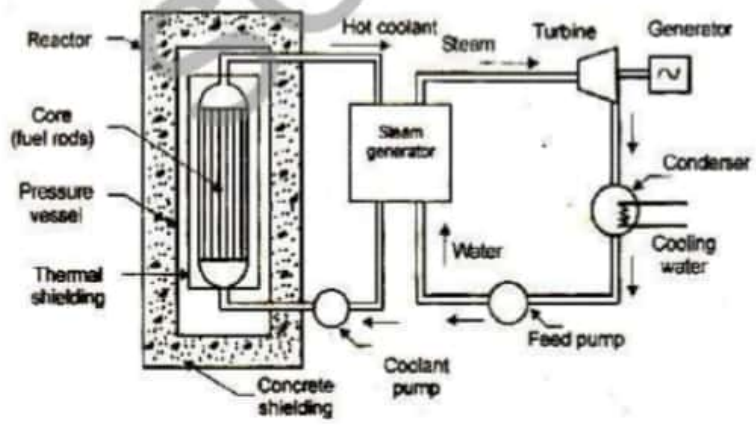
Out of these U235 is most unstable and is capable of sustaining chain reaction and has been given the name as primary fuel. U233 arid Pu239 are artificially produced from Th232 and U238 respectively and are called secondary fuel.

i) Moderators

In any chain reaction, the neutrons produced are fast moving neutrons. These are less effective in causing fission of U235 and they try to escape from the reactor. It is thus implicit that speed of these neutrons must be reduced if their effectiveness is carrying out fission is to be increased. This is done by making these neutrons collide with lighter nuclei of other materials, which does not absorb these neutrons but simply scatter them. Each collision causes loss of energy and thus the speed of neutrons is reduced. Such a material is called a 'Moderator'. The neutrons thus slowed down are easily captured by the fuel element at the chain reaction proceeds slowly.

A moderator should process the following properties :

1. It should have high thermal conductivity.
2. It should be available in large quantities in pure form.
3. It should have high melting point in case of solid moderators and low melting point in case of liquid moderators.
4. It should provide good resistance to corrosion.
5. It should be stable under heat and radiation.
6. It should be able to slow down neutrons



ii) Reflectors

Some of the neutrons produced during fission will be partly absorbed by the fuel elements, moderator, coolant and other materials. The remaining neutrons will try to escape from the reactor and will be lost. Such losses are minimized by surrounding (lining) the reactor core with a material called a reflector which will reflect the neutrons back to the core. They improve the neutron economy. Economy: Graphite, Beryllium.

iii) Shielding

During Nuclear fission alpha, beta, comma particles and neutrons are also produced. They are harmful to human life. Therefore it is necessary to shield the reactor with thick layers of lead, or concrete to protect both the operating personnel as well as environment from radiation hazards.

iv) Cladding

In order to prevent the contamination of the coolant by fission products, the fuel element is covered with a protective coating. This is known as cladding.

Control rods are used to control the reaction to prevent it from becoming violent. They control the reaction by absorbing neutrons. These rods are made of boron or cadmium. Whenever the reaction needs to be stopped, the rods are fully inserted and placed against their seats and when the reaction is to be started the rods are pulled out.

v) Coolant

The main purpose of the coolant in the reactor is to transfer the heat produced inside the reactor. The same heat carried by the coolant is used in the heat exchanger for further utilization in the power generation.

Some of the desirable properties of good coolant are listed below

1. It must not absorb the neutrons.
2. It must have high chemical and radiation stability
3. It must be non-corrosive.
4. It must have high boiling point (if liquid) and low melting point (if solid)
5. It must be non-oxidizing and non-toxic.

The above-mentioned properties are essential to keep the reactor core in safe condition as well as for the better functioning of the content.

6. It must also have high density, low viscosity, high conductivity and high specific heat. These properties are essential for better heat transfer and low pumping power.

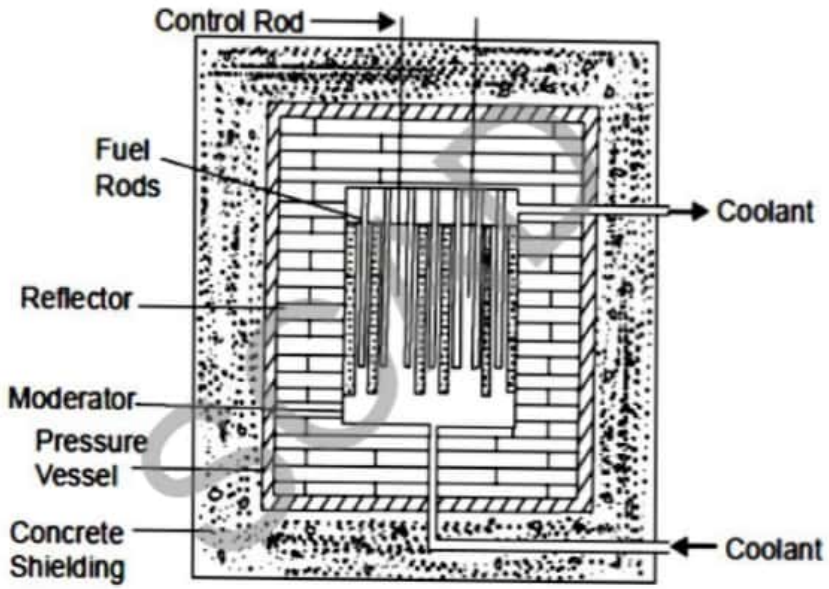
The water, heavy water, gas (He, CO_2), a metal in liquid form (Na) and an organic liquid are used as coolants. The coolant not only carries large amounts of heat from the core but also keeps the fuel assemblies at a safe temperature to avoid their melting and destruction.

vi) Nuclear reactor:

A nuclear reactor may be regarded as a substitute for the boiler fire box of a steam power plant. Heat is produced in the reactor due to nuclear fission of the fuel

Radiation hazards and Shielding:

The reactor is a source of intense radioactivity. These radiations are very harmful to human life. It requires strong control to ensure that this radioactivity is not released into the atmosphere to avoid atmospheric pollution. A thick concrete shielding and a pressure vessel are provided to prevent the escape of these radiations to atmosphere. Fig. shows a schematic diagram of nuclear reactor.



vii) Steam generator

The steam generator is fed with feed water which is convert th heat of the hot coolant. The purpose of the coolant is to transfer th d in the reactor core and use it for steam generation. Ordinary water or heavy water is a common coolant.

viii) Turbine

The steam produced in the steam generator is passed to the turbine and work is done by the expansion of steam in the turbine.

ix) Coolant pump and Feed pump

The steam from the turbine flows to the condenser where cooling water is circulated.Coolant pump and feed pump are provided to maintain the flow of coolant and feed water respectively.

Advantages of nuclear power plant

1. It can be easily adopted where water and coal resources are not available.
2. The nuclear power plant requires very small quantity of fuel. Hence fuel transportation cost is less.
3. Space requirement is less compared to other power plants of equal capacity.
4. It is not affected by adverse weather conditions.
5. Fuel storage facilities are not needed as in the case of the thermal power plant.

Disadvantages

1. Radioactive wastes, if not disposed of carefully, have adverse effect on the health of workmen and the population surrounding the plant.
2. It is not suitable for varying load condition.
3. It requires well-trained personnel.
4. It requires high initial cost compared to hydro or thermal power plants.

2. Write about principle of nuclear energy and chain reaction .Draw and explain the construction and working principle of Pressurized Water Reactor (PWR)? (Nov/Dec 2015,April/May 2017)

A nuclear power plant is similar to a conventional steam power plant except how that energy is evolved. The heat is produced in the nuclear power plant by fission, whereas in steam and gas turbine plants, the heat is produced by the furnace. The nuclear reactor acts as a furnace where nuclear en by splitting or fissioning of the nucleus of fissionable material like Uranium U-235. It is claimed that 1 kg U-235 can produce as much heat energy that can be produced by burning 4500 tones of high grade coal or 1700 tons of oil.

Heat energy evolved by the fission reaction of one kg of U235 can produce as much energy as can be produced by burning 4500 tons of high grade coal.

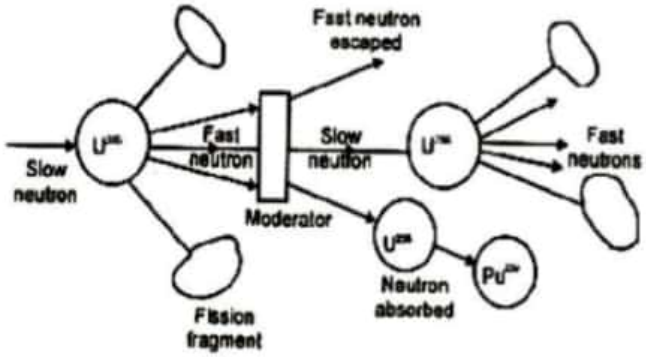
Uranium exists in the isotopic form of U235 which is unstable.

When a neutron enters the nucleus of U235, the nucleus splits into two equal fragments and also releases 2.5 fast moving neutrons with a velocity of 1.5 × 107 metres / sec producing a large amount of energy, nearly 200 millions electron-volts. This is called "nuclear fission".

Chain reaction

The neutrons released during the fission can be made to fission other nuclei of U235 causing a "chain reaction. A chain reaction produces enormous amount of heat, which is used to produce steam".

The chain reaction under uncontrolled conditions can release extremely large amounts of energy causing "atomic explosion



primary water can reach higher temperatures and is used to convert a secondary water supply into steam and from there to the steam turbine.

In a typical design concept of a commercial PWR, the following process occurs:

1. The core inside the reactor vessel creates heat.
2. Pressurized water in the primary coolant loop carries the heat to the steam generator.
3. Inside the steam generator, heat from the primary coolant loop vaporizes the water in a secondary loop, producing steam.
4. The steam line directs the steam to the main turbine, causing it to turn the turbine generator, which produces electricity.

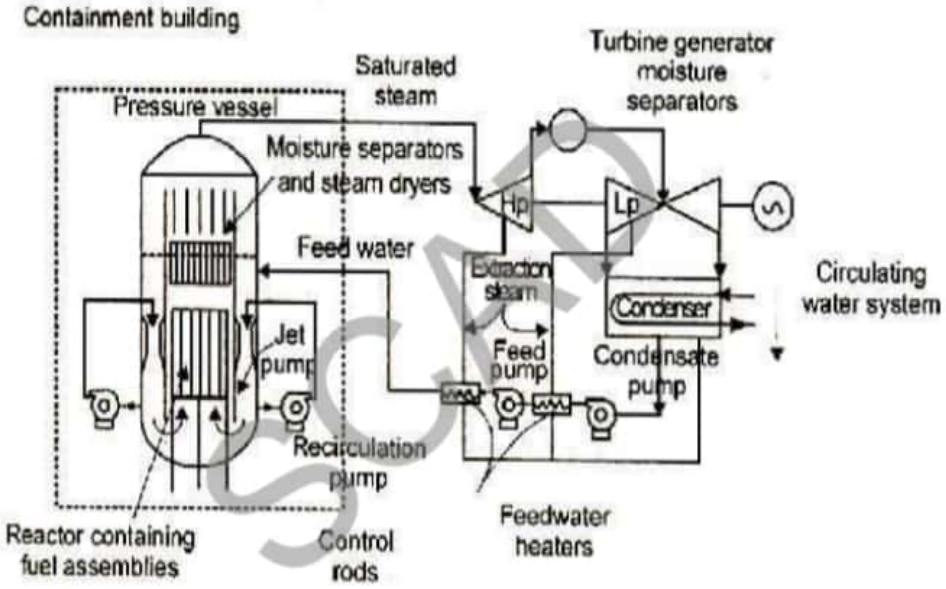
The unused steam is exhausted to the condenser, where it is condensed into water. The resulting water is pumped out of the condenser with a series of pumps, reheated, and pumped back to the steam generator.

The reactor's core contains fuel assemblies that are cooled by water circulated using electrically powered pumps. These pumps and other operating systems in the plant receive their power from the electrical grid. If offsite power is lost, emergency cooling water is supplied by other pumps, which can be powered by onsite diesel generators. Other safety systems, such as the containment cooling system, also need electric power. PWRs contain between 150-200 fuel assemblies

Function of the moderator is to reduce the energy of neutrons evolved during fission in order to maintain the chain reaction. The moderators which are commonly used are ordinary water and heavy water.

5. Draw and explain construction and working principle of Boiling Water Reactor (BWR)? (May/June2016)

Figure shows a simplified BWR. Light water, which acts as the coolant and moderator, passes through the core where boiling takes place in the upper part of the core. The wet steam then passes through a bank of moisture separators and steam dryers in the upper part of the pressure vessel. The water that is not vaporized to steam is re-circulated through the core with the entering feed water using two recirculation pumps coupled to jet pumps (usually 10 to 12 per recirculation pump). The steam leaving the top of the pressure vessel is at saturated conditions of 7.2 mPa and 278 deg C.



The steam then expands through a turbine coupled to an electrical generator. After condensing to liquid in the condenser, the liquid is returned to the reactors as feed water. Prior to entering the reactor, the feed water is preheated in se... ...f feed water heaters. The balance of plant systems (Example: Turbine water heaters) are similar for both PWR and BWRs.

The BWR reactor core, like that in a PWR, consists of a large number of fuel rods housed in fuel assemblies in a nearly cylindrical arrangement. Each fuel assembly contains an 8×8 or 9×9 square array of 64 or 81 fuel rods (typically two of the fuel rods contain water rather than fuel) surrounded by a square Zircaloy channel box to ensure no coolant cross flow in the core. The fuel rods are similar to the PWR rods, although larger in diameter. Each fuel rod is a zirconium alloy clad tube containing pellets of slightly enriched uranium dioxide (2% to 5% U-235) stacked end-to end.

The steam then expands through a turbine coupled to an electrical generator. After condensing to liquid in the condenser, the liquid is returned to the reactors as feed water. Prior to entering the reactor, the feed water is preheated in several stages of feed water heaters. The balance of plant systems (Example: Turbine generator, feed water heaters) are similar for both PWR and BWRs.

The BWR reactor core, like that in a PWR, consists of a large number of fuel rods housed in fuel assemblies in a nearly cylindrical arrangement. Each fuel assembly contains an 8×8 or 9×9 square array of 64 or 81 fuel rods (typically two of the fuel rods contain water rather than fuel) surrounded by a square Zircaloy channel box to ensure no coolant cross flow in the core. The fuel rods are similar to the PWR rods, although larger in diameter. Each fuel rod is a zirconium alloy clad tube containing pellets of slightly enriched uranium dioxide (2% to 5% U-235) stacked end-to end.

Thermal Plant	Hydro Plant	Nuclear Plant
Located where water and coal and transportation facilities are adequate.	Located where large reservoirs or dams can be created like in hilly areas.	Located in isolated areas away from population.
Initial cost is lower than hydro and nuclear.	Initial cost pretty high due to large dam construction.	Initial cost is highest as cost of reactor construction is very high.
Running cost is higher than nuclear and hydro due to amount of coal required.	Practically nil as no fuel is required.	Cost of running is low as very very less amount of fuel is required.
Coal is source of power. So limited quantity is available.	Water is source of power which is not a dependable quantity.	Uranium is fuel source along with platinum rods. So sufficient quantity is available.
Cost of fuel transportation is maximum due to large demand for coal.	No cost for fuel transportation.	Cost of fuel transportation is minimum due to small quantity required.
Least environment friendly.	Most environment friendly.	Better friend of environment than steam power plant.
25% overall efficiency.	Around 85% efficient.	More efficient than steam power.
Maintenance cost is very high.	Maintenance cost is quite low.	Maintenance cost is the highest as highly skilled workers are required.
Maximum standby losses as boiler still keep running even though turbine is not.	No standby losses.	Less standby losses.

PART- B

1.Explain the working principle of diesel engine power plant.

(May/June 2016 & April/May 2017)

Diesel engine consists various components and processes.

1. Fuel Supply System

It consists of fuel tank for the storage of fuel, fuel filters and pumps to transfer and inject the fuel. The fuel oil may be supplied at the plant site by trucks, rail, road, tank, cars, etc.

The five essential functions of a fuel injection system are:

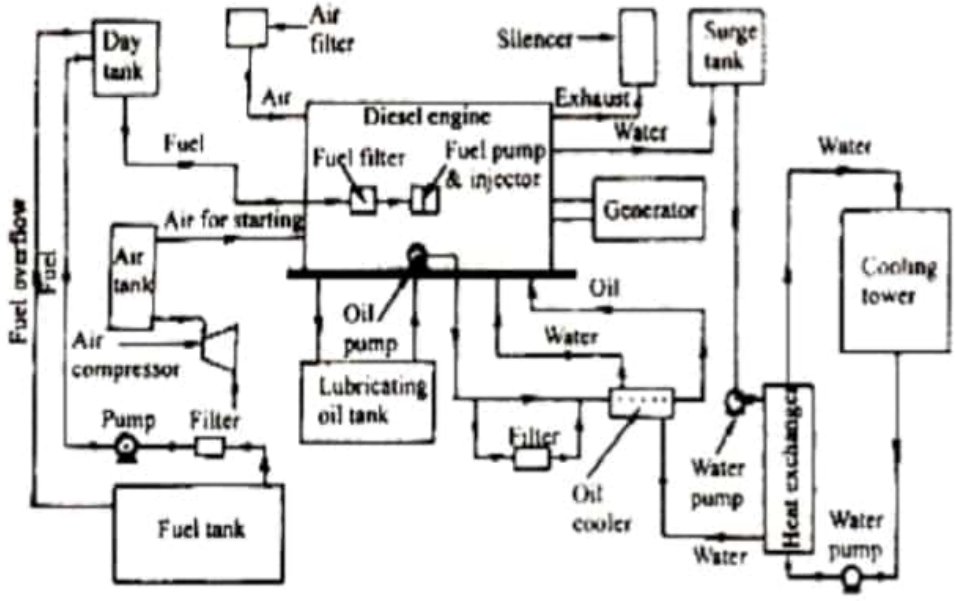
1. To deliver oil from the storage to the fuel injector.
2. To raise the fuel pressure to the level required for atomization.
3. To measure and control the amount of fuel admitted in each cycle.
4. To control time of injection.
5. To spray fuel into the cylinder in atomized form for thorough mixing and burning.

The above functions can be achieved in a variety of ways.

1.Common Rail.

2.Individual Pump Injection.

3. Distributor.



2. Air Intake and Exhaust System

It consists of pipe for the supply of air and exhaust of the gases. Filters are provided to remove dust etc. from the incoming air. In the exhaust system silencer is provided to reduce the noise.

Filters may be of dry type (made up of cloth, felt, glass, wool etc.) or oil bath type. In oil bath type of filters the air is swept over or through a bath of oil in order that the particles of dust get coated. The duties of the air intake systems are as follows:

i) To clean the air intake supply.

ii) To silence the intake air.iii) To supply air for super charging

The intake system must cause a minimum pressure loss to avoid reducing engine capacity and raising the specific fuel consumption. Filters must be cleaned periodically to prevent pressure losses from clogging. Silencers must be used on some systems to reduce high velocity air noises.

Strainer : This oil then pump to dry tank, by means of transfer pump.

During transferring from main tank to smaller dry tank, the oil passes through strainer to remove solid impurities. From dry tank to main tank, there is another pipe connection. This is over flow pipe. This pipe connection is used to return the oil from dry tank to main tank in the event of over flowing.

From dry tank the oil is injected in the diesel engine by means of fuel injection pump.

3. Starting System

For the initial starting of engine the various devices used is compressed air, battery, electric motor or self-starter.

- **Cooling System**

The heat produced due to internal combustion, drives the engine. But some parts of this heat raise the temperature of different parts of the engine. High temperature may cause permanent damage to the machine. Hence, it is essential to maintain the overall temperature of the engine to a tolerable level.

During combustion process the peak gas temperature in the cylinder of an internal combustion engine is of the order of 2500 K. Maximum metal temperature for the inside of the combustion chamber space are limited to much lower values than the gas temperature by a large number of considerations and thus cooling for the cylinder head, cylinder and piston must therefore be provided. Necessity of engine cooling arises due to the following facts

1. The valves may be kept cool to avoid knock and pre-ignition problems which result from overheated exhaust valves (true for S.I. engines).
2. The volumetric and thermal efficiency and power output of the engines decrease with an increase in cylinder and head temperature.

Based on cooling medium two types of cooling systems are in general use. They are

(*a*) Air as direct cooling system.

(*b*) Liquid or indirect cooling system

Air-cooling is used in small engines and portable engines by providing fins on the cylinder. Big diesel engines are always liquid (water/special liquid) cooled.

Liquid cooling system is further classified as

(i) Open cooling system

(ii) Natural circulation (Thermo-system)

(iii) Forced circulation system

(iv) Evaporation cooling system.

(i).Open cooling system:

This system is applicable only where plenty of water is available. The water from the storage tank is directly supplied through an inlet valve to the engine cooling water jacket. The hot water coming out of the engine is not cooled for reuse but it is discharged.

(ii). Natural circulation system:

The system is closed one and designed so that the water may circulate naturally because of the difference in density of water at different temperatures. It consists of water jacket, radiator and a fan. When the water is heated, its density decreases and it tends to rise, while the colder molecules tend to sink. Circulation of water then is obtained as the water heated in the water jacket tends to rise and the water cooled in the radiator with the help of air passing over the radiator either by ram effect or by fan or jointly tends to sink.

(iii). forced circulation cooling system:

The system consists of pump, water jacket in the cylinder, radiator, fan and a thermostat. The coolant (water or synthetic coolant) is circulated through the cylinder jacket with the help of a pump, which is usually a centrifugal type, and driven by the engine. The function of thermostat, which is fitted in the upper hose connection initially, prevents the circulation of water below a certain temperature (usually upto 85°C) through the radiation so that water gets heated up quickly.

5. Lubricating System

This system minimises the water of rubbing surface of the engine. Here lubricating oil is stored in main lubricating oil tank. This lubricating oil is drawn from the tank by means of oil pump. Then the oil is passed through the oil filter for removing impurities. From the filtering point, this clean lubricating oil is delivered to the different points of the machine where lubrication is required the oil cooler is provided in the system to keep the temperature of the lubricating oil as low as possible.

(i).Liquid lubricants or wet sump lubrication system

These systems employ a large capacity oil sump at the base of crank chamber, from which the oil is drawn by a low-pressure oil pump and delivered to various parts. Oil then gradually returns back to the sump after serving the purpose.

(ii).Solid lubricants or dry sump lubrication system

In this system, the oil from the sump is carried to a separate storage tank outside the engine cylinder block. The oil from sump is pumped by means of a sump pump through filters to the storage tank. Oil from storage tank is pumped to the engine cylinder through oil cooler. Oil pressure may vary from 3 to 8 kgf/cm2. Dry sump lubrication system is generally adopted for high capacity engines.

(iii).Mist lubrication system

This system is used for two stroke cycle engines. Most of these engines are crank charged, *i.e.*, they employ crank case compression and thus, are not suitable for crank case lubrication. These engines are lubricated by adding 2 to 3 per cent lubricating oil in the fuel tank. The oil and fuel mixture is induced through the carburettor. The gasoline is vaporized; and the oil in the form of mist, goes via crankcase into the cylinder

5.Starting System

For starting a diesel engine, initial rotation of the engine shaft is required. Until the firing start and the unit runs with its own power. For small DG set, the initial rotation of the shaft is provided by handles but for large diesel power station. Compressed air is made for starting.

Advantage of Diesel Power Plant

1. Very simple design also simple installation.
2. Limited cooling water requirement.
3. Standby losses are less as compared to other Power plants.
4. Low fuel cost.
5. Quickly started and put on load.
6. Smaller storage is needed for the fuel.
7. Layout of power plant is quite simple.
8. There is no problem of ash handling.

Disadvantage of Diesel Power Plant

1. High Maintenance and operating cost.
2. Fuel cost is more, since in India diesel is costly.
3. The plant cost per kW is comparatively more.
4. The life of diesel power plant is small due to high maintenance.
5. Noise is a serious problem in diesel power plant.

Application:

1. They are quite suitable for mobile power generation and are widely used in transportation

Systems consisting of railroads, ships, automobiles and aeroplanes.

2. They can be used for electrical power generation in capacities from 100 to 5000 H.P.

7 Function of Different Components used in Hydro-Electric Power Plant:

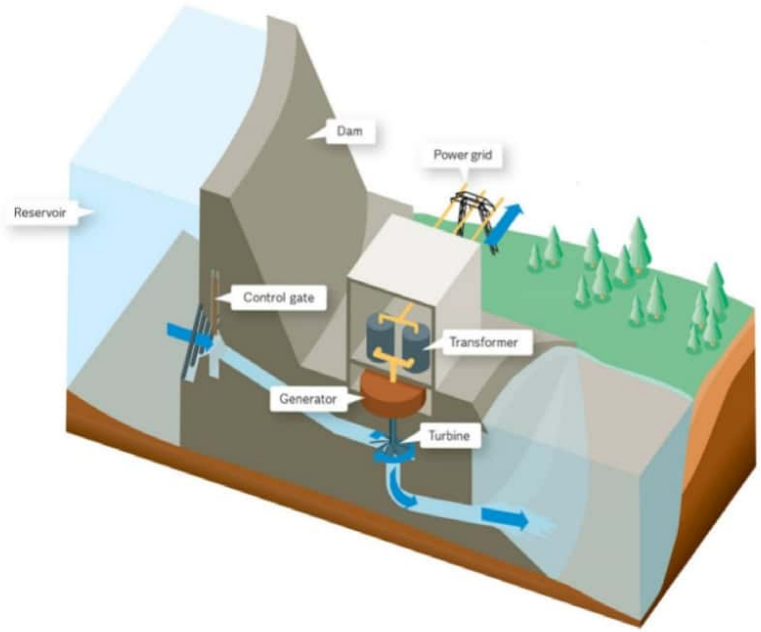


Fig: Shows all Parts of Hydro-Electric Power Plant (use only for understanding)

1. **Catchment Area:** धरणाचे पाणलोट क्षेत्र

   In hydro-electric power plant collect the rain water through surrounding hilly area, the surrounding all water collect & stored area to those place is known as catchment area.

   जल विद्युत निर्मिती केंद्र हे पुर्ण पणे पावसाच्या पाण्यावर अवलंबून असते त्यामुळे पाणलोट क्षेत्र जेवडे मोठे तेवढ्या जास्त मुबलक प्रमाणात आपण पाणी साठवू शकतो.

2. **Reservoir:** *(Shown in above figure)*

   The function of reservoir is to store the water near dam; this water is useful to drive the water turbines. The reservoir is useful to provide a head of stored water.

   याचा उपयोग धरणाजवळ मुबलक प्रमाणात पाणी साठ करणेसाठी होतो. या मुळे साठवलेल्या पाण्यात दाब तयार होते. या दाबाचा उपयोग करून आपण पाणी वीज निर्मिती केंद्राकडे सोडतो.

3. **Track Rash:**

Fig: Track Rack

It is used in hydro-electric power plant to filter the water before it flows towards turbine. The unwanted impurities (e.g. fish, plastics etc.) present in the stored water are avoided to flow towards turbine.

4. Head-Race Level: *(Shown in Schematic arrangement of HPP)*

The water surface in the reservoir up to the dam is known as he
जमिनीपासून ते उपलब्द असलेले पाण्याची पातळी म्हणजे हेड रेस लेवल होय.

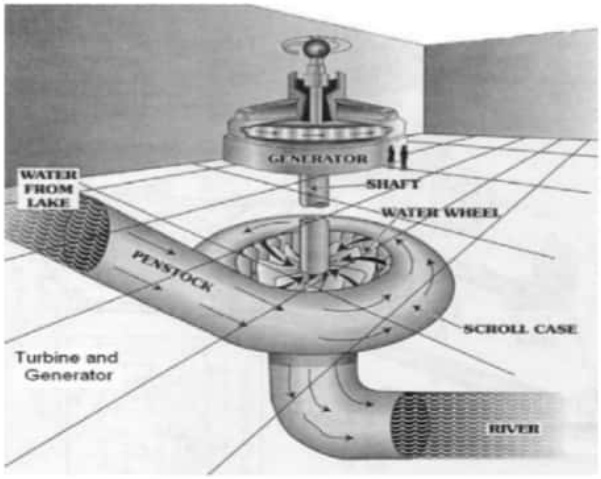
5. Dam:

The dam is used in hydro-electric power plant to store the water. Whenever the dam stored the water, it provides suitable head to this stored water. This stored water is useful throughout the year to run the hydro-electric power plant. Dam is made up of cement, concrete & sand materials. If higher rainfall occurs then door of dams are opened to flow of water.

6. Spill Way:

The excess water from dam is discharges through spillway at a permissible level.

7. Penstock:



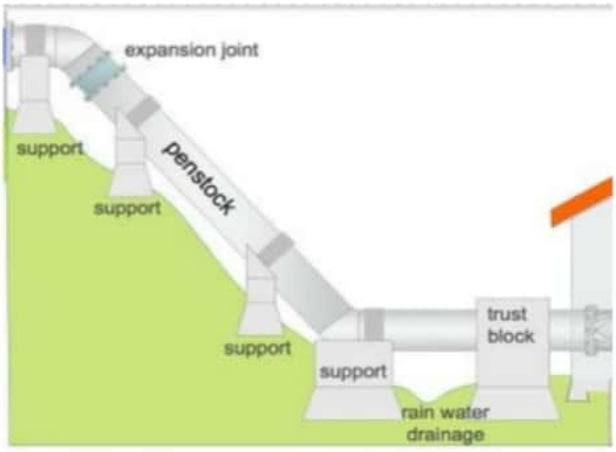


Fig: Penstock arrangement in HPP

It is the device which is used in hydro-electric power plant for the purpose of flow of water. The water flow of from dam towards turbine with the help of penstock. It converts the potential energy of water into kinetic energy. The penstocks are made up of cast iron or concrete material. The penstock is hollow in nature & of large diameter.

पेन स्टोक हा धरण आणि वीज निर्मिती करणारे घर या दोनीच्या माडे जोडलेले असते. पेन स्टोक हा स्टील किवा सिमेंट चा पोकळ पाईप होय. ज्यावेळी वीज निर्मिती करण्यास सुरवात होणार असते तेह्वा साठवलेले धरणातील पाणी प्रथम पेन स्टोक च्या मदतीने टरबाईन कडे सोडले जाते.

8. Tunnel (Water ways): बोगदा

The passage of flow water from dam is called Tunnel or intake. Water ways may be in the form of canal or tunnel or penstock. OR It is used to carry the water from water reservoir to surge tank.

9. Surge tank:

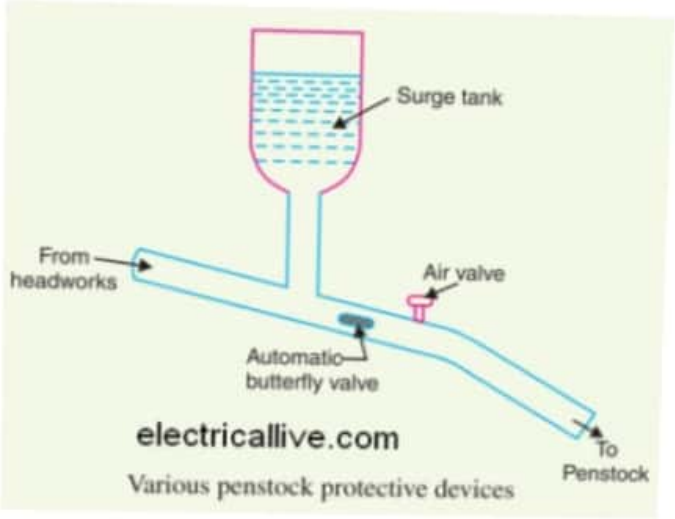


Fig: Surge Tank

It is a device which is connected in between dam & power house. It is of vertical type, at the time of starting of hydro-electric power plant, near power house valve is closed. Then water flows from dam towards turbine & filled the surge tank, after that valve is open either manually or automatically, water flow towards turbine when valves are open & turbine or prime mover starts to rotate. This sequence is follow to avoid or to prevent the turbines against water hammer effect.

10.Forebay:

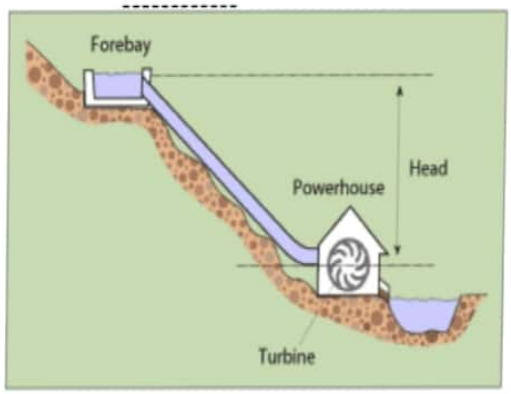


Fig: Forebay

Instead of surge tank some hydro-electric power plants used Forebay. The Forebay are useful as the surge due to change in load occurs. Forebay is an

enlarged body of water at the intake (dam) to store more quantity of water. It is nothing but regulating reservoir. Forebay is stores the rejected water as the load on the turbine decreases & supplies water immediately when load on turbine increases i.e. it is nothing but surge tank for small capacity hydro power station.

काही विद्युत निर्मिती केंद्रात सर्ज-टकी च्या ऐवजी फोर बे वापरले जाते. या विद्युत निर्मिती केंद्राची क्षमता थोडी कमी असते. यामध्ये सुरवातीलाच भरपूर प्रमाणात पाणी साठवले जाते. व ते पाणी वीज निर्मिती घर कडे सोडले जाते. पाणी चालू किवा बंद करणेसाठी व्हाल्व्ह वापरतात.

11.Valve house:

Fig: Valve used to ON/OFF water flow

It is installed near power house, its function is to start or stop the flow of water towards turbine.

व्हाल्व्ह हा पेन स्टोक वर बसवला जातो. याचा उपयोग पाणी चालू किवा बंद करणेसाठी केला जातो. व्हाल्व्ह हा स्वयंचलित किवा स्वतः हाताने चालू किवा बंद करता येतो.

12.Power House: वीज निर्मिती करणारे घर:

It is the main heart of hydro-electric power plant. Form the electrical engineers point of view. In Power house main function is to produce electrical power. For that purpose the turbine or prime mover is mechanically coupled with generator. The mechanical energy is converted into electrical energy through

generator or whenever turbine starts to rotate at higher speed the generator produces electrical power output.

यामध्ये टरबाईन आणि विद्युत ऊर्जा निर्माण करणारे जनित्र एकमेकास जोडले जाते. ज्यावेळी आपण टरबाईन वरती जास्त दाबाने पाणी सोडले जाईल तेव्हा टरबाईन व विद्युत ऊर्जा निर्माण करणारे जनित्र फिरण्यास चालू होतात व आपणास विद्य्युत ऊर्जा मिळते.

13.Prime Mover or Turbine:

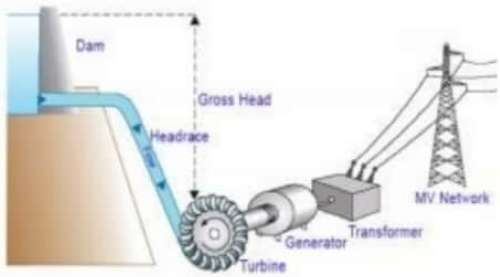


Fig: Prime Mover (Turbine) # Generator of HPP

Its main function is to take water from dam at high pressure & start to rotate. The prime mover or turbine converts kinetic energy of water into mechanical energy. In hydro-electric power plant depends upon head or height pelton wheel, Francis, Kaplan & Propeller types of turbines are used.

14.Draft tube:

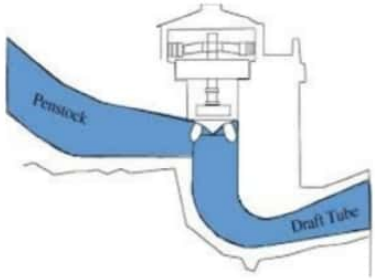


Fig: Draft Tube

It is used in hydro-electric power plant near the turbine. Its main function is to press the water & its pressure increases. Depends upon the type of turbine draft tube are required.

15.Generator:

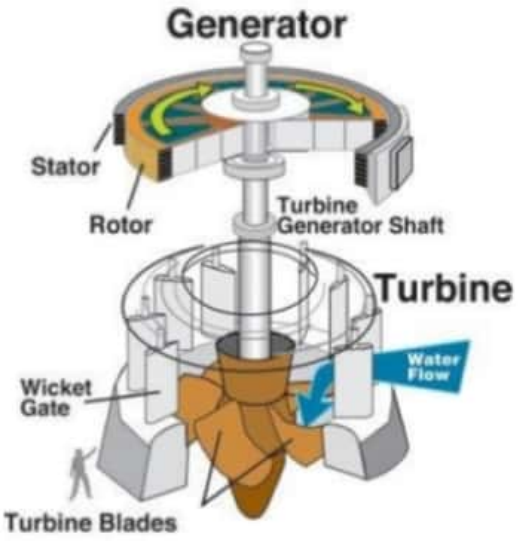
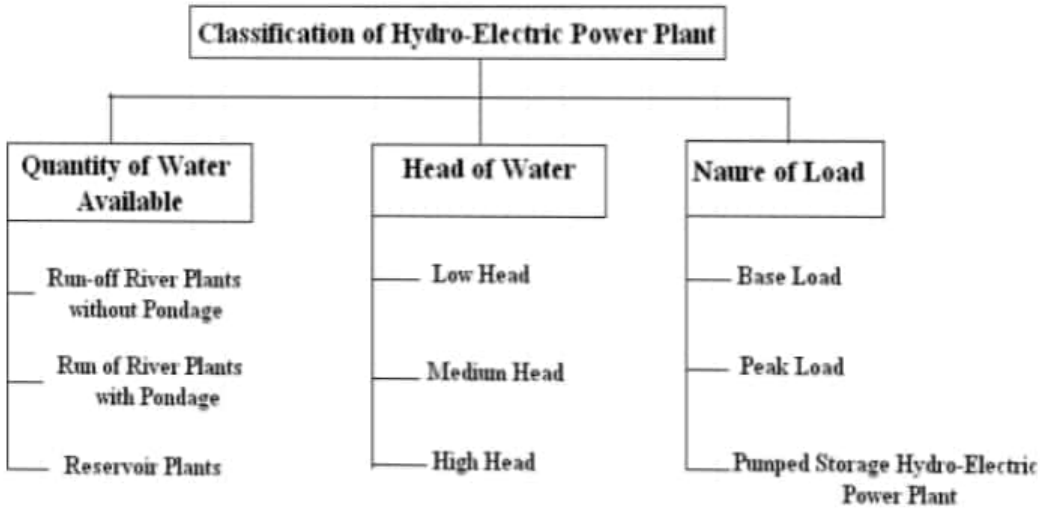


Fig: Turbine # Generator

It is used to convert the mechanical energy into electrical energy. For that purpose the turbine & generator are mechanically coupled.

8. Classification of Hydro-Electric Power Plant:



1. **Classification According to Quantity of Water Availabl**
    a. **Run of River Plants Without Pondage.**
    b. **Run of River Plants with Pondage.**
    c. **Reservoir Plants.**

6. Schematic arrangement of Hydro-Electric Power Plant:

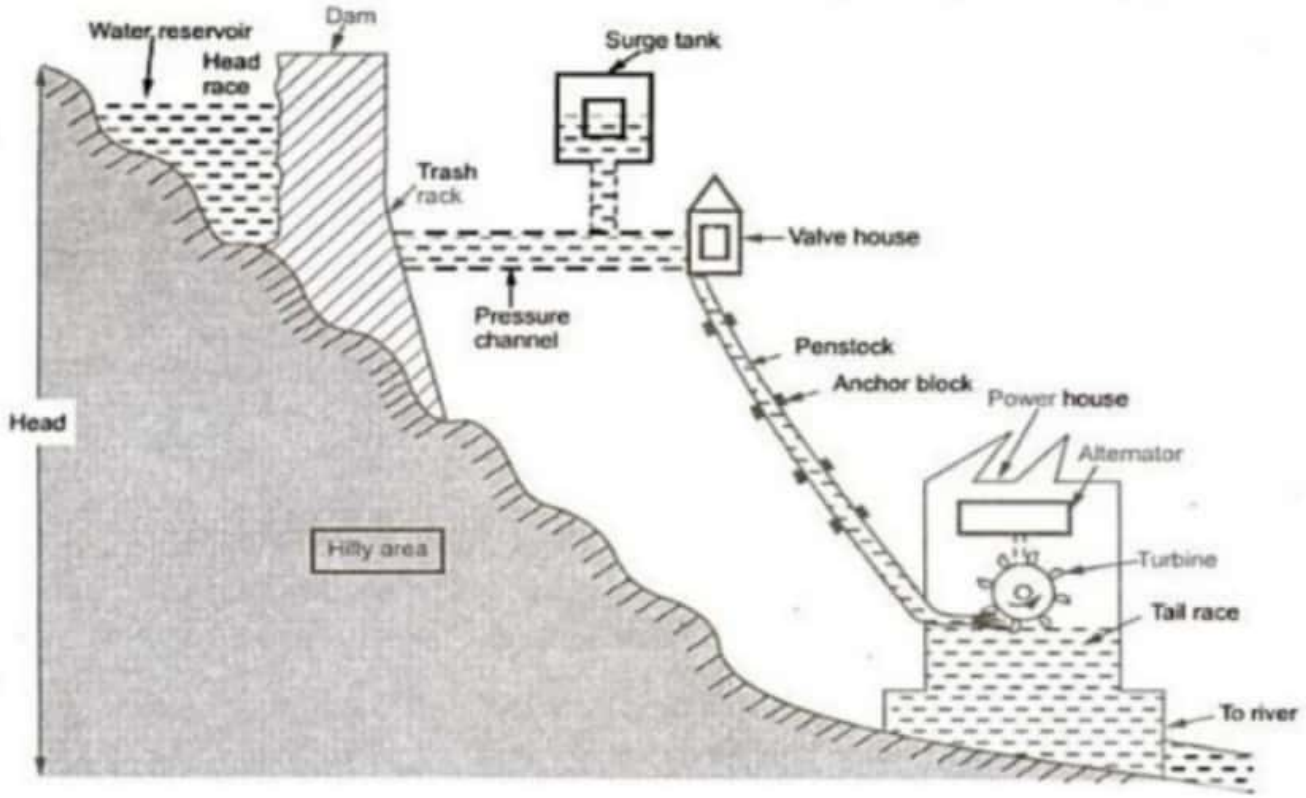
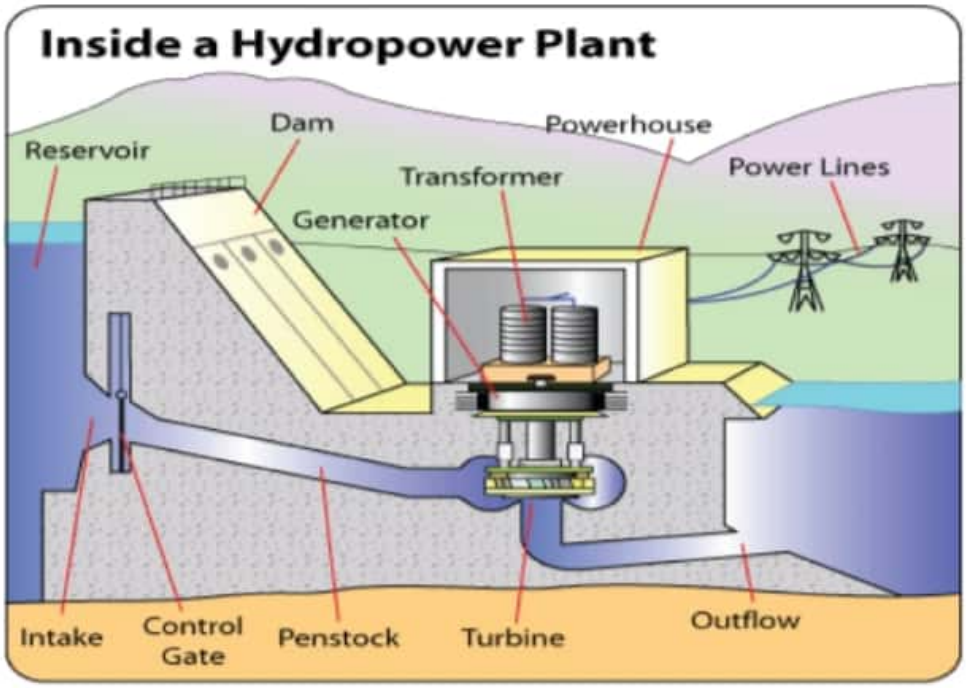


Fig: Hydro-Electric Power Plant



11. Advantages & Disadvantages of Hydro-Electric Power Plant:

Advantages:

1. There is no fuel cost as water is available in nature.
2. There is no fuel transportation cost.
3. There is no necessity of fuel & ash handling equipment.
4. There is no air pollution.
5. It is very neat & clean plant.
6. Operating & maintenance cost are very low.
7. H.P.P can be put into service immediately.
8. There are no standby losses.
9. Efficiency of plant is highest and does not change with age.
10. Power generation can be controlled quickly & rapidly without any difficult.
11. This plant is suitable for supplying power to variable load.
12. By controlling discharge of water precisely, constant speed & frequency can be maintained.
13. The life of plant is longest.
14. Generation cost per unit (KWH) is lowest.
15. In addition to generation of electric energy H.P.P. is also useful for supply of drinking water, supply of water for irrigation and control the flood.

Disadvantages:

1. High capital cost due to construction of dam.
2. It depends on nature as it require huge amount of water which is store during rainy season.
3. Firm power (Output) is totally depends on monsoon.
4. It takes long time for complete erecting of power plant.
5. It requires large area (catchment) area for storage of water.
6. As sites are away from load centre, so cost of transmission and losses in it are more.
7. There is limitation to select the site of HPP because of their requirements.