

5.3 HYDROELECTRIC POWER

Hydroelectric power, often simply called hydroelectricity, is electricity generated by the flow of water. It's one of the oldest and most widely used renewable energy sources, harnessing the energy of flowing water to generate electricity. Hydropower, or hydroelectric power, is one of the oldest and largest sources of renewable energy, which uses the natural flow of moving water to generate electricity. Hydropower currently accounts for 28.7% of total U.S. renewable electricity generation and about 6.2% of total U.S. electricity generation.

Here's how hydroelectric power works:

1. Hydropower Plants:

Hydroelectric power plants are typically constructed near rivers, dams, or other water sources with significant elevation changes.

2. Water Reservoir or Dam:

In a typical hydroelectric power plant, a dam is built to create a reservoir, or artificial lake, by impounding water from a river. The dam controls the flow of water, allowing it to be released in controlled amounts.

3. Penstock:

The water from the reservoir is channeled through large pipes called penstocks, which lead to turbines located inside the power plant.

4. Turbines:

As the water flows through the penstock, it strikes the blades of the turbines, causing them to rotate.

5. Generator:

The rotating turbines are connected to generators, which convert mechanical energy into electrical energy through electromagnetic induction.

6. Electricity Generation:

The electricity generated by the turbines is transmitted through power lines to homes, businesses, and industries for various uses.

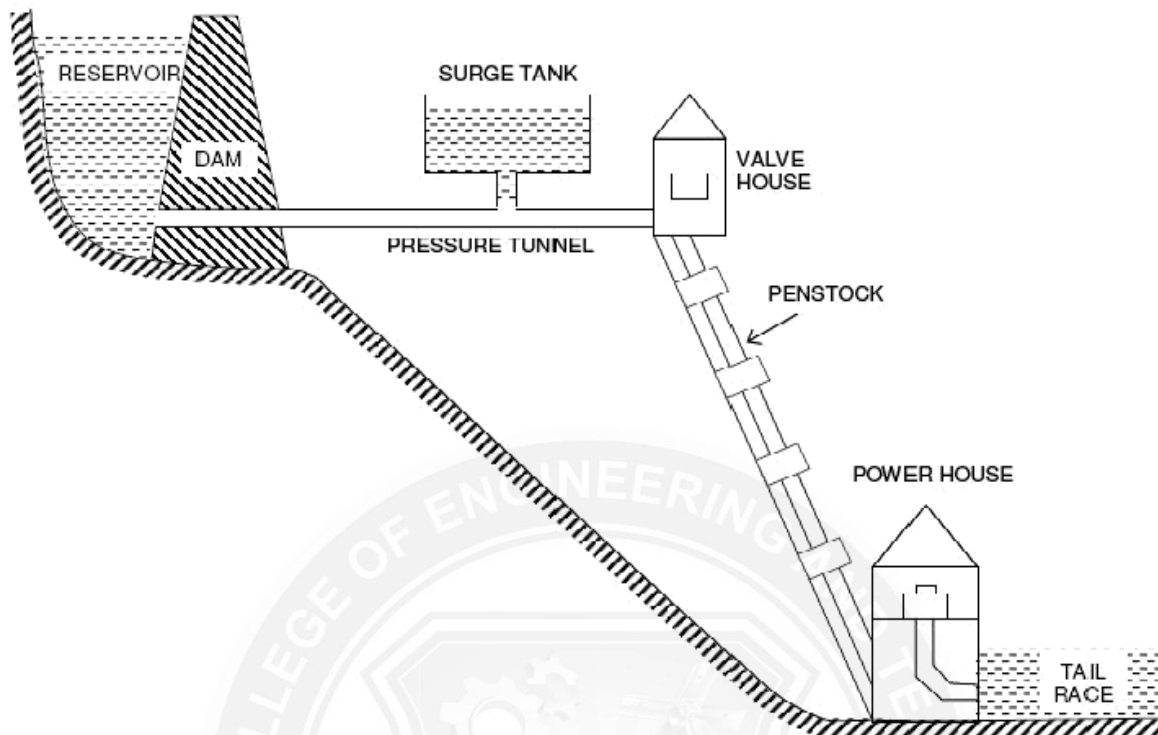


FIG.5.3.1 LAYOUT OF HYDROELECTRIC POWER

Hydroelectricity

Hydroelectricity refers to the generation of electrical power by the use of hydropower. Hydropower here mainly is the gravitational force of falling water. This does not use any water in energy production. In the previous article on the Thermal power plants, you learned that steam was causing the movement in the turbines. Here the flow of the water from a height causes the rotation in the turbines, but more on that later. Coming back to hydroelectricity, it is the most widely used form of renewable energy accounting for 3% of the world's total energy consumption. The cost of hydroelectricity is relatively low, giving it a competitive edge as a source of energy. The average cost of electricity for a large hydropower plant is very low. Energy production is dependent on the amount of water that is let out since this can be controlled, hydropower plants have the advantage of being flexible. The output can be controlled as required by the need.

Hydro Power Plant

Hydroelectricity is produced by utilising the gravitational force of falling water. To this end, the hydropower plant requires a dam. This dam is placed on a source of water, preferably a river. The dam is a massive wall that blocks the flow of the river, therefore, a lot

of water collects behind the dam. Near the bottom of the dam, there is an intake from which the water is let into the dam. This intake leads to a drop through the penstock inside the dam. The device used to obtain energy from the falling water here is a turbine. Thermal power plants also use turbines but there are some major differences between the steam turbines and hydro turbines. The turbine is connected by a shaft to the generator. When the water rotates the turbine, electrical energy is generated.

Hydropower plants also have a facility of pumped storage wherein water is kept as a reserve for periods of peak power demand. This is the hydroelectric equivalent of recharging your battery. When the power demand is low, say in the middle of the night, the dam uses a pump to pump the water back up to the reservoir behind it. This water is then used during times of peak power demands.

Hydroelectric power offers several advantages:

1. Renewable:

Hydroelectricity is renewable because it relies on the natural water cycle, which is continuously replenished by rainfall and snowmelt.

2. Clean Energy:

Hydroelectric power is considered a clean energy source because it produces minimal greenhouse gas emissions and air pollutants compared to fossil fuels.

3. Reliable:

Hydroelectric power plants can provide a steady and reliable source of electricity, as long as there is a consistent supply of water.

4. Flexible:

Hydroelectric power plants can quickly adjust their output to meet changes in electricity demand, making them suitable for both base-load and peak-load power generation.

5. Water Management:

Hydroelectric dams can also provide benefits such as flood control, irrigation, and water supply for drinking and agriculture.

However, hydroelectric power also has some drawbacks and considerations, including environmental impacts such as habitat disruption, alteration of river ecosystems, and displacement of communities due to dam construction. Additionally, the feasibility of hydroelectric projects depends on factors such as water availability, topography, and regulatory considerations. Nonetheless, hydroelectric power remains an important and widely used renewable energy source worldwide.

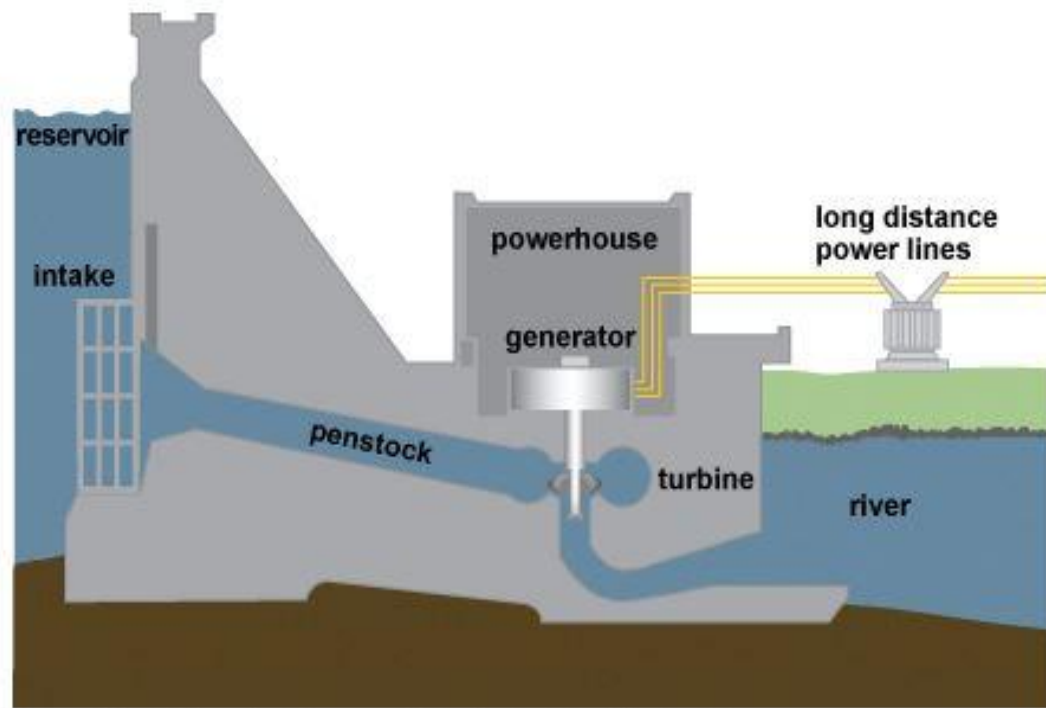


FIG.5.3.2 HYDROELECTRIC POWER

Hydroelectricity Verdict

The production capacity of a dam is dependent on the water supply available. Once constructed, a hydropower plant will be operational for decades and provided its water sources don't run out, it can produce electricity at a constant rate. As mentioned earlier, the output can be easily controlled. The reservoir that forms behind the dam can be used for irrigation or for leisure purposes. Also, once the construction is completed, there is a negligible amount of greenhouse gas emission.

Dams also have a couple of problems, though. Dams are very expensive to build and to last decades, they must be built to a high standard. Also in the case of dam breaches, the runaway water will cause significant flooding in the downstream regions. Also, the creation

of a reservoir causes a massive tract of land to get submerged. This area is lost and people living in such areas are displaced. Sometimes they are compensated, sometimes not. This creates a lot of tension between the construction and the affected people. Also, the construction of a dam blocks the natural flow of water and severely reduces the flow downstream. Such situations can cause disputes between neighbouring countries and even neighbouring states such as Karnataka and Tamil Nadu.

ADVANTAGES OF HYDROELECTRIC ENERGY

1. Electricity can be produced at a constant rate once the dam is constructed
2. The gates of the dam can be shut down if electricity is not needed, which stops electricity generation. Hence by doing this, we can save water for further use in future when the demand for electricity is high.
3. One of the biggest advantages of hydroelectric power plants is that they are designed to last many decades, and so they can contribute to the generation of electricity for years.
4. Large dams often become tourist attractions because the lake that forms in the reservoir area behind the dam can be used for leisure or water sports.
5. The water from the lake of the dam can be used for irrigation purposes in farming.
6. Since the water is released to produce electricity, the build-up of water in the dam is stored to produce extra energy until needed.
7. Hydroelectric energy generation does not pollute the atmosphere because the hydroelectric power plant does not produce greenhouse gases.
8. Hydropower plants can be considered a reliable energy generation source. Since hydropower totally depends on water present on this planet, this energy source will remain inexhaustible because of the water cycle as it continuously keeps on maintaining balance on the Earth.

DISADVANTAGES OF HYDROELECTRIC ENERGY

1. It is not an easy task to assemble a hydropower plant because the dams are extremely expensive to build, and they require extremely high standards and calculations for their construction.

2. It becomes important that the hydropower plant must serve for many decades because of its high cost of construction, and this totally depends on the availability of water resources.
3. If flooding happens due to natural calamities or the failure of dams, it would impact a large area of land, which means that the natural environment can be destroyed.
4. People are forcibly removed from the particular area where a hydropower plant is going to be assembled. This affects the day-to-day life of people living in that area.
5. A serious geological damage can be caused due to the construction of large dams.
6. To construct a hydro plant, it is important to block the running water source due to which the fishes can't arrive at their favourable place, and as the water stops streaming, the areas along the riverside start to vanish out which eventually influences the life of creatures that depend on fish for food.

