"Hydro Hydraulic Power Generation "

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Abstract

The Aim of this thesis is to develop a System of Energy Generation with the use of Hydro Power Plant. The theory shows us a innovative development that could be happened with a wide approach towards existing technology. Here, we do have receive a good idea that could modifically utilize the Hydro Plant associatively for Power Generation.

By using the available resources to make innovative Contributions and influence for the green energy. Showing the Significance of this Study by informing our theoretical understanding for the Project. The Hydro Hydraulic Power Generation is a Conceptually developed system that can be used to generate electricity from the water flowing in Tailrace of Hydropower Plant .

It will associately work with the pre existing hydro plant to effectively reutilize the kinetic power from hydro plant water flowing in the Tailrace. This concept will generate ample amount of electricity along side the hydro. Which then be synchronize at Control Tower of Hydro plant and then transmitted as per need.

1. Introduction

The water of the oceans and water bodies on land are evaporated by the energy of the sun's heat and gets transported as clouds to different parts of the earth. The clouds travelling over land and falling as rain on earth produces flows in the rivers which returns back to the sea. The water of rivers and streams, while flowing down from places of higher elevations to those with lower elevations, loose their potential energy and gain kinetic energy. The energy is quite high in many rivers which have caused them to etch their own path on the earth's surface through millions of years of continuous erosion. In almost every river, the energy still continues to deepen the channels and migrate by cutting the banks, though the extent of morphological changes vary from river to river. Much of the energy of a river's flowing water gets dissipated due to friction encountered with its banks or through loss of energy through internal turbulence. Nevertheless, the energy of water always gets replenished by the solar energy which is responsible for the eternal circulation of the Hydrologic Cycle.

Hydropower engineering tries to tap this vast amount of energy available in the flowing water on the earth's surface and convert that to electricity. There is another form of water energy that is used for hydropower development: the variation of the ocean water with time due to the moon's pull, which is termed as the tide. Hence, hydropower engineering deals with mostly two forms of energy and suggest methods for converting the energy of water into electric energy. In nature, a flowing stream of water dissipates throughout the length of the watercourse and is of little use for power generation. To make the flowing water do work usefully for some purpose like power generation (it has been used to drive water wheels to grind grains at many hilly regions for years), it is necessary to create a head at a point of the stream and to convey the water through the head to the turbines which will transform the energy of the water into mechanical energy to be further converted to electrical energy by generators. The necessary head can be created in different ways of which two have been practically accepted.

The Hydro Hydraulic Power Generation is a Conceptually developed system that can be used to generate electricity from the water flowing in Tailrace of Hydropower Plant .

It will associately work with the pre existing hydro plant to effectively reutilize the kinetic power from hydro plant water flowing in the Tailrace. This concept will generate ample amount of electricity along side the hydro. Which then be synchronize at Control Tower of Hydro plant and then transmitted as per need.

2.Construction and Components

2.1 Construction :-

The Hydro Hydraulic Power Generation is a Conceptually developed system that generates electricity from flowing water coming out of the Hydro Power plant in the Tailrace area. It consists of a interconnected component system that generates electricity when the water flows over the tile arrangement sheets compressing it up and down with the flow of water.

The sheets design made in such a way that , when water strikes on the one of the sheets then they compressed alternatively making the pressure to create energy. And then again the back-flow lifts up the compressed sheets and the uncompressed sheet get compressed. This making the up-down of sheets in a arranged manner so that continuous generation carry on.

When we are imposing this mechanism system that time we have to take in consideration some of the structural views. So that whenever we are arranging it that time it must have a simple base Structure on which these are placed mechanically and in the renovating or maintenance point of view which makes it easier.

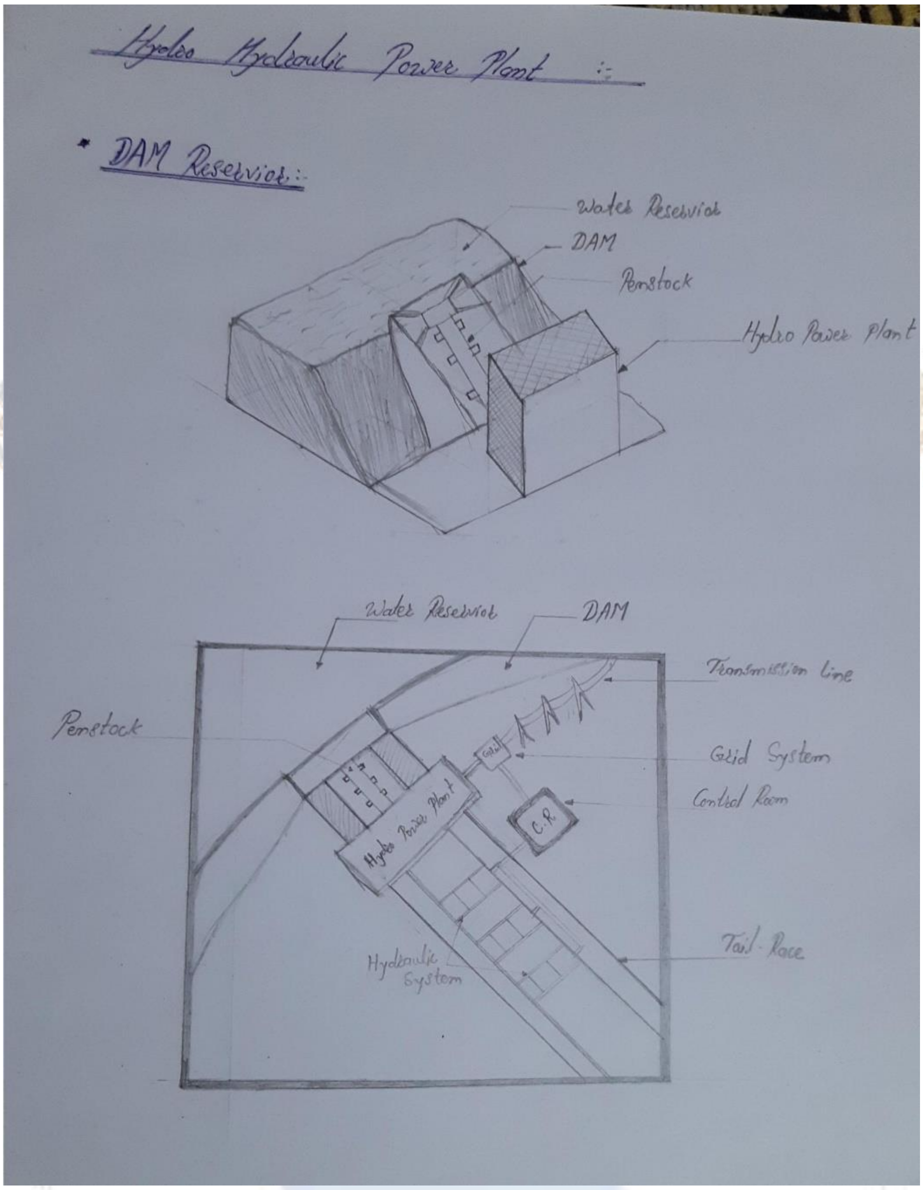

Fig. 2.1.1 Hydro Hydraulic Power Generation

2.2 Components :-

The Hydro Hydraulic Power Generation Generation is a Close loop System that consists of numerous components having a specific purpose for the complete operation. These are more effectively explained below.

2.2.1 Tile Arrangements :-

Tile Arrangements are the group of sheets that are placed on Structural base constructed in the Tailrace. Which are been attached to the hydraulic piston of the mechanism. The basic function of the Tile arrangement is that to be point of contact between the water flow and power generation system. It mainly consists of no. Of Compressible sheet aligned in a specific way and no. of Oil duct channels to circulate Compressible oil flow.

The Tiles or Sheets would have a interlocking mechanism that helps for better operating. Duct lines system has to be mechanized in a way that it will not allow the back flow of oil and on the other hand it has to add collective oil pressure inside.

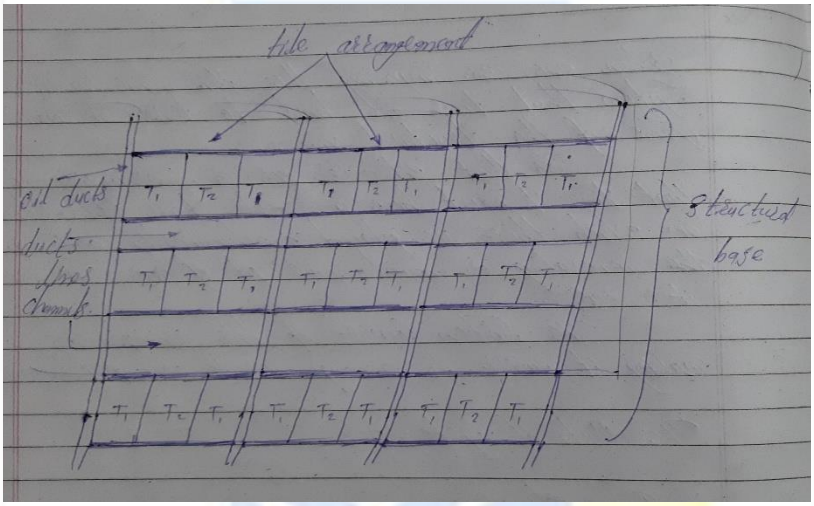

Fig. 2.2.1.1 Tile Arrangements diagram

Oil Ducts:-

The Oil duct is a combination of multiple channels thst is used to circulate the pressurized oil to accumulator and carry on to the other parts of the system and back again. With a complex mechanical arrangement.

Damage Prevention :-

The thing that has to take under Consideration is that, we have to make a primary protection covering for the tile arrangement in order to prevent it from a any debris which could be a potential danger, trees, rocks, fishes, etc. Just similar to that a cage structure from the upper side for its protection without affecting its reliability.

Factors to be Considered:--

- Width of the sheet and its size.
- Interchanging, Alternative Sheet movement.
- Compressing and Uplifting angles.
- Horizontal and Vertical Oil Ducts

2.2.2 Hydraulic Piston:-

The hydraulic cylinder consists of a cylinder barrel, in which a piston connected to a piston rod moves back and forth. ... The piston has sliding rings and seals. The piston divides the inside of the cylinder into two chambers, the bottom chamber (cap end) and the piston rod side chamber (rod end/head-end).

Operation

Hydraulic cylinders get their power from pressurized hydraulic fluid, which is typically oil. The hydraulic cylinder consists of a cylinder barrel, in which a piston connected to a piston rod moves back and forth. The barrel is closed on one end by the cylinder bottom (also called the cap) and the other end by the cylinder head (also called the gland) where the piston rod comes out of the cylinder. The piston has sliding rings and seals. The piston divides the inside of the cylinder into two chambers, the bottom chamber (cap end) and the piston rod side chamber (rod end/head-end).

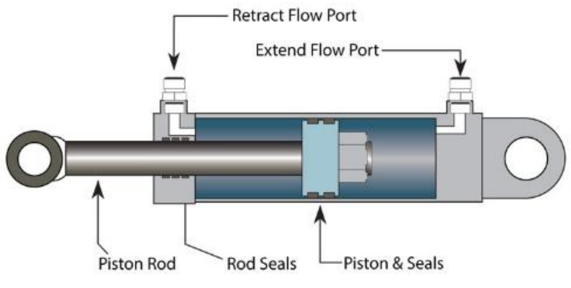

Fig.2.2.2.1 Schematic Diagram of Hydraulic piston

Fig. 2.2.2.2 Hydraulic Piston

2.2.3 Accumulator :-

Accumulator is a pressure vessel for storing hydraulic pressure in it utilizing compressible and decompressible nature of nitrogen gas. So, it can be said that the accumulator has a similar function to the rechargeable electrical battery.

In electricity, electrical energy is stored to the battery. On the other hand, in the hydraulic field, fluid energy (pressure of the fluid) is stored in an accumulator and is discharged when required.

Operation

- Utilizing the compressibility of gas and non-compressibility of fluid (mainly oil), fluid energy is stored in or discharged out of the accumulator.
- Working as a separater, the bladder separates the gas from the fluid.
- The gas (Nitrogen, by all means) shall be charged in the accumulator (bladder).
- When the fluid flows in to the accumulator, the precharged nitrogen gas is compressed. And, as much as the nitrogen gas is compressed, the fluid is stored in the accumulator.
- Thus the fluid is stored in the accumulator as "fluid with energy", and the stored fluid is discharged out of the accumulator to let it do powerful job when necessary.

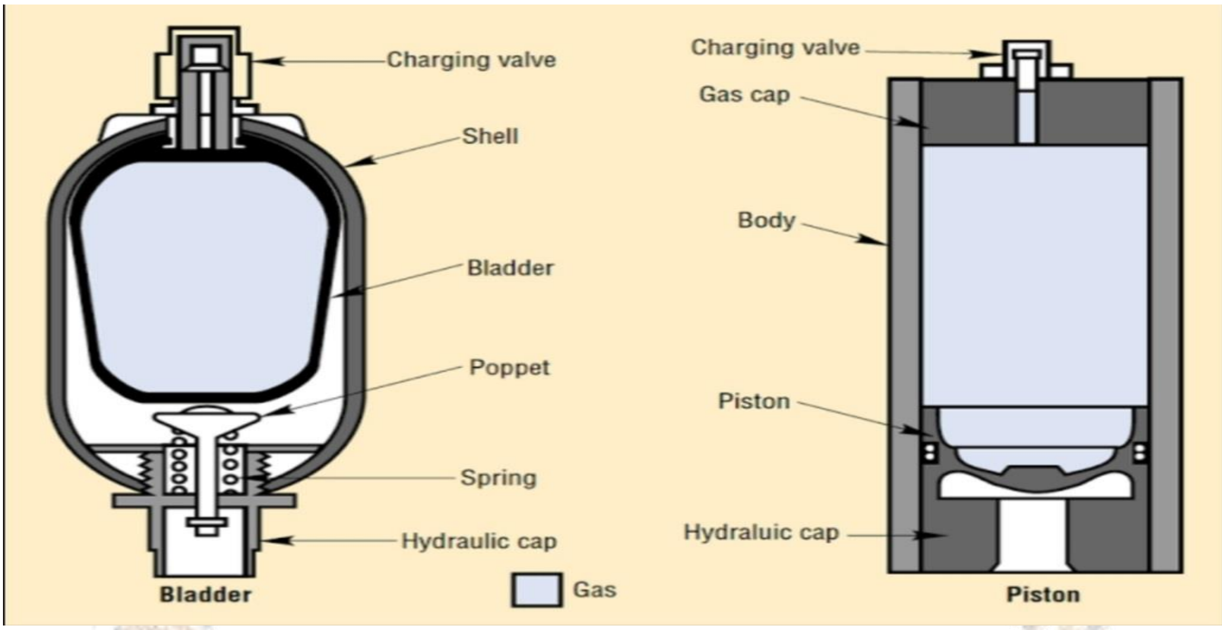

Fig. 2.2.3.1 Schematic Diagram of Accumulator

Uses and Applications

Accumulators usually are installed in hydraulic systems to store energy and to smooth out pulsations. Typically, a hydraulic system with an accumulator can use a smaller pump because the accumulator stores energy from the pump during periods of low demand. This energy is available for instantaneous use, released upon demand at a rate many times greater than what could be supplied by the pump alone.

Accumulators also can act as surge or pulsation absorbers, much as an air dome is used on pulsating piston or rotary pumps. Accumulators will cushion hydraulic hammer, reducing shocks caused by rapid operation or sudden starting and stopping of power cylinders in a hydraulic circuit.

Types of Accumulators

There are four principal types of accumulators: the weight-loaded piston type, diaphragm (or bladder) type, spring type, and the hydro-pneumatic piston type. The weight-loaded type was the first used, but is much larger and heavier for its capacity than the modern piston and bladder types. Both weighted and spring types are infrequently found today. Hydro-pneumatic accumulators, are the type most commonly used in industry

Fig 2.2.3.2 Hydraulic Accumulators

2.2.4 Hydraulic Motor

A hydraulic motor is a mechanical actuator that converts hydraulic pressure and flow into torque and angular displacement (rotation). The hydraulic motor is the rotary counterpart of the hydraulic cylinder as a linear actuator. Most broadly, the category of devices called hydraulic motors has sometimes included those that run on hydropower (namely, water engines and water motors) but in today's terminology the name usually refers more specifically to motors that use hydraulic fluid as part of closed hydraulic circuits in modern hydraulic machinery.

Conceptually, a hydraulic motor should be interchangeable with a hydraulic pump because it performs the opposite function - similar to the way a DC electric motor is theoretically interchangeable with a DC electrical generator. However, many hydraulic pumps cannot be used as hydraulic motors because they cannot be backdriven. Also, a hydraulic motor is usually designed for working pressure at both sides of the motor, whereas most hydraulic pumps rely on low pressure provided from the reservoir at the input side and would leak fluid when abused as a motor.

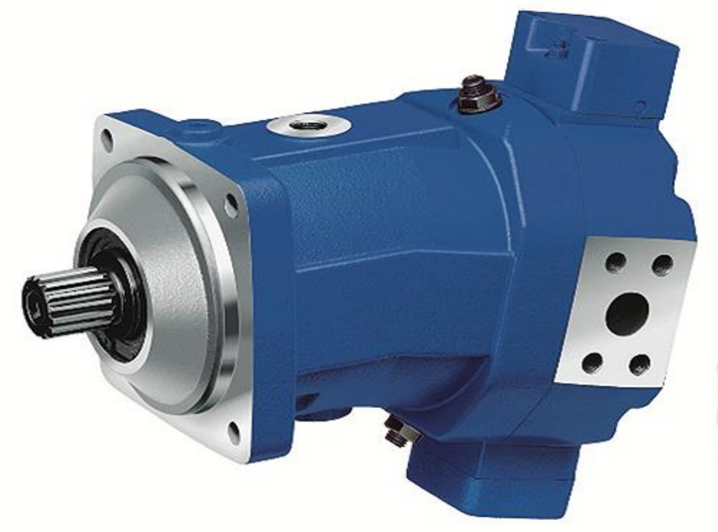

Fig. 2.2.4.1 Hydraulic Motor

Uses and Applications

Hydraulic pumps, motors, and cylinders can be combined into hydraulic drive systems. One or more hydraulic pumps, coupled to one or more hydraulic motors, constitute a hydraulic transmission.

Hydraulic motors are used for many applications now such as winches and crane drives, wheel motors for military vehicles, self-driven cranes, excavators, conveyor and feeder drives, cooling fan drives, mixer and agitator drives, roll mills, drum drives for digesters, trommels and kilns, shredders, drilling rigs, trench cutters, high-powered lawn trimmers, and plastic injection machines. Hydraulic motors are also used in heat transfer applications.

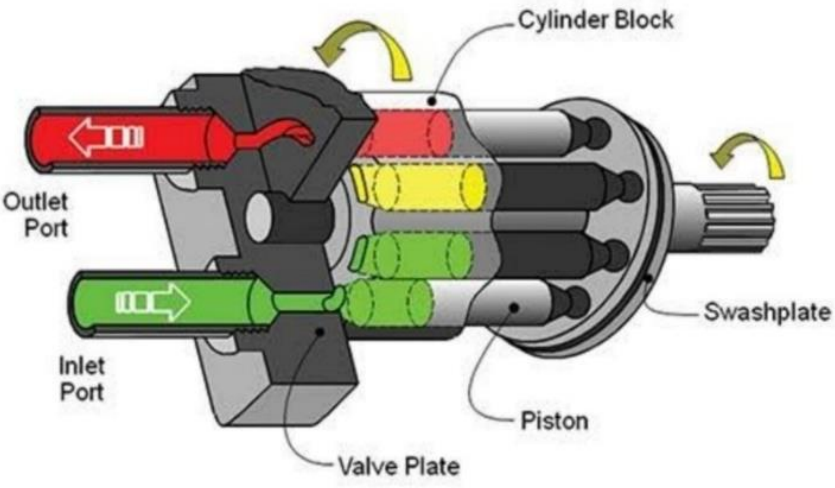

Fig.2 2.4.2 Schematic Diagram of Hydraulic Motor

Types of Hydraulic Motor

There are three types of hydraulic motors: gear, piston, and vane. Gear motors are compact and provide continuous service at rated power levels with moderate efficiency. They have a high tolerance for contamination of the hydraulic oil which is a consideration for applications in dirty environments.

2.2.5 Generator

A hydraulic generator uses a hydraulic motor to replace the large, heavy, gas or diesel motor found on traditional generators. On average a hydraulic generator is 50% lighter and smaller; it's quieter, more reliable, virtually maintenance-free and there's no pollution or carbon exhaust.

Using the existing on-board power train, energy is transferred to the hydraulic generator through the hydraulic fluid. Because it's not limited by big diesel or gas engines, drive shafts or drive belts, you can put the hydraulic generator anywhere.

Fig. 2.2.5.1 Hydraulic Generator

A hydraulic generator transforms the hydraulic power of a working machine into high-quality electricity with great efficiency. The electricity is suitable for all-electric equipment from small devices to heavy work tools

2.2.6 Hydraulic Fluid Tank

When it comes to reservoir design, bigger is not necessarily better. In fact, the trend is to provide smaller reservoirs.

In addition to holding in reserve enough fluid to supply a hydraulic system's varying needs, a reservoir, a large surface area to transfer heat from the fluid to the surrounding environment

enough volume to let returning fluid slow down from a high entrance velocity. This lets heavier contaminants settle and entrained air escape a physical barrier (baffle) that separates fluid entering the reservoir from fluid entering the pump suction line air space above the fluid to accept air that bubbles out of the fluid access to remove used fluid and contaminants from the system and to add new fluid space for hot-fluid expansion, gravity drain-back from a system during shutdown, and storage of large volumes needed intermittently during peak periods of an operating cycle, and a convenient surface to mount other system components, if practical.

Shape and construction

There is no standard reservoir shape. Geometrically, a square or a rectangular prism has the largest heat-transfer surface per unit volume. A cylindrical shape, on the other hand, may be more economical to fabricate. If the reservoir is shallow, wide, and long, it may take up more floor space than necessary and does not take full advantage of the heat-transfer surface of the walls.

Theoretically, because heat rises, the reservoir top holds the greatest potential for heat transfer to the atmosphere. However, in particularly dirty environments, contaminants often collect on the reservoir top and act as insulation. This reduces the effective heat transfer from the top of the reservoir, so reservoir sides could actually be the most effective heat transfer area in some instances. On the other hand, a tall and narrow geometry conserves floor space and provides a large surface area for heat transfer from the sides. Depending on the application, however, this shape may not provide enough area at the top surface of the fluid to let air escape.

The reservoir should be strong and rigid enough to allow lifting and moving while full. Appropriate lift rings, lugs, or forklift provisions should be included.

Operation

- Reservoir accessories are used for:
- Straining new fluid as it enters a system
- Filtering air drawn into the reservoir as hydraulic fluid level rises and falls during system operation
- Indicating fluid level in the reservoir
- Indicating fluid temperature
- Routing return fluid to minimize potential pump cavitation and improve heat transfer
- Heating cold or low-viscosity fluids to necessary operating temperature, and
- Removing ferrous contaminant particles from the fluid.

Fig 2.2.6.1 Hydraulic Fluid Tank

3.Requirements

There are some basic requirements which came under consideration at the time of project setting, they are as follows.

1.Site Selection

The kinetic energy of water utilizes for hydropower plants. A life of hydropower plants is higher compared to the thermal and nuclear plant. But the installation cost and time are higher. This type of generating stations use to supply electricity where a continuous source of water is available. However, this type of plants cannot install anywhere.

Following factors must be consider while selecting the site of the hydro generating station.

1) The quantity of water available

On the basis of measurements of stream flow, the quantity of water is estimated. In this estimation, also consider the previous record of rainfall, the maximum and minimum quantity of water available throughout the year and losses due to evaporation and percolation. Therefore, the net volume of water available for power generation can be determined.

2) Storage of water

The storage capacity of water can be calculate from the mass curve. During the year, wide variation in rainfall occurs. Hence, It makes necessary to store water for continuous generation of power throughout the year.

3) Head of water

The water head depends on the topology of the area. The head of water has a considerable effect on the cost and economy of power generation. Low falls on the unregulated flow of water are uneconomical for power generation. So, it is necessary to choose a site with a high head of water.

4) The distance of power station site from load centers

If the load center is far from the power station, it will increase the cost of the transmission line. The losses occur in the transmission line increase the cost. Therefore, the site for hydropower plant choose near the load center.

5) Accessibility of the site

The site is easily accessible by rail and by road. So, it is easy for the transportation.

6) Water pollution

Polluted water may damage the blade of the turbine by corrosion. Hence, this led to the unreliable operation of the plant. Therefore, it is necessary that the quality of water is good.

7) Geological investigation

It is necessary to choose a place which can withstand the water thrust and other stress. The construction of the plant is strong and stable. This construction can withstand natural calamities like thunderstorm, earthquake, etc.

8) Environmental effect

The place chooses that is free from hazards and chemical effects .So, these are the factors which must be consider while selecting the site of hydropower plant.

2.Material Selection

The major components of a hydroelectric plant are a river, dam, turbine, generator, and power cables. And being associated with it Hydro Hydraulic Power Generation also possess the same criteria. All the components work together to generate electricity. A river that typically has a large drop in elevation at some point is ideal for a hydroelectric plant.

Different techniques of MCDM were used to select the best penstock material for hydropower plants, where four alternatives, namely, polyvinyl chloride (PVC), high-density polyethylene (HDPE), glass-reinforced polymer (GRP) and mild steel (MS), were considered, along with five attributes (yield strength, life, thickness, cost of material and maintenance cost), in the study.

3. Storage units and Distribution

Pumped-storage hydroelectricity (PSH), or pumped hydroelectric energy storage (PHES), is a type of hydroelectric energy storage used by electric power systems for load balancing. The method stores energy in the form of gravitational potential energy of water, pumped from a lower elevation reservoir to a higher elevation. Low-cost surplus off-peak electric power is typically used to run the pumps. During periods of high electrical demand, the stored water is released through turbines to produce electric power.

the upper lake collects significant rainfall or is fed by a river then the plant may be a net energy producer in the manner of a traditional hydroelectric plant.

The reservoirs used with pumped storage are quite small when compared to conventional hydroelectric dams of similar power capacity.

The main disadvantage of PSH is the specialist nature of the site required, needing both geographical height and water availability. Suitable sites are therefore likely to be in hilly or mountainous regions, and potentially in areas of natural beauty, making PSH susceptible to social and ecological issues.

4. Labors Requirement

The scope of labors and working conditions assessment and management includes human resources policies, staff and workforce planning, occupational health and safety, equal opportunity, staff development and training, and grievance and bargaining mechanisms.

For the projects at the preparation stage, assessments should establish compliance requirements for the labors force, identify any risks or challenges that have arisen in relation to the project location, and inform the development of labors policies, plans and procedures. At the implementation stage, the focus should be on construction-related activities and implementation plans. At the operations stage, labors and work conditions issues will be centered on operation and maintenance of assets, monitoring and implementation of plans and programmers, and a diversity of corporate activities.

4.Advantages and Disadvantages

As being associated with Hydropower generation the Hydro Hydraulic Power relates with it. While hydroelectric energy provides the world with clean energy, there are some problems with it. Today, we will examine the advantages and disadvantages of hydropower.

Hydroelectric energy is the most commonly used renewable energy source in the world. According to the 2019 Hydropower Status Report, hydroelectricity gave us a whopping 21.8 GW of energy and grew by 9% over the year.

Advantages of Hydroelectric Energy

1. Renewable

Hydro-Hydrolic power is completely renewable, which means it will never run out unless the water stops flowing. As a result, hydro plants are built to last. In some cases, equipment that was built to last 25 years is still operational after double the amount of time has passed.

2. Emission Free

The creation of hydroelectricity does not release emissions into the atmosphere. This is, of course, the biggest appeal of any renewable energy source.

3. Reliable

Hydropower is, by far, the most reliable renewable energy available in the world. Unlike when the sun goes down or when the wind dies down, water usually has a constant and steady flow 24/7.

4. Adjustable

Since hydropower is so reliable, hydro plants can actually adjust the flow of water. This allows the plant to produce more energy when it is required or reduce the energy output when it is not needed. This is something that no other renewable energy source can do.

Disadvantages of Hydroelectric Energy

1. Impact on Fish

To create a hydro plant, a running water source must be dammed. This prevents fish from reaching their breeding ground, which in turn affects any animal that relies on those fish for food.

As the water stops flowing, riverside habitats begin to disappear. This can even remove animals from accessing water.

2. Limited Plant Locations

While hydropower is renewable, there are limited places in the world that are suitable for plant construction. On top of this, some of these places are not close to major cities that could fully benefit from the energy.

3. Higher initial Costs

While no power plant is easy to build, hydro plants do require you to build a dam to stop running water. As a result, they cost more than similarly sized fossil fuel plants.

Although, they will not need to worry about purchasing fuel later on. So it does even out over the long-term.

4. Carbon and Methane Emissions

While the actual electricity generation in the plant does not produce emissions, there are emissions from the reservoirs they create. Plants that are at the bottom of a reservoir begin to decompose. And when plants die, they release large quantities of carbon and methane.

5. Susceptible to Droughts

While Hydropower is the most reliable renewable energy available, it is dependent on the amount of water in any given location. Thus, the performance of a hydro plant could be significantly affected by a drought. And as climate change continues to heat up or planet, this could become more common.

And so that of Hydro Hydraulic Power Generation.

5.Research and Development

The Hydro Hydraulic Power Generation is a Conceptually developed system that can be used to generate electricity from the water flowing in Tailrace of Hydropower Plant . It will particularly use the kinetic energy of the flowing water and provide energy. Basically it is not a well checked, well developed system but the conceptual arrangement shows a signs to generate electricity. Inspired from the Eco Wave power the mechanism of this system nearly similar .

Here, their isn't a well developed and well checked infrastructure module available. So that we do have make a lot Research in the development for the infrastructure base formation that will withstand the Sheet or tile structure in the Tailrace's flowing water. Throughout all the associated information is collected from the available resources from various fields of hydropower plants and the industrial components from the current market.

So that there is a lot of potential in the Hydro Hydraulic Power Generation that will use to generate electricity from the water flowing in Tailrace. This will simultaneously able to build a system that generates power in an innovative way to use already available source without investing a lot. With the current technology and another furthermore research there are a lot of opportunities here to inhance the existing techniques.

6. Future Scopes

As of now, hydropower is now regarded as important as coal and natural gas. What's more, hydropower dams are the future of mass production of electricity. Several countries have invested billions of dollars to upgrade dams and use them for power generation. According to Allied Market Research, the global hydropower generation market is expected to reach $317.8 billion by 2027, growing at a CAGR of 5.9% from 2020 to 2027. The surge in demand for electricity and inclination toward clean energy have boosted the market growth.

However, the annual growth of hydropower generation has reduced over the past few years, due to reconsideration of other renewable sources such as wind and solar as they have fewer impacts on the environment. However, the power generation from water reservoirs is still the most economical and reliable source of energy production.

Hydropower is regarded as a big battery of the nation where you can store power in the form of water so that for Hydro Hydraulic Power Generation as well .Today, energy from the river is responsible for one-fifth of the world's electricity generation, and in the future, it is projected to increase. While wind and solar power are gaining importance, the cost of hydropower generation is still lower.

Hydropower is key to fulfil India’s renewable enrgy ambitions for electricity generations. But contractual conflicts, environmental concerns and financial constraints play spoilsport

On April 5, 2020, India carried a nine-minute-long electricity experiment to express solidarity and combat Covid-19. Hydropower heralded its heroic capacity to manage the safety and stability of the nationwide electricity grid system despite an unexpected load depression of about 31,089 MW. Hydropower is clean and cheap in long run. It has features like quick ramping, black start and reactive absorption — required for ideal peaking power or spinning reserve.

India is committed to have 40 per cent of its installed capacity from non-fossil fuel sources by 2030, and is pursuing a renewable target of 175 GW by 2022 and 450 GW by 2030. Therefore, hydropower is highly relevant for grid integration of renewable energy and for balancing infirmities.

Project status

India has an estimated hydropower potential of 1,45,320 MW, excluding small hydro projects (SHPs). At the end of February 2020, installed capacity was about 45,700 MW. Several hydroelectric projects (HEPs) in India are languishing due to contractual conflicts, environmental litigations, local disturbances, financial stress and unwilling purchasers. Only about 10,000 MW of hydropower could be added over the last 10 years. In a bold move, the Government of India accorded renewable energy (RE) status to large HEPs in March 2019, enabling new HEPs to receive concessions and green financing available to RE projects. Courtesy the Draft Electricity (Amendment) Bill 2020, hydropower purchase obligation (HPO) may appear to become a reality soon. However, a better option is re-engineering of the power market to treat hydropower as a peaking and grid-balancing power, and also to distribute its higher tariff over the entire energy consumption on a prorate basis.

Hydropower potential is located mainly in northern and north-eastern regions. Arunachal Pradesh has the largest unexploited hydropower potential of 47 GW, followed by Uttarakhand with 12 GW. As water and water power are State subjects, the construction of HEPs is often delayed due to conflicts among riparian States — the Subansiri HEP is a prime example of this. Unexploited potential is mainly along three river systems — the Indus, Ganges and Brahmaputra (see Chart). India has several international issues across these river systems. Like electricity, hydropower should also be brought on the concurrent list to formulate uniform policy and process for faster development.

7. Conclusion

Hydropower plants are a vital energy source to the world. Water is an efficient and reliable fuel. The use, creation, and expansion of power plants should continue being pursued.

- Hydraulic Power Generation is a revolutionary source for "GREEN ENERGY".
- It can change the dependancy on the Traditional method of energy generation with Innovative Approach.
- This can be lead to an excellent alternative to reach the increasing demand of electricity.
- Have an opportunity to increase work space for research and development.
- Much Eco-Friendly with nature.

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