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Potential of Hydro Power Plant in India

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Abstract

Sun, wind, water, ocean, tidal, and other renewable energy sources are available. Hydro power plants are growing as a source of energy in developing India. After fossils fuel and nuclear resource are examples of non-sources of energy, a large portion of India is searching for green energy. A survey report on hydro power plants in India is presented in this paper. So, in the long term, the Indian government has approved different plans and policies for the development of hydro power plants in which the element of water is primary sources of electricity and energy are two terms that are used interchangeably. Generated by the flow of water. Large hydropower Plants are the most technically advanced, and they are often custom-designed for each location, with turbines built especially for the power plant. There are several factors to consider while operating and developing a Hydroponics. The factory is on the move. Necessitates a methodical approach, which is discussed in the article. The main hydro projects in India are also included in this paper.

Keywords: Economic; Electricity; Hydroelectric; Power stations; Plant

Introduction

For All" by 2012, which would need the construction of new capacity of more than 100,000 MW. Thermal, hydro, nuclear, and other sun, wind, and hydrothermal power are examples of sustainable power sources, tidal, and others are the main sources of power. Water, which is abundant in India, is the primary source of hydro power plant. Hydro power plant is defined as. Water may be utilized in a number of methods The most often used technique is to utilize a hydro power plant dam, in which water is collected and used to rotate turbines, capturing energy that is used to power the generator. Large hydropower, medium hydropower, and small hydropower are the three types of hydropower. These are categorized based on their ability to generate electricity [1].

Range of large hydropower plant is >100 MW

Range of medium hydropower plant is 30-100 MW

Range of small hydropower plant is 1-30 MW

There's certain hydropower plants that are only utilized on a limited scale. Mini hydropower plant, with a capacity of 100 kW to 1 MW, and micro hydropower, with a capacity of up to 100 kW, these are often used to get a sense of a tiny town or rural industry when the grid is unavailable [2].

Mechanism of hydro power plant

The water is kept back to the dam. Because the length of a reservoir determines the power of water that flows to the turbine, this reservoir is placed extremely high height. As the reservoir's height rises, the potential energy of the water is increases. The gate regulates the flow of water into the plants. Water is allowed into the turbine based on the load requirement. Both potential and kinetic energy are present in the water coming from the gate terminal. The shaft transports rainwater to the turbines, which is intended to transfer water from the intake to the turbine without cavitation. Because of the penstock's length and the volume of water in it increases even higher [3]. The overall power generated by a hydro power plant is determined by the height of water in the water reservoir and the quantity of water in the penstock. The turbine generator unit was then allowed to fill with water. When water hits a turbine blade, the potential energy and kinetic potential Water's energy is transformed to rotary motion, which is then used powers the turbine blades. The spinning blades cause the shafts of the turbines, which is contained within a generator. In the generator's coils, this spinning shaft produces alternating current. The magnetic field is produced by this spinning shaft within the generator, which is then transformed to electrical energy by the electromagnetic field mechanism [4]. As a result, the shaft that connects the turbine and generator is critical. Hydro power plants use the energy of water to generate electricity (Figure 1).

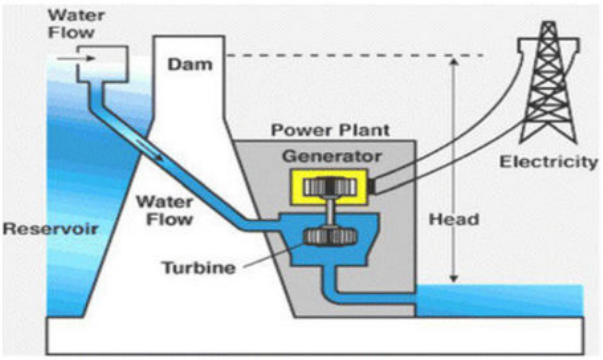

Figure 1: Diagrammatic Representation of mechanism of hydro power plant.

Civil components: It consists of the components that are responsible for entry of water supply into the turbine units. These are generally Intakes, spillways, forebay tank, penstock, and tailrace [5].

Intake: The structured-diversion gates valves redirect water from the source to the hydro power plant. It contributes in delivering the necessary amount of water to the plant without interfering with the river's regular flow. The garbage racks often serve as a filter for aquatic creatures and waterborne items that enter the plant's waterways. The intake may be on the side or on the bottom. For small hydro plants, the bottom type is utilized [6].

Spillway: In flood-prone regions, spillways are an essential component of hydropower plants. These are the split gates that remove surplus flood water by diverging its egress from the plant, minimizing the negative impact the effects of heavy rain on the plants and its constituents [7].

Forbay tank: For bay tank is a type of storage tank that is located at the end of a headrace pipe or canal. Their primary goal is to avoid cavitation caused by air entering the penstock. For small hydro plants, the Forbay water is critical since it determines the plant's operating head [8].

Penstock: In a hydropower plant, they are near conduction tubes used to deliver water into the turbine. Because Water's kinematic energy is too transformed to electrical energy at this step, it is the most significant civil component. The pressure within the penstock should be adequately maintained, with 120 psi or higher being ideal. They should be large enough to prevent friction losses caused by flowing water. The fast water hammering is caused by a decrease of velocity in the tube; this mechanical power must be spent somewhere, so the tube contorts, expands, and smashes against the inner walls to absorbed the stress. The similar effect may be achieved with a penstock that has long runs and a fast rate of flow. As a result, make sure the pipe and gate valves can resist these stresses [9].

Trailracr: The primary purpose of trailracr is to return the used water from the turbine to the water source [10].

Advantages of hydro power plant

Renewable and green: This is a sustainable and environmentally friendly source of energy. Its accessibility is limitless. It has a minimal carbon footprint and is environmentally friendly. Its contribution to the reduction of global warming. However, although water is an infinite resource that will never run out, there are only a limited number of locations where viable hydro power plants can be built. However, it is a step toward green energy [11].

Reliability: Hydroelectricity is very dependable. In terms of electric power, there is relatively little variation. When there is a need for a variety of outputs, this volatility is also visible. As a result, countries with abundant hydropower utilize hydroelectricity as a base load energy source [12].

Flexibility: Water flow regulation is made simple by using the shutting and opening of the gate. When there is a spike in demand, an additional gate is opened, allowing more water to flow and more energy to be generated. In the same way as there is low consumption, certain gates are closed to fulfill the demand [13].

Vegetation and Fishery: The land around a hydro power plant may be utilized to grow a variety of plants. Because water is kept in reservoirs, there is never a surplus, so plants may be irrigated from the plant even in the heat. In addition to hydro plants, fisheries farms are promoted. Flexibility Flexibilit [14].

Safety: In comparison to fossil fuels and nuclear energy, it is safer. These plants produce chemicals that, if inhaled on a daily basis, may cause a variety of health issues. Aside from that, the dam's structure ensures protection during floods and droughts [15].

Problem Associated: Despite the fact that water is a renewable resource, hydro power plants cannot be built everywhere. The many factors to be considered when constructing a dam for a hydro power plant project are appropriate meteorological conditions, local habitat, climatic conditions, water flow, and head. The location for the dam and other components should be appropriate. The installation of a hydro power plant project necessitates a significant portion of the land area, which may cause disruption to the local environment. The afforestation program, which disrupts the environment, meets the need for a wide area. Many aquatic animals are sometimes harmed when a dam is built over a water body. The region should not be prone to flooding or earthquakes. It is much better to have a less eroded region [16]. Sedimentation in hydroelectric reservoirs decreases storage capacity, which causes water speed issues. The turbine and other equipment are harmed by silt. The cost of constructing a hydroelectric facility is very high. It requires more personnel than other power Plants. It also has a significant maintenance expense. Because the facility is linked with a variety of electric machines and drives, the loss factor is very significant.

Hydropower generation plant plans in India

In number of dams, India is ranked third position in the world, after China, the United States, and Russia. In the nation, about 4720 major dams have been built. The size of hydro power plant producing units has grown from 22 MW (at independence) to 250 MW now. So far, India has commissioned 20 underground power stations with a total installed capacity of 9930 MW, with another 21 power stations under development with a total capacity of 9951 MW. The Nathpa Jhakri hydro power plant in Himachal Pradesh currently has a maximum capacity of 2400 MW. The Tehri dam, located on the Bhagirathi River in Tehri in Uttarakhand, is India's highest dam and ranks tenth in the world for height. The Hirakud dam, located in Sambalpur, Odisha, on the Mahanadi River, is the world's longest dam (57.8 kilometers) and the world's first hydro multifunctional project after independence.

Power house: Every hydro power plant project concludes with the construction of a power plant, which is responsible for the production and distribution of energy. It also has a control center where all of the plant's activities are monitored. Turbine-generator set, driving system, load controller, and distribution unit are the most common components.

Turbine: This component is crucial because it extracts energy from water hits and converts that kinetic energy into mechanical energy.

Generator: The generator, in conjunction with the turbine, transforms mechanical energy into electrical energy into electrical energy. The hydro turbine may be categorized as a response turbine or an impulse turbine depending on how it works. The kinetic energy of a water jet is transformed to mechanical energy in an impulse turbine, while mechanical energy is produced through the conversion of kinetic energy of pressured water in a reaction turbine. In hydro systems, several types of generators are utilized, including as synchronous generators, DC generators, and induction generators. Large hydro power Plants utilize synchronous generators, while tiny hydro power plants use induction generators. Because they generate rectified alternating current, DC generators are easy to maintain and utilize in

small hydro plants. The turbine and generator must be housed in the same location.

Load controllers and drive system

The turbine shaft, generator shaft, couplings, bearings, gearboxes, and pulleys are all part of it. Its primary purpose is to transfer the electricity generated by the turbine to the generators at a constant frequency and voltage, as well as at the necessary speed and direction. The electricity flow must be controlled at all hydro plants. The load controller is in charge of load control. The load controller installation is dependent on the generator utilized.

Unit of supply: Electricity supply and delivery to consumers are handled by the distribution unit. Grids are categorized as local or extensive based on the capacity of hydro power plants. For big and medium hydro, an extensive system is utilized, capable of supplying electricity to more than 10,000 people. Because a small hydro plant can only provide electricity to up to 10,000 people, it is limited to the local grid. Aside from that, small and micro hydro plants are self-contained and do not need a grid. Such a system is fed by a storage system, such as a battery. Load may also be categorized as load plant and peak load plant depending on the distribution system.

Types of hydro power plant

Impoundment: An impoundment facility is the most prevalent kind of hydropower station. A dam is used in an impoundment construction, which is usually a major hydroelectric plant, to keep river water in a reservoir. The reservoir's water powers a rotor, that begins a generator, which generates energy. The liquid may be released to suit changing energy demands, as well as for flood control, recreation, fish migrations, and other environmental concerns.

Diversion: A diversion, often known as a "run-of-river" operation, directs a part of a river *via* a canal or a penstock to generate electricity by using the natural decrease in river bed height. Water flow is controlled by gates, valves, and turbines in a penstock, which is a closed tube that sends water to turbines. A dam may not be required for a diversion.

Storage that is pumped: Pumped storage hydropower, or PSH, is a form of hydropower that operates like a huge battery. A PSH plant may store electricity produced by alternative energy sun, wind, and atomic sources of energy for future use. These plants store waters from a storage lake to a greater reservoir to save energy. A PSH facility stores energy by pumping water from a lower reservoir to a higher when the demand for electricity is low, a reservoir is used. Water is released into to the bottom lake at times of high demand for energy, when it drives a turbine that produces electricity.

Literature Review

Conducted on the hydro power plant potential of a mountainous slope in the Kopili River system in Assam (India). They assessed the potential by using a geographical a Geographic Information System (GIS) with a hydrological model (SWAT 2000). To describe the study watershed, existing data on topography, soil, land, weather, and outflow were utilized. Authors concluded that it is feasible to overcome any network operating limitations that typically limit the capacity that may be built in a wind park by using the water storage capability. Suggested method also improves the controllability of the wind park's production output, with the goal of increasing wind power's involvement in electricity markets.

Stated that Indian Himalayan basins have been designated for dam construction, but the cumulative impacts the effects of such reservoirs on ecological systems unclear. Author 292 reservoirs' locations were plotted on a map and predicted their impact on terrestrial ecosystems under various landcover loss scenarios. Data on land use/cover in the Himalaya valleys, wherever dams are constructed situated, was examined. Author also calculated dam density on rivers in the fifth through seventh orders and compared it to current world statistics. To forecast, to do so, we utilized an organism's relationship model. Estimate short-term and long-term species extinctions forest degradation (SAR). They looked at the distribution trends of species and dams using scatter plots or correlation analyses to see whether there was any overlap among species-rich areas or dam locations. The impacts Impact disruption on the communal architecture of undisturbed woods were studied.

Dam construction will impact almost 90% of Indian Himalayan valleys, and 27 percent of such dams will harm thick forest. Our design predicted that dam-related operations will submerge 54,117 hectares of forest and damage 114,361 ha. A dam's density of 0.3247 per 1000 square kilometers would be ideal. approximately 62 times higher than current world averages, and 1 dam per 32 km of river system will be 1.5 times greater than numbers recorded for US rivers. The majority of dams, according to research, would be built in Himalayan species-rich regions. Habitat loss due to dam construction would likely result in the extinction of 22 vascular plants and 7 vertebrate taxa by 2025, according to the SAR model, while dam-related disruption construction would most likely result in a 35 percent reduction in tree species diversity percent, 42 percent increase in tree density, and In thick woods, tree basal cover increased by 30%. If all planned In India's Himalayas, dams are now being built. Built, these findings, coupled with a very poor national environmental impact assessment and execution, indicate to severe species loss.

Bilal Abdullah discussed the cross-flow hydraulic turbines. They stated that these turbines are gaining favor in the construction of small hydro-power plants with lower pressure and low water flow rates, owing of its basic structure and simplicity of manufacture near the location of the power plant. The turbine characteristics must be included in the design to obtain maximum efficiency in a cross-flow turbine. All cross-flow turbine design parameters were computed at optimal efficiency in this study. Runner dimension, runner height, runner velocity, turbine power, water jet thickness, blades spacing, number of blades, radius of blade bending, attack angle, and blade and exit angles are among these parameters. The authors of this research came to the conclusion that cross-flow turbines are suitable for building modest hydroelectric generating facilities.

Discusses that water storage is used to enhance wind park functional economics benefits or to reduce active force production fluctuations caused by the wind energy resource's intermittency. If wind power forecasting is available, optimizations done on an hourly basis method is presented to determine the optimal daily operating Wind turbines and hydropower will follow this approach. Generating pumping devices. The method used to determine an envelope of suggested operating conditions takes advantage of the stochastic features of wind power. As a result, it is feasible to overcome any network operating limitations that typically limit the capacity that may be built in a wind park by using the water storage capability.

This method also improves the controllability of the wind park's production output, with the goal of increasing wind power's involvement in electricity markets. After analyzing few related studies regrading to hydro power plant, I conclude that Hydro power plants are increasing as a source of energy in developing India. After fossil resources and atomic energy are examples of non-renewable energy sources, a significant part of India is looking for green energy. So, in the long run, the Indian government has authorized various plans and hydroelectric power production methods plants in which the most important source is water of energy as well as electricity produced by the rate of flow of water. There are many variables to consider when running and constructing a hydro power plant.

Discussion

Compared to other large-scale generating alternatives, hydropower plants have the lowest operating costs and the longest plant life. After the initial investment in the necessary civil works has been made, the plant's life can be extended economically through relatively low-cost maintenance and periodic replacement of electromechanical equipment (turbine runners, generator rewinding, etc-in some cases, the addition of new generating units). The operational life of a hydro plant that has been in operation for 40-50 years may be doubled. Water is a renewable source of energy that is not affected by market changes. Countries with abundant fossil fuel sources, Iran and Venezuela, for example, have adopted a huge strategy. Hydro development program because of the environmental advantages. For many nations that rely on the fossil fuel imports for electricity production, the expansion of hydroelectric energy may imply energy freedom. Hydropower Plants use the energy stored in water flowing downhill to generate electricity. Rain, which is generated as a consequence of water evaporation into the atmosphere under the effect of solar heating, is the source of water that feeds rivers and streams. The quantity of energy available from this source may be calculated by adding up the entire amount of energy released if all rainwater falling over an area was permitted to flow to sea level. This is a rough estimate of the total theoretical hydropower capacity. However, because so much of this is unusable, another figure is frequently used the technically exploitable hydropower potential. According to these estimations, just around 38% of the world's entire potential has been realized. Hydropower projects are classified as large or small hydropower projects based on their location on rivers.

Conclusion

India's electricity industry is expected to expand rapidly. This is a critical juncture in the country's economic development, as it must adapt to shifting global conditions. The state and federal governments are taking steps to improve India's energy industry by implementing policies and implementing measures. Because of its tropical environment, a large portion of India is reliant on hydroelectric electricity. Hydroelectric plants are both environmentally and economically beneficial. Its development can satisfy future power demand since it is a green and clean renewable energy. These are plants that can be built on a little river; so many parts of India who are off the grid but have a greater resource may use this type of energy to meet their basic needs. It aids in the irrigation and development of crops. During the summer, it also serves as a storage facility for the home. As a result, the Indian government should create more water-related programs and policies. Apart from the new plant, the existing one should be refurbished and updated with new power drives.

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