Technical Analysis of Micro Hydel Plant in Punjab

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Abstract: Hydro power kept on assuming a noteworthy part in the development of electrical administration around the world. The power plants of hydro electric produce from few kW to thousands of MW and are substantially more efficient and reliable as a clean and renewable source of energy than power plants of fossil fuels. Micro-hydropower systems are comparatively small sources of power that are accurate in majority of the cases for individual clients as well as group of clients who are independent of the grid of supply of electricity. A micro-hydropower system is usually categorized as having a capacity of generation of less than 100 kW. In this research work, a survey of plant is done and the problems are found out. The main problem of hydropower plant is trash rack. A trash rack is used to filter out waste materials from water so that only water can go into river and other waste materials like polythene, small clothes and debris can be filtered out. But there is no trash rack. The hydro plant has worked only for 3 months but is should work for 12 months. The main problem is that it is not providing output which it should produce. So steps must be taken care off to increase the production of electricity.

Keywords: Micro hydropower, MW, KW

1. Introduction

The water of the oceans and water bodies on land are dissipated by the energy of the heat of the sun and gets transported as clouds to the distinctive earth divisions. The clouds going over land and falling as downpour on earth produces streams in the rivers which comes back to the sea. The water of the streams and rivers, while streaming down to from places of higher heights to those with lower heights, free their potential energy and put on kinetic energy. The energy is high in numerous rivers which have made them to draw their own way on the surface of earth through huge number of years of nonstop erosion. In approximately every river, the energy even then keeps on deepening the channels and relocates by cutting the banks, however the degree of changes in morphology fluctuate from river to river. A significant part of the energy of the flowing water of the river gets disseminated because of the encountered friction with its banks or via energy loss through internal turbulence. Also, the water energy dependably gets recharged by the solar energy which is in charge of the everlasting circulation of the Hydrologic Cycle. [1]

Hydro power kept on assuming a noteworthy part in the development of electrical administration around the world. The power plants of hydro electric produce from few kW to thousands of MW and are substantially more efficient and reliable as a clean and renewable source of energy than power plants of fossil fuels. This brought about redesigning of small to medium sized generating stations of hydro electric wherever there was sufficient supply of flowing water and the requirement of electricity. As the demand of electricity was expanding Mega projects of the plants of hydro power were created. The larger part of these power plants included dams of large size which overflowed huge zones of land to give storage of water and subsequently a consistent electricity supply. As of late, the effects on environment of such type of large projects of hydro are being distinguished as a foundation for concern. It is turning out to be progressively troublesome for the developers to construct new dams in the view of resistance from people and environmentalists living on the land to be overwhelmed. Thusly, the need has emerged to assess the hydro electric power plants at small scale in the scope of micro and mini power plants of hydroelectricity. [2]

2. Micro Hydropower System

Falling and flowing water contain potential energy. Hydropower originates from changing energy in flowing water by method of wheel of water or via turbine into valuable mechanical power. This power is changed into electricity by utilizing an electric generator or is utilized straightforwardly for running machines of milling. Many people in North America comprehend hydropower as including huge dams and generating facilities at large scale. Hydropower systems at small scale, though, are getting a lot of public enthusiasm as a promising, renewable source of power of electricity for parks, homes and remote communities. Hydropower technology has been with us for over a century. Numerous early towns, mines and mills in Canada constructed some type of generation of power from small systems of hydropower in the late 19th and untimely 20th centuries. [4]

Micro-hydropower systems are comparatively small sources of power that are accurate in majority of the cases for individual clients as well as group of clients who are independent of the grid of supply of electricity. Hydropower systems are categorized as per their installed capacity of the generation of power- large, medium, small, mini and micro. Electrical power is measured in megawatts (MW), kilowatts (kW) or watts (W). A micro-hydropower system is usually categorized as having a capacity of generation of less than 100 kW. The systems that have the capacity of installation between 100 kW and 1000 kW are alluded to as mini-hydro. Small hydro is characterized as having a limit of more than 1.0 MW and up to 10 MW, even though in Canada smallhydro can be characterized by territorial and provincial utilities as having a limit of under 30 MW or 50 MW. The key advantages of small hydro are as follows:

- High efficiency (70-90%) by a wide margin the best of all the technologies of energy.
- High factor of capacity (specifically > 50%).
- High predictability level, fluctuating with annual patterns of rainfall.
- Slow rate of progress; the power of output fluctuates just steadily from day to day (but not from minute to minute).
- A good connection with demand i.e. there is maximum output in winter.
- It is robust and long-lasting technology; systems can promptly be designed to last for 50 years or even more than this.

The components of micro-hydro systems are as given below [4]:

- A water turbine which change over the energy of falling or flowing water into mechanical energy that drives a generator, which produces electrical power. It is the heart of micro-hydropower system.
- A mechanism of control to give stable power of electricity.
- Lines of electrical transmission to convey the power to end point.

The following components may be required to produce a micro-hydro power system [4]:

- A weir or intake to redirect flow of stream from the course of water.
- A pipeline/canal to convey the flow of water to forebay from the intake.
- A trash rack and forebay tank to separate out debris and keep it from being drawn into turbine at the intake of the pipe of penstock.
- A pipe of penstock to pass on the water to the powerhouse.
- A powerhouse, in which generator and turbine change over the power of water into electricity.
- A tailrace via which water is discharged back to the stream or river.



Figure 1: Description of micro hydro system

3. Related Work

This section provides background knowledge of the related research area including micro hydro power plants installed in different countries and also the problems in those plants.

Reference [5] looked at the achievability of applying a system of the generation of micro hydro power as one of the empowering advancements that already submitted for an adjusted dispersed generation technique through an altered Micro grid as a component of the different regional programs of energy in progress in Africa. Moreover, this paper likewise indicates advancements on R&D in different technologies concentrated on energy maintainability. The evaluation of this paper recommends that generation systems of micro hydro power coordinated even at powered levels of Micro grid can possibly give proficiency of service to communities that are rural. As we know they will have the capacity to give frequency and voltage control, this improvement will serve as essential blocks of building for expansion of future system. Problems related to potential resources for generation of hybrid distributed and reliability of the supply of power is tended to.

In paper [6], authors have talked about design of micro hydel power plant. The asynchronous state of hydro power plant relies on the variation of speed in the set of generator turbine which is affected by states of the gate of hydraulic turbine. This paper manages with the technical feasibility of small plant of hydropower for utilization in domestic (micro-hydro), how it can be actualized in Valara waterfall, Kerala, India. Comprising inside this paper is a prologue to micro hydro system, simulation and design of generator and hydraulic turbine and how they are applied particularly for the generation of power. The proposed site has substantial potential for generation of power, still the wellspring of micro hydro energy remain stay undiscovered.

In reference [7], authors have has explained a case study on technical and economic analysis of micro hydro plant. The plants of hydro power with the power generated less than 10 Mw are turning out to be more appealing both economictechnical aspects and issues related to environment. The benefits acquired with production of electrical energy utilizing this primary renewable source of energy originate from financial investment on account of self utilization or money related wages when electrical energy is conveyed to the utility and after that sold. Moreover, this sort of the production of energy is environment friendly, take part toward emission of gas and reduction of global warming and can be utilized to control the watercourses. This paper demonstrates a view of the technical solutions which are available to be utilized as a part of micro hydro power plants and also proposes appropriate equipment for a specific solution, in light of average values of water flow and water fall. The financial analysis of the power plant which is considered is additionally demonstrated.

Paper [8] exhibits a report of survey on plant of hydro power in India. There are different resources of renewable energy such as wind, ocean, tidal, water and sun etc. Among all these sources, plants of hydro power are rising in the developing India. After sources of energy which are nonrenewable such as, nuclear and fossil fuel, significant part of the India is searching for the energy which is environment friendly. So for a long run perspective, Government of India has passed different policies and plans for the advancement of the hydro plant in which the main source is water and from the flow of water, electricity is obtained. There are different elements to be taken into account to run and produce a hydro plant. The plant run requires a methodical procedure which is examined in this paper. This paper additionally incorporates the major project of hydro in India.

In paper [9], authors demonstrated an approach for the control of flow for the control of speed of hydro turbines. The power can be handled by controlling the rotational movement of the spear valve. A model based on flow control is proposed in this paper for the regular control of small hydropower plants. A servomotor is utilized to handle the water flow by managing the rotational movement of the spear valve. The spear valve bring about the "continuous' control of the water flow. The appropriateness of servomotors for the management of small hydro power plants is examined and PI controllers are utilized to more improve their governing ability. The representation of state space is utilized to show the proposed model mathematically. Broad simulations are carried out to examine the behaviour of proposed model. The optimization of parameters is carried out by Artificial Neural Networks.

4. Motivation

In this research work, survey of the micro hydropower plant is done. Micro hydro power plants are small sources of generating power which are useful for some individuals or a group of small people who are using their electricity independently. The main problem of this hydropower plant is trash rack. A trash rack is used to filter out waste materials from water so that only water can go into the river which is then used to produce electricity. The materials which are filtered out with the help of trash rack are polythene, small clothes, debris and also many more waste materials etc. There is no trash rack in this hydropower plant and all the waste materials go into the turbine and this does not produce proper electricity. This hydropower plant has worked only for 3 months in a year. But it should work for whole year i.e. 12 moths so that more electricity can be produced and there is no loss of the electricity. The main problem we can conclude from all is this micro hydro power plant is not providing output which it should produce. It is not generating electricity as required and also according to the investment done on this plant.

The main problems related to plant are given below:

- 1) Blockage in trash racks.
- 2) Breakage in turbine shaft.
- 3) Discharge problem.
- 4) Grid failure.

The research is based on the following objectives:

- 1) To develop and install micro hydel power plants for generation of electrical power.
- 2) To electrify the remote and rural areas where grid power is not available.
- 3) To standardize the local micro and mini hydel plants and support the local industries.
- 4) To promote indigenous technologies of indigenous turbine.
- 5) To do analysis of unit comparison.
- 6) To calculate the plant loss, earnings and difference between the plant with and without overload.

The problems present in the plant are as shown in the given photos:



Figure 2: Breakage in turbine shaft



Figure 3: H-Links in Turbine



Figure 4: Close view of H-Links

5. Results and Discussions

This section presents the results in the forms of graphs and also the comparison of micro hydro power generation.



Figure 5: Unit Generation without Overload (Ideally)



Figure 6: Earning without Overload (Ideally)



Figure 7: Unit generation with Overload (Ideally)



Figure 8: Earning with Overload



Figure 9: Generation Chart of Plant

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Figure 11: Loss in year 2013-2014

6. Conclusion

In this research work, survey of the micro hydro plant is done and the problems present in this plant are discussed. Micro hydro power plants are used for generating electricity at small scale. But this micro hydro plant is not producing output as it should produce. So the problems which are in this plant i.e. problem of trash rack, turbine and shaft must be removed and hence production of electricity can be increased. The trash rack is used for filter out the waste material from the water and hence only water can go through the intake into the turbine so that there comes no problem in production of electricity. There head on the river which is generally of size 2.5 m. If the size of head on the river is increased to 5 m then more and more electricity can be produced so that there is no loss of electricity. There should be more and more remote areas and electricity should be given to agricultural and irrigation areas. If there are more remote areas, more electricity can be produced and then used more and more. Therefore required electricity can be produced from this micro hydro power plant and there is no loss of electricity.

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