

Hydropower Technology and its Application

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1. INTRODUCTION

Hydropower is the safest and cleanest potential energy of a water resources which converted into kinetic energy that spins a turbine during an electricity generator. The kinetic energy of falling water was first used for grinding wheat more than 2000 years ago. Since then hydropower has been used to generate electricity. The world's first hydropower was developed at Cragston in Northumberland England by William George Armstrong in 1878, and were first in Asia. Now, India identified 56 sites for pumped storage with installed capacity of 94,000 H.W. Due to increase of population changing life style, materials needs of people demand of hydropower is also increasing. At present 160 countries in the world used hydropower technology for power generation with a local capacity of 1060 GW. Hydropower generates 3500 TWG per year equivalent to 15.8% of global electricity generation. It supply more than 50% electricity in 35 countries. It also provide other services like flood control, irrigation and it is eco-friendly, low cost and does not emit GHG.

Hydropower technologies consists of two configuration the first is based on dams with reservoirs and the second, run of the river system (with no reservoir) the dam scheme can be sub-divided into small dam with night and day regulation, large dam with seasonal storage and pumped storage reversible plants for both pumping and electricity generation that are used for energy storage and night day regulation according to electricity demand.

2. OBJECTIVES OF THE STUDY:-

- To know about the details of hydropower technology.
- To study about hydropower technologies applications, types etc.
- To study its challenges and to give practical suggestions for hydropower technology development.

3. IMPORTANCE:-

Due to increase of population changing life-style, increasing needs of materials for people demand of hydropower is also increasing, but at the same time it effect negatively in

environment if application of these technologies are not run according to researches and developed technologies. For sustainable development of hydropower every details understandings about technologies and its application is most essential.

4. METHODOLOGY:-

The paper is prepared by descriptive and explanatory methods and the data is collected from secondary sources of Books, Journals, Newspapers, Internet sources etc.

5. APPLICATION OF HYDROPOWER TECHNOLOGIES:-

The step of generating hydropower is firstly collection of run off of seasonal rain and snow in lakes, streams and rivers during the hydrological cycle. Whatever small, large, micro or mini-power plants. The run of water flows to dam downstream. The water falls through a dam into the hydropower plant and turns a large wheel called a turbine. The turbine converts the energy of falling water into mechanical energy to drive the generator. After this process has taken place electricity is transferred to the communities through transmission lines and the water is released back into the lakes, streams or rivers.

6. TYPES OF HYDROPOWER TECHNOLOGY APPLICATION:-

At present these are there types of hydropower technology Application. These are:- Storage, Run of River and Pumped Storage facilities or system. Storage system is used a dam to capture water in a reservoir. This stored water is released from the reservoir through turbines at the rate require to meet changing electricity needs or other needs such as flood control, fish passage, irrigation, navigation, recreation etc.

Run of river system used only the natural flow of the river to operate the turbine. This type of project can be constructed without dam.

Pumped storage system is an innovation of the 1950s have specially designed turbines. These turbines have the ability to generate electricity in the conventional way when water is delivered through penstocks to the turbine from the reservoir.

It can also be reversed and used as pumps to left water from the powerhouse back up into the reservoirs where the water is reserved for latter used. During the daytime when electricity demand suddenly increases, the gates of the pumped-storage facilities are opened and stored water is released from the reservoir to generate and quickly deliver electricity to meet the demand. At night when electricity demand is lowest, the turbines are reversed and pumped water back into the reservoir.

7. METHOD OF CALCULATING AMOUNT OF POWER:-

A hydropower resources can be evaluated by its available power. Power is a function of the hydraulic head and rate of fluid flow. The head is the energy per unit weight of water. The static head is proportional to the difference in height through which the water falls. Dynamic head is related to the velocity of moving water. Each unit of work can do an amount of work equal to its weight.

The power available from falling water can be calculated from the flow rate and density of water, the height of fall, and the local acceleration due to gravity. In S.I. unit the power is

$$P = \lambda \beta Qgh \text{ where } P = \text{Power}$$

λ = is dimensionless efficiency of the turbine

β = is the density of water is kilograms per cubic meter.

Q = is the flow is cubic meters per second.

g = is the acceleration due to gravity.

h = is the height difference between inlet and outlet is meters.

8. HYDROPOWER POTENTIAL IN INDIA:-

India was available amount of hydroelectric potential and ranks 5th position in terms of hydro-potential in global scenario. According to CEA total hydropower potential capacity in India is 148700 MW installed capacity. The basic wise potential is given below:-

Table - I

Basic of India/Rivers	Installed capacity
Indus	33832 MW
Ganga	20711 MW
Central India River system	4152 MW
Western flowing Rivers of southern India	9930 MW
Eastern flowing rivers of southern India	14511 MW
Brahamaputra basin	66065 MW
Total	148701 MW

Major hydropower generating units of India:-

Table – II

Name	State	Capacity
Bhakra	Punjab	1100
Nagarjuna	Andrapradesh	960
Koyna	Maharashtra	920
Dehar	Himachal Pradesh	990
Sharavaty	Karnataka	810
Srigailam	Andra Pradesh	770

Top ten countries in the world (in terms of installed capacity):-

Table – III

Country	Power Capacity	Installed Capacity
Tagiskistan	27000 MW	4000 MW
Canada	341312 MW (first)	66954 MW
USA	319484 MW (second)	79511 MW
Brazil	285603 MW	57517 MW
China	204300 MW	65000 height MW(highest)
Russia	160500 MW	44000 MW
Narway	121824	27528
Japan	84500	27229
India	82237	22083
France	77500	77500

9. STEPS FOR APPLICATION OF HYDROPOWER TECHNOLOGY :

Developed countries liked America works to developed new techniques that can reduce operations and maintenance costs; Increase unit availability and plant capacity factors, reduce risk through enhanced system reliability.

1. Optimization of water use for hydropower technology.
2. Application of advanced materials and manufacturing methods.
3. Assessment of the value of water power grid services.
4. The water power programme should work to update information in order to understand the declines in electricity, generation capacity factors and facility available.
5. Costs of hydropower technologies should be aim to reduce

The US water power programme launched a team of US National laboratories to developed and demonstrate a suit of advance integrated analytical tools, known as the water use optimization toolset (WUOT). This tools assess managers and operators efficiently resulting in more energy and grid services from available water sources and thus enhancing the water benefits from improved hydropower operations and planning. The WUOT includes tools for hydrologic forecasting seasonal hydro systems analysis, real time operations and

environmental performance operations. The WUOT is applied in following locations.

1. Oroville Complex on the Feather River in Maryland, California.
2. The upper Colorado River.
3. The Chonowingo Dam on the Sushquena river.

10. ADVANTAGES OF HYDROPOWER TECHNOLOGY :

Hydropower technology provide unique benefits not available with other power generating technologies. They do not contribute to air pollution, acid rain, ozone depletion and do not provide toxic wastes. Besides, it control floods, provide irrigation and recreational opportunities such as fishing, swimming, rafting etc.

11. DISADVANTAGES :

The hydropower technology many suffered disadvantages due to environmental factors. Building a dam across a river floods the land, effect the local community that would have lived and worked on the flood land, change the character of river.

Power generating dam blocked river for energy conversion which adversely effected by variations in flow.

Large scale hydropower plants can be polluting and damaging to surrounding ecosystems changing the course of waterways and effect communities, agriculture and ecosystems.

12. CONCLUSION

Hydropower is the most safest easiest, cleanest and largest suppliers among all powers. So, like patrol, diseal it does not emit carbon dioxide etc. But the application of hydropower technology damaged environment, causing flood, effect ecosystem effecting fish and other aquatic life. So, in the application of hydropower technology careful manipulation and research activities should be undertaken so that flood and environmental damaged is not caused.

- [1] Hydropower Resources at Risk; The status of Hydropower Regulation and Development 1997. DOE/ID 10603 Idaho Falls, September 1997.
- [2] United States Department of Energy Idaho Operation Office.
- [3] IEA 1012), "Technology road map, Hydropower"
www.iea.org/publication/freepublication/technologyhydroroadmap/hydropower.pdf
