HYDROELECTRIC ENERGY DEPENDENCY WITH INCREASE SOURCES OF ENERGY CONSUMPTION

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ABSTRACT

Water and energy are the key resources required for both economic and population growth, and yet both are decreasing rapidly. The distribution of water use large amounts of energy, similarly the production of energy requires large amounts of water in processes such as thermal plants cooling systems, raw materials clearance. This study analyzes the water needs for energy production in according to the energy source sector (electricity, transportation or domestic).A hydroelectric dam captures energy from the movement of a river. In this process the kinetic energy of flowing water is converted to electric energy using turbines. The dam is used to hold the water and increase it potential energy, so that the water can produce more electrical power. Current and future water needs are quantified according to energy demand. In this paper tells how the hydroelectric energy depends on the sources and how to decrease with increasing the no of sources.

Keywords: Dam, Generator, River, Turbines, Water Energy.

I INTRODUCTION

Water and energy are the key resources required for both economic and population growth. Water and energy resource systems are fundamentally interrelated. Water is required in the production of energy, and energy is required in the treatment and transport of water, a linked relationship known as the water-energy. Water-energy is a series of connection, conflicts and competitions and the couplings between water security, energy security, and food security. A hydroelectric dam captures energy from the movement of a river and the dam is used to hold the water which can be used for wildlife sanctuaries, sources of drinking water, irrigation, industry and household. The water on hold creates pressure so that the water can produce more hydro electric power. Hydro electric power is the process of changing the kinetic energy of flowing water in a river into electrical power.

Hydro electric power is the only renewable energy technology which is presently commercially viable on large Scale. It is renewable, produces negligible amounts of greenhouse gases, it is the least costly way of storing large amounts of electricity and it can easily adjust the amount of electricity produced to the amount demanded by consumers. Hydro electric power accounts for about 17 % of global generating capacity, and about 20 % of the energy produced each year. Hydro electric power is renewable because it draws its essential energy from the sun which drives the hydrological cycle which, in turn, provides a continuous renewable supply of water. Hydro electric power represents more than 92 percent of all renewable energy generated, and continues to stand as one of the most viable sources of new generation into the future. It also provides an option to store energy, to optimize electricity generation. This article provides a detailed review of different studies on hydro electric power of Jawahar Dam over the years (1993-2012).

II STUDY AREA AND DATA

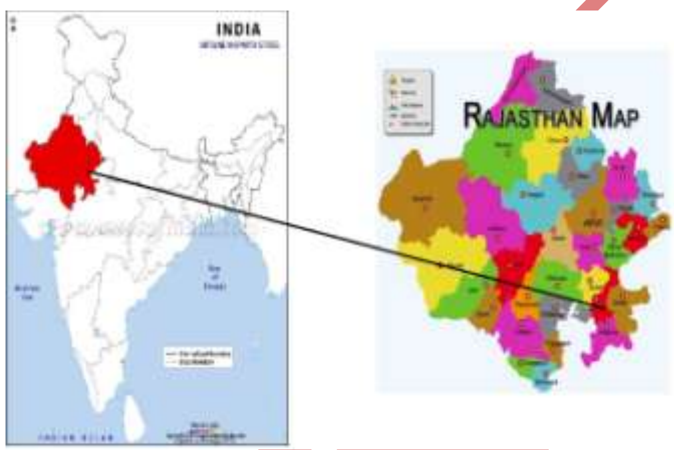


Fig.1 Showing Study Area

Jawahar Sagar Dam is a dam across the Chambal River shown in figure1. It is situated 24 kilometres south-west of Kota, Rajasthan, India. Jawahar Sagar hydro power station is the third stage in the project of "Chambal valley development scheme" it has produced a total power of 60 MW from the three unit of 33 MW each. Jawahar Sagar dam has a height of 45 metres and is spread over 393metres. It has catchment of 27,195km^2 and provides relief to the people during times of severe water storage. In present study, having a data from 1993 to 2012 which include generation data, auxiliary consumption data, average discharged data /month, which are grouped into class intervals of 5 years.

III METHODOLOGY

Hydro electric power dependency has increased with recent years, as it is a pollution free and renewable source of energy. Hydro electric power is transmitted at 220KV & 132KV feeders & 220/132KV Transformers at 220KV GSS Sakatpura Kota. The hydro electricity generated depends on the water collected by annual rainfall and water discharged from Rana Pratap Sagar power station, which is utilized for the generation of electricity. The source of consumption increases with increase population, industrial growth and gradual urbanization of the area. The major sources of electricity sink are industry, house hold, agriculture, commercial purpose, in short overall development of an area is dependent on the electricity. Our study is to show how the load factor on the hydroelectric dam increases in gradual years. The annual rainfall of the area is 880mm and the total collection of water is from Rana Sagar dam discharge and form the annual rainfall in that area. The annual power electricity generated by the dam gradually increased with the increase in demand of electricity. The total power generated by the dam is proportional to the amount of water that is collected by the dam and is discharged The figure2 show the total discharge of water in MCFT for the given years and the total amount of hydroelectricity generated in LU. Such that for discharge

1 MCFT = 11.57 Cusecs,

Cusec = cubic feet per sec= 28.317 litres per sec

And for electricity

1 MWH = 1000000 WH

= 106 WH = 103 X 103 WH

=103 KWH = 103 U = 0.01 LU

Hydroelectric power is produced as water passes through a dam, and into a river below. The more water that passes through a dam, the more energy is produced. Electricity is produced by a device called a turbine. Turbines contain metal coils surrounded by magnets. When the magnets spin over the metal coils, electricity is produced. Turbines are located inside dams. The falling water spins the magnets. The ability of the hydroelectric plant to generate power is determined by the mechanical energy of the water, the flow of the river, and the efficiency of the dam, which can be simplified by the following equation:

Power = (Height of Dam) x (River Flow) x (Efficiency).

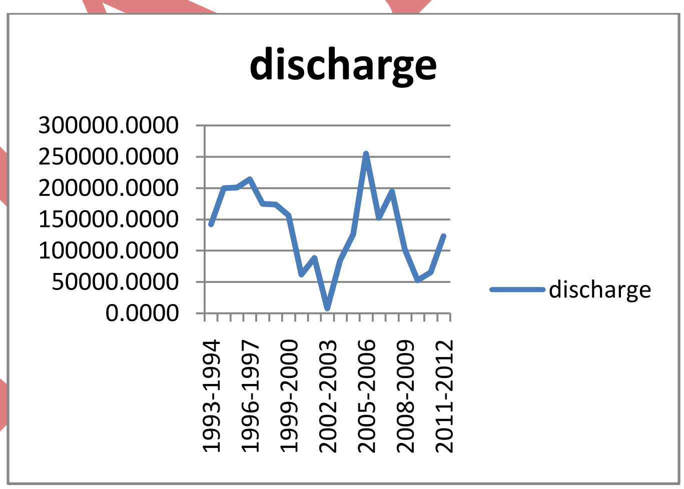


Fig.2 Graph Showing Discharge of Water during Years in MCFT.

3.1 Importance of Hydroelectric Energy

The hydropower currently provides about 20% of the world's electricity supply and more than 40% of the electricity used in developing countries. The hydroelectricity energy is mainly important because it is pollution free and renewable source of energy. it is also a easy energy source as the dam produce electricity as well as controls the water usage of a area. it is a flexible source of electricity since plants can be ramped up and down very quickly to adapt to changing energy demands. The major advantage of hydroelectricity is elimination of the cost of fuel. The cost of operating a hydroelectric plant is nearly immune to increases in the cost of fossil fuel such as oil, natural or coal, and no imports are needed. Dedicated hydroelectric projects are often built to provide the substantial amounts of electricity needed for aluminum electrolytic plants. While some carbon dioxide is produced during manufacture and construction of the project, this is a tiny fraction of the operating emissions of equivalent fossil-fuel electricity generation.

3.2 Advantages and Disadvantages of Hydroelectric Energy Systems

3.2.1 Advantages

- Hydroelectricity produces no gas emissions or waste.
- Hydroelectric stations are inexpensive to operate.
- Hydroelectric power is one of the most responsive (easy to start and stop) of any electric power generating source.
- Hydroelectric power produces no chemical or waste heat pollution.
- Hydroelectric power plants require little maintenance.
- Reservoir lakes can be used for recreation and can provide considerable flood protection to downstream areas.
- Hydroelectric installations can be used to breed fish and other aquatic products.

3.2.2 Disadvantages

- Hydroelectric power production requires flooding of entire valleys and scenic areas.
- Dams are expensive to build, and due to drought may become useless, or produce much less power than originally planned.
- Dams can break in a massive flash flood.
- Sedimentation can progressively curtail a dam's ability to store water and generate energy.
- Damming can cause loss of land suitable for agriculture and recreation.

3.3 Dams or Barrage

Hydro comes from the Greek word for water. Hydro electricity or hydro-power is usually generated by turbines in a dam in a river. The dam means that a great body of water builds up in the river valley behind the dam. This is released through the turbines when electricity is needed smaller than dams are barrages across the mouths of rivers which capture water from high tides and release it to generate electricity. Smaller still are turbines in river and tidal streams which do the same thing.

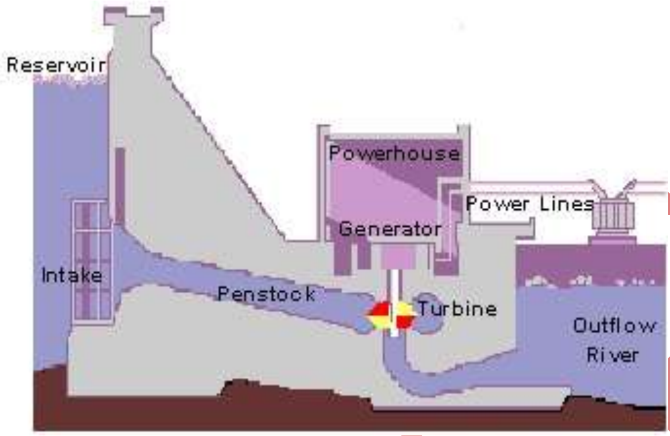


Fig.3 Show A Hydroelectric Dam With Turbine.

The theory is to build a dam on a large river that has a large drop-in. The dam stores lots of water behind it in the reservoir. Near the bottom of the dam wall there is the water intake. Gravity causes water to fall through the penstock inside the dam. At the end of the penstock there is a turbine propeller, which is turned by the moving water. Dams are individually unique structures, and dam construction represents the biggest structures in basic infrastructure with in all nations (Novak *et al*., 1996).The current and estimated electricity generation from the HP and 27,900 MW of the total HP is at small-scale sites, generating 115 TWh/yr.

3.4 Turbine Systems

Electricity is produced by a device called a turbine. Turbines contain metal coils surrounded by magnets. When the magnets spin over the metal coils, electricity is produced. Turbines are located inside dams. Jawahar Sagar Dam is across the Chambal River and in which used the Francis turbine to produce the electricity.

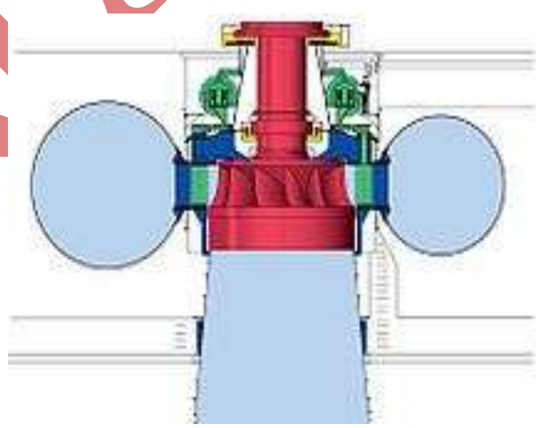


Fig.4 The Francis Turbine Is A Type Of Water Turbine.

The Francis turbine is a type of water turbine that was developed by James B. Francis in Lowell Massachusetts. It is an inward-flow turbine that combines radial and axial flow concepts. Francis turbines are the most common water turbine in use today. They operate in a water head from 10 to 650 meters (33 to 2,133 feet) and are primarily used for electrical power production. The turbine powered generator power output generally ranges from 10 to 750 megawatts, though mini-hydro installations may be lower. Penstock (input pipes) diameters are between 1 and 10 meters (3 and 33 feet). The speed range of the turbine is from 83 to 1000 rpm. Guide vanes around the outside of the turbine's rotating runner adjust the water flow rate through the turbine for different water flow rates and power production rates. Francis turbines are almost always mounted with the shaft vertical to keep water away from the attached generator and to facilitate installation and maintenance access to it.

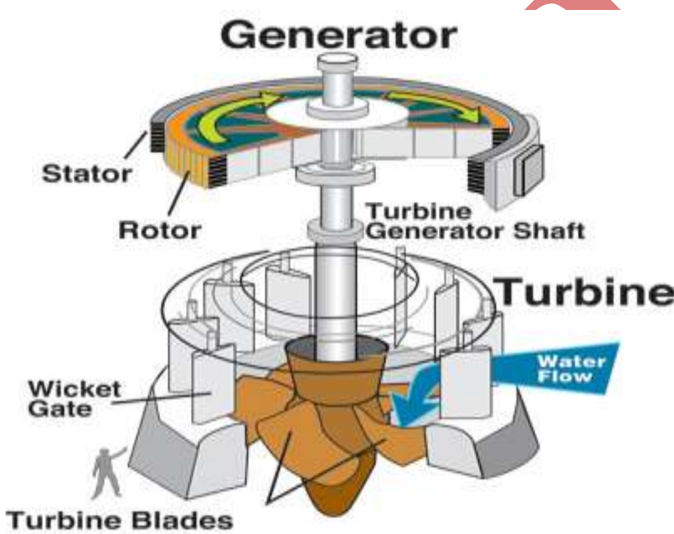
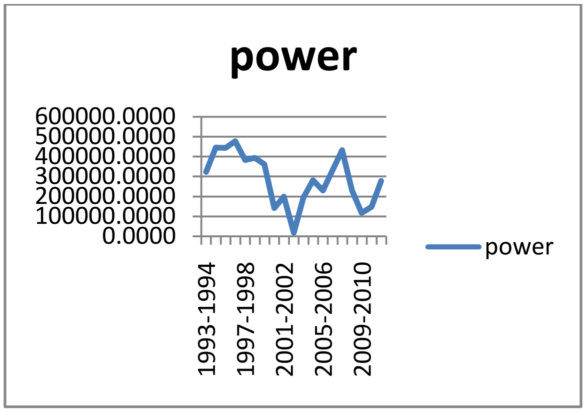


Fig.5 Shows A Typical Generator-Turbine System.

Two main types of generators are used in the Jawahar Sagar dam synchronous and asynchronous. Both generator types are well known throughout the industry and have been steadily improved to meet the needs and demands of the hydropower sector. Figure 5 shows a typical generator-turbine system. The efficiency of small hydropower depends mainly on the performance of the turbine. Today, generators commonly have efficiency rates of 98–99%. As a general rule, larger and newer plants have higher efficiencies of up to 90%. Efficiency can be as low as 60% for old and smaller plants (OECD/IEA, 2003). Hydropower is the most efficient way to generate electricity. Modern hydro turbines can convert as much as 90% of the available energy into electricity.

IV RESULTS AND DISCUSSIONS

The hydroelectricity generation depend on lot of factors mainly the rain. There is more electricity demand during that time as lot of electricity is wasted on irrigation and also for cooling purpose in summers. So there is a fluctuation in power generation with accumulation of water.



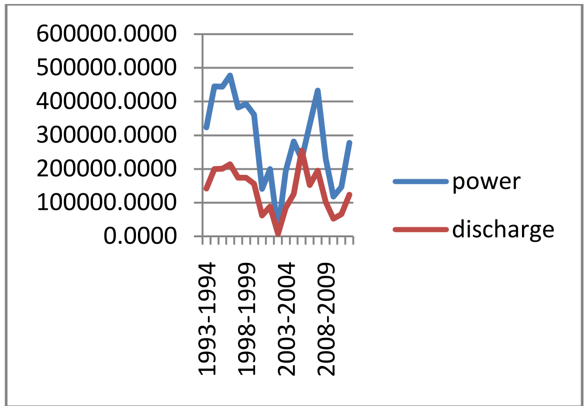


Fig.6 **Fig.7**

Fig.6 graph shows the power generation in MWH from 1993 to 2012.

Fig.7 graph shows relative water discharge and power generation.

It can be seen that there is a linear relation between water quantity used and the electricity generated. The scatter plot between discharge and power generated show the details. The linear show that more water available more electricity is generated by the plant.

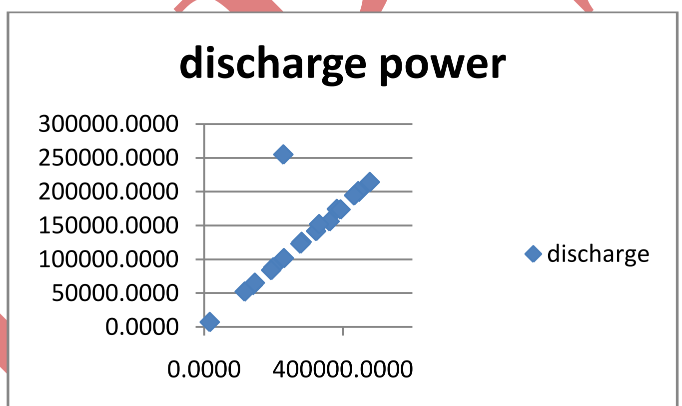


Fig.8 Shows A Linear Relationship Between Used Water Quantity And Generated Electricity.

V. CONCLUSIONS

In this paper there is a study of power generated by Jawahar dam the basic machinery used and the detailed study of total power consumed/generated with the total water collected or discharged to produce electricity. The study shows linear relationship between availability of water with consumption of electricity. The consumption of electricity is also directly related to rainfall. Lesser rainfall more will be the requirement of electricity to pump water into agricultural area and in a state like Rajasthan here the low rainfall already caused enough water dependency in pumping water from ground thus by decreasing the ground water table and thus by increasing the amount of electricity needed. The increase in number of households and with development of industries there had been a gradual increase in demand of electricity for which there had been increase in load factor of the generator station. Overall future of hydroelectricity will be a major source of electricity generation apart from thermal power plants.

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