

“Generation of Renewable Energy by Installing Hydropower Plant at Dam”

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Abstract: Sources of power generation range from various conventional sources such as coal, lignite, natural gas, oil, hydro and nuclear power to viable non-conventional sources such as wind, solar, and agricultural and domestic waste. Hydropower electricity generation is considered one of the cheapest and ecofriendly technologies regarding electricity generation costs, and it is the most traditional, clean, renewable energy source. Electricity demand in the country has increased rapidly and is expected to rise further in the coming years to come. In order to meet and fulfill the increasing demand for electricity in the country, massive and mega addition to the installed generating capacity is required. Indian infrastructure is recently growing at faster rates to meet present need and requirement of the county with the help of the state of art technology. However, considering the environmental advantages offered by hydropower, they have also can have some disadvantages and consequences in the environment affecting water quality and disrupting river ecology. We investigated the costing of the hydropower electricity generation and impact of the hydropower electricity to minimize the cost of water distribution to the consumers.

Keywords: - Hydropower electricity, Renewable, energy, Water power ,infrastructure development, cost optimization,

1. INTRODUCTION

Energy is the basic necessity for development of any country. Electricity is one of the most important blessings that science has given to mankind. It has also become a part and parcel of modern life style and no one can think of a world without it. Electricity has many uses in our day to day life. It is used for lighting rooms, running fans and domestic appliances like using electric stoves, Air conditioner, hair drier, washing machine, mixture grinder and more. All these provide comfort to people and same time as compare to conventional methods. In factories and industries, large machines are worked with the help of electricity. Most of essential items like food, cloth, paper, metal furniture's and many other things are the product of electricity.

Conservation of electricity is more essential due to the concern for fast depletion of non-renewable sources of energy in the country. Conservation of electricity necessary to save the environment and the Earth from warming. Considering the prevailing situation, it is the responsibility of society to look at the problem more seriously and make attempts to ensure proper and judicious use of electricity. We cannot afford to waste electricity at all. Switching off electricity when not needed, maximum use of natural light and air, use of energy efficient equipment's of correct size, refurbishing of electricity gadgets and motors in operation, etc. are some of the simple methods, which save electricity. Educating the general public on the methods of conservation of electricity and possibilities of spending less on electricity can go a long way in reducing electricity requirements. It will be a contribution of both the power distribution utility and its consumers for a better tomorrow.

The electricity is generated by various sources as per availability like thermal power, wind power, solar

power, nuclear power, tidal wave power, wind power etc. for generation of electricity power every sources has its advantages and disadvantages. A major discussion that we have been watching form last couple of decades related to size of hydropower plant even though the hydropower has a lots of benefit it also has some drawbacks, related to environment and displacement of local resident. Since electricity is produced from energy available in various forms in nature it is desirable to look into the various sources of energy their sources are,

- 1) Sun
- 2) Wind
- 3) Water
- 4) Fuel
- 5) Nuclear energy

Hydropower is electricity energy generated by using the energy of moving water, rain or melted snow, usually originating in hills and mountains, create streams and rivers that eventually run to the ocean. In the recent rea of globalization world, every country is in the search of modern technology with eco friend concept, almost each and every part of our country development are in progress. For the faster and progressive development of the country. We are surrounded by technology, innovation and happiness. Electricity is one of the greatest technological innovations of mankind to achieve more generation from water there is need of planning to conserve the water and effective use of hydropower generation for commercial as well as for domestic purpose. The generation of hydropower electricity depends on the availability of rain water in particular location. The rain water conservation at elevated level have the capacity to generate the hydropower electricity.

The best geographical areas for exploiting small-scale hydro power are at steep rivers flowing all year round, for example, the hilly areas of countries with high year-round rainfall, or the great mountain ranges and their foothills, like the Andes and the Himalayas. Islands with moist marine climates, such as the Caribbean Islands, the Philippines and Indonesia are also suitable. Low-head turbines have been developed for small-scale exploitation of rivers where there is a small head but sufficient flow to provide adequate power.

The contribution of conventional and non-conventional electricity generation can be shown in chart no 1

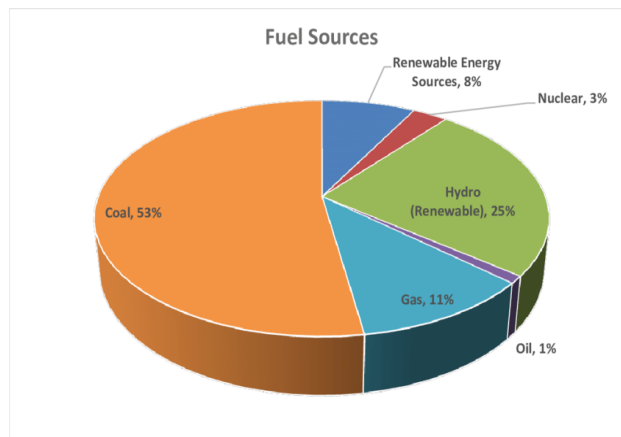


Chart no 01

Conventional and non-conventional electricity power contribution.

At present in the world major part of people are living without electricity in India by year 2020 it is 250 million considering the present population and available electricity is very less as compare to present demand.

INDIA'S ENERGY MIX

The generation of electricity by different sources and their share can be shown in chart no 02

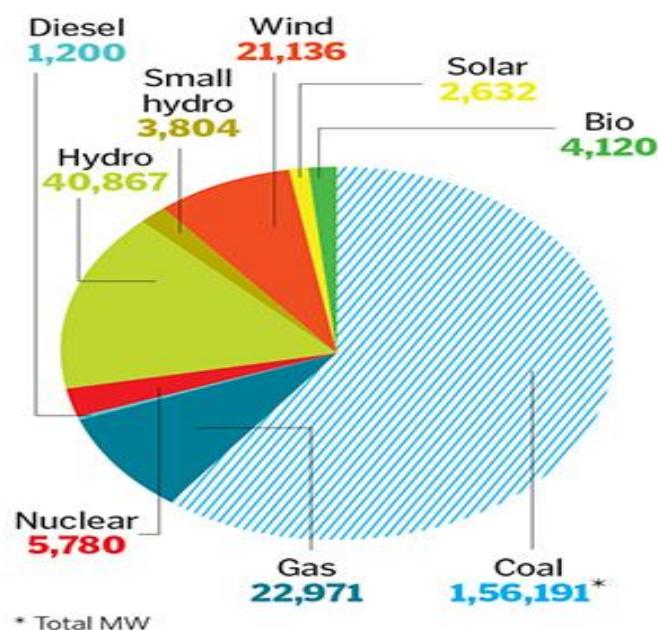


Chart No. 02 : Share of Electricity generation

1.1 BRIEF HISTORY

The process of work on generation of electricity by using water is started in year 1876 and first power project in world arch lamp in crag side country house in Northumberland England in 1878. The first hydropower in India 130KW capacity commissioned in the hill of Darjeeling in 1897. Since then around 700 small hydro projects with less than 25MW capacities are already commissioned. About 57260 MW (21.2%) of total power generation is contributed by renewable energy resources. India targeting 175GW power generation from RES by 2022. Out of 175 GW, renewable energy sector of India targeted 5GW from small hydro power projects in India hydropower electricity generation capacity having small share as compared to conventional type of energy. India is ranked 7th larger producer of hydropower electricity power generation. India is prominent in generation pf electricity from hydropower from available sources. First hydropower electricity power plant in India was established at Darjeeling in 1898 and after four years another plant established at shivanasurdrum

Classification of power plants:

Hydroelectric power plants can be classified, on the basis of installed capacity, as large, medium, small, mini, and micro hydro power plants. Generally, the mini, micro, and pico hydro come under the subcategory of small hydro plants.

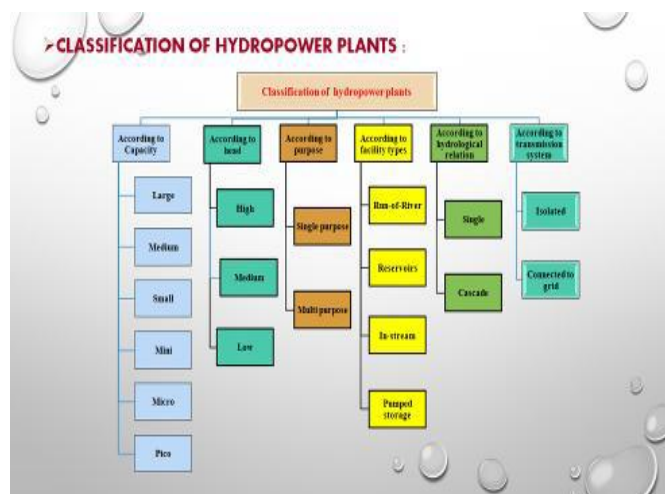


Fig.-1 . Classification of Hydropower plant

1.2 SMALL HYDROPOWER PLANT

Hydropower turbines convert water pressure into mechanical shaft power which can be used to drive an electricity generation or other machinery. The power is proportional to the product of pressure head and volume flow rate. The general formula of pressure head for any hydro system power output is given in equation

$$P = \rho g Q h$$

Where

P- is mechanical power produced at the turbine shaft

h- hydraulic efficiency of turbine

ρ - is density of water

g- acceleration due to gravity

Q- is volume flow rate passing through turbine

h- effective pressure head of water across the turbine (m) the best turbine can have hydraulic efficiencies in the range of 80 to 90 % (Higher than most other prime movers) shown in Fig. 1 .1

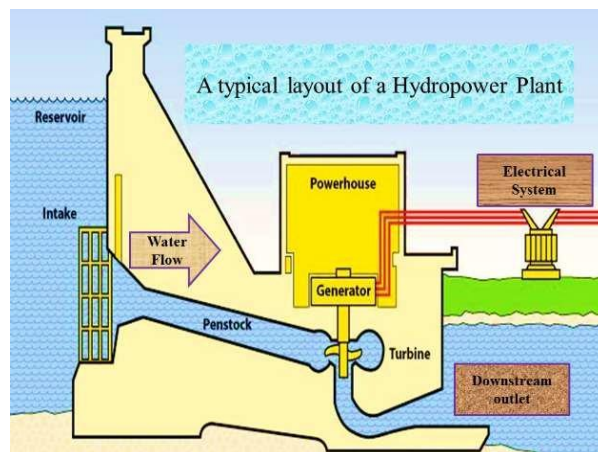


Fig. -2 Hydropower plant

2.0 STUDY AREA AND PARAMETER STUDIED

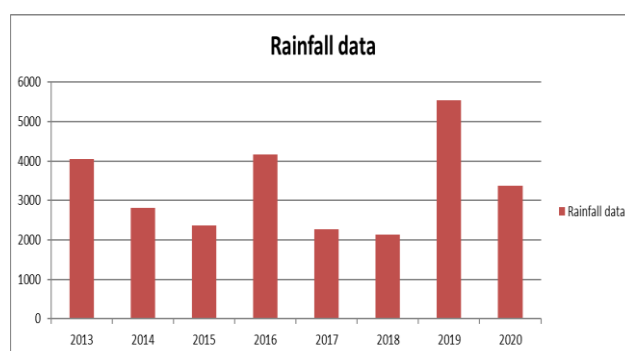
The proposed Hetawane water supply outlet 0.350 MW HEP project is located near village Vakrul in Taluka Pen, District. Raigad, Maharashtra at the Dam Toe of Hetawane medium project. The project proposed to harness the Hydel Power Potential from water supply discharge for generating the electricity. The project

site is approachable from Pen by “Alibagh-Pen-Khopoli Road”. The site is approachable in all seasons. The nearest Railway station Khopoli is about 15 km from the project. The project site is well served by communication network.

The catchment area is about 70.45 sq.km. upstream of the project. The catchment lies in mountain ranges of Sahyadri having steep slope. The catchment is generally hilly, rocky and consists of large percentage forest & uncultivated area. The average annual rainfall is about 3051 mm. the catchment gets the major portion of rain fall from South West m monsoon during the months of June to September. The post monsoon rains begin in October and extend up to end of December

It is proposed to generate electricity by installing small Hydro Power House by utilizing the water supply releases requirements from separate outlet for the generation of electricity.

Rainfall data: as per the rainfall data available of last five years is tabulated. The average rainfall data during the year is 3200 mm which is sufficient for the generation of hydropower electricity at the dam which will be very effective for cost minimization of water distribution cost.



Graph No. 01: Rainfall data (2013-2020)

3.0 COST WORKING AND ANALYSIS

Hetwane dam is the main source of CIDCO water supply scheme, which will distribute the potable water supply to the consumers of Navi Mumbai area. The total pipe line network of around 52 Km of length. The present expenditure for treatment of water and water supply distribution from the dam source to the end consumer is work out to Rs. 3.85 per Cum. The distribution of treated water from treatment plant to consumers by means of pumping though pipe line network. The expenditure includes raw water procurement cost, primary treatment of water, electrical energy charges, operation and maintenance charges, and other miscellaneous charges and given in table No 01.

Table no 01 (present cost of water procurement)

Sr No.	EXPENDITURE COST	AMOUNT IN RS
A	Expenditure (Dec 2020 Jan 2021)	
1	Quantity Procured (in Cum) (4195780+4279608)	84,75,388.00
2	Rate @ Rs. 0.17/ Cum	0.17

3	Amount of Water Procurement Bill paid (Royalty Charges) in lacs M & R Expenses	14,42,091.00
4	Electric Energy charges.(9791160+9763280)	1,95,54,440.00
5	O & M of pumps	15,61,111.11
6	Electric Maintenance charges	28,38,888.00
7	Expenses on Water Treatment	29,02,000.00
8	Maintenance of Garden	15,40,000.00
9	Security Expenses	4,80,592.00
10	Additional Expenses	9,48,560.00
11	Establishment Cost	13,61,833.00
B	Total expenditure in Rs.	3,26,29,515.11
13	Expenditure cost per Cum (B/A1) in Rs./Cum	3.85

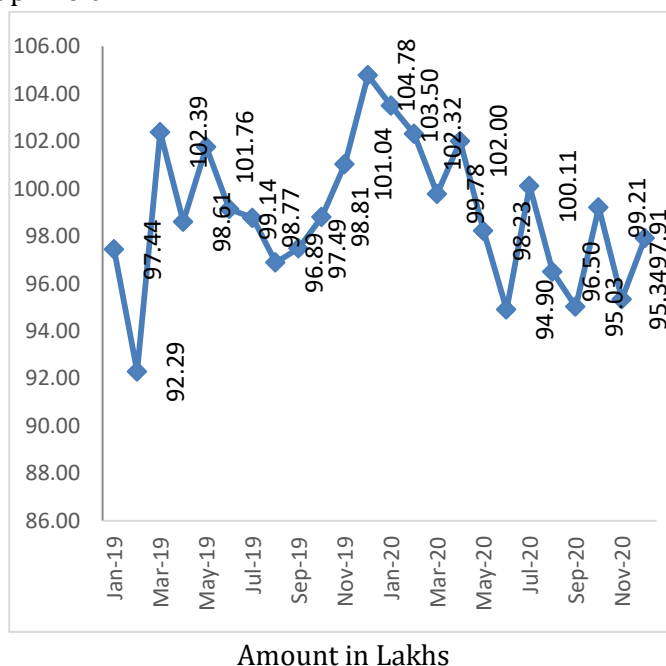
The cost of electricity for pumping of water from the source to consumers is work out to Rs. 100 lakhs per month i.e. @ 59.96% in the total expenditure on cost of per Cum of procurement of water. The electrical energy charges for the distribution of water charges having major contribution in procurement cost of water, which will affect the water distribution cost. The previous and present record of the electric energy charges expenditure on the water supply distribution is tabulated in table No 02. The month wise contribution of electricity energy charges (in Rs) .

Table no 02 Month wise electrical charges

Sr No	Year	Month	Amount (Rs)
1	2019	Jan-19	97,44,461
2	2019	Feb-19	92,29,209
3	2019	Mar-19	10,23,8551
4	2019	Apr-19	98,61,013
5	2019	May-19	101,75,830
6	2019	Jun-19	99,14,377
7	2019	Jul-19	98,77,207
8	2019	Aug-19	96,89,095
9	2019	Sep-19	97,49,144
10	2019	Oct-19	98,81,192
11	2019	Nov-19	101,03,729
12	2019	Dec-19	104,78,132
13	2020	Jan-20	103,49,803
14	2020	Feb-20	102,31,525

15	2020	Mar-20	9978061
16	2020	Apr-20	10200483
17	2020	May-20	9822815
18	2020	Jun-20	9490417
19	2020	Jul-20	10011282
20	2020	Aug-20	9649838
21	2020	Sep-20	9502526
22	2020	Oct-20	9920975
23	2020	Nov-20	9534036
24	2020	Dec-20	9791160

The monthwise electricity charges in year 2019-20 are compare and varis from month to month and graphically inidcated in graph no 02



Graph No. 02: Month wise Electricity bill amount

From the existing expenditure on the water may be reduced to some extent by curtailing the cost of the electricity use for the pumping which is supply for the Maharashtra State Electricity Board.

5.0 COST REDUCTION BY INSTALLATION OF HYDROPOWER PLANT

A hydropower plant is proposed to installed at the site location for the generation of hydropower electricity which will be use for the pumping of water from dam source to the end consumers. The present expenditure on the electricity charges which is 100 Lakhs per month will minimize to 30.00 lakhs. The purpose of installation of hydropower plant is to produce the electricity for water supply distribution system and hence the water procurement cost is coming down to Rs. 1.77/Cum. The capital contribution involved in construction of hydropower plant will be recovered in two years period.

4.0 CAPITAL COST OF PLANT:

The initial investment cost of proposed hydropower plant including civil and mechanical based on current market rates works out to Rs. 15.00 crores and 10 % maintenance cost of the based on the current market rate and which will be return in 15 months.

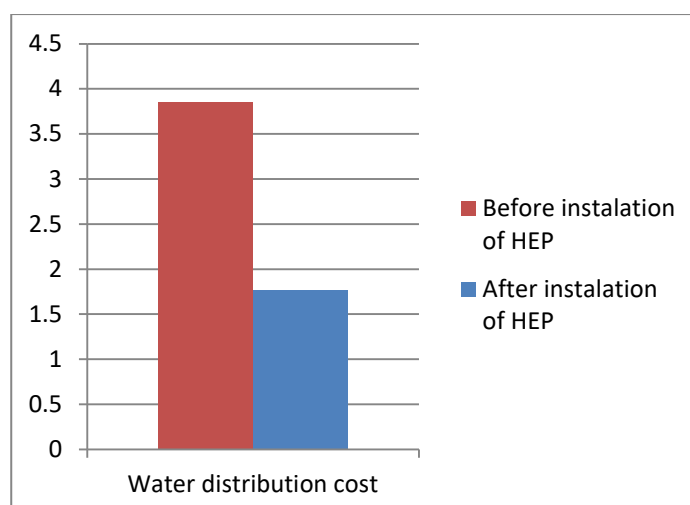
Comparison and Discussion: The cost of water after installation of hydropower plant is work out to Rs. 2.00 Which is 48% less than the present cost. The electricity generated from the proposed hydropower plant is

tabulated as below which show the water procurement and distribution cost

Table no 03 Month wise electrical charges

Sr No.	EXPENDITURE COST	AMOUNT IN RS
A	Expenditure (Dec 2020 Jan 2021)	
1	Quantity Procured (in Cum) (4195780+4279608)	8475388.00
2	Rate @ Rs. 0.17/ Cum	0.17
3	Amount of Water Procurement Bill paid (Royalty Charges) in lacs M & R Expenses	14,42,091.00
4	Electric Energy charges. (1000000+1000000)	20,00,000.00
5	O & M of pumps	15,61,111.11
6	Electric Maintenance charges	28,38,888.00
7	Expenses on Water Treatment	2902000.00
8	Maintenance of Garden	15,40,000.00
9	Security Expenses	4,80,592.00
10	Additional Expenses	9,48,560.00
11	Establishment Cost	13,61,833.00
B	Total expenditure in Rs.	15075075.11
13	Expenditure cost per Cum (B/A1) in Rs./Cum	1.77

6.0 Comparison and Discussion: The electricity generated from the hydropower plant is used for the distribution of water from the dam source to the consumers. The electricity cost which is having 59.96% contribution in cost of water as per the table no 03 Now the electricity is available with the own source with the lesser price. The cost of water distribution after installation of hydropower plant is work out to Rs. 2.00 /cum Which is 48% less than the present cost. Hence there is a saving of 48 % of amount in the water procurement cost as against the initial investment of 15.00 crores for the installation of hydropower plant and which is returns in the next 15-month period. The electricity generated from the proposed hydropower plant is tabulated as below which show the water procurement and distribution cost



Graph no 03: Comparison before and after installation of Hydro Electric power plant

7.0. RESULT AND CONCLUSION:

Hydropower plant becomes an important source of clean energy requirement in the coming future. To meet the upcoming requirement of the electrical energy and their fulfilment it is necessary to increase investment and enhancing clean technology for future sustainable power needs. As per the data available the installation cost of hydropower plant is recovered in next 15 month of duration and procurement cost of water is reduced by 48% with present cost of water procurement i.e. Rs.3.85/Cum to Rs 1.77/Cum

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