RESEARCH ARTICLE OPEN ACCESS

Renewable Energy Based Floating Power Generator (Rivers and Canals)

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Abstract
We have developed a stand alone, (river and canal water stream) floating power generator system for village electrification, agriculture water pumping, bridge street lights and such other utilities. The system is the unique one of its kind as per our knowledge and various surveys. The physical structure of the system is made of the non corrosive and unbreakable materials like mild steel, fiber glass etc. It works, as it rotates in the water flow. It does not require any kind of the external electric grid power for its working. As the water flows, the specially designed blades of the system rotate in the direction of the flow and ultimately the consistent power is generated, this power can be used directly or it may be stored in battery and the utilized as and when required. No permanent installation, No pollution and environment friendly floating Pico turbine. The observations taken from the sight are tabulated and accordingly results are discussed.
Key Words: Water Stream, Float, Water Wheel, Water proof power generator, Electric load

I. Introduction

Humans have used the hydropower for more than 2000 years. Hydropower is the rate at which hydraulic energy is extracted from specific amount of falling water as a result of its velocity or position or both. As a working fluid, water in a hydropower system is not consumed and is available for other uses. Hydropower can be used to power machinery or to generate electricity or both at the same time. The small scale hydro plants are suitable for mechanical applications while large scale hydro power plants are used for electricity generation [1]. For a well planned and operated hydropower project, electricity generation technology is stated as one of the cheapest in terms of cost possibly because of the working fuel availability free of cost without its wastage [2]. It is the most important renewable energy contributes for more than 19% of the world total electricity generation. Small scale hydro is in most case "run-of-river" with no dam or water storage and is cost effective system. India is endowed with rich hydropower potential but less than 25% has been developed or taken up for development. For a well planed and operated hydropower project, hydropower electricity generation technology is one of the cheapest in terms of the electricity generation costs possibly because the fuel (flowing water) is available without any direct cost. This relatively low electricity generation cost makes the hydropower, one of the best renewable energy sources [3, 4]. Being a clean, cheap and renewable source of energy, a lot of research is being put in to efficient utilization of water resources we have available on the planate [5].

Hydroelectric power plants are able to respond to power demand fluctuations much faster than other electricity generation systems such as thermal electric power stations.This makes hydropower a flexible energy conversion technology and also explain why hydroelectric power stations are sometimes used for peaking purposes. Further, hydroelectric power technology is a high efficient energy conversion process. The energy conversion system efficiency for a well-operated hydroelectric power plant can be around 85%, while the system efficiencies for thermal-electric plants are less than 50%. In India, hydropower projects having less than 25MW of installed capacity are defined as small scale projects. A classification by head refers to a difference in level between inlet (headrace) and outlet (tailrace) of a hydropower installation [6].

A "run-of-river "type hydropower project generate electricity from the river flow without significant impoundment. Water flow in the river depends on precipitation and ground water flow. These parameters may have substantial daily, monthly, or seasonal variations.

Our newly developed floating water wheel power generator system is a stand alone device which can be anchored and unanchored as and when needed in any open water body like canal and rivers. This portable unit can be shifted easily to the required place, as government doesn't allow a permanent installation in river and canal, it is also a costlier job

to have civil foundation in water for such standalone system so it is the need of the time; this is purely a Renewable hydro powered pollution free green power source of electricity. The floats are designed from FRP material to protect from humid and rust condition, the aerodynamically designed FRP floats minimize the thrust of flowing water on them and boosting the force of flowing water to drive water wheel at lower flow rate. The floats are mounted with hot dip GI chassis fitted with water wheel, gear and linear power generator. The entire floating generator was anchored using ropes tided on both sides of river bank.

The flowing water between the two floats rotates the water wheel which drives the AC variable frequency generator through gear, the generated AC power is used directly to store the battery bank, but this generator can also be used directly to the load. This floating generator can be anchored in any canal, flowing river or flowing stream. The generated power can be connected to load, if your load is continues like water pump for irrigation then this will keep on running for all the time but if your load is lighting load then you have to connect it to power controller for charging battery so that the generation of the day can be use to run more lighting load in night time, the direct lighting load without battery is not advisable because it will reduce your load to $1/3^{rd}$. The generation and harnessing of the power depends on the size of generator and flow rate of water. The system needs very low maintenance for a long period of time, because of low rpm generator and the type of quality materials used to fabricate this system, the generator used in the system is water proof with no carbon brush and no slip rings so the life of the generator system is very long with very low maintenance.

II. Fabrication and working

The base of this system is the Floats designed aerodynamically and fabricated from fiber resigns material specially to harness the maximum flow of the flowing water with maximum stability at the anchored place. The chassis of the system is fabricated from hot dip galvanized MS material to protect it from corrosion. The float is tied with the steel wire at the banks of the flowing water body. This system contains FRP blades [8] on shaft, which rotates due to flow of water. On the rotating shaft generator is coupled with gear having ratio of 1:10. The special designed generator is waterproof, brush less, slip-ring less and resin sealed generator with double sealed Z bearing in SS304 housing. The out put of generator is connected to load through power controller placed on the land side which is connected through water proof submersible cable. One such system installed on site is shown in figure – 1.

The low rpm generator is designed for a longer life without regular maintenance. To de-motivate the theft of generator from the river the material utilized in the device does not have resale value. The generator can be removed during flood situation in the river.

As the water flows, the fiber blades wheel rotates driving the gear which plunges the generator to produce variable AC power which is feed to battery bank for lighting load, power generation depends on the speed of the rotation of the wheel and ultimately on the speed of the flow of water.

Figure -1: Floating Power Generator on site

Water wheel suspending shaft chassis has a provision of adjusting the water submerging level of water wheel flaps so that the optimum result can be obtained from coupled generator. The attached generator has axial flux with linear drive; we designed this generator because due to low flow rate of large volume of water we get more thrust for linear drive compared to rotational power of high rpm and so the generator was designed accordingly. Cable with floats is laid down in water to bring electric power. This is purely a green power source, the system is maintenance free for a long period of time, because of the type and the quality of the materials used to fabricate this system, the life of the system can be up to 20 years.

3.1. Water wheel Technical Details

Diameter of water wheel : 07'
Flap size : 04'X 02'
Number of flap : 12
Number of float : 0 2 (7'X2'X2')
Rotation of water wheel at flow of 4.2 cusec: 04 rpm

3.2 Information of Water wheel

Blades: 12 nos.
Time for one full rotation of water wheel is 15 second
Volume of water between two blades: 5.24 cub. ft (submerging of blades is adjustable)
There are 12 blades, the single rotation time is 15 second the water wheel passes the water of 5.24 cub. ft X 12 Blades = 63 Cub. ft / 15 second
63 cub.ft. ÷ 15second = 4**.2** Cusec
(This flow rate observed at Mahi river site Kherda, Gujarat State)

3.3. Generator Details

Number of generator attached to the system : 01
Type of generator : PM
brush less, AC. Gear Ratio : 1:10
Stroke of generator at flow of 4.2 cusec: 40 stroke/ min
Drive : Axial Flux
Capacity of generator : 500 watt/hr

III. Results and Discussion

Flow of Water In Cusec	Output Power in Watt
3.5	60
4	80
4.5	110
5	140
5.5	185
6	250

Table -1

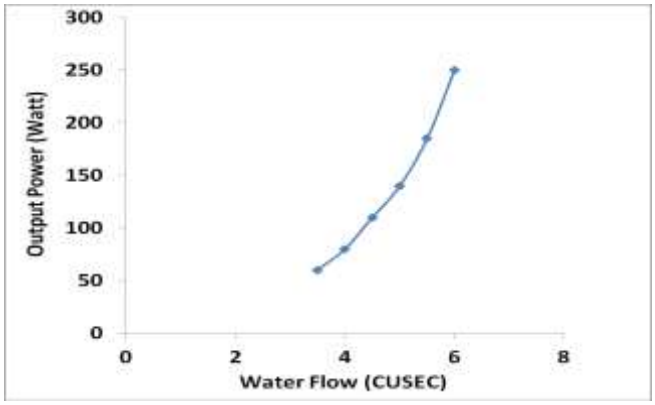

Figure – 2: Power Curve

Observations were made during the on-sight testing of our floating Generator system. The observations are tabulated in table -1 and respective graph is shown in figure -2. Based on the observations an approximate estimation was prepared for a generation of a day. The calculation is done for an average flow rate of water between floats is 4.4 cusec and the following technical specifications.

As per the above specifications, an average amount power generated in a day was 2.4 KW/hr at an average water flow rate of 4.4 cusec

IV. Conclusion

This floating power generator is an efficient device compare to the other conventionally available ones. It is a convenient and cost effective system as it does not requires any permanent installation having civil work. It can be seen that the output power can be increased by increasing the size of water wheel blades. The output power is increases exponentially with flow of water. Also the efficiency of the system can be increased with larger size.

References

[1.] Chiyembekezo S. Kaunda,[1] Cuthbert Z. Kimambo,[2] and Torbjorn K. Nielsen[1] ISRN Renewable Energy, Vo. 2012 (2012), Article 730631
[2.] USA Department of Energy, Hydropower Technology Information. Basic Energy Information, http://www1.eere.energy.gov/water/hydro_plant_types.html, 2012.
[3.] A. Brown, S. Muller and Z. Dobrotkova, International Energy Agency (IEA) information paper November 2011

[4.] "Renewable energy technologies—cost analysis series, volume 1: power sector," Paper 3(5) (2012)
[5.] Savale P.A. "Role of Renewable Energy Resources in Rural Development of India" Journal of Environmental Research and Development, Vol.10 No. 1, July-September -2015, p.124 - 138
[6.] International Renewable Energy Agency (IRENA) "Renewable Energy Technologies - Cost Analysis Series, Vol.1: Power Sector", IRENA Working Paper 3/5, 2012
[7.] Shreelal.N.Jha and J.R.Gandhi, Renewable Energy Based Floating Aeration and Ozonation System for Rivers and Canals, *J. Environment Res. Develop*. 5(4), 661-663,(2011)