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DESIGN AND MANUFACTURING OF BOX TYPE TURBINE

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ABSTRACT

An environmental protective electrical power generating system is the need of this generation. This project relates to an innovative approach for generating electrical power utilizing the flow of liquid, as the energy source for operating turbines which in turn, drive electrical power generators. In urban areas, we see a lot of huge residential structures. Residents in these structures consume a huge amount of water. All the water used in various chores is exhausted through waste water pipeline into drainage pipeline. The water running down the waste water pipeline possesses kinetic energy which is wasted by discharging into drain. In this project we employ a turbine and generator arrangement in the waste water pipeline so that we could utilize the energy of water that otherwise was wasted. The objective is to create self-sustainable system to generate electricity with the help of the kinetic and pressure energy of the flow of water which runs the turbine assemblies including spherical turbines coupled to generator, sequentially located in the subsequent channel of water. In this project activity, we will be studying the required process parameters, design requirements, operational parameters, cost of implementation and power generating capacity of a turbine in-pipe water power generator for ten households in a street.

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I. INTRODUCTION

As India is progressing its power needs are increasing day by day. The demand in urban regions is high which causes several power cuts in rural areas. With rampant electricity shortages in outlying villages and remote areas, it would be ideal to exploit the micro-hydro potential of water pipes to produce electricity. No water is wasted here since there is no alteration in the pipe dimensions or water flow. However the use of small turbines generating ½ to 1 kW power is desired and such a turbine needs to be designed and put to practical use. This alternate source of power would be available all the time.

Water Pipe line network is vast and extensive in areas where farming is done. Pipes are used in conveying water from reservoirs and dams to different parts of the country. This setup aims at using the force of the moving water in pipes to generate electricity that can be either stored or immediately used in nearby areas. This paper shows the technique used for the same. Currently hydro power from rivers and oceans are only tapped. We have included power ratings that were recorded for models of several sizes and water pressures.

Water possesses a lot of energy which is in the form of kinetic and pressure energy flowing vertically through pipe. The turbines working till date occupies a large amount of cross sectional area in pipe. When the area reduces, it converts pressure energy into kinetic energy which results in increase of velocity. This velocity of water is utilized in in-pipe turbine and used for generating electricity. The in-pipe water generator is an electrical power generating pipeline which can produce renewable energy completely clean, reliable low cost electricity.

The in-pipe turbine is setup in the pipe; the flowing water strikes the spherical blades of the turbine and leads to the rotation of it. The vertical shaft of the turbine is coupled to the generator which generates electricity and stores in batteries.

Fig.1: Box Pipe Turbine System Setup

With the rapid development of industry, commerce, and standards of living, the energy requirements of various nations are increasing significantly. Currently, the primary sources of global energy supply are oil, coal, and other fossil fuels. Due to the depletion of natural resources, the development of green energy technologies has become a vital topic in national development and academic research. Considering that household water from urban buildings is discarded after use, converting the energy from household water into electricity is the focus of this study.

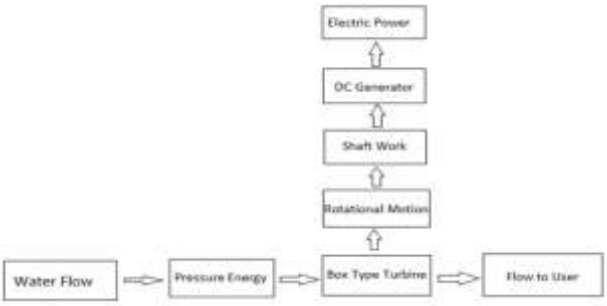

Fig.2: Basic flow chart

II. LITERATURE SURVEY

[1] Peter Bachant and Martin Wosnik In this study we measured the power output from and drag force on a cylindrical-helical and a spherical-helical cross-flow turbine in a towing tank, motivated by the scarcity of data in the literature for helical turbines. Results showed that in a low-blockage tow tank or channel environment the cylindrical GHT outperformed the spherical LST in terms of power coefficient, which was accompanied by a higher drag coefficient. The GHT reached a maximum power coefficient of 0.35 at l ¼ 2.3 where the LST reached a maximum power coefficient of 0.24 at l ¼ 2.2. These results were not surprising given that the LST is designed for higher blockage flow conditions. We applied a simple momentum theory-based blockage correction to the data, but did not have a way to evaluate its effectiveness. The correction may include errors due to the limitations of one-dimensional momentum theory, e.g., neglecting free surface deformation, and the assumption of uniform flow at each cross-section of the channel. The fact that our drag coefficients were slightly above unity, and the fact that momentum theory breaks down in this case also warrant further investigation on the effectiveness of the correction method employed. However, the results presented here provide a useful reference case for comparing to other methods. Future effort should be dedicated to improving blockage corrections, such that they may be used in both directions, i.e., low blockage experimental results could be used to predict performance in a high blockage case.

[2] C.P. Jawahar and Prawin Angel Michael The present review is a comprehensive one on the research progressmade in the turbines in the published literature, used for micro hydelpower applications. The present work also highlights the availability ofturbines with the manufacturers both in India and abroad. The salientfeature that can be drawn from this work is that efforts have been madeby researchers to enhance the efficiency of the turbine used for microhydro resources. However, there is a research gap from the viewpointof design of turbines that large powered turbines are currently beingused for low power generation in hydro power plants.This research gap presents a great challenge to the researchers asturbines which are designed to cater to these specific needs only wouldbe cost effective and reliable for the implementation in hydro powerplants. Based on the promising results presented in the literature, itseems that the research activities on the design of turbines for specificneeds would increase in future. In recent years design of micro hydro power plants has been examined by various groups throughout the world due to its merits of offering better performance than the conventional fossil fuels to meet the energy need. Considering the portfolio of energy, the improvement of hydro power will partake in decrease of greenhouse gas emission and better malleability in the grid operation. This inquisition study examined the turbine of small hydro plant from the perspective of efficiency improvement while maintaining the global cost of the project per kW arrive within confined range. In this documentation an extensive epitomize of turbines available in India and other countries has been described. The selection of head, runner diameter along with its accomplishment are also presented. This study reveals an improvement for the design of turbines while comparing the functioning of other existing system for similar operating condition. Since most power plants now-a-day's use large turbines for the low power production, losses and overall cost increases, hence this survey will be helpful to reduce the cost of the plant.

[3] Tarik EfeKendir and Aydogan Ozdamar Load changes occurring in water turbines often result in pressure waves at hydroelectric power plants. Load reduction or the sudden closure of the turbines causes high pressures to build on the penstock similarly to a water hammer. This pressure can cause damage to components of the power plant. Surge tanks are used to prevent these problems. For two power plants operating at similar flow rates, diameters and lengths of the penstocks, and diameters and lengths of the tunnels, the surge tank with a smaller volume is the most economically viable. The purpose of this study is to obtain an optimised surge tank configuration to reduce the cost of a hydropower plant in the future. Two methods were used for determining the optimum tank form: characteristic and finite difference methods (for the rigid and elastic method/approach). In addition, frictional losses and velocity loads inside the pipes and surge tanks were examined for different surge tank configurations in this study. In this paper, economically optimised surge tanks used for hydroelectric power plants were investigated. For this purpose, four basic surge-tank systems were numerically investigated. A inclined straight V-type surge tank was found to be the most optimum configuration. Both rigid and

elastic water column calculation methods were used for this study. Following this approach, an experimental model of a hydroelectric power plant with an optimised surge tank was created based on the model. This experimental model and prototype were numerically investigated. Finally, the results were compared and were found to be in agreement. Environmentally friendly renewable energy sources can be divided into six main categories: geothermal, hydraulic, wind, wave, biomass, and solar energy, all of which can be converted into electrical energy. It is thoughtthat by the year 2050, 70% of the world's energy consumption will be provided by renewable resources. These resources are necessary because of the environmental pollution caused by the use of fossil fuels. Additionally, fossil fuels are becoming increasingly scarce, which will lead to their eventual extinction. Hydroelectric power plants, where hydraulic energy is obtained from renewable energy sources, are environmentally friendly, clean, have a renewable supply (above 90%), low energy costs, high longevity (200 years), a short amortisation period (5e10 years), very low operating expenses (0.20 cent/kwh), are not dependent upon foreign energy sources, meet peak demands and do not have fuel expenses.

[4] J.A. Laghariet. al Mini hydro schemes can be adapted as the most economical option for rural electrification than any other available renewable energy sources such as solar and wind. New designs in propeller turbine and alternative option such as PAT, induction generator and intelligent controllers can successfully make these schemes more economical and cost-effective options. However, the successful operation of these schemes greatly depends upon government efforts and subsidy initiatives. Private sector participation should also be encouraged through a combination of bank loans and government incentives. It is expected that implementation of mini hydro schemes with new cost-effective designs will result in growth of local industries, which will lead to overall economical and social development in developing countries. Implementations of mini hydro schemes with conventional hydraulic, electrical equipment's and controllers have proven very expensive and uneconomical. Many developing countries that are in need of rural electrification have encountered economical problem when setting up these mini hydro schemes. To address this problem, alternative options and new designs of these equipment's have been explored by many researchers around the world. The application of these new designs would reduce the overall cost of mini hydro development and would help in making it a cost effective technology. These new designs will also help developing countries to provide electricity to rural areas or remote regions where interconnection of transmission line from the electrical grid is uneconomical. The new designs can also be an enabling factor in boosting up electricity generation using a renewable energy source. This paper provides survey of all these alternative options and new designs in the controller, hydraulic turbine and generators that have been implemented in different countries of the world. Owing to depletion of fossil fuel and environmental pollutions it produce, many utilities have switched their generation sources to renewable energy. Among the renewable energy sources, mini hydro has gained the highest attraction due to its environment friendly operation. It can be the best economical option for rural electrification in developing countries. However, their implementations have been proven uneconomical due to involving of conventional expensive equipments such as hydraulic turbines, electrical equipment and controllers. Since these conventional equipments are designed for large hydro power plant, their usage may not suitable for mini hydro schemes.

[5] Ratchaphon Suntivarakornet. al This study developed a horizontal spiral turbine which had the feature of spiral blades around a turning axle. The turning axle was placed parallel to the direction of the water flow. The blades' radius expansion was designed by applying the Golden Ratio function. The experiment analyzed the optimal ratio of the diameter of the turbine (D) to the length of the turbine (L) by developing 2 ratio models (D/L) of 1/2 and 2/3 to test with 2-6 stranded turning turbines with a stable number of blades. Results at different velocities in the laboratory showed that the optimal number of blades were 3 with the ratio of the turbine diameter to turbine length (D/L) of 2/3. After creating a prototype turbine to compare electric power and efficiency between the prototype and propeller turbines, at a water velocity of 1 m/s and 1.5 m/s the prototype had more electric power and efficiency of 45.5% and 21.46%, respectively. Horizontal spiral turbines were suitable for low speed of water. The shape of strands of the turbine are capable of generating energy from low water velocity; therefore, it is appropriate to utilize it with water resources or irrigation canals which have a water velocity of less than 2 m/s. This study aimed to develop horizontal spiral turbines for generating electricity by designing spiral turbines using the Golden Ratio function. The study analyzed the impact of the diameter-length ratio and the number of the turbine's blades (2 - 6 blades) on the torque of turbine. Then the prototype of the spiral turbine with a 0.6 meter diameter and 0.9 meter blade was designed to generate electricity with a water velocity of 1, 1.5 and 2 m/s in order to compare to the propeller turbine which had an identical diameter size. The results indicated that a 3-bladed spiral turbine with a 2/3 of diameter-length ratio of turbine had maximum torque at 1 m/s of water velocity. The spiral turbine produced an optimal efficiency of 48% which was 15% higher than that of the propeller turbine.

III. DESIGN AND CALCULATION

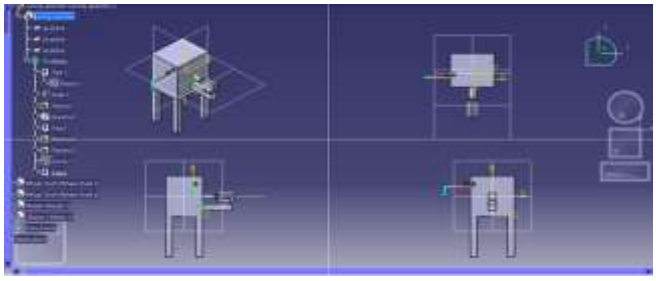

Fig 3. Four side view

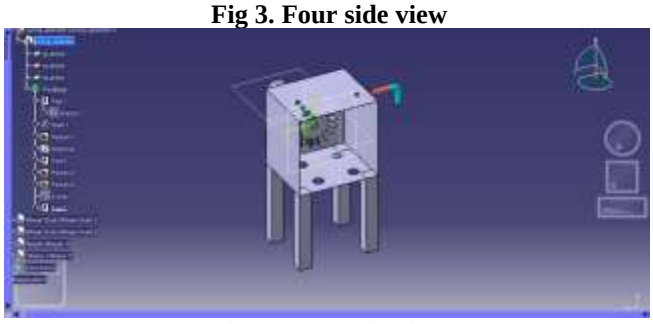

Fig 4. Isometric view

1. Design of Frame:

Frame design for safety FOR 25*25*3 mm Square Hollow mild steel channel

b = 25 mm, d= 25 mm, t = 3 mm.

Consider the maximum load on the frame to be 50 kg.

Force= W * g

= 50 kg * 9.81

= 490.5 N

Max. Bending moment = force*perpendicular distance of Square Bar Length

= 50*9.81*450

M = 220725 N-mm

We know,

$$M / I = \sigma b / y$$

Where,

M = Bending moment

I = Moment of Inertia about axis of bending that is; *Ixx*

y = Distance of the layer at which the bending stress is consider

(We take always the maximum value of *y*)

E = Modulus of elasticity of beam material.

I = bd3 /12

= 25*25^3 / 12

I = 32552.08 mm4

σb = My / I

= 220725*12.5 / 32552.08

σb = 84.76 N /mm2

The allowable shear stress for material is σallow = Syt / fos

Where Syt = yield stress = 210 MPa = 210 N/mm2

And FOS is factor of safety = 2

So σallow= 210/2 = 105 MPa = 105 N/mm2

Comparing above we get,

σb <σallow

i.e 84.76 < 105 N/mm 2

So design is safe.

IV. CONCLUSION

A prototype for the proposed approach was developed to an environmental protective electrical power generating system is the need of this generation. This project relates to an innovative approach for generating electrical power utilizing the flow of liquid, as the energy source for operating turbines which in turn, drive electrical power generators. Generate clean, reliable, low cost electricity; Eliminate dependency over fossil fuel ,as the waste can be recycle as well as pollution of river, sea and environmental balance can achieved.

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