Abstract:
Among several options for rural electrification, Pico hydropower has a special place for its ability to generate energy continuously provided the rated flow. The type of plant to be employed for a particular site is determined considering portability, modularity and of course cost of the system. Among several pico-hydro options, Gravitational Water Vortex Hydropower Plant (GWVHP) is a new addition in the family of ultra-low head hydropower systems and is one of the emerging technologies that have special attention of academicians globally. In GWVHP, an artificially formed vortex rotates a co-axially placed turbine coupled with a generator thus producing electricity. Starting with the development of GWVHP in context of Nepal, this study details about runner development for the conical basin for GWVHP. As commonly perceived, for any hydroelectric projects, the turbine runner forms the heart and has complex geometry. Considering this fact, to be able to fabricate the whole system in Nepal, a study on the simple robust runner is commenced. Three different runners are formulated and are studied from the experimental and computational approach. Blade geometry for each runner is formulated considering impulse type runner. The maximum efficiency for a runner is seen to be about 50%. One-way FSI simulation using ANSYS Fluent and ANSYS Static Structural is established which shows that for the turbine system runner tip is the most deformed area.

I. INTRODUCTION

Hydroelectric Power -- what is it?
It=s a form of energy … a renewable resource. Hydropower provides about 96 percent of the renewable energy in the United States. Other renewable resources include geothermal, wave power, tidal power, wind power, and solar power. Hydroelectric powerplants do not use up resources to create electricity nor do they pollute the air, land, or water, as other powerplants may. Hydroelectric power has played an important part in the development of this Nation=s electric power industry. Both small and large hydroelectric power developments were instrumental in the early expansion of the electric power industry. Hydroelectric power comes from flowing water … winter and spring runoff from mountain streams and clear lakes. Water, when it is falling by the force of gravity, can be used to turn turbines and generators that produce electricity. Hydroelectric power is important to our Nation. Growing populations and modern technologies require vast amounts of electricity for creating, building, and expanding. In the 1920=s, hydroelectric plants supplied as much as 40 percent of the electric energy produced. Although the amount of energy produced by this means has steadily increased, the amount produced by other types of powerplants has increased at a faster rate and hydroelectric power presently supplies about 10 percent of the electrical generating capacity of the United States. Hydropower is an essential contributor in the national power grid because of its ability to respond quickly to rapidly varying loads or system disturbances, which base load plants with steam systems powered by combustion or nuclear processes cannot accommodate. Reclamation=s 58 powerplants throughout the Western United States produce an average of 42 billion kWh (kilowatt-hours) per year, enough to meet the residential needs of more than 14 million people. This is the electrical energy equivalent of about 72 million barrels of oil. Hydroelectric powerplants are the most efficient means of producing electric energy. The efficiency of today=s hydroelectric plant is about 90 percent. Hydroelectric plants do not create air pollution, the fuel=falling water--is not consumed, projects have long lives relative to other forms of energy generation, and hydroelectric generators respond quickly to changing system conditions. These favorable characteristics continue to make hydroelectric projects attractive sources of electric power.

II. HOW HYDROPOWER WORKS?

Hydroelectric power comes from water at work, water in motion. It can be seen as a form of solar energy, as the sun powers the hydrologic cycle which gives the earth its water. In the hydrologic cycle, atmospheric water reaches the earth=s surface as precipitation. Some of this water evaporates, but much of it either percolates into the soil or becomes surface runoff. Water from rain and melting snow eventually reaches ponds, lakes, reservoirs, or oceans where evaporation is constantly occurring. Moisture percolating into the soil may become ground water (subsurface water), some of which also enters water bodies through springs or underground streams. Ground water may move upward through soil during dry periods and may return to the atmosphere by evaporation. Water vapor passes into the atmosphere by evaporation then circulates, condenses into clouds, and some returns to earth as precipitation. Thus, the water cycle is complete. Nature ensures that water is a renewable resource. Generating Power In nature, energy cannot be created or destroyed, but its form can change. In generating electricity, no new energy is created. Actually one form of energy is converted to another form. To generate electricity, water must be in motion. At facilities called hydroelectric powerplants, hydropower is generated. Some powerplants are located on
rivers, streams, and canals, but for a reliable water supply, dams are needed. Dams store water for later release for such purposes as irrigation, domestic and industrial use, and power generation. The reservoir acts much like a battery, storing water to be released as needed to generate power. The dam creates a head of water which is used to drive turbines. A pipe (penstock) carries the water from the reservoir to the turbine. The fast-moving water pushes the turbine blades, something like a pinwheel in the wind. The waters force on the turbine blades turns the rotor, the moving part of the electric generator. When coils of wire on the rotor sweep past the generator=s stationary coil (stator), electricity is produced. This concept was discovered by Michael Faraday in 1831 when he found that electricity could be generated by rotating magnets within copper coils. When the water has completed its task, it flows on unchanged to serve other needs.

III. LITERATURE REVIEW

The use of hydropower energy for energy generation is one of the oldest methods for harnessing renewable energy. Use of renewable energy is an essential ingredient of socioeconomic development and economic growth. Renewable energy sources such as wind energy, tidal energy etc. is abundant and can help in reducing the dependency on fossil fuels. With increased concern for environment now days led to the research for more environment friendly sources of energy and with this considerations wind energy can be considered as a viable option in this regard. Different configurations of wind turbines such as horizontal axis wind turbine and vertical axis wind turbines are mainly used for energy extraction. Horizontal axis mainly used in large scale applications and thus its implementation is generally a concern due to huge installment setup and initial cost; whereas vertical axis wind turbines offer promising solution for smaller ruler areas or medium sized residential spaces. Energy generation from wind turbines will surely be affected by geometry of blade it is using and its orientation in turbine. For effective use of turbine both parameters should be optimally set and determined. This review work focuses on various stages for design and development of highway vertical axis wind turbine which will studies various parameters such as general wind energy scenario, different available energy extraction methods, design and aerodynamic performance analysis of highway vertical axis wind turbines. Project work will include design parameters of highway vertical axis turbine blades considering different parameters such as geometry orientation in assembly. Literature Survey of Vertical Axis Wind Turbines The literature review pertaining to the pure experimental aspects of wind turbine and the literature related to experimental methods. D.A. Nikam et al. analyzed the on design and development of vertical axis wind turbine blade. This paper explains that the wind mill such as vertical and horizontal wind mill is widely used for energy production. The horizontal wind mill is highly used for large scale applications which require more space and huge investment. Whereas the vertical wind mill is suitable for domestic application at low cost. The generation of electricity is affected by the geometry and orientation of the blade in the wind turbine. To optimize this by setting the proper parameter for the blade design. The experimental result indicates that the blade plays critical role in the performance and energy production of the turbine. The optimized blade parameter and its specification can improve the generation of electricity. Altab Hossain et al. investigated the design and development of A 1/3 scale vertical axis wind turbine for electrical power generation. In this paper the electricity is produce from the wind mill by wind power and belt power transmission system. The blade and drag devices are designed in the ratio of 1:3 to the wind turbine. The experiment is conducted by different wind speed and the power produced by the windmill is calculated. The experimental result indicates that 567 W power produced at the speed of 20 m/s while 709 W power produced at the speed of 25 m/s. From this, the power production will increases when the velocity is high. M. Abid et al. analyzed the design, development and testing of a savonius and darrieus vertical axis wind turbine.

IV. OBJECTIVE AND SCOPE OF STUDY

Paper gives the brief idea about wind generation and the proposed fuzzy logic MPPT technique which can extract maximum power from wind. And trends related to time and speed. The proposed method is completely independent of the properties of turbine and generator. This new MPPT doesn’t need the wind speed measurements but the voltage and current load is measured. So this method is not using any mechanical sensor which will result in reduced costs and increased reliability of the system. Moreover this control strategy is comparatively easy, and has high practical value.

V. WORKING PRINCIPLE

It is the device which is used in hydroelectric power plant for the purpose of flow of water. The water flow of from dam towards turbine with the help of penstock. It converts the potential energy of water into kinetic energy. The penstocks are made up of cast iron or concrete material. The penstock is hollow in nature & of large diameter. The passage of flow water from dam is called Tunnel or Intake. Water ways may be in the form of canal or tunnel or penstock. OR It is used to carry the water from water reservoir to surge tank. It is a device which is connected in between dam & power house. It is of vertical type, at the time of starting of hydro-electric power plant, near power house valve is closed. Then water flows from dam towards turbine & filled the surge tank, after that valve is open either manually or automatically, water flow towards turbine when valves are open & turbine or prime mover starts to rotate. This sequence is follow to avoid or to prevent the turbines against water hammer effect.

VI. ADVANTAGES, DISADVANTAGES AND APPLICATIONS

ADVANTAGES:
1. It requires simple maintenance cares
2. Checking and cleaning are easy, because of the main parts are screwed.
3. Handling is easy.
4. Manual power not required
5. Repairing is easy.
6. Replacement of parts is easy.

DISADVANTAGES:
1. Rotor power output efficiency of a Darrieus wind energy conversion system is also somewhat lower than that of a conventional horizontal rotor.
2. Because a Darrieus rotor is generally situated near ground proximity, it may also experience lower velocity wind compared to a tower mounted conventional wind energy conversion system of comparable projected rotor disc area. This may yield less energy output.
3. Properly the biggest disadvantage with vertical axis machines is that far less is known about them than horizontal axis ones. This handicap is rapidly being removed. Initial cost is high.

APPLICATIONS
This System can effectively be implemented in all hydropower plant.

VII. CONCLUSION
This project work has provided us an excellent opportunity and experience, to use our knowledge. We gained a lot of practical knowledge regarding, planning, purchasing, assembling and machining while doing this project work. We feel that the project work is a good solution to bridge the gates between institution and industries. We are proud that we have completed the work with the limited time successfully. The “hydro power generation” is working with satisfactory conditions. We are able to understand the difficulties in maintaining the tolerances and also quality.

VIII. REFERENCES