A Review on Generation of Electrical Energy by Using Wind Energy

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Abstract- The paper aims at developing a system which makes use of wind energy for rural electrification Wind energy is treated as renewable source of energy. Wind energy has been used since the earliest civilization to grind grain. Pump water from deep wells, and power sailboats. Wind-mills in pre-industrial Europe were used for many things, including irrigation or drainage pumping, grain-grinding, saw milling of timber, and the processing of other commodities such as spices, cocoa, paints and dyes. Before the US installed an infrastructure of electricity wires, both water-pumping wind mills and small wind electric turbine ("wind chargers") were vital to farming and developing the American Great plains and west. In recent decades the industry has been perfecting the wind turbine to convert the power of wind into electricity. The wind turbine has many advantages that make it an attractive energy source, especially in parts of the world where the transmission infrastructure is not fully developed it is modular and can be installed relatively, quickly, so it is easy to match electricity supply and demand. The fuel-the wind- is free and plentiful. Which eliminates or reduces the need to purchase, ship, and store expensive fuel. It is flexible with the power generated, household use can appliances, such as lighting and refrigeration. Schools can use computers and televisions and industries can axes reliable power source. Perhaps most importantly the generator does not produce any harmful emissions in the process of generating the electricity, unlike many other generation sources.

Indexed Terms- Wind power, electricity, generation, wind turbines, Wind mill, and Renewable energy.

I. INTRODUCTION

The generation of wind energy on an industrial scale is relatively new, and the performance issue has not been thoroughly studied. Besides the electric utility scale applications, the proposed solution can be scaled down for collective optimization of residential wind turbines (KW range) dispersed over large areas. The less sophisticated sensory capability of household turbines will be mitigated by data access from external sources (e.g., public). A wind turbine enters a power grid with its strengths and weaknesses without much consideration of the grid requirements. For the wind power to become an equal partner with the energy generated from traditional and other sources, it must consider the requirements of the electric grid.

Wind power does not need to replicate the behavior of existing energy generating modes; however, it does need to meet a predefined set of specifications. One of the weakest points of wind power generation is the poor predictability of wind farm performance. Though numerous metrics can be used to measure performance, the most important one is the accuracy of the output prediction. The wind farm should be able to predict the amount of energy produced on different time scales, e.g., minutes *to* days in the quest of becoming a wind power plant. The power generated by wind turbines changes due the continuous fluctuation of wind speed and direction.

This causes problems for power system schedulers and dispatchers, as thus far tools for accurate prediction of wind energy production have not been developed. Highly accurate, localized, and timely prediction of wind parameters at the turbine and wind farm level is a key component in optimizing wind farm performance predictive models using local (wind turbine specific) and global (area specific) data.

The analysis of such a wide range of wind farm data has not been reported in the literature. The specific data parameters and their predictive power can be determined by a comprehensive analysis with datamining algorithms. Wind power performance has been partially addressed in the literature. Neural networks (generally one type – the back propagation network) and stochastic approaches appear to dominate the past research.

Energy is the input to drive and improve the life cycle. Primarily, it is the gift of the nature to the mankind in various forms. The consumption of the energy is directly proportional to the progress of the mankind. With ever growing population, improvement in the living standard of the humanity, industrialization of the developing countries, the global demand for energy expected to incurrence rather significantly in the near future. The primary source of energy is fossil fuel, however finiteness of fossil fuel reserves and large scale environment degradation caused by their wide spread use, particularly global warming, urban air pollution and acid rain, strongly suggests that harnessing of non-conventional, renewable and environment friendly energy resources is vital for steering the global energy supplies toward a sustainable path.

Wind turbines have come a long way since their original use in mechanical applications. In a wind power generating system, it is required that the generator tracks a prescribed torque-speed profile. Variable speed operation is introduced to gain high efficiency in the generating system. Otherwise the generating system cannot capture the largest possible energy available from the wind and the blades of the wind turbine will subject to torsional stress and windage friction. Vertical axis turbine technology has been growing at an increasing rate.

There are countless designs that are made suitable for almost any type of area so long as the amount of wind is sufficient. It has gotten to a point where vertical axis wind turbines are readily available for homeowners either through purchase or by do-it-yourself design. Unlike vertical-axis wind turbines, most horizontal axis wind turbines are not suitable for residential uses. The velocity of the wind is the most important factor for power production as the cube of the velocity is directly related to power production. For this reason, horizontal axis wind turbines used for commercial energy production are extremely tall so that they are able to capture the faster-moving, laminar air currents. The size of the cross-sectional area is also important as it is directly related to the power produced, which explains the large rotor on each horizontal axis turbine.

This portion of the paper discusses issues and arguments behind the need for renewable energy and a short history of wind power. Renewable energy is being highly sought now, more than ever, as fossil fuels are being depleted and the high costs are ever increasing to search deeper into the earth and reach out to more foreign areas for energy sources. This is especially true in The United States which houses 4.7% of the world's population, yet uses nearly 25% of the world's energy each year. Currently the U.S. imports one half of the fossil fuel energy it uses annually, costing nearly $65 billion. Fossil fuel reserves in the U.S. are rapidly depleting, and it very costly if the nation had to rely solely on imported fossil fuels.

II. NEW GENERATION SCHEME OF WIND POWER PLANT

Utilization of wind power by its transformation into electric one by wind power plants (WPP) is connected with certain difficulties arisen from irregularity and inconstancy of wind stream as energy carrier. Also, it should bear in mind that two machines properties of which are not suit for joint work in full measure join in WPP. So, for example, windmill makes maximal power at variable rotational frequency. At the same time, electric generator, as rule, is intended for operation at constant rotational frequency. These complications and variances bring necessity to find new solutions of WPP devices including its electric parts.

An analysis of WPP modes working at fixed rotational frequency shows that most appropriate variant of WPP is one consisting two electric generators according to low and high speeds of wind stream. Especially, it is actually for asynchronous WPP. It should be noted that many firms – producers of WPP, especially European ones, prefer WPP with asynchronous generators. They think that asynchronous generators in the best way meet requirements of WPP operation characterized by drastic and frequent changes of wind speed; there is noted their great stability, simplicity of lead-in parallel work and etc. As it is known, most time of year WWP works at low speed of wind, accordingly at less power output than installed capacity. Use of two generators for different rotational frequencies allows to increase efficacy of wind power transformation at low speeds.

However, usage of asynchronous generators in WPP is connected with necessity to consume reactive power from network system. It should be noted that energy datum of asynchronous generator become worse at low speeds of wind. The reduced facts were conclusive for firms producers at choose of WPP variants with two asynchronous generators including WPP with two-speed asynchronous generator. It is obvious that although a generator with smaller power uses smaller reactive power, nevertheless the mentioned defect remains especially at operation of generator with high power capacity. An asynchronous machine of smaller power (attitude of generator powers is 1:5 on average) makes with phase-wound rotor. Some functions are charged on this machine. First, it is used for soft electric start of WPP (at confined starter current). Second, it works as generator in synchronous mode at low speed of wind. Excitation is realizing by constant current need to rotor winding according to special scheme and is being regulated for keeping of cosf=1. Third, at high speed of wind, when big generator works, shaft of machine with small power disconnects from reducer shaft by means of special sleeve and it moves into synchronous compensator mode. The installed capacity of this machine is enough to compensate reactive power of big generator. For the following reasons, utilization of luch compensation scheme for asynchronous WPP with high power is more profitable than utilization of static condenser:- opportunity of full automation of reactive power regulation process; - opportunity of voltage and frequency stabilization, and it's especially important in the case of weak connection of WPP with power system; - much less overall dimensions and price. Magnetic slip coupling can be used as a sleeve for disconnection of shafts of smaller generator and reducer. To reduce mass and overall dimensions it is enough to have a sleeve with 2,5% slip. Along with stated function a sleeve can be also used for stabilization of rotational frequency of small generator.

III. SYSTEM DESIGN

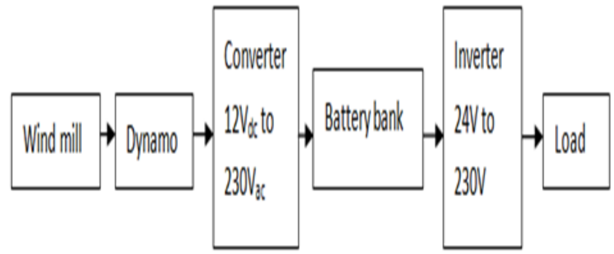

Fig1.System design.

A. Blades Of Windmill:-

The blades were handmade and it is challenging to create a perfect airfoil shape as the blades twists. It is easy to get irregularities in the shape between the three blades. Getting the correct $Ø_{p,\theta}$ is another challenge and the way we had chosen to attach the blades to the hub made it impossible to change the position afterwards. This is likely the biggest source of vibrations as we suspect that one of the blades ended up with a different $Ø_{p,\theta}$ to the other blades.

B. Dynamo For Windmill:-

Three phase power there is 1.33 magnets for every coil. Therefore, we chose to have 6 coils and 8 permanent magnets. Then comes the winding of the coils and we chose to have a star connection in order to get a 3-phase power. Figure shows the winding used in the generator.

In an ideal generator (i.e. same coils), $V_a = V_b = V_c$ and also $I_a = I_b = I_c$

C. Airfoils and hub

According to the calculated profile of airfoils, the design can start. For this prototype of wind turbine, we decided to make a turbine with three blades. The three blades are designed separately and assembled at the end on the hub in order to simplify the construction. For the construction of the blades and the hub we have used a material called ebazell 260 which is well workable and dimensionally stable. For the manufacturing of the blades, a band saw is used to rough the shape of the blade. Then, they are sanded to refine their shape until the final form. At the end, the three blades are fixed on the hub. The chord length of the root section is made to fit the hub. To strengthen cohesion of the rotor and blades, we decided to make two holes in each blade and in the hub as seen in figure. Then, we used metal rods coated with glue to attach the three airfoils onto the hub.

D. Magnets

As mentioned above, permanent magnets can be used to create the magnetic field. For small wind turbines such as the one that we have built, permanent magnets have one big advantage: wires are not needed to create the magnetic field. The permanent magnets used are made of Neodymium N42 which means that B_{peak} ≈1:3T.

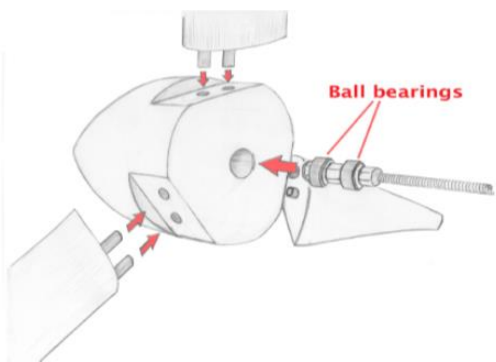

Fig2. Assembly of the airfoils and the hub.

E. Coils

The shape of the coils can have an impact on the current produced. However, in this project we made circular coils only for practical reasons and also it is commonly used in literature. These coils were arranged in a circle so that the magnets move in front of their center.

F. Design of the generator in an alternator producing

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In an ideal generator (i.e. same coils), Va = Vb = Vc and also Ia = Ib = Ic

IV. SCOPE OF WIND IN RENEWABLE ENERGY SOURCES

RES are those energy sources which are not destroyed when their energy is harnessed. Human use of renewable energy requires technologies that harness natural phenomena, such as sunlight, wind, waves, water flow, biological processes such as anaerobic digestion, biological hydrogen production and geothermal heat As the sun heats up the Earth unevenly, winds are formed. The kinetic energy in the wind can be used to run wind turbines, some capable of producing 5 MW of power. The power output is a function of the cube of the wind speed, so such turbines generally require a wind in the range 5.5 m/s (20 km/h), and in practice relatively few land areas have significant prevailing winds. Luckily, offshore or at high altitudes, the winds are much more constant. There are now many thousands of wind turbines operating in various parts of the world, with utility companies having a total capacity of 59,322 MW. This has been the most rapidly growing means of electricity generation at the turn of the 21st century and provides a complement to large-scale base-load power stations. Most deployed turbines in the EU produce electricity about 25% of the time (load factor 25%), but under favorable wind regimes some reach 35% or higher.

Globally, the long-term technical potential of wind energy is believed to be 5 times current global energy consumption or 40 times current electricity demand. This would require covering 12.7% of all land area with wind turbines. This land would have to be covered with 6 large wind turbines per square kilometer. Offshore resources experience mean wind speeds of ~90% greater than that of land, so offshore resources could contribute substantially more energy. Wind strengths vary and thus cannot guarantee continuous power. Some estimates suggest that 1,000 MW of wind generation capacity can be relied on for just 333 MW of continuous power. It is best used in the context of a system that has significant reserve capacity such as hydro, or reserve load, such as a desalination plant, to mitigate the economic effects of resource variability. It is particularly useful for India having such a long coast line and high altitude areas.

V. CONCLUSION

Our objective of this paper was to start of with a design visually resembling a traditional Horizontal Axis Wind Turbine wind turbine and be creative with the design and technical solutions within this framework. We feel that we succeeded in designing a wind turbine matching these objectives. However, the results achieved at the wind tunnel testing were lower than expected. The rotor coming off did most likely impact the result, but other sources of errors discussed in this paper have also had a major impact on the power output. The most important mistake done was not properly tightening the screws. Wind is an invisible fuel powering a turbine, and it needs to be studied just as coal and biomass have been studied. Unlike the construction of wind maps and weather prediction, the modeling of the wind to be advocated in this paper takes place at a local level.Energy is very precious for us and any wastage of it out only be a social crime but also become answerable to our next generation. To solve the energy crises is now mandatory and will answered to next generation.

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