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Power Production Using Solar and Vawt with Pole Mount Equipment

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ABSTRACT
To generate green power from the designed equipment and to increase the percentage of utilization of green energy in the household purpose with most economical methods like using the non-renewable sources via. Solar energy and wind energy and effect of pitch angle on power production. It is becoming cheaper to make electricity from solar energy and in many situations it is now competitive with energy from coal or oil. In contrast, renewable energy resources — such as wind energy — are constantly replenished and sustainable .The total equipment consist of two way power generation by using renewable energy resources (solar and wind).since they are adequately available at the residential areas in most of the parts of the world. In our country the monsoon winds which are generally carried out by throughout the year possess the speed of around 2kmph to 3kmph which is more than enough to run the designed turbine.

KEYWORDS: *alternator setup, energy storage, Gear ratio, VAWT*

I. INTRODUCTION

After the 19th century the demand for electricity escalated. This high demand caused development of new electric power generation facilities such as very large onshore and offshore wind energy farms, solar power plants, wave power plants and tidal power plants. The idea behind these large scale generation facilities is decreasing harmful effects of fossil fuels due to $_{NOx}$ and $_{Coy}$ emissions caused by power plants. The total equipment consist of two way power generation by using renewable energy resources (solar and wind).Since they are adequately available at the residential areas in most of the parts of the world. In our country the monsoon winds which are generally carried out by throughout more than enough to run the designed turbine. this wind turbine is so efficient that it can operate at speeds as low as 2MPH .the turbine can generate 2,000Kwh of electricity in a year at decent wind speeds ,the novel design had a capability to generate electricity at wind speeds varying from 2MPH to 45 MPH

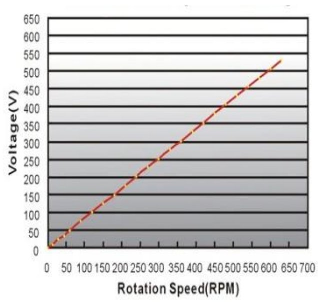


Figure 1graph drawn between speed v/s output voltages

- Large wind turbines are noisy
- They require more amount of wind to generate electricity
- It is very difficult to install and requires more space for installation

To generate green power from the designed equipment and to increase the percentage of utilization of green energy in the household purpose with most economical methods [2]. Wind turbines, like windmills, are mounted on a tower to capture the most energy. Recently, there is a growing promotion of installation of micro wind turbines and solar panels in houses. The aim of this study is to investigate the design and development of micro wind turbines for integration into residential, commercial and industrial complex.

II. RENEWABLE ENERGY NECESSITY IN INDIA

2.1 SOLAR POWER: India is densely populated and has high solar isolation, an ideal combination for using solar power in India. Much of the country does not have an electrical grid, so one of the first applications of solar power has been for water pumping; to begin replacing India's four to five million diesel powered water pumps, each consuming about 3.5 kilowatts, and off-grid lighting. Some large projects have been proposed, and a 35,000 km² area of the Thar Desert has been set aside for solar power projects, sufficient to generate 700 to 2,100 giga watts[3][4].

2.2 WIND ENERGY: If wind speed doubles, the power output increases eight times. Therefore, higher-speed winds are more easily and inexpensively captured. Wind speeds are divided into seven classes — with class one being the lowest and class seven being the highest. A wind resource assessment evaluates the average wind speeds above a section of land (e.g. 50 meters high), and assigns that area a wind class. Wind turbines operate over limited range of wind speeds. If the wind is too slow, they won't be able to turn, and if too fast, they shut down to avoid being damaged. Wind speeds in classes three (6.7 – 7.4 meters per second (m/s)) and above are typically needed to economically generate power [5]. Ideally, a wind turbine should be matched to the speed and frequency of the resource to maximize power production

***2.3* POWER FROM WIND:** The development of wind power in India began in the 1990s, and has significantly increased in the last few years [6]. Although a relative newcomer to the wind industry compared with Denmark or the US, domestic policy support for wind power has led India to become the country with the fifth largest installed wind power capacity in the world. The development of wind power in India began in the 1990s, and has significantly increased in the last few years. Although a relative newcomer to the wind industry compared with Denmark or the US, domestic policy support for wind power has led India to become the country with the fifth largest installed wind power capacity in the world.

As of December 2010 the installed capacity of wind power in India was 13,065.37 MW, mainly spread across Tamil Nadu (4132.72 MW), Maharashtra (1837.85 MW), Gujarat (1432.71 MW),, Karnataka (1184.45 MW), Rajasthan (670.97 MW), Madhya Pradesh (187.69 MW), Andhra Pradesh (122.45 MW), Kerala (23.00 MW), West Bengal (1.10 MW), other states (3.20 MW)[29] It is estimated that 6,000 MW of additional wind power capacity will be installed in India by 2012-2019[7][8]. Wind power accounts for 6% of India's total installed power capacity, and it generates 1.6% of the country's power.

2.4 POWER GERNERATION GRAPH

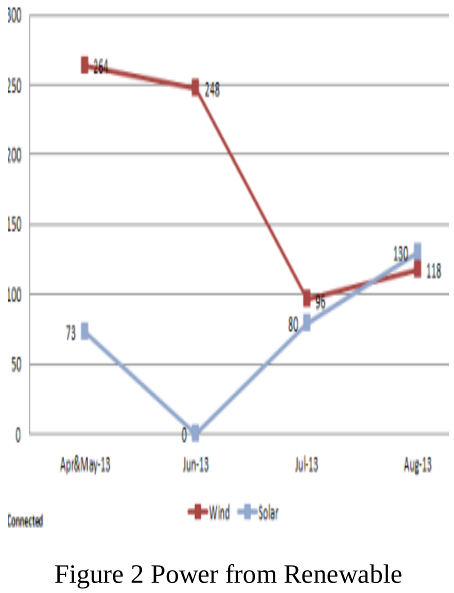


Figure 2 Power from Renewable

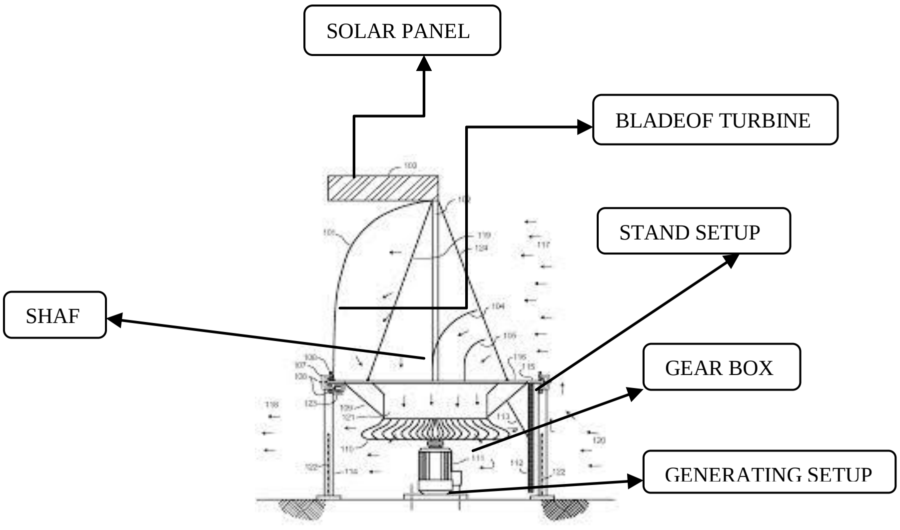


Figure 3 CROSSECTIONAL VIEW OF THE DESIGNED EQUIPMENT:

2.5 General aerodynamics: The forces and the velocities acting in a vertical axis turbine. The resultant velocity vector, is the vectorial sum of the undisturbed upstream air velocity and the velocity vector of the advancing blade [9],

$$W=U\ (-\omega * R)$$

Thus, the oncoming fluid velocity varies, the maximum is found for $\Theta=0$ and the minimum is found for $\Theta=180$, where Θ is the azimuthally or orbital blade position. The angle of attack α, is the angle between the oncoming air speed, W, and the blade's chord. The resultant airflow creates a varying, positive angle of attack to the blade in the upstream zone of the machine, switching sign in the downstream zone of the machine.

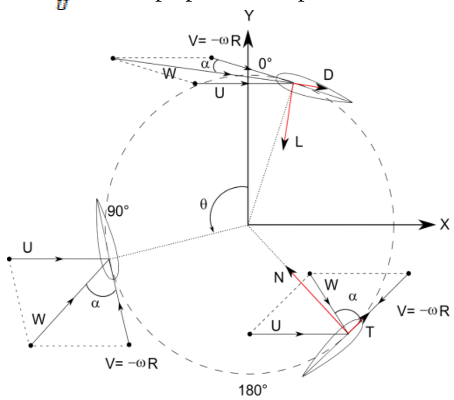
From geometrical considerations, the resultant airspeed flow and the angle of attack are calculated as follows

$$W = \sqrt{1 + 2\lambda\cos\theta + \lambda^2}$$

$$\alpha = \tan^{-1}\left(\frac{\sin\theta}{\cos\theta + \lambda}\right)$$

Where

$\lambda = \frac{\omega R}{U}$ is a tip speed ratio parameter [10]



Forces and velocities are acting up on turbine. The resultant aerodynamic force is decomposed either in lift (FL-drag (D) components or normal (N) - tangential (T) components. The forces are considered acting at 1/4 chord from the leading edge (by convention), the pitching moment is determined to resolve the aerodynamic forces. The aeronautical terms lift and drag are, strictly speaking, forces across and along the approaching net relative airflow respectively [11]. The tangential force is acting along the blade's velocity and, thus, pulling the blade around and the normal force is acting radially, and, thus, is acting against the bearings [12]. The lift and the drag force are useful when dealing with the aerodynamic behavior around each blade, i.e. dynamic stall, boundary layer, etc.; while when dealing with global performance, fatigue loads, etc., it is more convenient to have a normal-tangential frame [13]. The lift and the drag coefficients are usually normalized by the dynamic pressure of the relative airflow, while the normal and the tangential coefficients are usually normalized by the dynamic pressure of undisturbed upstream fluid velocity.The amount of power, P that can be absorbed by a wind turbine.

$$P = \frac{1}{2} C_p \rho A v^3$$

Where Cp is the power coefficient, ρ is the density of the air, A is the swept area of the turbine, and v is the wind speed [14].

III. HARDWARE REQUIREMENTS

TABLE I: components description

S.NO	*SPECIFICATIONS*	*RANGE*
1	Gear box	1:7 ratio
2	Generator setup	Combination of the automobile
3	Turbine design	8 blades
4	Stand	Has VAWT and generator
5	Windings	6 coils are placed on the generator

Figure 4 CONTENT DIAGRAM

IV. DESIGN AND WORKING

4.1 VERTICAL AXIS WIND TURBINE: Vertical axis wind turbines, as shortened to VAWTs, have the main rotor shaft arranged vertically. The main advantage of this arrangement is that the wind turbine does not need to be pointed into the wind. This is an advantage on sites where the wind direction is highly variable or has turbulent winds. With a vertical axis, the generator and other primary components can be placed near the ground, so the tower does not need to support it, also makes maintenance easier. The main drawback of a VAWT generally creates drag when rotating into the wind [15].The best type of wind turbine is of the 59% possible efficiency available to convert the kinetic energy in the wind into mechanical energy .Horizontal Wind Turbines: close to 30% Vertical Axis Wind Turbines: around 50% (though an excellent design could reach near 25%) [16]The bottom line is that while vertical axis wind turbines there are also additional design flaws that can lead to more wear-and-tear on vertical axis wind turbines making them less financially viable from the aspect of creating a long-term supply of reliable renewable energy.

4.2 Need for vertical axis wind turbine: Ordinarily, as wind passes around and through a wind turbine, it produces turbulence that buffets downstream turbines, reducing their power output and increasing wear and tear. That vertical-axis turbines produce a wake that can be beneficial to other turbines, if they're positioned correctly. The blades of this type of wind turbine are arranged vertically—like poles on a closer rather than spokes on a wheel, as with conventional wind turbines. Wind moving around the vertical-axis turbines speeds up, and the vertical arrangement of the blades on downstream wind turbines allows them to effectively catch that wind, speed up, and generate more power. (The spinning blades of a conventional wind turbine would only catch some of this faster wind as they pass through it—this actually hurts the turbine's performance because it increases stress on the blades.) The arrangement makes it possible to pack more turbines onto a piece of land. While the noise of conventional wind turbines has led some communities to campaign to tear them down The approach, however, faces some challenges. Vertical-axis wind turbines aren't as efficient as conventional ones—half of the time the blades are actually moving against the wind, rather than generating the lift needed spin a generator. As the blades alternatively catch the wind and then move against it, they create wear and tear on the structure

Figure 5: top view of designed VAWT

It is difficult to mount vertical-axis turbines on towers, meaning they are often installed nearer to the base on which they rest, such as the ground or a building rooftop. The wind speed is slower at a lower altitude, so less wind energy is available for a given size turbine. Air flow near the ground and other objects can create turbulent flow, which can introduce issues of vibration, including noise and bearing wear which may increase the maintenance or shorten its service life. However, when a turbine is mounted on a rooftop, the building generally redirects wind over the roof and these can double the wind speed at the turbine. If the height of the rooftop mounted turbine tower is approximately 50% of the building height, this is near the optimum for maximum wind energy and minimum wind turbulence.

4.3 ELECTRICAL GENERATOR: Experimenters found that using multiple turns of wire in a coil could produce higher, more useful voltages. Since the output voltage is proportional to the number of turns, generators could be easily designed to produce any desired voltage by varying the number of turns. Wire windings became a basic feature of all subsequent generator designs. Large power generations are now rarely seen due to universal use of alternating current for power distribution. The electrical generator shown in the below figure is having 6 winding connected in RYB phase sequences the wires of Y&B are joined together as one wire while the R phase is left opened, now those wires are connected to the battery storage then send to the load side terminal

Figure 6 design of electrical generator

4.4 GEARING SYSTEM:

Gears are generally used for one of four different reasons:

- To reverse the direction of rotation
- To increase or decrease the speed of rotation
- To move rotational motion to a different axis
- To keep the rotation of two axis synchronized.

The two gears are rotating in opposite directions that the smaller gear is spinning twice as fast as rotation for the larger gear. The fact that one gear is spinning twice as fast as the other results from the gear **ratio**. With the help of gears only there is smooth rotation between turbine shaft and alternator shaft. The transformation ratio is 1:7 between the turbine shaft and alternator shaft in this paper. By this as the turbine for once the alternator rotates for seven times.

4.5 RECTIFICATION: Rectification is essential for storage of power, since the output of turbine is pulsating A.C, hence the employment of the rectifier is necessary which converts a bi-directional wave is converted into a unidirectional

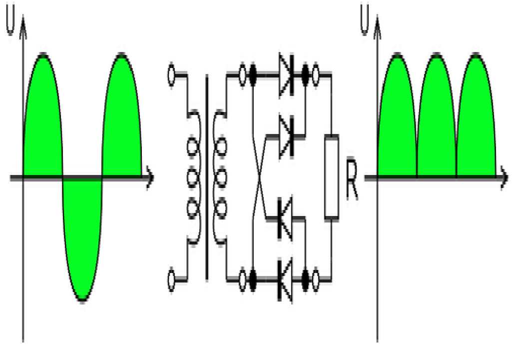


Figure 7 bridge rectifier with 4 diodes

4.6 Wheel Size and Economy: Large wind turbines have very high inertias in addition to very high power transmission requirements. These high powers (megawatts) bring the need for gear sets to increase the generator shaft speed in order to get sufficient power output. Therefore, the weight of the installation increases drastically. Tower structure becomes bigger and costs more. To reduce the cost and increase the output of the wind turbine, all inertias and weights should be reduced.

V. RESULTS

TABLE II
Critical speeds of rotating shafts and output

Speed (m/s)	*Voltage (V)*	*Current (A)*	*Power (W)*
10	2.6	0.452	1.1752
11	2.95	0.465	1.37175
12	4	0.52	2.08
12.5	4.23	0.537	2.27151
13.5	5	0.567	2.835
13.8	5.42	0.592	3.20864

It has been observed that the results show performance increases of up to 29% with a toe-out configuration. The generation of the power had been greatly increased by obtaining variable pitch angle for VAWT and also making itself starting for lightest motion of the air

5.1 Power output at constant speed and pitch angle =0 (constant)

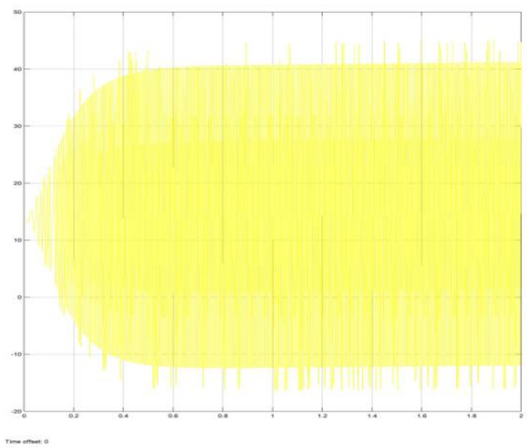


Figure 8 Total power from equipment (solar + wind) At constant speed and pitch angle =0 (constant)

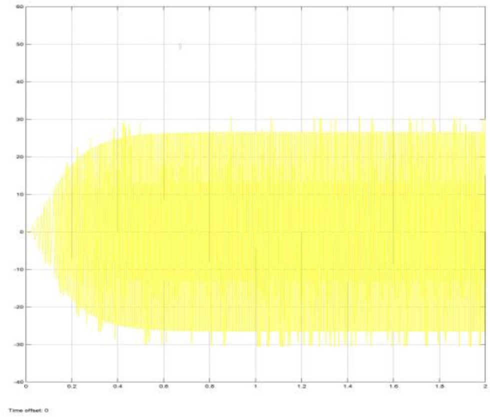


Figure 9 power from VAWT at constant speed and pitch angle =0 (constant)

5.2 Power output at variable pitch angle:

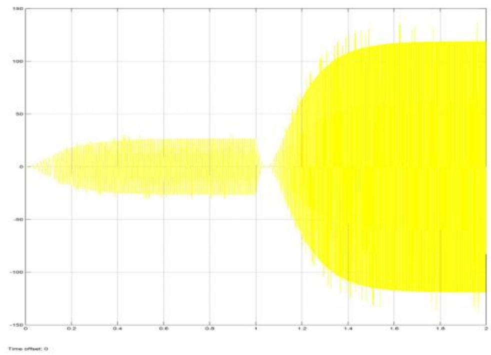


Figure 10 power from VAWT At constant speed variable pitch angle

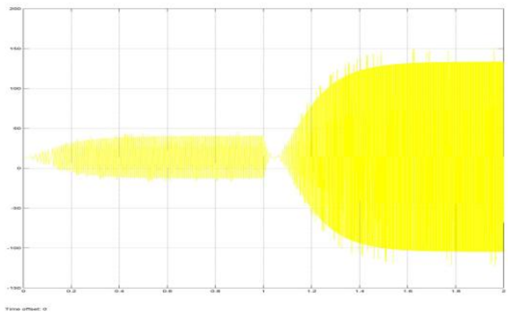


Figure 11 Total power from equipment (solar + wind) At constant speed variable pitch angle

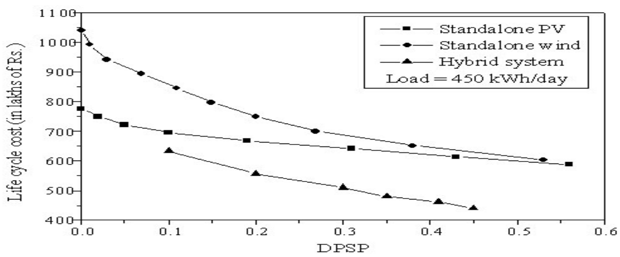


Figure 12 Hybrid system

Variation of deficiency of power supply probability with respect to life cycle cost for Standalone photovoltaic, wind and hybrid systems

V. CONCLUSION

The major advantage of wind – solar hybrid energy system is that when used together, the reliability of the system is enhanced. Additionally, the size of battery storage can be reduced. Thus, the analysis performed in this paper will set guidelines to energy consultants or engineers. Remote communities which cannot be reached by electricity grids, except at prohibitive costs, or which do not have easy access to conventional commercial fuels, can easily adopt these hybrid systems for irrigation The capitalization of renewable resources potential confers real premises to achieve some strategic aims, but also the durable development of energy sector and the protection of the environment. In order to exploit the economic potential of renewable resources in competitive conditions on the energy market, it is necessary to adopt and implement some energy policies and specific resources. The promotion of energy production from

REFERENCES

[1] Wind Turbines in Denmark, Danish Energy Agency, Tech. rep., 2009.[Online]. Available: http://www.ens.dk
[2] Small-scale wind energy, in Policy insights and practical guidance (CTC738), F.a.R.A. Department for Environment, Editor. 2008, Carbon Trust and Met Office.
[3] http://en.wikipedia.org/wiki/Solar_energy
[4] http://www.solarenergy.gen.in/
[5] Martin Best, A.B., Pete Clark, Dan Hollis, Doug Middleton, Gabriel Rooney, Dave Thomson and Clive Wilson, Small-scale Wind Energy – Technical Report, in Urban Wind Energy Research Project Part 1 – A Review of Existing Knowledge. 2008.
[6] Eti NOVA Project Statement. 2009 [cited 2010 20 April]; Available from: http://www.nova-project.co.uk/.
[7] http://en.wikipedia.org/wiki/World_energy_consumption.
[8] http://energy.gov/energysaver/articles/hybrid-wind-and-solar-electric-systems
[9] Amina El Kasmi, Christian Masson, An extended k-epsilon model for turbulent flow through horizontal-axis wind turbines, Journal of Wind Engineering and Industrial Aerodynamics, Volume 96, Issue 1, January 2008, Pages 103-122, retrieved 2010-04-26
[10] Sandra Eriksson, Hans Bernhoff, Mats Leijon, (June 2008), "Evaluation of different turbine concepts for wind power", Renewable and Sustainable Energy Reviews
[11] L.A. Schienbein, "VAWT Aerodynamic Activities at FloWind," 7th Annual VAWT Seminar, Sandia National Laboratories, April, 1987.
[12] T.D. Ashwill, D.E. Berg, H.M. Dodd, M. A. Rumsey, H. J. Suthend and P. S. R.R. Ramsay and G.M. Gregorek, Effects of Grit Roughness and Pitch Oscillations
[13] On the S824 Airfoil, Airfoil Performance Report, Revised (12/99), the Ohio State University, October, 1998. T.G. Carne, D.W. Lobitz, A.R. Nord, and R.A. Watson, Finite Element Analysis
[14] And Modal Testing of a Rotating Wind Turbine, SAND 82-0345, Sandia National Laboratories, Albuquerque, NM, October, 1982
[15] D.W. Lobitz, and T.D. Ashwill, Aeroelastic Effects in the Structural Dynamic
[16] Analysis of Vertical Axis Wind Turbines, SAND85-0957, Sandia National Laboratories,Albuquerque, NM, April, 1986
[17] C.R. Dohrmann, and P.S. Veers, "Time Domain Structural Response Calculations
[18] For Vertical Axis Wind Turbines," Proc.of the Eighth ASME Wind Energy Symposium, Houston, Texas, January, 1989.