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Wind Turbine - A Power Generation

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Abstract: **Energy is a hot topic in the news today: increased consumption, increased cost, depleted natural resources, our dependence on foreign sources, and the impact on the environment and the danger of global warming. Wind energy has the attractive attribute that the fuel is free energy and this will be the case for the project lifetime and beyond. Wind energy has great potential to lessen our dependence on traditional resources like oil, gas and coal and to do it without as much damage to the environment. Wind cannot be used as a dependable source of base load power because it may be blow or not depend upon temperature. So we use wind turbine near the sea because there is much larger availability of wind. The wind speed near sea shore is much higher than in plain areas.**

Keywords: **Wind energy, environment, dependence.**

I. INTRODUCTION

Winds are caused by the uneven heating of the atmosphere by the sun, the irregularities of the earth's surface, and rotation of the earth. The earth's surface is made of different types of land and water. These surfaces absorb the sun's heat at different rates, giving rise to the differences in temperature and subsequently to winds. During the day, the air above the land heats up more quickly than the air over water. The warm air over the land expands and rises, and the heavier, cooler air rushes in to take its place, creating winds. At night, the winds are reversed because the air cools more rapidly over land than over water. Wind turbines convert the kinetic energy of the moving wind into electricity.

II. KEYWORDS

Air density- The air density is a property used in science. Air density, like air pressure, decreases with increasing altitude.

Base load power – It is the minimum level of demand on an electrical supply system over 24 hours.

Energy – A property of objects which can be transferred to other objects or converted into different forms, but cannot be created or destroyed.

Generator – A device which is used to convert mechanical energy to electrical energy.

Gearbox- A arrangement of gear which is used to increase torque ratio.

Gear- A gear is a rotating machine part having cut *teeth*, or which *mesh* with another toothed part to transmit *torque*,

Power availability- The availability of power due to wind to transmit from one point to another without any loss.

Resources - A source or supply from which benefit is produced. Wind is a natural resource. It is a renewable resource .

Swept area- It is the area covered by the blade ie. Πr^2.

Tip speed- It is the ratio between the tangential speed of the tip of a blade and the actual velocity of the wind,

Wind- The perceptible natural movement of the air, especially in the form of a current of air blowing from a particular direction.

Wind turbine – A device which is used to convert mechanical energy into electrical energy.

III. THE RECORD OF WIND IN DELHI-NCR

Month of the year	Dominant wind dir	Wind probability>=4beaufort (%)	Average wind speed	Average air temp. (°c)
Jan	01	4	6	15
Feb	02	8	7	20
Mar	03	10	8	27
Apr	04	12	8	33
May	05	11	8	37
Jun	06	17	9	37
July	07	8	7	33
Aug	08	6	7	31
Sept	09	8	7	31
Oct	10	3	6	30
Nov	11	2	6	24
Dec	12	3	6	18
Annual	1-12	7	7	28

Statistics based on observations taken between 10/2009 - 03/2015 daily from 7am to 7pm local time.

IV. WIND SPEED IN GHAZIABAD

Annual average: **3.07**

Monthly average

month wind speed (m/s)

Jan	**2.77**
Feb	**3.13**
Mar	**3.46**
Apr	**3.87**
May	**4.02**
Jun	**4.11**
Jul	**3.39**
Aug	**2.91**
Sep	**2.85**
Oct	**2.16**
Nov	**1.83**
Dec	**2.40**

V. DESIGNING OF EQUIPMENT

1 Gear Box:

By using this data firstly the chain drive gear was used but it didn't give a specified result. So after that the spur gears are used . The ration of spur gear teeth are 120:38:85:20. It gives 500 rpm at the output terminal . With the help of 500 rpm and 12 pole machine the generator gives 1 KW power .

Figure.1 Arrangement of Spur Gears (gearbox)

We use 2 shaft ie...Low shaft and high speed shaft. Low speed shaft gives 30 rpm which is connected with the gear box of gear ratio 1:14. After the gear box high speed shaft gives approx 500 rpm (depending upon speed of wind) which is connected with the generator.

Figure.2 Structure of Gearbox

2. Blade:

Firstly the tin as a material was used for blade. But due to the lower mechanical strength of tin, it can't bear the tolerance of wind .

Due to the wind speed the blades were damaged. So after that we change the material of blade and also the blade length increased up to 1 meter for increasing availability of power from wind.

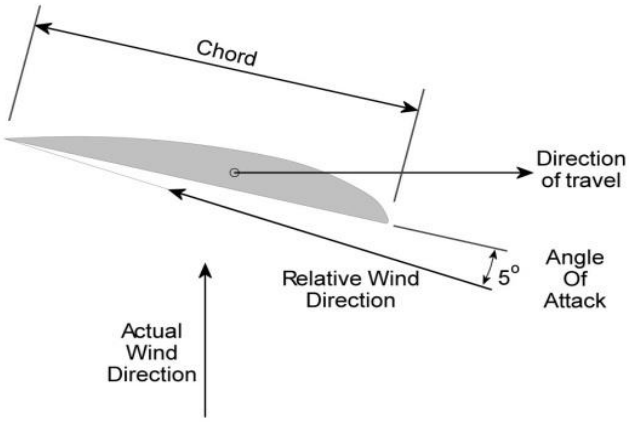

Figure.3 Designing of blade

The material used after first failure is PVC.

Figure.4 Damaged Blades Due To Designing Error

By using the given data the solidity of the rotor is 23.5% (2 meter diameter of blade has 3 no. of blades, each having 5mm width) .

3. Generator:

Adjustable speed generators modern high-power wind turbines are capable of adjustable speed operation. Key advantages of adjustable speed generators (ASGSS) compared to fixed-speed generators (FSGS) are:

■They are cost effective and provide simple pitch control; the controlling speed of the generator (frequency) allows the pitch control time constants to become longer, reducing pitch control complexity and peak power requirements. At lower wind speed, the pitch angle is usually fixed. Pitch angle control is performed only to limit maximum output power at high wind speed.

■They reduce mechanical stresses; gusts of wind can be absorbed, i.e., energy is stored in the mechanical inertia of the turbine, creating an "elasticity" that reduces torque pulsations.

■They dynamically compensate for torque and power pulsations caused by back pressure of the tower. This back pressure causes noticeable torque pulsations at a rate equal to the turbine rotor speed times the number of rotor wings.

■They improve power quality; torque pulsations can be reduced due to the elasticity of the wind turbine system. This eliminates electrical power variations, i.e., less flicker.

■They improve system efficiency; turbine speed is adjusted as a function of wind speed to maximize output power. Operation at the maximum power point can be realized over a wide power range

In this the doubled fed induction generator is used. This gives a control over power because the variation in speed provides damage to the system so the double fed induction generator varies their speed of shaft a/c to the wind speed and provide a mechanical as well as electrical balance to the system.

Compared to direct-in-line systems, this DFIG offers the following advantages:

■ Reduced inverter cost, because inverter rating is typically 25% of total system power, while the speed range of the ASGs is ±33% around the synchronous speed.

■ Reduced cost of the inverter filters and EMI filters, because filters are rated for 0.25 p.u. Total system power, and inverter harmonics represent a smaller fraction of total system harmonics.

■ Improved system efficiency. Approximately 2-3% efficiency improvement can be obtained.

■ Power-factor control can be implemented at lower cost, because the DFIG system (four-quadrant converter and induction machine) basically operates similar to a synchronous generator. The converter has to provide only excitation energy.

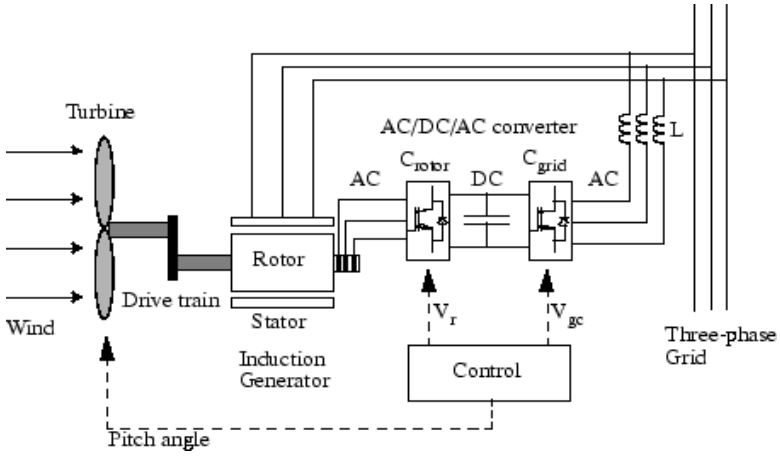

Figure.5 The Wind Turbine And The Doubly-Fed Induction Generator System

4. Nacelle:

The nacelle for this is made of cast iron so it bear a weight. It is used to cover the whole system and protect the system as well as surrounding.

VI. AVAILABILITY

In Ghaziabad the maximum speed available is 5 m/s and minimum speed is 2.7 m/s so the observation done on the bases of available data. The maximum kinetic energy available at the rotor are 245.3125 kg-metre^2. In general, the mathematical relation for the mechanical power extraction from the wind can be expressed as

$Pw=0.5*\rho*\pi*r2*vw\ 3\ *cp(\lambda,\beta)$

where Pw is the extracted power from the wind, ρ is the air density [kg/m3], r is the blade radius [m], vw is the wind velocity [m/s] and cp is the power coefficient which is a function of both tip speed ratio, λ, and blade pitch angle, β [deg]. So the power at the input terminal available is 120.203 watt.

VII. BRAKING SYSTEM

Electrical braking:

In this paper, the electric braking circuit using the NTC thermistors (negative temperature coefficient resistors) is proposed as a braking system for a cheaper and safe stop of the small wind turbine. The effect under the natural wind condition is examined by the field test using a 1kW small wind turbine. AS a result, it is clarified that the generator can decelerates gradually and reduce the burst current by using the braking circuit that composed of the NTC thermistor.

Controller for DFIG generator:

DFIG make use of power electronic convertors, those are able to regulate their own reactive power, so to work on given power factor , or to control grid voltage. The rotor-side converter is controlled by a two stage controller. There are two independent PI controllers, one for the d-axis component, and one for the q-axis component. Controller can regulate either the voltage or the power factor, but the maximum possible reactive power production is defined by the converter ratings.

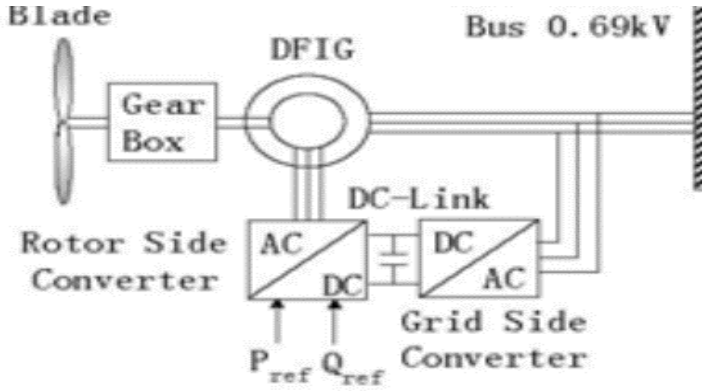

Figure.6 Assembly of Generator and Controller

VIII. CONCLUSION

The wind turbine is a effective source of energy but still required more invention so the aim of wind turbine systems development to continuously increase output power must be fulfill . . It is anticipated that in the near future, power rating of wind turbines will increase further, especially in offshore applications. In future from a small power of wind, a effective amount of power generation is generated so that in future the demand of supply may be fulfill . it is a renewable source of energy which is used so that we conserve our conventional resources so that in future we show the resources to our future generation .

REFERENCES

[1] "Innovation in Wind Turbine Design" (2011), Peter Jamieson

[2] ""Wind Turbine Design Cost and Scaling Model", Technical Report NREL/TP-500-40566, December, 2006, page 35, 36" (PDF). Retrieved 2013-11-06.

[3] "NREL: Dynamic Maps, GIS Data, and Analysis Tools Wind Maps". Nrel.gov. 2013-09-03. Retrieved 2013-11-06.

[4] www.urbanwind.net/pdf/technological_analysis.pdf

[5] Navid Goudarzi (June 2013). "A Review on the Development of the Wind Turbine Generators across the World". International Journal of Dynamics and Control (Springer)**1** (2): 192–202. doi:10.1007/s40435-013-0016-y.

[6] Matsui, Y. ; Niigata Univ., Niigata ; Sugawara, A. ; Sato, S. ; Takeda, T. Braking Circuit of Small Wind Turbine Using NTC Thermistor under Natural Wind Condition Power Electronics and Drive Systems, 2007. PEDS '07. 7th International Conference on 27-30 Nov. 2007.