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FABRICATION OF SMALL SCALE WIND TURBINE

FOR LOW POWER APPLLICATION

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Abstract-In this paper we discuss about wind mill fabrication for thelow power application.we can use dynamo based wind energy conversion system which gives higher efficiency than any other generating system.Variable dc voltage from dynamo is given to boost converter and connected to battery through charge controllers. From battery it is given to load via inverter. Wind power capacity has experienced tremendous growth in the past decade. There are many loads (such as remote villages, islands, ships etc) that are away from the main grid. They require stand-alone generator system (which can provide constant nominal voltage and frequency) to provide for their local electrification. This requirement has lead to widespread research on development of new technologies for stand-alone generators. Initially an overview of different existing generator technologies for grid connected operation is given. This paper presents the recent developments in wind energy turbine fabrication and their social and environmental benefits, a review of the interconnection issues of distributed resources including wind power with electric power systems.

1. INTRODUCTION

Wind energy is one of the world fastest growing energy technologies. It is estimated that 16% of the worlds electricity will be produced from wind power by 2020.Energy is major input for overall socio-economic development of any society. Wind energy is the fastest growing renewable energy. From centuries man has been trying to convert wind power to mechanical and more recently, electric power. Wind technology has improved significantly over the past two decades and wind power has negligible fuel costs. The amount of electricity generated from wind has been growing rapidly in recent years. The power in the wind can be computed by using the concepts of kineticsThe wind mill works on the principle of converting kinetic energy of the wind to mechanical energy. The power available in the wind increases rapidly with the speed hence wind energy conversion machines should be located preferable in areas where the winds are strong and persistent. The design aspect for the wind turbine as describe in this present The major components of a typical wind energy conversion system include a wind turbine, generator, interconnection apparatus and control systems. Wind turbines can be classified into the vertical axis type and the horizontal axis type. Most modern wind turbines use a horizontal axis configuration with two or three blades, operating either down-wind or up-wind. A wind turbine can be designed for a constant speed or variable speed operation. Variable speed wind turbines can produce 8% to 15% more energy output as compared to their constant speed[2] counterparts, however, they necessitate power electronic converters to provide a fixed frequency and fixed

voltage power to their loads. Most turbine manufacturers have opted for reduction gears between the low speed turbine rotor and the high speed three-phase generators [4].

Direct drive configuration, where a generator is coupled to the rotor of a wind turbine directly, offers high reliability, low maintenance, and possibly low cost for certain turbines. Several manufacturers have opted for the direct drive configuration in the recent turbine designs. At the present time and in the near future, generators for wind turbines will be dynamo, permanent magnet synchronous generators, and induction generators, including the squirrel cage type and wound rotor type.

2.OVERVIEW OF THE SYSTEM

2.1 WIND VELOCITY

The amount of electricity of a wind turbine can generate depends on the location wind speed it

depends on a number of factors as the height increase wind velocity also increases. Pressure gradient is a term to describe the difference in air pressure between two points in the atmosphere Greater the difference in pressure the faster the wind flows (from high to low pressure) this is called coriolis effect

2.2 BLADE DESIGN

The blades are perhaps the most important part of our wind turbine - they are the 'engine' that drives our generator. These wind turbine blades have a simple airfoil and when finished they'll look (and work) a bit like airplane wings. This design is a simple one. It's a compromise we made keeping the following things in mind: efficiency, strength, cost and availability of materials, and ease of construction.

Before you start a few terms should be defined. The 'tip' of the blade is the end that's at the very outer diameter - farthest away from the alternator. The 'front' of the blade is the surface that faces towards the wind, it's flat and angled a bit. The 'back' of the blade is facing away from the wind and it's rounded in shape. The 'Root' is the inside of the blade, closest to the hub and the alternator. The 'Leading Edge' is the edge of the blade that gets there first (if it were an airplane wing then the leading edge is the front of the wing). The 'trailing edge' is the edge is the edge of the blade that gets there last (if it were an airplane wing it would be the back edge of the wing). The 'Pitch' of the blade is the angle between the surface of the front of the blade, and the plane of the blade's rotation. It changes over the length of the blade. The Chord of the blade is the width (the distance between the leading edge and the trailing edge) and it gets less (the blade gets narrower) as the diameter gets larger.

The thickness of the blade is the thickness at the 'fattest' point in the airfoil.

Pictured above is the shape of the blades. You can see how the blade is tapered. At the tip (radius = 60 inches) its 3 inches wide. At the half way point (Radius = 30 inches) its 6 inches wide. Draw a line between those two points and extend it to where it

meets the edge of the board (this will be somewhere around radius 14 inches but it can vary depending on the width of your lumber). You can either make a template and trace it onto all three blades, or just lay it out on one blade and cut out the profile, then trace it to the other three.

2.3 SWEPT AREA

The swept area refers to the area of the circle created by the blades as they swept through the air

$$\text{swept area}\ A = \pi r^2 A = \pi r^2$$

$$\pi = 3.14 \pi = 3.14$$

r= radius of the circle i.e., length of the 1blade

2.4 POWER

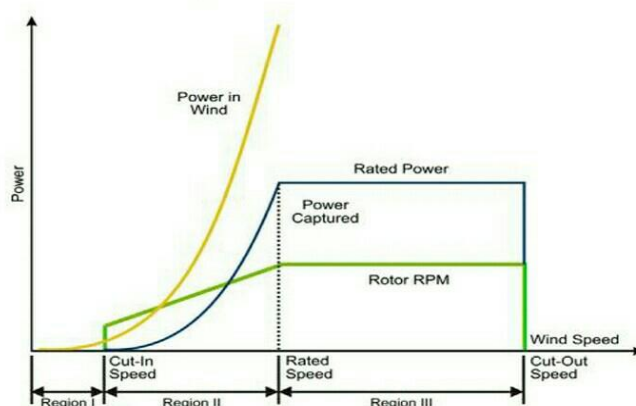The total energy produced is calculated by

$$P = 1/2 * \rho\rho *a*v\text{^}3$$

p= power

$\rho\rho$ = air density

a=swept area

v=velocity of the wind

(p= ½*1.23*3.14*4^3 = 123 watts)

In region I the wind speed is too slow to derive the turbine and produce valuable energy. The Cut-in speed is 4-5 m/s inmodern wind turbines. When the wind speed is above the cut-out speed, 22-25m/s, the turbines must stop operation to prevent overloads and damage to the turbine's

components. In Region II the turbine has to operate at the maximum possible efficiency by adjusting the speed of the generator. Generally two basic schemes of wind turbine control system can be considered. In region III, the wind speed is strong enough to produce the rated or maximum power[4]. Pitch control mechanism is used tokeep outputturbine power constant.

2.5 SOLIDITY

Solidity is usually defined as the percentage of the circumference of the rotor which contains material rather than air. High solidity machines carry a lot of material and have coarse blade angles
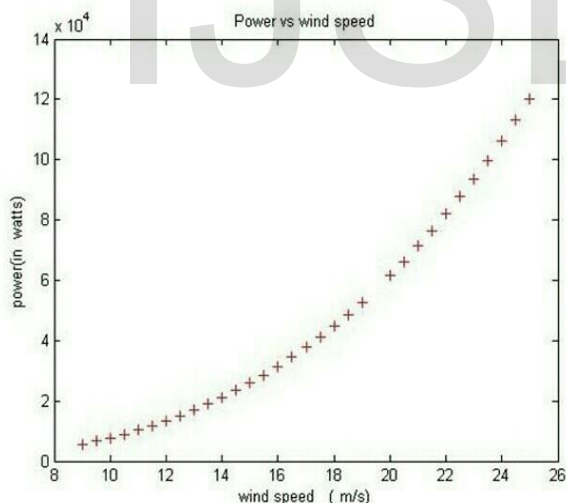
$$\sigma\sigma_{=N*C/}\pi\pi_{*R\text{^}2}$$

N=Number of blades

C= blade chord

R= radius of wind turbine

($\sigma = \sigma =$ 0.1 i.e... 10%) low solidity, thereforehigh speed and low torque

The above graph represents the increase in power with respect to wind speed, as the wind speed increases the power also increases [3]. When the velocity of the wind decreases the power produced also decreases

2.6 POWER CO-EFFICIENT

The power essentially taken from the wind turbine rotor, Pr, is some portion of the offered power,

described by the coefficient of performance that is basically a type of power conversion efficiency:

$$Cp = Pr /P$$

Here Cp (power coefficient) signifies the efficiency of the blades to obtain the power in wind. It is the portion of power which is fetched from the wind to the turbine blades.[3] The theoretical boundary of is about 59.3%
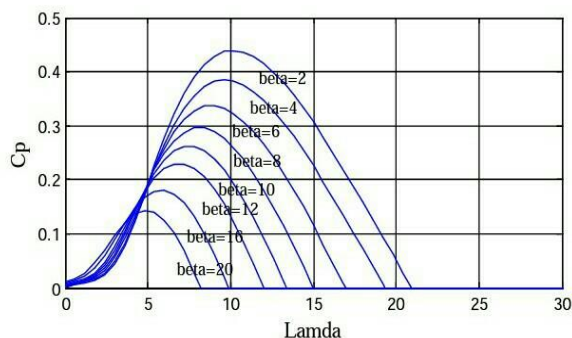
2.7 CONVERTER CIRCUITS

A Buck converter is a switch mode DC to DC converter in which the output voltage can be transformed to a level less than or greater than the input voltage[5]. The magnitude of output voltage depends on the duty cycle of the switch. It isalso called as step up/step down converter. The name step up/step down converter comes from the fact that analogous to step up/step down transformer the input voltage can be stepped up/down to a level greater than/less than the input voltage. By law of conservation of energy the input power has to be equal to output power (assuming no losses in the circuit). Input power (Pin) = output power (Pout) In step up mode Vin<Vout in a Buck Boost converter, it follows then that the output current will be less than the input current[5]. Therefore for a Buck boost converter in step up mode, Vin<Vout and Iin>Iout In step down mode Vin>Vout in a Buck Boost converter, it follows then that the output current will be greater than the input current. Therefore foraBuck boost converter in stepdown mode. Vin>Voutand Iin<Iout

3. SIMULATION RESULTS AND DISCUSSION

To verify the feasibility of the proposed configuration and control strategy, simulations were performed using a system model that was constructed using MATLAB/Simulink. The following simulation parameters were used: PMSG rated power, 400 kW;

PMSG rated voltage, 690 V; DC-link voltage of Udcref = 1600 V; DC-link capacitance, 10 mF; main GSC capacity, 400 kVA; auxiliary GSC capacity, 200 kVA; upper bound on the converter current, 1.2 to 1.5 p.u. of the rated current value (1.5 p.u. was used in this study); main GSC grid filtering reactance, 2.0 mH; main GSC grid filtering capacitor, 500 uF; auxiliary GSC grid filtering reactance, 1.3 mH; and PWM with a switching frequency of 12.8 kHz is used for both the main and auxiliary GSC.

An uncontrolled three-phase diode rectifier was utilized to simulate nonlinear loads with currents of approximately 100 A. 5.1. Operation under Normal Grid Conditions illustrates the system performance under normal conditions with nonlinear loads. At t = 0.1 s, the auxiliary GSC initiated the APF control mode to implement harmonic compensation for the nonlinear loads around the wind farm. The simulation results for the D-PMSG WT with an auxiliary GSC under normal conditions. (a) Phase-a voltage of the power grid (solid Phase-a current waveform for the auxiliary GSC; (c) The grid current before and after the compensation.
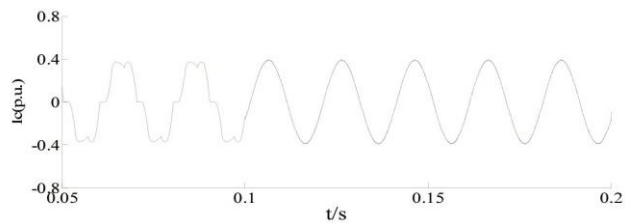
(a) Phase-a voltage of the power grid (solid line); phase-a current of the main GSC (dashed line);.
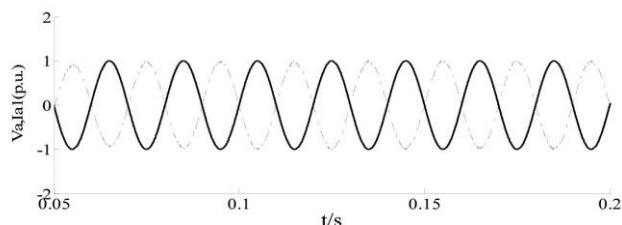
b) Phase-a current waveform for the auxiliary GSC
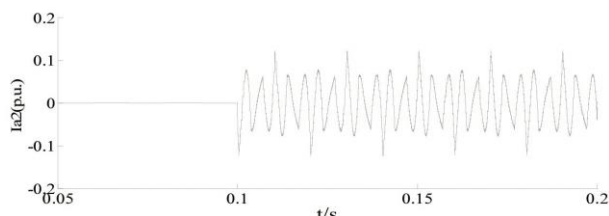
c) The grid current before and after the compensation

In a, the solid line corresponds to the phase-a grid voltage, and the dashed line corresponds to the phase-a output current of the main GSC, i.e., the grid-connected current of the main GSC (with a measured current direction that was opposite to the actual flow). Demonstrates that GSC transfers the active power extracted from the wind turbine to the grid at a power factor of 1. The nonlinear load in the system produced various harmonics in the grid current[4]. At t = 0.1 s, the auxiliary GSC initiated APF control and the harmonic compensation current is injected to the grid, as shown in b. It can be found from c that the grid current was significantly improved

4. CONCLUSION

Almost the efficient wind turbine have been fabricated for the low power application With advances in power electronics and microcontrollers, These controllers may use DC-DC converters to boost the voltage of a given power source up to a higher voltage to match the requirement of a load, such as in the case of the wind turbine operating below the charging voltage of a battery pack. A DC-DC converter, either buck or boost, may also be used in impedance matching a power source to a given load with an improvement in the overall system efficiency.

ACKNOWLEDGEMENT

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