International Journal of Research in Advent Technology, Vol.4, No.4, April 2016
E-ISSN: 2321-9637
Available online at www.ijrat.org

A Novel Variable Speed Wind Energy System Using Generator and Switch Converter

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Abstract-In this paper, we design the prototype proposed by single phase supply from wind energy generation using DC generator and switch converter, also we know that from the wind energy as we get variable energy or power. Wind energy has a growing trend in the world due their numinous advantages the wind energy is free in exhaustible and it produce no waste or green house gases. The DC generator wind turbine are now days increasingly used in large wind forms because of their ability to supply power at constant voltage and frequency. Hence we used MPPT(Maximum Power Point Tracking),MPPT control under different wind speed and delivering to the grid simultaneously. We also used two switch converter to convert DC power into AC power. This converter occur sinusoidal output, low manufacturing cost. The result verify effectiveness of the proposed interface configuration. A sensorless vector control strategy for DC generator in grid connected wind energy convertion system is present. This paper explicity deals with the study of grid connected DC generator where frequency and voltage of the machine will be dictated by the electrical grid.

Keywords- Dc generator, grid, inverter, MPPT, Pulse Width Modulation(PWM).

1. INTRODUCTION

With increased penetration of wind power into electric grids Dc generator turbine are largely developed due to their variable speed features and hence influencing system dynamics. The continuous trend of having high penetration of wind power has made it necessary to introduce new practices. For example, grid .The wind turbine would contribute to the control of voltage and frequency and also to stay connected to the host network following a disturbance.

The model can be achieved by neglecting the rate of change of stator flux linkage ,(transient stability model) given rotor voltage as control parameter. Additionally in order to model PWM converter in the simplest scenario, it is assumed that the converters are ideal and the DC link voltage between the converters is constant. Consequent, depending to the converter control, a controllable voltage (current) source can be implemented to represented the operation of the rotor side of the converter in the model. Therefore based on the above assumption it would not be possible to determine whether or not the DC generator will actually trip following a fault. In a more detailed approach actual converter representation with PWM averaged model has been proposed where network is replaced by average circuit model on which all the switching element are separated from the remainder of network and incorporated into a switch network containing all the switching element.

However the proposed model neglects high frequency effects of the PWM firing scheme and therefore it is not possible to accurately determine DC link voltage in the event of fault. A switch by switch representation of the PWM converter with their associated modulate for inverter has also been proposed. In order to resolve the identified problems, a switch by switch model of voltage fed current controlled PWM converter where triangular carrier based sinusoidal PWM is applied to maintain the switching frequency constant. Power quality is actually an important aspect in integrating wind power plant to grid. This is even more relevant since grid are how dealing with a continuous increase of non linear loads such as switching power supplies and large drive directly connected to the network.

2. BLOCK DIAGRAM OF WIND ENERGY GENERATION SYSTEM

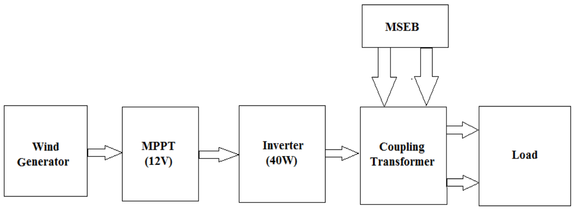

Fig: Wind energy generation system

In this system we used following components

1. Wind generator
2. MPPT
3. Switch converter/Inverter
4. Coupling Transformer

2.1 Wind generator:

Wind turbines produce electricity by using the power of the wind to drive an electrical generator. Passing over the blades, wind generates lift and exerts a turning force. The rotating blades turn a shaft inside the nacelle, which goes into a gearbox. The gearbox adjusts the rotational speed to that which is appropriate for the generator, which uses magnetic fields to convert the rotational energy into electrical energy. The power output goes to a transformer, which converts the electricity from the generator at around 700V to the appropriate voltage for the power collection system, typically 33 kV.
A wind turbine extracts kinetic energy from the swept area of the blades. The power contained in the wind is given by the kinetic energy of the flowing air mass per unit time. That is

$$P_{air}=0.5pAV\infty^3$$

Where P_{air} is the power contained in wind (in watts) , ρ is the air density (1.225 kg/m3 at 15°C and se normal pressure), A is the swept area in (square meter), and is the wind velocity without rotor interference, i.e., ideally at infinite distance from the rotor (in meter per second).
Although the above equation gives the power available in the wind, the power transferred to the wind turbine rotor is reduced by the power coefficient, C

$$C_p=P_{\text{wind turbine}}/P_{air}$$

$$P_{\text{wind turbine}}=0.5pCpAV\infty^3$$

Maximum value of C_p is defined by the Betz limit, which states that a turbine can never extract more than 59.3% of the power from an air stream. In reality, wind turbine rotors have maximum Cp values in the range 25-45%.

2.2 MPPT:

Due to incident wind speed, maximum output power of wind turbine is obtained in different speed of the turbine. The generator speed must be adjusted according to instantaneous wind speed to obtain incident maximum power. Optimum generator speed is determined by MPPT block of control system. Maximum speed is used as reference speed for speed controller of Dc Generator.

In this paper, an alternative approach for WG maximum- power-point-tracking (MPPT) control is described. The MPPT process is based on monitoring the WG output power using measurements of the WG output voltage and current and directly adjusting the dc/dc converter duty cycle according to the result of comparison between successive WG-output- power values. The proposed MPPT method does not depend on the WG, wind and rotor-speed ratings or the dc/dc converter power rating. Although the proposed method has been tested on a battery-charging application using a dc/dc converter, it can also be extended in grid-connected applications by appropriate modification of the dc/ac inverter control. The proposed system is built around a high-efficiency dc/dc converter and a low- cost inverter unit, which can easily perform additional operations such as control of additional renewable energy sources (RES) or battery charging management.

2.3 Switch converter/Inverter

The simple inverter circuit is shown below

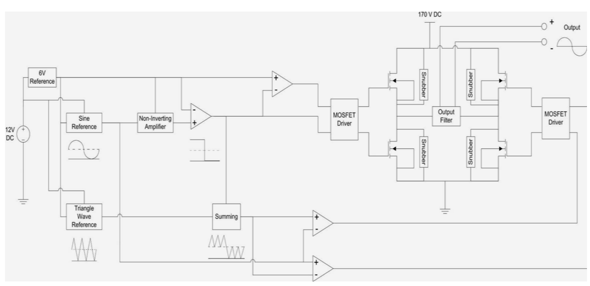

Fig. Basic inverter

Following components are used for the construction of inverter.

1. Decoder IC
2. PWM converter
3. Inverterlogy switching IC
4. MOSFET
5. Step up transformer

Output of MPPT given as input to inverter circuit which in pure DC form as the conversion of inverter function of to convert DC to AC.

Input given to the inverter is firstly fed to the MOSFET 7805 to provide constant 5 volt supply to drive PWM converter IC. PWM converter converts constant DC into pulsating form. These pulses are given as input to 2 MOSFET to operation of sine wave conversion. The switching of these two MOSFET is done by using 2 capacitor by providing gate pulse to the MOSFET In this circuit MOSFET drive integrated circuit and a low pass filter are necessary to generate 50 Hz, 12 volt AC sine wave across the step up transformer. The step up transformer increase the voltage level from 12 volt to 180 volt

3. Advantages, Disadvantages and Applications

3.1 Advantages

1. Induced new way to produce clean energy.
2. These are closer to the roof and hence Maintenance cost is low.
3. It can be installed in small area.
4. It does not produce any emission.
5. It is distributed power generation application.
6. It has complete control of active and reactive power.

3.2 Disadvantages

1. Installation cost is high
2. In the winter season only small amount of wind is available

3.3 Applications

1. It can be used in remote areas where conventional power supply is uneconomic.
2. Used for grid connection.
3. In agricultural purpose.
4. These methodologies help to reduced carbon emission and saving fuel

4.Tables

Table 1: Output voltage, current and power generated

SR.NO	Output voltage	Current	Power generated
1	0.77	0.84	0.65
2	0.8	0.93	0.75
3	1.5	1.00	1.55
4	2.2	1.1	2.4

Table 2: RPM V/S voltage generated

SR.NO	Speed of turbine	Output voltage
1	500	0.77
2	600	0.8
3	900	1.5
4	1300	2.2
5	1500	2.4

5. Equations

Equation for power generation

The power in the wind is proportional to:

a) The area of windmill being swept by the wind

b) The cube of wind speed

c) The air density-which varies with amplitude

The power generated by wind energy is given by,

Power=(density of air *swept area*velocity cubed) / 2

$P_w=1/2*\rho(A_w)(V)^3$

Where,

P is power in watts (W)

ρ is the air density in kilograms per cubic meter

A_w is the swept area by air in sq.meters

V is the wind speed in meter per second

Kinetic energy of wind

The kinetic energy of the wind is the source of the driving force of a wind turbine.

The kinetic energy can be depicted by the formula

$E=f*mspec*V^3$

Where,

E is kinetic energy

mspec is the specific mass of air

V is velocity of the moving air

f is calculating factor without any physic meaning

6. RESULT AND CONCLUSION

6.1. RESULT

The output power depends on the speed of wind turbine.

Sr. No.	Speed Of Turbine (in rpm)	Output Voltage (in volts)
1.	1440	6
2.	1920	8
3.	2400	10
4.	2800	12
5.	4800	20
6.	7200	30

Table 6.1: Speed v/s Generated Voltage

6.2. CONCLUSION

We have discussed here the basic operation of DFIG and it's controls using AC/DC/AC converter. First we simulated a wind turbine driven isolated (not connected to grid) induction generator. But for best efficiency the DFIG system is used which is connected to grid side and has better control. The rotor side converter (RSC) usually provides active and reactive power control of the machine while the grid-side converter (GSC) keeps the voltage of the DC-link constant. So finally we simulated grid side and wind turbine side parameters and the corresponding results have been displayed. The model is a discrete-time version of the Wind Turbine Doubly-Fed Induction Generator Power Systems. Here we also took the protection system in consideration which gives a trip signal to the system when there is a fault (single phase to ground fault) on the system. The faults can occur when wind speed decreases to a low value or it has persistent fluctuations. The DFIG is able to provide a considerable contribution to grid voltage support during short circuit periods. Considering there results it can be said that doubly fed induction generator proved to be more reliable and stable system when connected to grid side with the proper converter control systems.

REFERENCES

[1] Aman Upadhyay, Mr. Amit Agrawal, "Design and Simulation Of wind energy conversion system synchronized with electrical grid using DFIG",Volume3,issue7.

[2] S. H. Song, S. Kang, and N. K. Hahm, ''Implementation and control of grid connected AC--DC--AC power converter for variable speed wind energy conversion system,'' *Appl. Power Electron. Conf. Expo.*, vol. 1,pp. 154--158, 2003.

[3] N. Yamamura, M. Ishida, and T. Hori, ''A simple wind power generating system with permanent magnet type synchronous generator,'' in *Proc.IEEE Int. Conf. Power Electron. Drive Syst.*, 1999, vol. 2, pp. 849--854.

[4] T. Tafticht, K. Agbossou, A. Cheriti, and M. L. Doumbia, ''Output power maximization of a permanent magnet synchronous generator based standalone wind turbine,'' in *Proc. IEEE ISIE 2006*, Montreal, QC, Canada, pp. 2412--2416.

[5] M. Chinchilla, S. Arnaltes, and J. C. Burgos, ''Control of permanent magnet generators applied to variable-speed wind-energy systems connected to the grid,'' *IEEE Trans. Energy Converters.*, vol. 21, no. 1, pp.130-- 135, Mar. 2006.