International Journal of Research
Available at https://edupediapublications.org/journals
e-ISSN: 2348-6848
p-ISSN: 2348-795X
Volume 05 Issue 12
April 2018

An Efficient Upf Rectifier For A Standalone Wind Energy Conversion System

SEENI PANDIAN.K , M.TECH (POWER SYSTEM), PRIST UNIVERSITY,THANJAVUR

ABSTRACT

This paper use a suitable power converter topology and design a suitable controller for a Wind Energy Conversion system with Permanent Magnet Synchronous Generator (PMSG) for stand alone and grid integrated operations. The present work presents the system in which a PMSG feeds an isolated load through a closed loop boost converter. The output voltage and frequency of the PMSG is variable in nature due to non uniform wind velocities and is not synchronized with the grid frequency. In order to condition and feed it to grid we need power electronic interface. The variable ac output is rectified by a diode rectifier and maintained constant by a boost converter. The boost converter is provided with a closed loop feedback control, which is designed using PI controller.

In this controller the output voltage is continuously sensed and duty ratio of the switch is varied to maintain the DC link voltage constant. The converter output is fed to three phase inverter which employs a sine PWM technique, the output of which is fed to the load. The power converters and together with independent control systems can effectively improve the output voltage and frequency of the wind PMSG feeding an isolated load.

INTRODUCTION

Earth is a marvelous marble with countless beauties in its nature, from plants, flowers, trees birds and so on to underwater wonders. It's everybody's responsibility to take care of earth and its environment and minimize pollution. Wind is one of the renewable sources of energy which is nonpolluting. The wind is a by-product of solar energy. Approximately 2% of the sun's energy reaching the earth is converted into wind energy. The surface of the earth heats and cools unevenly, creating atmospheric pressure zones that make air flow from high- to low-pressure areas and also rotation of earth causes wind. This wind is capable of exerting a force and creates motion which is utilized in the wind energy conversion systems. Wind power technology is experiencing significant growth in developing countries like India.

As a result of scientific assessments of wind resources throughout India, wind power has emerged as a viable and cost effective option for power generation. Also studies shows that small scale wind energy conversion systems are more efficient and cost effective. Among AC type generation systems, those based on Permanent magnet synchronous generator (PMSG) is one of the most favorable and reliable methods of power generation for small and large scale wind turbines. To meet the amplitude and frequency requirements of conventional load and grid, the amplitude and frequency

outputs of PMSG require additional conditioning and power electronic interfacing. Advantages of PMSGs are highest energy yield, higher active/reactive power controllability, and absence of brush/slip ring, low mechanical stress, absence of copper losses on rotor, high power density, and lower rotor inertia, robust construction of the rotor and low level of acoustic noise.

A scheme based on a grid-connected wind turbine with a permanent magnet synchronous generator that uses a back-to-back full scale pulse width modulation (PWM) converter connected to the grid. This increases the system cost and has prevented, the more widespread use of small grid-connected wind turbines. Considering the usage of permanent magnet synchronous generators, three-phase diode rectifiers followed by dc–dc choppers are more economical than three-phase insulated gate bipolar transistor (IGBT) converters. A simple ac–dc–ac converter for grid-connected wind power generation systems is used with advantages that include inexpensive cost and easy control of the generator load.

The dc-distribution system involves a better integration of distribution generators and the storage systems, compared with the ac-grid with respect to bi-directional power exchange and power quality. The protection schemes were proposed for permanent magnet synchronous generator (PMSG) wind turbines farm connected in parallel to dc-link. In variable speed wind turbine technologies, the PMSG has received increased attention because of its operation at high power factor, high efficiency and increased reliability due to its self excitation property. Three-phase six switch rectifier is of wide interest to be used as generator side converter but this rectifier suffers from several disadvantages; larger power losses due to switching operation of three semiconductor devices in each interval, expensive structure, and short circuit possibility through the leg.

Wind power is the most fast growing energy source in the world. According to the technological development the wind energy cost reduced down to the range of 4cents/kWh recently, which is competitive against conventional energy sources. The total capacity of wind power is about 25,000MW and the average power rating of a unit is 1.2MW in 2001.

Many number of on-shore or off-shore wind farms are being built on behalf of the policy of good tariff for electricity from natural renewable energy source, wind. More than 75% of large wind turbines constructed in 2001 are variable speed machine with grid connection. If the turbine serves as a voltage source for an isolated area, huge amount of energy storage (battery) or other energy source (such as engine generator) is needed for stable operation due to the variable wind speed characteristics. So an inexpensive and efficient power converter for grid connection is required for modern wind energy conversion systems. High flux density permanent magnet synchronous generators are becoming popular in industry applications especially for gearless drive systems with advantages such as small size, less weight and flexible design structure.

Recent developments made the trade-off benefits exceed the cost premium of machine in the power ranges up to several hundred kW.

Considering these trends, one of the best topologies for wind power conversion system is the full size ac-dc-ac converter. In case of the usage of synchronous generator, simple 3-phase diode rectifier with dc-dc chopper is more cost effective solution for ac-dc converter than 3-phase IGBT PWM converter. In a buck-boost converter is proposed for dc-dc chopper and the output current reference of the chopper is decided for the maximum power point tracking of wind turbine. But the voltage stress of chopper switch is greater than that of boost converter. Also the leakage inductance of generator and cable cannot be used as an equivalent dc inductor. Control scheme in is based on stand-alone type wind power generating system, which requires large battery at dc-link. Widely used energy sources, such as oil, natural gas, coal and nuclear, are finite and generate pollution. Clean renewable sources, such as solar, wave and wind have been vigorously developed over recent years and wind is now on the verge of being truly competitive with conventional sources. Others will doubtless follow.

A modern large electric windmill or wind energy conversion system (WECS) may generate up to 1.5MW and comprises: tower up to 80m tall, wind turbine rotor; more than 60m diameter, mechanical transmission operating at typically 20rev/min; generator; interface to the grid. Numerous turbine varieties have been developed, notably horizontal- and vertical-axis types with power regulation in high winds by active control of blade pitch angle or passive regulation based on aerodynamic stall.

EXISTING SYSTEM:

In this paper, a near-unity-power-factor front-end rectifier employing two current control methods, namely, average current control and hysteresis current control, is considered. This rectifier is interfaced with a fixed-pitch wind turbine driving a permanent-magnet synchronous generator. A traditional diode-bridge rectifier without any current control is used to compare the performance with the proposed converter. Two constant wind speed conditions and a varying wind speed profile are used to study the performance of this converter for a rated stand-alone load. The parameters under study are the input power factor and total harmonic distortion of the input currents to the converter.

PROPOSED SYSTEM

A suitable power converter topology and design a suitable controller for a Wind Energy Conversion system with Permanent Magnet Synchronous Generator (PMSG) for stand alone and grid integrated operations.

The present work presents the system in which a PMSG feeds an isolated load through a closed loop boost converter. The output voltage and frequency of the PMSG is variable in nature due to non uniform wind velocities and is not synchronized with the grid frequency. The converter output is fed to three phase inverter which employs a sine PWM technique, the output of which is fed to the load.

The wind turbine is the prime mover of the Permanent magnet synchronous generator. As the wind velocity is non-uniform in nature, the output of PMSG will be fluctuating. Therefore it cannot be interfaced directly to the load. The output of PMSG is converted to DC using a full bridge rectifier and the variable DC is converted to constant DC by a closed loop Boost converter. This constant DC output is converted to AC using an inverter. This inverter is operated with Sine PWM technique and fed to the load.

CONCLUSION

The power electronic topology comprising of diode rectifier, DC to DC boost converter and inverter for a variable wind energy conversion system with PMSG for a standalone application is presented.

The state space averaging technique employed for obtaining transfer function of the boost converter and the subsequent design of PI controller using Ziegler Nichol's technique for the dc-dc boost converter for maintaining the required dc link voltage constant is given in detail.

The analysis and dynamic response with the designed controller is carried out for varying wind speed and load and the simulation results are given to validate the design.

REFERENCES:

[1] R.Esmaili, "Application of advanced power electronics in renewable energy sources and hybrid generating systems", Dept. of Electrical and Computer Engineering, Ohio State University, 2006.

[2] Hyong Sik Kim, D.D. C, "Review on wind turbine generators and power electronic converters with the grid-connection issues," 20th Australasian Universities Power Engineering Conference (AUPEC), 2010, pp. 1 – 6, Dec. 2010

[3] W. Hu, Z. Chen, Y. Wang, and Z. Wang, "Flicker study on variable speed wind turbines with permanent magnet synchronous generator," in Proc. 13th Power Electron. Motion Control Conf., Sep. 2008, pp. 2325– 2330.

[4] L. Tan, Y. Li, C. Liu, and P. Wang, "An improved control strategy for the current source back-to-back converters," in Proc. Int. Conf. Electr. Mach. Syst., Oct. 2008, pp. 1985–1989.

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

[6] Darbyshire and C. V. Nayar, "Modeling, simulation, and testing of grid connected small scale wind systems," in Proc. Australasian Univ. Power Eng. Conf. (AUPEC), Dec. 2007, pp. 1–6.