Design A Speed Controller For Doubly Fed Induction Generator Based on Wind Turbine System

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Abstract- *DFIG(Doubly Fed Induction Generator) is widely used as electrical power generator in wind farm generating system. This generating system is the interconnection of three individual section which are wind farm section, central or controller section and generating system. Controller section plays an important role to established connection generator as well as wind turbine system. In this paper we have design a controller for the generator that is based on matlab programme. This makes system more reliable as compare to conventional converter using system.*

Under different operating condition of generator, controller make the generator to run at around rated speed that is desirable for any power generating station. If turbine speed becomes over rated, controller enables signal for the generator to change its pitch angle and maintain constant speed.

At the global level, the use of renewable energy increases continuously to reduce environmental pollution, so even something new in this field can lead to big change for human being as well as industrial sector.

Keywords- DFIG, Controller, Wind Turbine, Speed

I. INTRODUCTION

Electrical power is one of the most widely used source of energy for our homes, work places, industrial sector. In recent Indian government has planned to introduce ELECRIC vehicle incorporated with BOIFUEL and ELECTRIC POWER in Global Mobility Summit 2018. Population and industrial are growing rapidly which are more prominent area where electrical power is consumed. Our earth crust have limited natural source, these are exhausted rapidly because its extensively used in industrial sector and which is more dominating area where these resources are used. Energy conservation is major issue of concern these days it has motivated nations and across the world to think about replica of energy source which can utilize it in ample amount.

Renewable energy like solar, wind, tidal currents of oceans is sustainable, inexhaustible and environmentally friendly clean energy and amount of these energy is large in equatorial region of all continent specially SHAHARA DESERT OF SOUTH AFRICAN CONTINENT AND NOTHERN PART OF SOUTH AMERICAN CONTINENT AND THAR DESERT IN INDIA . Due to these entire area, in these area the possibility of wind power generation is very high. So wind power generation has attracted and is of great interest in these area to produce power by using wind farm generation in recent years. Specially, wind power is today's most rapidly developing alternative source of energy.

II. IDENTIFY, RESEARCH AND COLLECT IDEA

A detailed literature review has been done and complete analysis of doubly-fed induction generation (DFIG)-based wind turbine-generator are presented here. More specially, the previously studied related to this topic and researches have been done on modelling, the control strategies, and the state of the art converter topologies applied in DFIG- based wind turbine-generator systems for speed controlling are presented here.

1) Dewei Xu [2008]

Here authors developed and designed control strategies of brushless doubly-fed induction generator by implementing two cascaded induction machines so that he is able to eliminate the brushes on rotating part and copper ring, and a closed-loop stator flux oriented control scheme to achieve speed control.

They implied a direct power control (DPC) method for cascaded brushless doubly-fed induction generators which has character of quick dynamic responses and outstanding strategy for steady state performance analysis .

he model of DFIG generator can be represented in the stationary stator frame of reference with rotating at rotor speed and the synchronously rotating reference frame.

2) Kostyantys Prostenko [2012]

They are designed BDFIG model and controller designed for wind energy application which is not applicable for speed control operation. For testing of designed of model, they used Matlab/simulation. Observation obtained from experiment, they concluded that controller allows independent speed and reactive power regulation. This indicates that model can be used under wide range of turbine speed and generator can impact on overall efficiency of generating system. This model can be used for off-shore wind energy with reduced cost.

3) Sunny Katyara [2018]

In this paper, vector control strategies have been implemented on matlab. This technique is used in decoupling of reactive and active power to the grid. They used conventional lag lead (PID) as a feedback controller to mitigate unwanted power oscillation. Proposed model has been successfully implemented for doubly fed induction generator using vector control strategy. it uses PID controller to get better damp out for damping of power oscillation. Vector control strategy is more complex method because in requires conversion process from three phase to two phase signals. That's why it needs a simple and convenient method of controlling the generator over wide range of turbine above the rated speed of generator.

4) Jawaharlal Bhukya [2016]

In this paper, model has been designed on the basis of variable wind turbine speed and direction of flow of power is presented and simulation result has been shown for super synchronous speed of generator. Two converter is used back to back for continuous power flow. The DFIG is controlled by both rotor side controller and stator side controller. The RSC is controlled by current via voltage control and reference power controller loop. The main work of this paper is to control DFIG by controlling active and reactive power by using stator flux oriented frame of reference which performs better simulation result and controls, maintains constant DC link voltage. Here DFIG is controlled by voltage and current control loop over wide range of wind speed variation. The mathematical expression are presented in dq-axis reference for voltage and current controller to control rotor side stator side controller.

III. IDENTIFIED RESEARCH GAP

On the basis of reviewing of literature in the above section, the following research gap has been found:

(a) There has been a conventional control scheme are used for speed control with the help of pulse width modulator. Here so many belt harmonics are produced and make them machines more noisy. To overcome this problem a special type of controller has to be designed.
(b) Maximum power point tracking for wind turbine has been already designed, the only require is to control the speed of DFIG under different wind speed. Researchers are working on it.

IV. DFIG AND REVIEW OF RELATED RESEACH

In conventional power system that uses synchronous generator, a wind turbine can operate as fixed-speed or variable-speed wind turbine, here macines are controlled with the help of using conventional pulse width modulation technique which comes in power electronics converter that loses an extra amount of power energy. There are various reasons for using a variable-speed turbine.

1) Variable speed turbines can be extensively used in all over the world and offer a higher energy production as comparison to a constant speed turbines.
2) The pitch angle can be controlled by reducing the mechanical load .
3) Variable-speed wind turbines reduces noise level and are extensive controllability of both active and reactive power.
4) Variable-speed wind turbines show less variation i.e almost constant output power.

Two machines which are based on variable wind speed, first is (PMSG) permanent magnet synchronous generator and second doubly-fed induction generator (DFIG).

The main objective of this dissertation is to design and analyse a DFIG control technique for various wind speed and grid synchronisation under different reference frames and conditions. A rotor-side controller can be designed with the help of current-loop control and speed-loop control.

V. IMPROVEMENT AS PER REVIEWER COMMENTS

After reviewed a lot of research paper under taken by researcher in the field of speed control of DFIG. The following problem statement should be formulated.

1) More variation in speed becomes trouble in the system so it requires to overcome.
2) All the system are more robust and not very convenient to use in practical application.

3) Oscillation of power are require to damp out quickly as possible.
4) Vector control strategy are not suitable for power oscillation. It should be used PI or PID based controller.
5) Double converter produce more number of harmonics and system becomes noisy. In this dissertation, we used only single converter at the grid side which is more convenient to the system under various changing the speed of generator.

VI. CONCLUSION

Control of a doubly-fed induction generator has been presented and it can be easily shown that the speed of generator does not depend on the speed of turbine speed. More speciality of this dissertation is to control the speed of generator under various speed of turbine has been successfully designed. The controller exactly follow the condition that have been implemented.

By increasing population day by day, the world have to think alternative source of energy to replace conventional resource like petroleum, coal etc, At present industrial sector also uses it in large amount. Which causes environmental imbalance that will huge impact on human being.

Another sector which is thermal power plant produces smoke in large amount that lead to pollution of air

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