POWER QUALITY CONTROL OF THE DFIG BASED ON WIND ENERGY SYSTEM

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***Abstract*—This paper deals with a powerful modeling and control of doubly fed induction-generator (DFIG) based on the wind turbine systems. Active and reactive power control of the DFIG is based on the feedback technique by using the suitable voltage vectors on the rotor side. The proposed controller is based on the feedback technique in order to reduce the fluctuations of the generator. This paper provides a global review of past and present converter topologies applicable to permanent magnet generators, induction generators, synchronous generators and doubly fed induction generators. As the improved power quality, high energy efficiency and controllability, etc. With increased penetration of wind power into the electrical grid, Doubly Fed Induction Generator (DFIG) for wind turbines are largely deployed due to their variable speed feature and hence influencing system dynamics. The many different generator–converter combinations are compared on the basis of topology, cost, efficiency, power consumption and control complexity. An improved feedback control technique is adopted to get a better power flow transfer and to improve the dynamic system and transient stability. In stable condition, the improved performance of the controller, the proposed method is verified for the effectiveness of the control method is done in stable conditions.**

I. INTRODUCTION

A doubly fed induction generator (DFIG) with a power converter is a common and effective way to design a transfer the mechanical energy from the variable speed rotor to a constant frequency electrical grid. The stator is directly connected to the grid while the rotor is fed through a variable frequency convertor. In order to generate the active power at constant voltage and frequency, the active power flow between the rotor circuit and the grid is controlled both in magnitude and direction by controlling the stator flux and rotor current of the asynchronous generator. The lowered energy cost by varying the rotor parameters and the blade shape. In cases of determining the constraints via gradient-based optimizers, a multi-disciplinary to develop the study was performed taking into account power production, structural loading, noise emission, lifetime and reliability [1].

In order to extract maximum power from the turbine and provide constant grid voltage and frequency the control method need to be designed. The control schemes integrated with the power electronic converter are configured to increase output power at the possible wind speeds. Converter and generator topologies for permanent magnet generators, caged rotor induction generators, synchronous generators and doubly fed induction generators including more specifically wound rotor induction machines is made possible by arrangement of various topologies.[2].

As the wind power penetration is continuously rising the Power utilities mainly depends on the power quality issues. In this conditions the proper care must be taken and the important factor to notify wind power impact properly in the power system planning and operation. Whencarryingoutwindpower embedded networkplanningoroperationanalysis,engineers havetoputmuch effort intothe modelling of the wind turbines rather than concentrating on the problem itself. Hence, a wind turbine model compatible with commercial power system [3]

By the Variable speed operation of the DFIG wind turbine mainly based on the active and reactive power capabilities,which results the lower cost of the converter and power losses are reducedas compared to wind turbine with fixed speed generator.The improved efficiency in capturing more wind power and their capability to achieve the higher power quality is possible by the variable speed wind turbine with recent specification.[4]

For variable speed DFIG based on wind turbine conversion system for variable speed novel adaptive higher sliding mode control strategy is studied in this part. The very most advantage of this it is simplified design of DFIG because it avoids measure of speed, rotor current ,rotor position thus its crucially reduce the complexity. The roasting and stability of the proposed adaptive terminal sliding mode control is verified using the MATLAB/SIMULINK based DFIG model.[5]

II. DOUBLY FED INDUCTION GENERATOR BASED ON WIND TURBINE SYSTEM

The (DFIG) for wind energy conversion system is studied here.In order to control the power flowing in between the stator of (DFIG) and the grid, a control law is synthesized using PI controllers. Doubly fed induction generator (DFIG) is a popular wind turbine (WT) system due to its high energy efficiency. An effective way to control strategy for both the rotor and grid side converters to enhance the low voltage ride through capacity of the DFIG wind turbine (WT), without the need of additional current and voltage protections. For the grid side control scheme, a compensation item, which reflects the variation of the DC-link current of the rotor side converter, is added during the fault to smooth the oscillations of the DC-link voltage. [6]

As very higher performance vector control of DFIG (doubly-fed induction generator) based on the wind power generation which demands accurate rotor position and speed information to the controller The DFIG is a fascinating choice for wind power generation at a wide speed range below and above the synchronous speed. The DFIGs are mainly controlled from rotor sides for wind power generation schemes due to the numerous advantages.The most important goal is to reduce the voltage disturbance under normal operating conditions. The controller design technique is used to achieve the best outcome of the wind energy conversion system. The rotorvoltage to control the suitable parameters of the DFIG based on control method of DC voltage. [7]

The most important use of the variable speed wind turbines are it improves the dynamic behavior, resulting in the reduction of the drive train mechanical stress and electrical power fluctuation, and also the increase of power capture.The power generation systems commercially available in the wind energy market recently is the doubly fed induction generator with the stator directly connected to the grid and with its rotor winding connected to the grid through a variable frequency converter. The most advantages of this system is that the rating of the power converter is one third of that of the generator [8].

The maximum power from the wind is extracted by the machine side converter. Done by using a constant speed direct-driven wind turbine in Mat lab. The kinetic energy in the wind is converted into mechanical energy by the turbine by shaft and gearbox arrangement due to the different operating speed ranges. The generator converts this mechanical energy into electrical energy. Then generator side PWM converter converts ACpower into DC power, grid side converter converts DC power into AC power and send to grid. However, as wind is an intermittent renewable source, the wind source extracted by a wind turbine is therefore not constant. For this reason, the fluctuation of wind power results in fluctuated power output from wind turbine generator. Finally this model enable to control the 1.5MW wind turbine permanent magnetic generator which feeds alternating current to utility grid. [9].

Doubly fed induction generators (DFIG) based wind turbine is an emerging technology, which becomesincreasingly popular due to its various advantages over fixed speed generator systems. A DFIG with wind turbine have an capacity to generate maximum power with varying and adjustable speed and ability to control active and reactive power by the power converters, low power rating of cost converter components, and so on. World's largest sum of electricity generation contributed by non-renewable sources of fuel such as coal, gas and oil. These fuels emit lots of CO2 other harmful gases to the atmosphere and their residues in the water, which raised global warming issues of earth health problems of human and wild-life issues. In order to avoid these mentioned drawbacks. A survey is done and made A new immortal idea of the wind turbine DFIG. [10].

III.METHODOLOGY

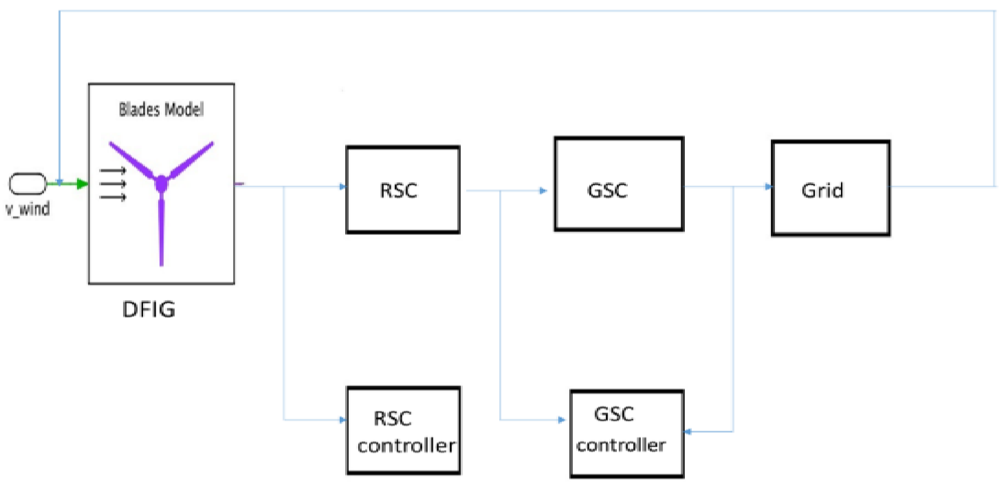

Fig. Schematic Diagram of wind energy based on DFIG System

The schematic diagram of a grid connected doubly fed induction generator (DFIG) wind turbine system (WT) as shown in the above fig.This system including the wind turbine, the induction generator,the back to back PWM converters,and the control system,is connected to the grid through a transformer.The control system consist of two control levels including the WT control and DFIG control. The WT level controls the output mechanical power of the wind turbine. And the wind speed is determined by dfig. In this method the DC voltage deals with the rotor voltage to control the parameter of the DFIG,such as stator flux, stator current, active and reactive power of the system.The control of the RSC(rotor side converter) is utilizing the controller for power flow from the DFIG.The dc link voltage is operated to the below rated value of the GSC(grid side converter).This system that can be used for RSC and GSC to reduce the dynamic transient from the system.The main goal of the controller design procedure is to improve the performance of wind energy conversion. The power flow between the rotor circuit and the grid must be controlled both in magnitude and in direction.The function of the RSC is to govern both the stator-side active and reactive powers independently. While the function of the GSC is to keep the dc-link voltage constant regardless of the magnitude and direction of the rotor power. The GSC control scheme can also be designed to regulate the reactive power. The reactive power control by the RSC and GSC is needed to keep the voltage within the desired range, when the DFIG feeds into a weak power system with insufficient local reactive compensation. The wind turbine controller controls the pitch angle of the blades, which determine the mechanical power that the turbine extracts from the wind.

IV. CONCLUSION

The schematic diagram of a grid connected doubly fed induction generator (DFIG) wind turbine system (WT) as shown in the above fig.This system including the wind turbine, the induction generator,the back to back PWM converters,and the control system,is connected to the grid through a transformer.The control system consist of two control levels including the WT control and DFIG control. The WT level controls the output mechanical power of the wind turbine. And the wind speed is determined by dfig. In this method the DC voltage deals with the rotor voltage to control the parameter of the DFIG,such as stator flux, stator current, active and reactive power of the system.The control of the RSC(rotor side converter) is utilizing the controller for power flow from the DFIG.The dc link voltage is operated to the below rated value of the GSC(grid side converter).This system that can be used for RSC and GSC to reduce the dynamic transient from the system.The main goal of the controller design procedure is to improve the performance of wind energy conversion.The power flow between the rotor circuit and the grid must be controlled both in magnitude and in direction.The function of the RSC is to govern both the stator-side active and reactive powers independently. While the function of the GSC is to keep the dc-link voltage constant regardless of the magnitude and direction of the rotor power. The GSC control scheme can also be designed to regulate the reactive power. The reactive power control by the RSC and GSC is needed to keep the voltage within the desired range, when the DFIG feeds into a weak power system with insufficient local reactive compensation. The wind turbine controller controls the pitch angle of the blades, which determine the mechanical power that the turbine extracts from the wind.

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