STUDY ON POWER CONTROL OF DOUBLY FED INDUCTION GENERATOR

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Abstract - *In recent year, wind energy has become one of the most useable sources is renewable energy which has additional transmission capacity as well as maintaining system reliability. The generation of electrical power by using wind power. That is simply in that we convert wind energy into electrical energy and directly supplied to the grid through voltage source converter. The variable speed wind generation system based on doubly fed induction generator. The stator of doubly fed- induction generator connect to grid and rotor of doubly fed-induction generator connected through AC-DC-AC converter. In this converter does not need to be rated for the machine's full rated power. Variable speed wind turbine it is more advantages rather than fixed speed wind turbines. The AC-DC-AC converter contains the DC-link which used to maintain reference value fixed at 1400v and reactive power regulate to zero.*

Key Words: AC-DC-AC Converter; doubly fed-induction generator; grid connected; Renewable energy; DC- link;

1. INTRODUCTION

In a recent year, electricity power produced from wind power because wind power is considerably more than present human power use for all sources especially wind power generation are environmentally clean and ecofriendly wind generation schemes are classified into fixed speed system and variable speed system the use of doubly fed induction generator is increased as increase in use of wind power generation. The control system doubly fed induction generator is AC-DC-AC converter which is connected in rotor side the ability of the doubly fed induction generator is provide reactive power during the variable speed operation the grid side converter and rotor side converter are connected to the back to back converter. The rotor side converter is current controlled and grid side converter is voltage controlled Rotor winding are connected to grid via slip ring and AC-DC-AC voltage source converter that control both rotor and grid frequency can freely flexible from (50Hz to60 Hz). The converter which control rotor current it is possible to adjust the active power and reactive power fed to grid from the stator independently of the generator's turning speed. The doubly fed induction generator rotors are typically wound with 2to3 times the number of turns of turns of the stator. This means the current will be low as compare to rotor voltage.

2. DFIG CONTROL BY AC-DC-AC CONVERTER

The controlled rectifier and controlled inverter based converter is called AC-DC-AC converter consisting of two conventional pulse width modulated, voltage source inverters . It differs from the diode rectifier based converter for the rectification stage, where the diode rectifier with chopper circuit is replaced by controlled rectifier. The controlled rectifier gives the both directional power flow capability, which is not possible in the diode rectifier based power conditioning system. The controlled rectifier highly reduces the input current harmonics and harmonic losses. The output voltage and input current waveforms of a AC-DC-AC converter are illustrated respectively. The grid side converter enables to control the active and reactive power passes to the grid and keeps the DC-link voltage constant, improving the output power quality by removing total harmonic distortion. The generator side converter works as a driver, controlling the magnetization demand and the desired rotor speed of the generator. The decoupling capacitor between grid side converter and generator side converter provides separate control capability of the two converters. A simulation analysis of AC-DC-AC converter based wind turbine generator system was carried. The harmonic spectrums of the AC-DC-AC converter. Due to some special features this converter topology has received great attention recently.

Electric produce components in a module form, all the devices in a single pack; suitable for this converter, which makes the converter compact and lightweight. The AC-DC-AC converter can be used for permant magnet squirrel cage and squirrel cage induction generator based wind power generation systems. Siemens employs AC-DC-AC converter for power conditioning of squirrel cage induction generator based wind turbine generator systems. The voltage rating of the most common generators is usually in the range of 380–690 V except that Repower employs 6.6 kV doubly fed induction generator. Therefore, converter voltage level is also in the range of 380–690 V due to the low generator voltage rating and the use of two-level converter topology. In order to integrate the wind turbine with local medium voltage grid a step-up transformer is normally installed inside the nacelle of the wind turbine. In the last two decades a lot of research and development have been reported to improve the performance of this converter. New control schemes were proposed to improve the performance of inverter section and field programmable gate array based reconfigurable control strategy has been proposed. An integrated control strategy of AC-DC-AC converter has been developed for direct drive PMSG based wind turbine systems

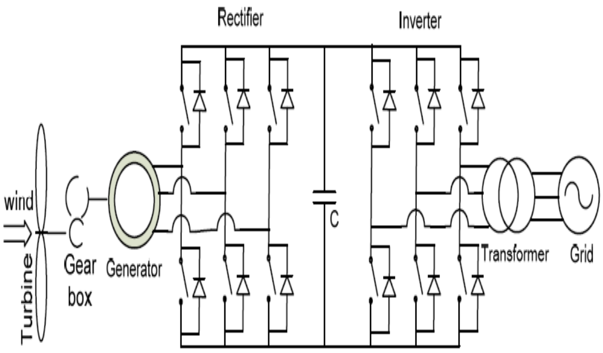

Fig. 1: AC-DC-AC Converter Based Wind Turbine Generator

a) ROTOR SIDE CONTROL

The control strategy made for the machine side converter. The purpose of the machine side converter is to maintain the rotor speed constant is controlled through iqr. To ensure unit power factor operation like grid side converter the reactive power demand is also set to zero. irrespective of the wind speed and also the control strategy has been Implemented to control the active power and reactive power flow of the machine using the rotor current components. The active power flow is controlled through idr and the reactive power flow The standard voltage oriented vector control strategy is used for the machine side converter to implement control action. Here the real axis of the stator voltage is chosen as the d-axis. The rotor-side converter is used to control the wind turbine output power and the voltage measured at the grid terminals.

The power is controlled in order to follow a pre-defined power-speed characteristic, named tracking characteristic For the rotor-side controller the d-axis of the rotating reference frame used for d-q transformation is aligned with air-gap flux. The actual electrical output power, measured at the grid terminals of the wind turbine, is added to the total power losses (mechanical and electrical) and is compared with the reference power obtained from the tracking characteristic. A Proportional- Integral (PI) regulator is used to reduce the power error to zero. The output of this regulator is the reference rotor current Iqr _ref that must be injected in the rotor by converter Crot

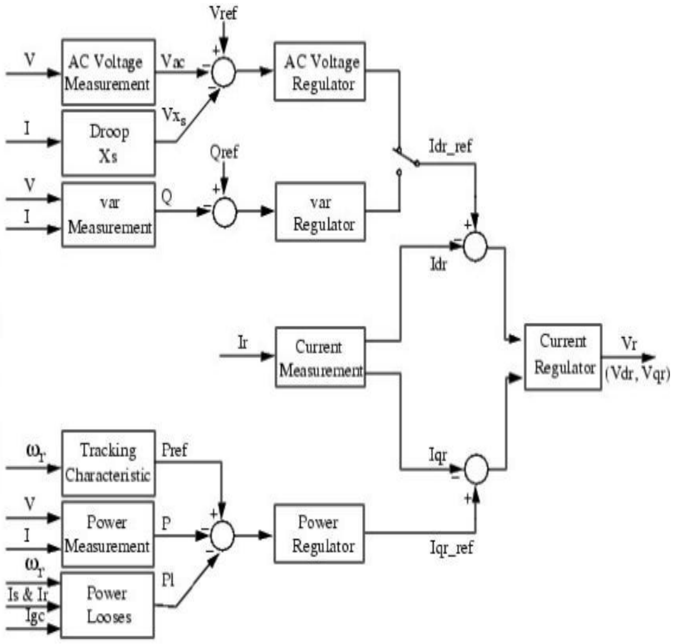

Fig. 2: Rotor Side Converter Control

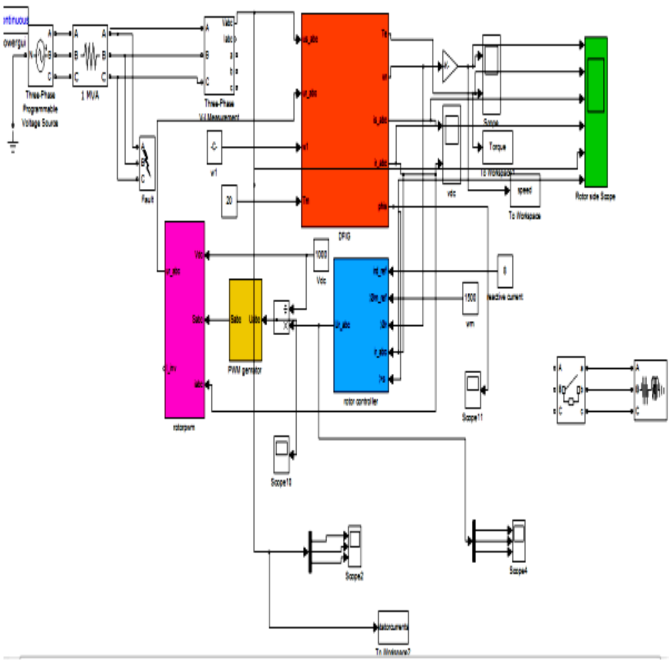

Fig. 3: Simulink Diagram of Rotor Side Control

b) GIRD SIDE CONTROL

The Grid side converter is used to regulate the voltage of the DC bus capacitor. For the grid-side Controller the d-axis of the rotating reference frame used for d-q transformation is aligned with the positive sequence of grid voltage. This controller consists of:- A measurement system measuring the d and q Components of AC currents to be controlled and the DC voltage. An outer regulation loop consisting of a DC voltage Regulator. An inner current regulation loop consisting of a current Regulator

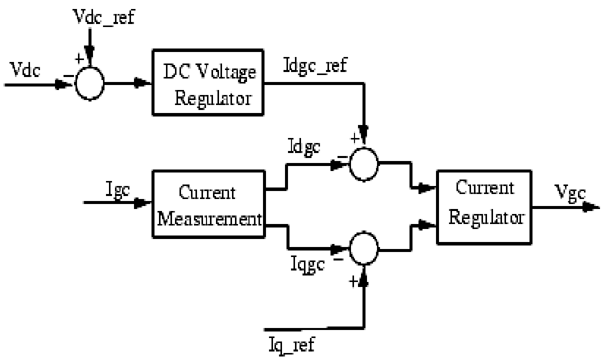

Fig. 5: Simulink Dig Of Grid Control

c) PITCH ANGLE CONTROL

The pitch angle is kept constant at zero degree until the speed reaches point D speed of the tracking characteristic. Beyond point D the pitch angle is proportional to the speed deviation from point D speed. For electromagnetic transients in power systems the pitch angle control is of less interest. The wind speed should be selected such that the rotational speed is less than the speed at point D.

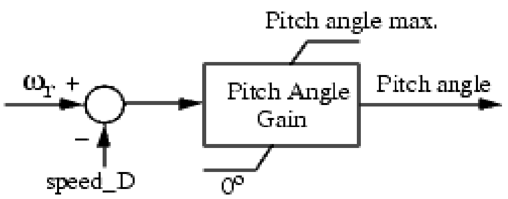

Fig. 6: Pitch Angle Control

Fig. 7: Variation Of Pitch Angle

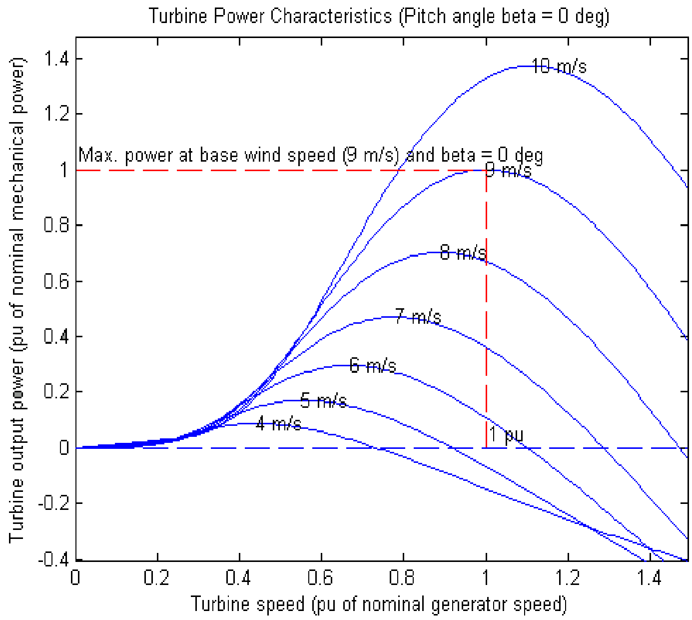

Fig. 7: Variation Of Pitch Angle

3. CONCLUSION

The behavior of doubly fed induction generator under power system disturbance was simulated using MATLAB/SIMULINK platform concept. Accurate transient simulations are required to investigate the influence of the wind power on the power system stability. The DFIG considered in this analysis is a wound rotor induction generator with slip rings. The stator is directly connected to the grid and the rotor is interface via a AC-DC-AC convertor partial scale power converter . Power converter are usually controlled utilizing vector control techniques which allow the decoupled control of both active and reactive power flow to the grid. In the present investigation, the dynamic DFIG working is presented for both normal and abnormal grid conditions. The control performance of DFIG is satisfactory in normal grid conditions and it is found that, both active and reactive power maintains a study pattern in spite of fluctuating wind speed and net electrical power supplied to grid is maintained constant. During grid disturbance, considerable torque pulsation of DFIG and torsion oscillation in drive train system has been observed.

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