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Mitigation of Harmonics in DFIG Based Wind Energy Conversion System

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ABSTRACT: The aim of this project is to control a Wind Energy Conversion System (WECS), equipped with a DFIG, for maximum power generation.Maximum Power Point Tracking (MPPT) control algorithm is applied to a DFIG whose stator is connected to the grid through a back-to-back AC-DCAC converter.

The Stator Side Converter (SSC) is controlled in such a way to extract the maximum power, for a wide range of wind speed. The Grid Side Converter (GSC) is controlled in order to ensure a smooth DC link voltage between the two converters. The harmonics are reduced by using filters of RC type and the value of harmonics are displayed at the wind side and load side.The presented simulation results demonstrate the performance of the system.

KEYWORDS:MPPT, Grid side converter,Stator side converter,Harmonics.

I. INTRODUCTION

Based on the extensive literature review on the topic, following are the major issues which are seriously concerned with stand-alone power generation employing doubly fed induction generators (DFIG). The main objective is to integrate electricity networks into a single system that maximize the generation and distribution of energy and which makes it possible to utilise large share of green energy. Electrical systems will undergo a major evolution, improving reliability and reducing losses.

This objective is achieved with the Simulation of DFIG based WECS. This system comprises of a wind turbine which transforms wind's kinetic energy into rotating motion, a gear box to match the turbine speed to generator speed, a generator which converts mechanical energy into electrical energy, rectifier which converts ac voltage to dc, a controllable dc-dc converter to trace the maximum power point, inverter which converts dc voltage to ac, filter for elimination of the ripples and then to the utility grid.

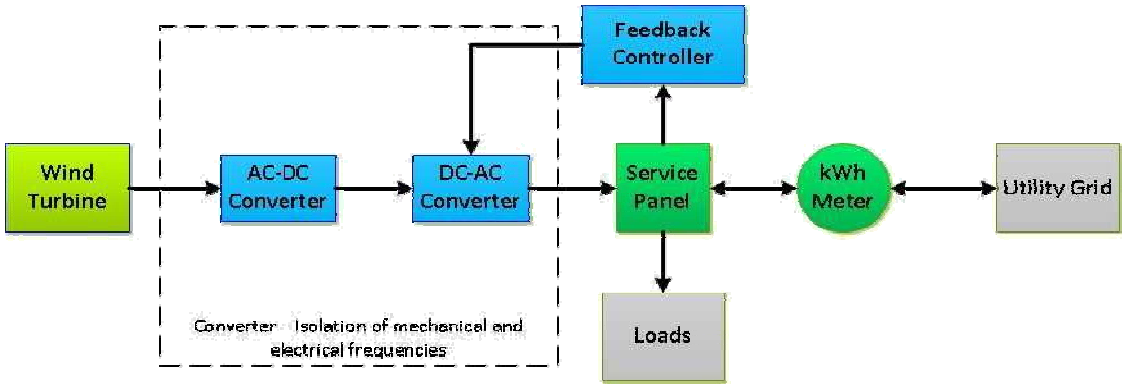

Fig 1. Block diagram

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II. LITERATURE SURVEY

Non-conventional mode of generation of electricity has several advantages over conventional sources of generation.In the paper, "Reliability comparison of power electronic converters for grid-connected 1.5kW wind energy conversionsystem", by Arifujjaman, briefs the reliability analysis of the power electronic converters for grid-connected permanent magnet generator-based 1.5 kW wind energy conversion system based on the semiconductor power losses.In paper, "Wind turbine control systems: principles, modeling and gain-scheduling design", author briefs the application of linear parameter varying (LPV) gain scheduling techniques to the control of wind energy conversion systems is emphasized

In the paper "A stand-alone hybrid generation system combining solar photovoltaic and wind turbine with simple maximum power point tracking control," Nabil A. Ahmed, Masafumi Miyatake, discuss about the connection of small turbines, permanent magnet synchronous generator, selfexcited induction generator, double field excited induction generator are used with gear box. One of the most efficient wind energy conversion systems is permanent magnet based wind energy conversion system with fixed pitch angle.

III. EXPERIMENTAL RESULTS

When a new inverter circuit is developed or a control strategy of a inverter, it is often convenient to study the system performance by simulation before building the breadboard or prototype. Fortunately larger number of user friendly digital programs is available for the study of power electronics system. Example SIMULINK, PSPICE, EMTP etc, out of this SIMULINK is user friendly and most suitable for power electronics and drives.The simulation diagram is shown in the figure 2 consists of PMSG based wind generation, diode rectifier, stator side side converter with MPPT and Fuzzy logic controller and Grid side inverter. The output of the circuit is taken across the utility grid. In this circuit the simulation results are taken from the wind side, dc link and utility side for the verification of the circuit.

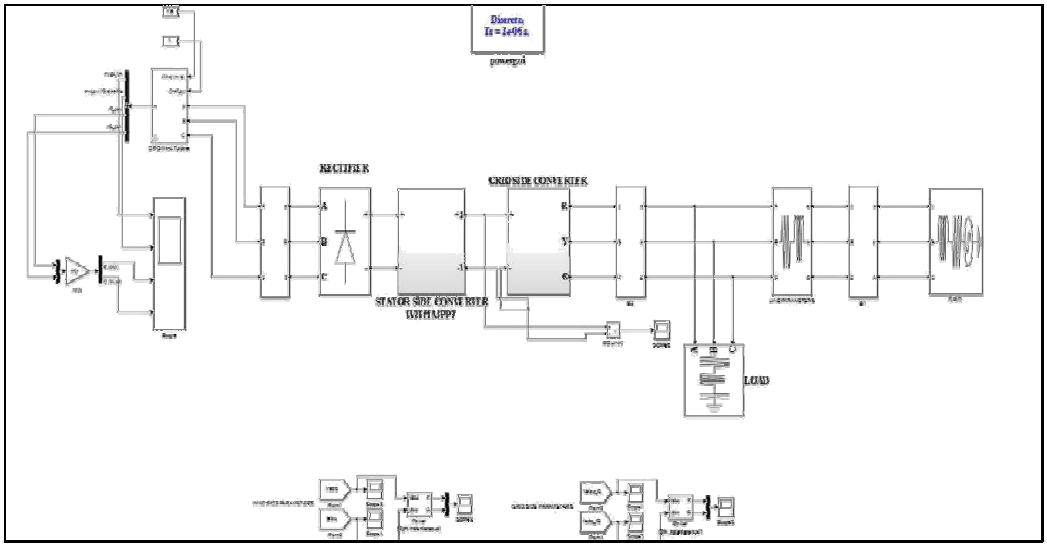

Figure 2 Simulation circuit for MPPT based controller using DFIG

This is the Simulink diagram for a doubly fed induction generator connected to grid side. The system is connected to a 575V, 3 phase source which is connected to a 9MW wind farm (6 of 1.5 MW each) via. Stator side converter with maximum power point tracking, Grid side converter and a transmission line.After simulating we got the results and waveforms of the voltage, current and THD and are verified and presented as shown below.

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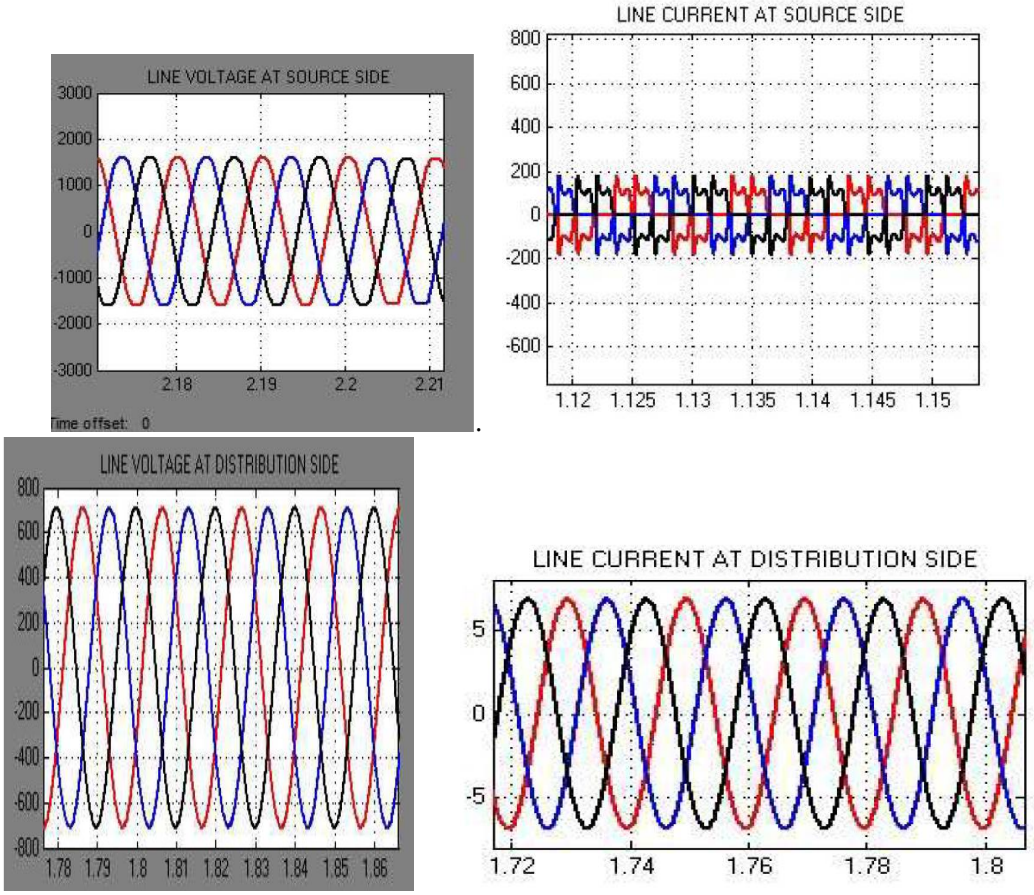

IV. CONCLUSION AND FUTURE SCOPE

A new converter topology MPPT based controller for DFIG power generation has been developed. This system can support individual source and for hybrid source simultaneously. Simulation results have been presented to verify the proposed circuit features. This power generation can also be used in domestic application, street light, traffic signals.In future this project can be modified by changing the DC-DC converter by using supervisory control techniques and it can also be changed by changing the existing converter to new emerging converter As the report only had pulled the grid connection requirement for wind power generation, which has been planned to stretch upon to the study of photovoltaic (PV) and its grid connection planning in Indian scenario. Also, few more work related to micro grids and hybrid energy with energy storage system are premeditated to complete by near future. Upon the finalizing of the entire study, the further research perspective would deliberately act as an advocate to discover the rank and strategy of nation's development in power and energy with respect to current and future energy demand.

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