IJARCCE

ISSN (Online) 2278-1021
ISSN (Print) 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering
ISO 3297:2007 Certified
Vol. 6, Issue 12, December 2017

A STATCOM Control Scheme in Grid Connected Wind Energy System for Power Quality Improvement

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Abstract: The power quality affects form injection of wind power into an electric grid. Wind turbine performance and power quality are determined on the basis of measurements. According to the guideline specified in International Electro-technical commission standard, IEC-61400. Wind turbine with grid system concerning the power quality measurements. The active power, reactive power, a variation of voltage, flicker, harmonics and electrical behavior of switching operation are the measurement of power quality. The power described a power quality problem. The power quality problem presented to the installation of wind turbines with the grid. In this proposed scheme is Static Compensator(STATCOM). Battery energy storage system(BESS) with a point of common coupling is connected to the Static Compensator to mitigate power quality issues. The integration of the real power source under fluctuating wind power is BESS. Using MATLAB/SIMULING to simulated the STATCOM control scheme for grid-connected wind system in power system block. From reactive power demand of the load and induction generator, the proposed scheme relies on the main supply. The co-ordination rule of the grid development and the scheme for the improvement in power quality as per the IEC-standard on the grid has been presented.

Keywords: STATCOM, Induction generator, Grid-connected system, flicker harmonics, wind turbine.

I. INTRODUCTION

To have sustainable growth and social progress, it is necessary to meet the energy needs by utilizing the renewable energy resources like wind, biomass, hydro etc. In sustainable energy system, energy conservation and the use of renewable energy are the key paradigms. The conversion of wind energy is wind power. Wind turbine generates a wind power in a useful form of electricity. At the end of 2008, worldwide nameplate capacity of wind-powered generators was only 121.2GW. Although wind produces only about 1.5% of the total electricity produced worldwide, its use is growing rapidly having doubled in the past 3 years. With the growing need for electricity, new methods are being explored day by day. As simultaneously, the old methods are being put to more use. The use of wind as a source of harness electricity has almost doubled in the past few years. But, the integration of wind with the existing power system presents technical challenges requiring consideration of voltage regulation, stability, power quality related issues etc. Thus the power quality of the electricity produced is greatly affected and this leads to the need to propose a scheme to utilize the wind in an efficient manner and thus improve the power quality. The issues of power quality are great importance to the wind turbine. Thus power generation from wind can be greatly benefitted by a scheme that provides an efficient method for producing good quality power. Since wind turbines are relatively unstable sources that fluctuate with wind conditions; hence they must be properly interfaced to avoid carrying over the instabilities into a constant load or grid.

II. METHODOLOGY

Following the methodology are
a) Grid connected system for power quality improvement.
b) Operation of Grid system
c) Control scheme

a) Grid connected system for power quality improvement

The Static Compensator is a static synchronous compensator. It is power electronics based regulating device which is composed of voltage source converter(VSC). The current control voltage source of STATCOM inverter injects the grid current. In that, the source current is harmonic free and then phase angle with respect to the source voltage has desired value. Due to absorption current, the reactive part and harmonic part, induction generator will be reduced. To

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accomplish these goals, the grid voltages are sensed and are synchronized in generating the current common for the inverter. The proposed grid is connected to the system and then implemented for power quality system of improvement at the point of coupling(PCC) is shown in Fig1. It has connected to nonlinear load and induction generator and the main important one is STATCOM. This methodology only improves the power quality of grid-connected system. It base work on current control voltage source.

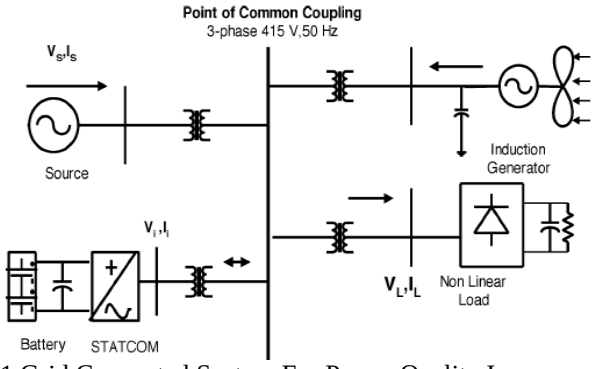

Fig 1.Grid Connected System For Power Quality Improvement.

b) Operational Scheme in Grid System

The operational scheme of grid system has shunt STATCOM with battery storage system and it connected with an interface of the induction generator and non-linear load at PCC. The STATCOM compensator output is varied according to the controlled strategy, so as to maintain the power quality norms in the grid system. The current control strategy is included in the control scheme. It defines the functional operation of the STATCOM in a reactive power support, to the induction generator and to the nonlinear load in a grid system. The main block diagram of the system operational scheme is shown in Figure 2.

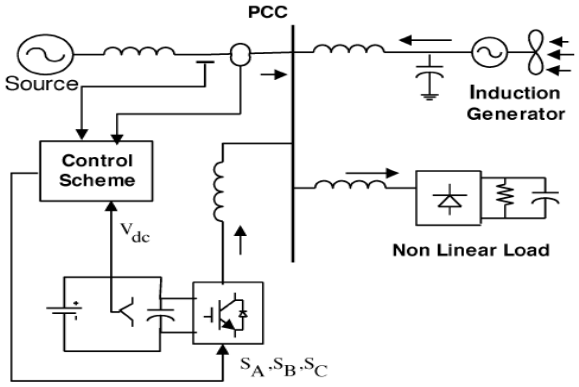

Fig 2.Operational Scheme in Grid System

c) Control Scheme

Using bang-band controller, the control scheme is base on injects the current in to the grid. The current control technique of hysteresis uses the controller. It has only 2 states of operation i.e. ON and OFF state. It is widely preferred for its dynamic response and ease of switching between the 2 states. In between boundaries of hysteresis area control system variable keeps the controller using this technique. It gives correct switching signal for STATCOM. The control scheme for generating the switching signals is shown in Fig 3.

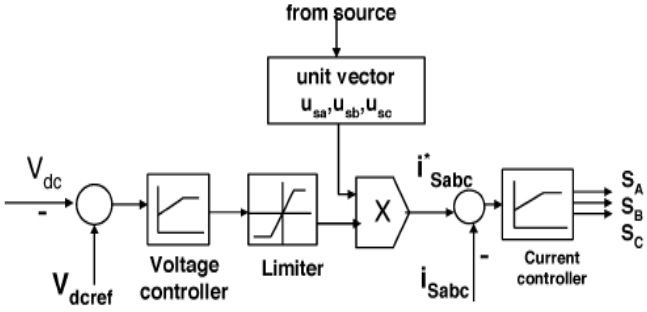

Fig 3. Control Scheme

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III. WORKING PRINCIPLE

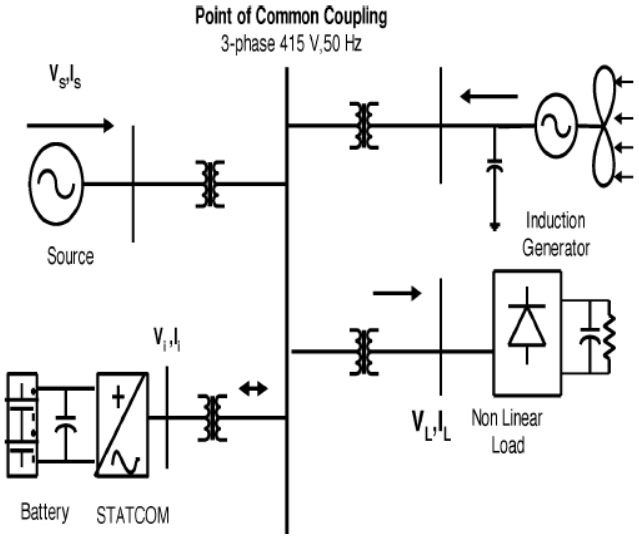

Fig4:Grid connected system for power quality system

In STATCOM current control voltage source inverter injects the current in the grid. The source current will reduce a harmonic part and their phase-angle with respect to the source voltage has desired value. Similarly, the injected current will be reducing the reactive part, harmonic part of the load and the induction generator current. It improves a power factor and the power quality. To accomplish these goals, the grid voltages are sensed and are synchronized in generating the current command for the inverter. The proposed grid-connected system is implemented for power quality improvement at a point of common coupling (PCC). It consists of wind energy generation system and battery energy storage system with STATCOM.

In Fig 5 shows in our project kit. It operates in two modes:

1. When wind power is available

- When the wind power is available the supply to the grid is provided by the wind energy and the extra energy is used to charge the battery.

2. When wind power is not available

- When the wind power is not available, the relay isolates the wind turbine from the grid and the supply to the grid is provided from the battery. The stored energy from the battery discharge and is converted into AC and given to the supply.

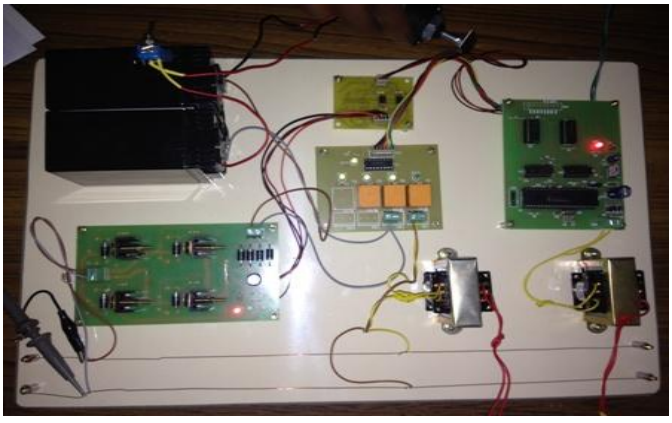

Fig5: Project

DOI 10.17148/IJARCCE.2017.61224

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IV. SIMULATION

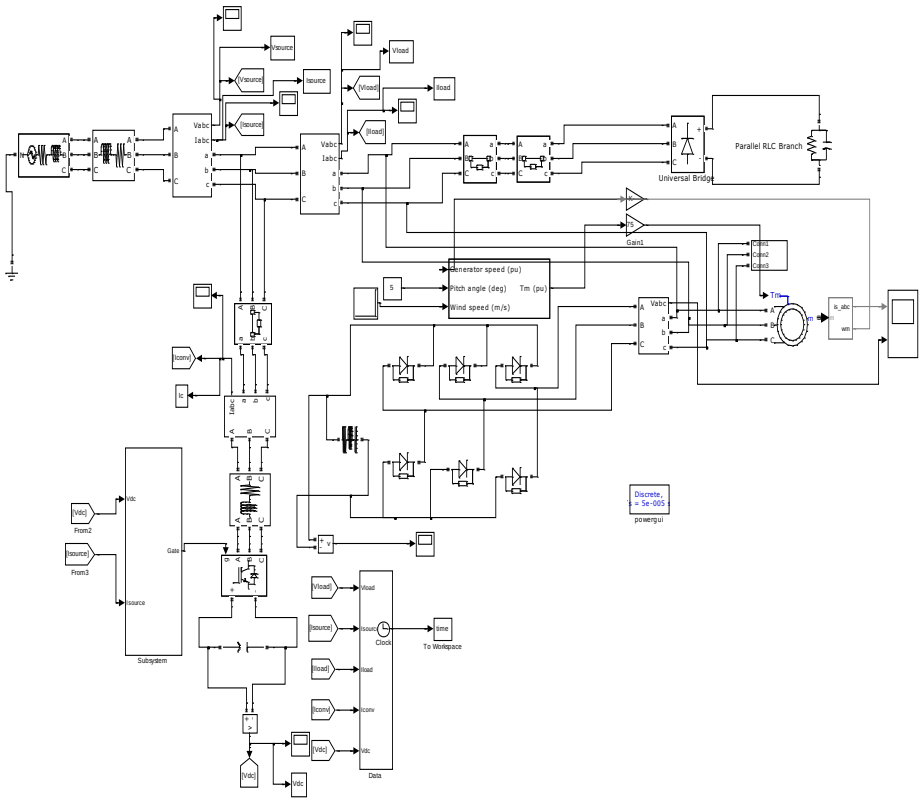
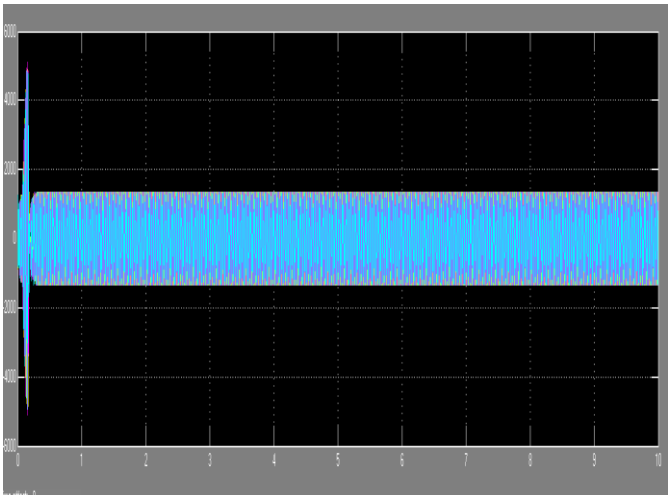


Fig6: MATLAB model of a STATCOM

In above Fig shown in MATLAB model for STATCOM control scheme for grid connected wind energy system for power quality improvement. Using simulink and power system blockset toolboxes, to make our simulation.

V. SIMULATION OUTPUT

Wind energy output of Voltage:



In grid system, the DC link voltage regulated a source current. DC link voltage is maintained constant across the capacitor as shown in Wind energy output of Voltage.

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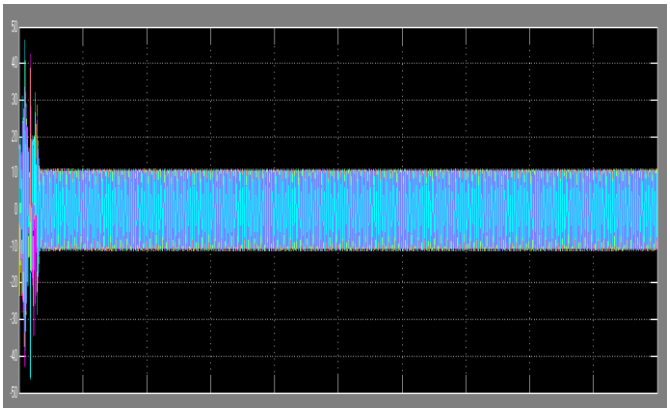
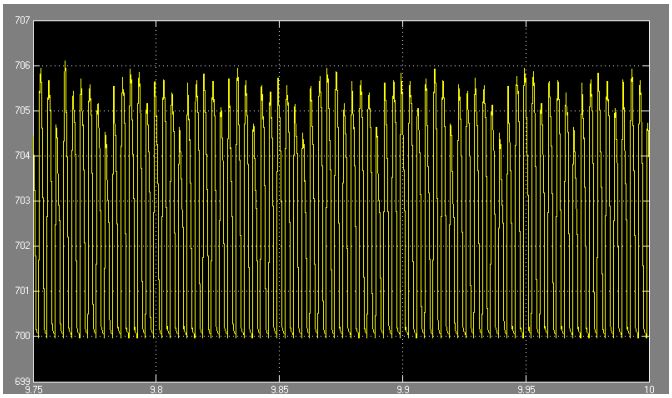
Wind energy output of Current:



The current through the DC link capacitor indicates the charging and discharging operation shown in Wind energy output of Current.

STATCOM output Voltage:

Due to effects of nonlinear load and wind generator, the observed source current of the grid is affected. In thus purity of waveform may be lost on both sides in the system. The inverter output voltage under STATCOM operation with the load variation is shown in STATCOM output voltage.



VI. CONCLUSION

This project presents the STATCOM based control scheme for power quality improvement in grid-connected wind generating system and with a linear load. The power quality issues and its consequences on the consumer and electric utility are presented. In order to maintain the power quality, the control system operation is develop for STATCOM BESS in the MATLAB/SIMULINK. It maintains the source voltage and the current in-phase and support the reactive power demand for the wind generator and load at PCC in the grid system, thus it gives an opportunity to enhance the utilization factor of the transmission line.

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