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**Note on RECENT TECHNOLOGIES**

# Power quality improvement for Grid connected wind energy system using STATCOM-Control scheme

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**Abstract:** Power Quality may get affected due to the wind power injection into an electric grid. The wind turbine performance and thereby power quality are determined on the basis of measurements and the norms followed according to the guideline specified in International Electro-technical Commission standard, IEC-61400. The influence of the wind turbine in the grid system concerning the power quality measurements are-the active power, reactive power, variation of voltage, flicker, harmonics and electrical behavior of switching operation and these are measured according to national/international guidelines. The paper study demonstrates the power quality problem due to installation of wind turbine with the grid. In this proposed scheme STATIC Compensator (STATCOM) is connected at a point of common coupling with a battery energy storage system (BESS) to mitigate the power quality issues. The battery energy storage is integrated to sustain the real power source under fluctuating wind power. The STATCOM control scheme for the grid connected wind energy generation system for power quality improvement is simulated using MATLAB/SIMULINK in power system block set. The effectiveness of the proposed scheme relives the main supply source from the reactive power demand of the load and the induction generator.

**Key words:** STATCOM control ・Static Compensator ・Quality measurements ・Using MATLAB/SIMULINK

## 1. INTRODUCTION

It is necessary to improve power quality in electrical power systems operation. In order to meet the energy need by utilizing the speed wind turbine operation, the fluctuation in the renewable energy resources like wind, biomass, hydro, wind speed transmitted as fluctuations in the generation, etc In sustainable energy system, energy mechanical torque, electrical power on the grid and leads conservation and the use of renewable source are the key to large voltage fluctuations. The need to integrate the renewable energy like wind turbine produces continuous variable output wind energy into power system is to make it possible to power. These power variations are mainly caused by minimize the environmental impact on conventional plant effect of turbulence, wind shear and tower-shadow and of [1]. The integration of wind energy into existing power control system in the power system. Thus, the network system presents a technical challenges and that requires needs to manage for such fluctuations. The power quality consideration particularly of voltage with regulation, customers stability, connected power in close issues proximity can [3]. Today, more t be viewed with respect to the wind generation, quality problems. The power quality is an essential transmission and distribution network, such as voltage customer-focused measure and is greatly affected by the sag, swells, flickers, harmonics etc. However the wind operation of a distribution andtransmission

Network. Generator introduces disturbances into the distribution the issue of power quality is of great importance to the network. One of the simple methods of running a wind wind turbine [2]. There has been an extensive growth and generating system is to use the induction generator quick development in the exploitation of wind energy in connected directly to the grid system. The induction recent years. The individual units can be of large capacity generator has inherent advantages of cost up to 2 MW, feeding into distribution network, effectiveness and robustness. However; induction generators require reactive power for the generated active power of an induction generator is varied due to wind, absorbed reactive power and terminal voltage of an induction generator can be significantly affected.

In the event of increasing grid disturbance, a battery energy storage system for wind energy generating system is generally required to compensate the fluctuation generated by wind turbine. A STATCOM based control technology has been proposed for improving the power quality which can technically manages the power level associates with the commercial wind turbines.

## 2. BESS-STATCOM

The battery energy storage system (BESS) is used as an energy storage element for the purpose of voltage

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regulation. The BESS will naturally maintain dc capacitor voltage constant and is best suited in STATCOM since it rapidly injects or absorbed reactive power to stabilize the grid system. It also controls the distribution and transmission system in a very fast rate. When power fluctuation occurs in the system, the BESS can be used to level the power fluctuation by charging and discharging operation. The battery is connected in parallel to the dc capacitor of STATCOM.The STATCOM is a three-phase voltage source inverter having the capacitance on its DC link and connected atThe point of common coupling. The STATCOM injects a compensating current of variable magnitude and frequency component at the bus of common coupling. 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

*System Operation:* The shunt connected STATCOM with battery energy storage is connected with the interface of the induction generator and non-linear load at the PCC in the grid system. The STATCOM compensator output is scheme that defines the functional operation of the STATCOM compensator in the power system. A single STATCOM using insulated gate bipolar transistor is proposed to have a reactive power support, to the induction generator and to the nonlinear load in the grid system.

**Control Scheme:** The control scheme approach is based on injecting the currents into the grid using "bang-bang controller." The controller uses a hysteresis current controlled technique. Using such technique, the controller keeps the control system variable between boundaries of hysteresis area and gives correct switching signals for STATCOM operation. The proposed control scheme is simulated using system SIMULINK in power system block set. The system performance of proposed system under dynamic condition is also presented.

*Voltage Source Current-Control-Inverter Operation:*
The three phase injected current into the grid from STATCOM will cancel out the distortion caused by the Linear type. He power quality issues and its consequences on the nonlinear load and wind generator. The IGBT based three- consumer side and electric power utility are discussed. The operation phase inverter is connected to grid throughthe of the control system developed for the STATCOM-BESS transformer. The generation of switching signals from in MATLAB/SIMULINK for maintaining the power reference current is simulated within hysteresis band of quality is simulated. It has a capability to eliminate out the 0.08. The choice of narrow hysteresis band have shown demanded reactive power is provided by the inverter. The real power transfer from the batteries is also supported by the controller of this inverter.

*Power Quality Improvement:* It is observed that the source current on the grid is affected due to the effects of nonlinear load and wind generator, thus purity of waveform may be lost on both sides in the system. The inverter output voltage under STATCOM operation with load variation. This shows that the unity power factor is maintained for the source power when the STATCOM is in operation. The current waveform before and after the STATCOM operation is analyzed. The Fourier analysis of this waveform is expressed and the THD of this source current at PCC without STATCOM is 4.71%. The power quality improvement is observed at point of common coupling, when the controller is in ON condition.

The STATCOM is placed in the operation at 0.7 s and source current waveform is shown. The above tests with proposed scheme has not only power quality improvement feature but it also has sustain capability to support the load with the energy storage through the batteries

## 3. CONCLUSION

This paper presents the STATCOM-based control scheme switching for power in quality harmonic improvement parts of in the grid load currentonnected. The control voltage and current in-phase and support the reactive signal of switching frequencywithin its operating band. Power demand for the wind source generator and load at PCC in The choice of the current band depends on the operating the grid system, thus it gives an opportunity to enhance voltage and the interfacing transformer impedance. The integrated the compensated current for the nonlinear load and wind generation and STATCOM with BESS the outstanding performance. Thus the proposed scheme in the grid connected electric system fulfills the power quality norms as per the IEC standard 61400-21.