# ENHANCEMENT OF POWER QUALITY OF GRID-CONNECTED WIND ENERGY SYSTEM USING STATCOM

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***Abstract*: In this scheme the STATCOM is connected at the point of common coupling with Injection of wind power into an electric grid affects the power quality. So, the primary aim of shunt compensation in a distribution system are to cancel or compress the effect of harmonic contents in load such that current drawn from the source is nearly sinusoidal. The Induction machine is driven by the wind turbine. Where the wind turbine is synchronizing with electrical grid system, various power quality problems such as voltage sag, voltage swell, flicker, harmonics etc. The paper study demonstrates the power quality problem due to the installation of wind turbine with the Battery energy storage system (BESS) to mitigate power quality problems. The control scheme used here is Bang-Bang controller. A bang-bang controller is based on hysteresis current control scheme is developed for STATCOM. The STATCOM control scheme applied for the grid connected wind energy generation system (WEGS) used for enhancement of power quality is simulated using MATLAB/SIMULINK in power system block set. This proposed scheme assures the enhancement of power quality in a generated output.**

## INTRODUCTION

For the supportable growth and social progress, it is essential to fulfill the energy demand by using renewable energy resources like solar, wind, biomass, hydro etc. in property energy system, energy preservation, therefore the use of renewable source are important paradigm. The necessity to include the renewable energy like wind energy into power system is to create its potential to minimize the environmental impact. The power quality is used to explain how closely the electrical power delivered to the customers corresponding to the appropriate standard and so operate their end-use equipment correctly. Now a days power system are complicated networks with hundreds of generating stations and load centers being interconnected through the power transmission lines. An electric power system has three main components power generation, power transmission, and power distribution. The loads mainly being Non-linear loads as result there is a chance of harmonics being injected to the source side. FACTS devices will be used to overcome the power quality issues such as voltage variations, flickers, harmonics etc. A STATCOM is connected with Battery energy storage systems (BESS) at the point of common coupling (PCC) to make source current harmonic free and to improve the system performance.

The proposed STATCOM with hysteresis current control scheme for improving the power quality has following objectives.

a) Maintain the source side power factor at unity.
b) For fast response bang-bang controller is implemented in STATCOM.
c) Minimize the THD percentage at the PCC waveform.

## POWER QUALITY ISSUES AND ITS CONSEQUENCES

Even a few years back, the main concern of electricity consumer was the reliability of supply. Defining reliability as the continuity of electric supply. Even through the power generation in most advanced countries is fairley reliable, the distribution is not always so. The various power quality problems are voltage sag, swell, interruption, voltage unbalance, flicker, and harmonics etc. are discussed below.

## VOLTAGE SAG

Voltage sag is defined as decrease in voltage between 10 to 90% of its nominal rms voltage at the rated power frequency i.e.50Hz.Voltage sag consequences are tripping of motor etc.

## VOLTAGE SWELL

It is an increase in RMS voltage in range of 10% to 80% for duration greater than half cycle and less than 1 minute. A swell can occur due to a single line-to-ground fault on the system which results temporary voltage rise on the other unfaulted phases. Swell can also be caused by switching off a large load or switching on a large capacitor bank.

**VOLTAGE INTERRUPTION**

Voltage interruption is nothing but the supply voltage is lower than 10% of its nominal voltage. Interruptions can results the power system faults, equipment failure, control system malfunction.

**VOLTAGE UNBALANCE**

It is deviation in the magnitude and phase of one or more of the phases, of a three phase supply, with respect to the magnitude of the other phase and can even cause a large motor to trip.

**FLICKER**

It comes due to frequent on-off or switching regularly of large loads connected to grid. It results in rapid variation in voltage and changing brightness of incandescent and fluorescent lamps at consumer end.

**HARMONICS**

It is sinusoidal component of a periodic wave having a frequency,it is an integral multiple of the fundamental frequency. A non-linear element in power systems such as power electronic devices, static power converters, arc discharge devices etc creates harmonics in the power system. These harmonics may cause communication interference, heating, and malfunction of equipments.

**POWER QUALITY IMPROVEMENT**

The STATCOM based current control voltage inverter injects the current into the grid. The source current are harmonic free and phase –angle with respect to source voltage has a desired value. The current injected by the inverter will cancel out the reactive part and harmonic part of the load induction generator current, thus it improves the power factor and the power quality. The power quality improvement at point of common coupling (PCC), it is implemented by grid system. The STATCOM is connected to induction generator and nonlinear load at point of common coupling (PCC).The grid system is consist of wind energy generation system and battery energy storage system with STATCOM.

**STATCOM-BESS**

The battery energy storage system (BESS) is used as energy storage element. The BESS will maintain the constant dc capacitor voltage. In this system power fluctuation occurs,the BESS is used to level the power fluctuation by charging and discharging operation.

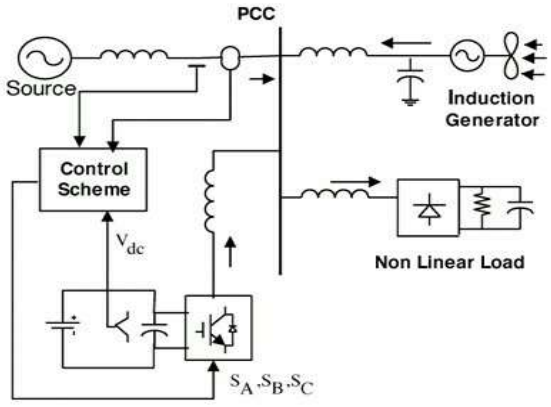


Figure a Diagramatic representation of operating scheme

**SYSTEM OPERATION**

The system under the study of STATCOM is interfaced with the BESS system .The STATCOM-BESS system is connected to the PCC in the grid where non- linear loads and induction generator based wind turbine are also interfaced. the STATCOM-BESS system is controlled by current control .The current control controls the output of STATCOM in such manner hence achieve power quality in the electrical grid .The STATCOM is support both reactive as well as real power demand in other sub-system.

**SIMULINK MODEL**

The proposed operational and control scheme simulated using simulink into power system block set is shown in figure b**.**

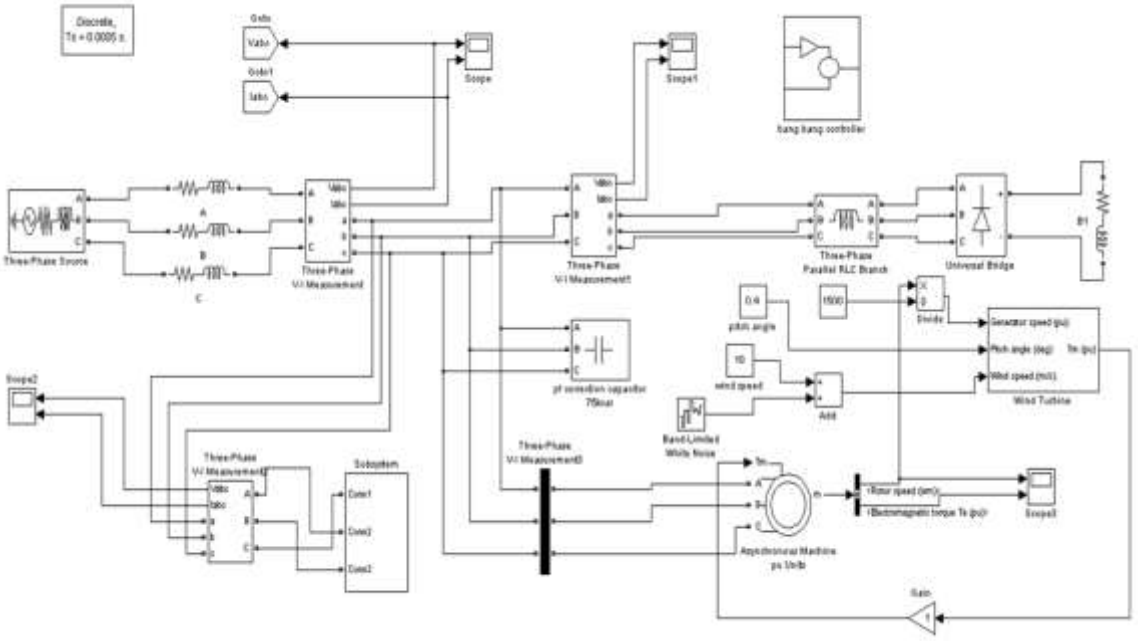

Figure b SIMULINK model of the proposed operational scheme

**RESULTS**

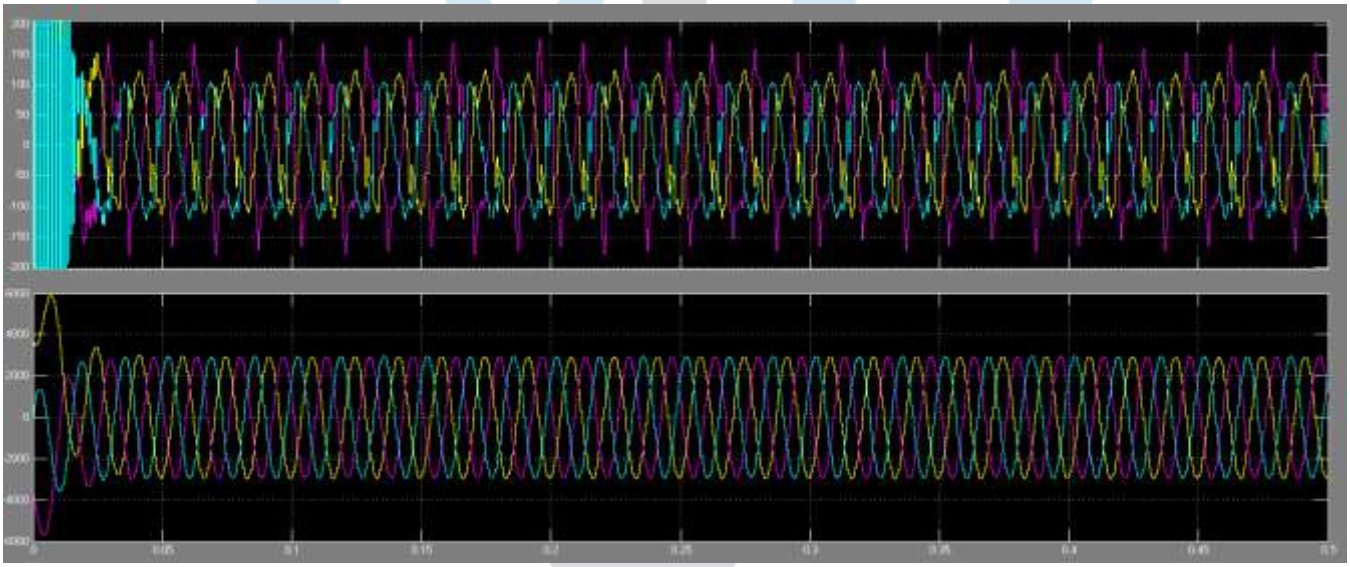

Fig1: linear load output waveform.

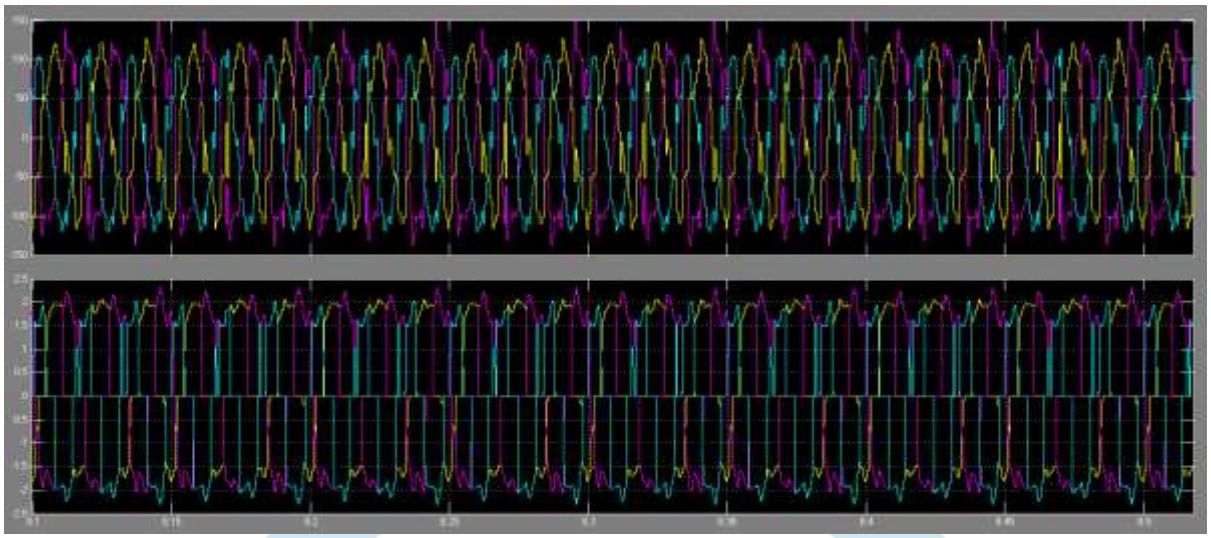

Fig2: Non-linear load output waveform.

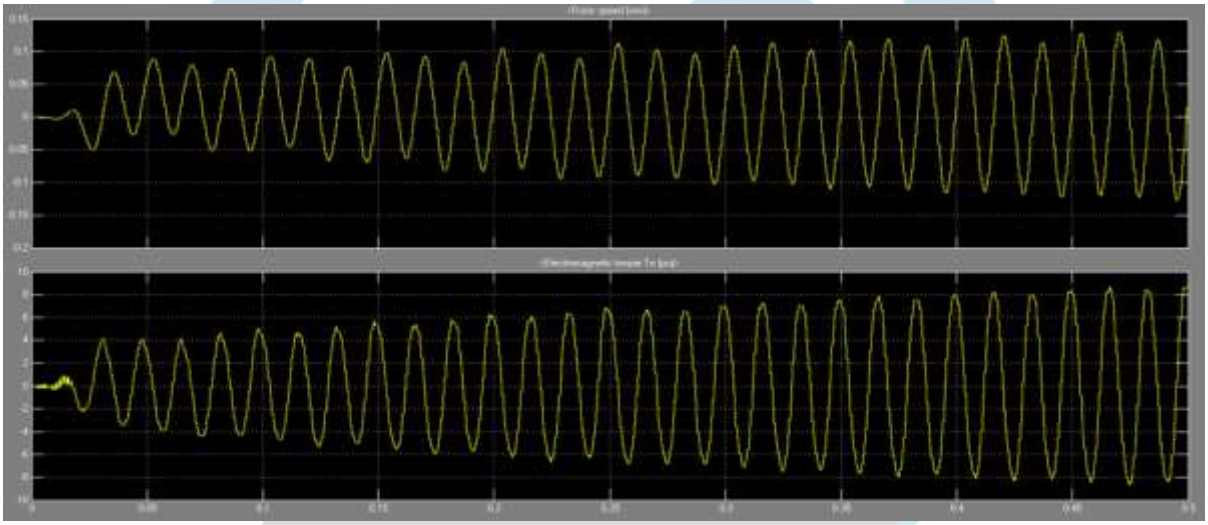

Fig3: Rotor speed (wm) & electromagnetic torque Te (pu).

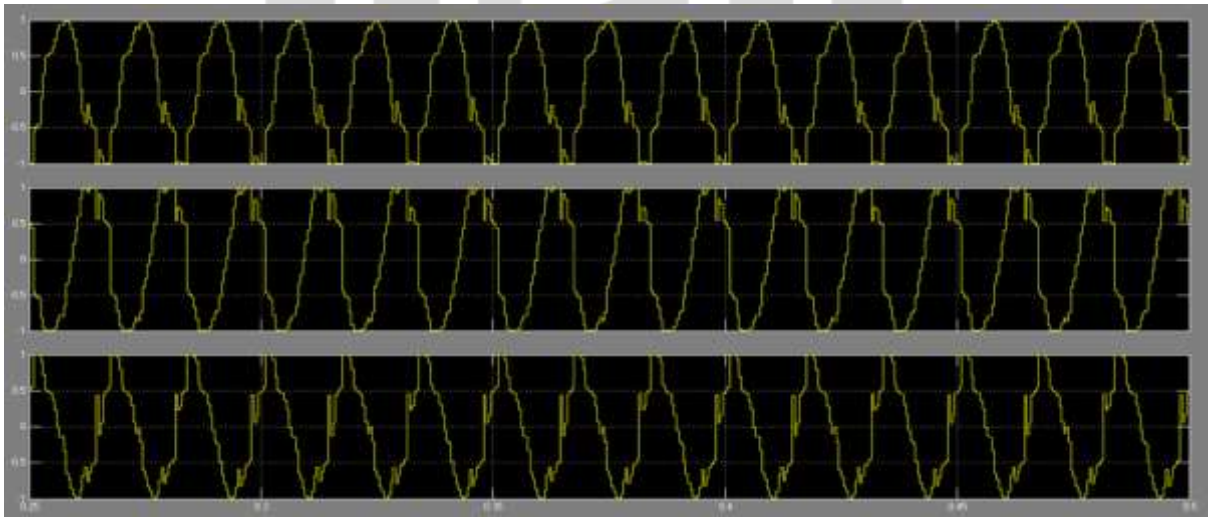

Fig4: Bang-Bang controller of STATCOM.

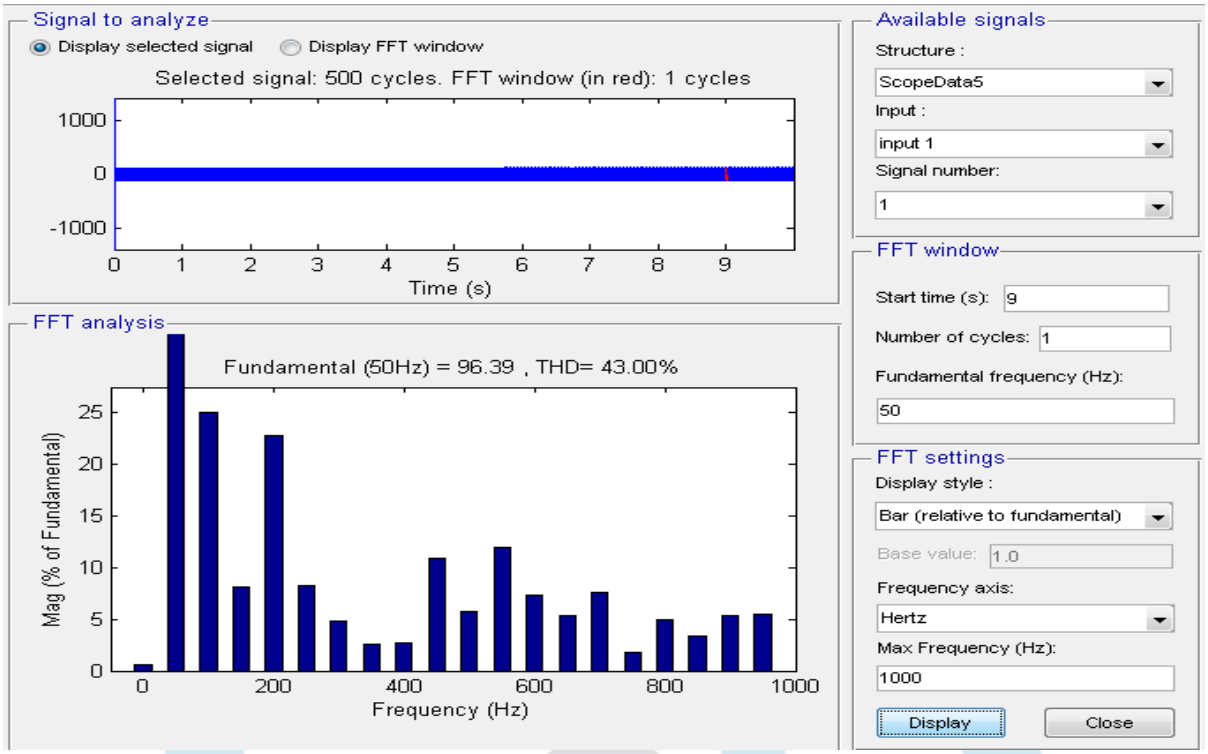


Fig5: Three phase source Current & Voltage output with STATCOM & its FFT analysis.

## CONCLUSION

This paper presents STATCOM based battery energy storage system. The entire STATCOM-BESS system is modelled in MATLAB/Simulink software. The STATCOM is simulated using bang-bang controller. The STATCOM injects the current into the grid and it cancel out the reactive and active parts of induction generator and load current. the load voltage is compensated by using solar powered STATCOM.

## REFERENCES

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