International Journal of Research
Available at https://edupediapublications.org/journals
e-ISSN: 2348-6848
p-ISSN: 2348-795X
Volume 06 Issue 06
May 2019

To Improvement Power Quality To Grid Connected Wind Energy System By Statcom

Lallan kumar[1], Atha Dixit[2]
MAHARISHI UNIVERSITY OF INFORMATION TECHNOLOGY,LUCKNOW(UP)
DEPARTMENT OF ELECTRICAL ENGINEERING

Abstract:

At present time the electrical energy basic need all over the world. But in the transmission system of wind energy system is affected voltage variation, flicker, harmonics and switching operation .Hence the power system losses stability and lagging power factor to connect the load. In this paper researched by using of static compensator (STATCOM) with using the battery stored system (BESS) at the common point coupling to power factor improvement and minimise total harmonic distortion of the grid system. To improve power quality by using STATCOM to connect the grid of wind energy system of a scheme of simulated of the power system of block set. The required power system maintain voltage stability and phase difference is zero, minimize distortion, harmonics to power system according to the guidelines specified in IEC-61400 standard (International Electro-technical Commission) provides some norms and measurement parameter. .

Keywords- *BESS,STATCOM,FACT,GTO,PWM,THD*

1. Introduction

The power quality is an essential customer-focused measures and is greatly affected by the operation of a distribution and transmission network. The issue of power quality is of great importance to the wind turbine. A STATCOM based control technology has been proposed for improving the power quality which can technically manage the power level associates with the commercial wind turbines. The proposed STATCOM control scheme for grid connected wind energy generation for power quality improvement has following objectives.

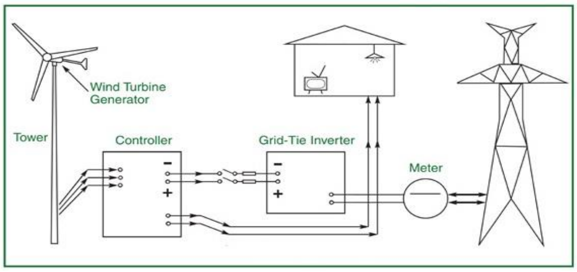


Figure 1.1 grid tie wind turbine system

- The power factor is improvement about unity on the source side.
- STATCOM is supported only Reactive power to wind Generator and Load.

Simple bang-bang controller for STATCOM to achieve a fast dynamic response.

2. STATCOM

Flexible Alternating Current Transmission Systems (FACTS) devices, namely Static Synchronous Compensator (STATCOM), Static Synchronous Series Compensator (SSSC) and Unified Power Flow Controller (UPFC), are used to control the power flow through an electrical transmission line connecting various generators and loads at its sending and receiving end.

- The STATCOM is compensate the voltage variations across the AC transmission Line
- When due to transient condition it has increased the stability of transmission line (i.e., during sudden changes in the load at the receiver end of the AC transmission line), STATCOM gives quick response of transmission line .

International Journal of Research
Available at https://edupediapublications.org/journals
e-ISSN: 2348-6848
p-ISSN: 2348-795X
Volume 06 Issue 06
May 2019

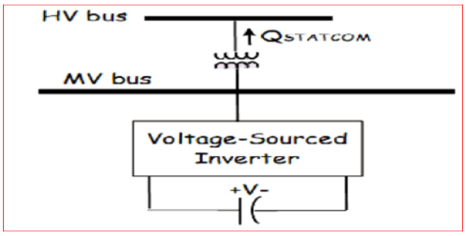


Figure: 1.2 basic block diagram of STATCOM

The STATCOM achieves this by monitoring the reactive power demand of the plant and supplying the correct amount of reactive power in order to dynamically compensate the reactive power demand. The advantages of adding a STATCOM to the plant in this case are summarized below:

1. Increased power factor of the plant (and thus a reduction in the plant's energy bill)

2. Elimination (or at least a major reduction) of voltage fluctuations at the plant input and in the ac power network, thus increasing the productivity of the application

4.3 Grid Connected System Configuration

2. The STATCOM is injects the current from the grid in such a way free from the harmonics and their phase angle is needed to the desired value. This injects current is cancel out reactive part and 3rd and 5th harmonics of the load and current of induction generator, improve power factor and power quality. The improvement power quality of the grid connected system is implemented at points of common coupling (PCC), as shown in Fig. 1. Consists of wind energy generation system and battery energy storage system with STATCOM Main Title

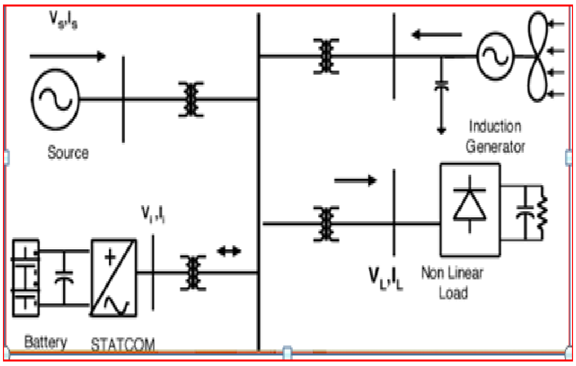


Figure 1.3 common couplings 3-phase 420 V at 50Hz

Wind Energy Generating System-

Wind energy generating station is working on a constant speed method with pitch control turbine. The induction generator is field circuit, it can accept constant and variable loads, and has natural protection against short circuit. The available power of wind energy system is presented as under in

$P_{wind=}\frac{1}{2}\rho AV^3 wind$ ……….(4.6)

Where ρ (kg/m^3) is the air density and A (m^2) is the area swept out by turbine blade,Vwind is the wind speed in m/s. It is not possible to extract all kinetic energy of wind, thus it extracts a fraction of the power in wind, called the power coefficient Cp of the wind turbine, and is given in

$P_{mech}=C_pP_{wind}$ …….. (4.7)

Where Cp is the power coefficient, depends on type and operating conditions of wind turbine. This coefficient can be expressed as a function of tip speed ratio λ and pitch angle θ. The mechanical power produce by a wind turbine is given in (4.6)

$P_{mech}= \frac{1}{2} \rho \Pi AV^3 windC_p$

Where R is the radius of the blade (m)

BESS-STATCOM

The voltage regulation depends upon the energy storage element like (BESS) the battery energy storage system. The will normally keep up DC capacitor voltage steady and is most appropriate in STATCOM since it quickly infuses or ingested responsive energy to balance out the matrix framework. The distribution and transmission system is controlled very fast rate. The BESS can be used charging and discharging operation due to power fluctuation. The battery is connected in parallel to the DC capacitor of STATCOM

3.TATCOM CURRENT CONTROL:

3.1 Control Strategy

The control scheme approach is based on injecting the currents into the grid using "Direct Control. The direct current control uses track PWM technology on the current instantaneous value for feedback control. Basically an indirect current is respectively simple, the quality is not high slow speed, the current control way is fast and quality is high, it can get control method respectively simple .

International Journal of Research
Available at https://edupediapublications.org/journals
e-ISSN: 2348-6848
p-ISSN: 2348-795X
Volume 06 Issue 06
May 2019

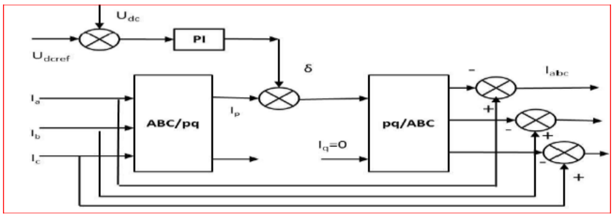


figure 3.1 Instantaneous reactive and harmonic current detection

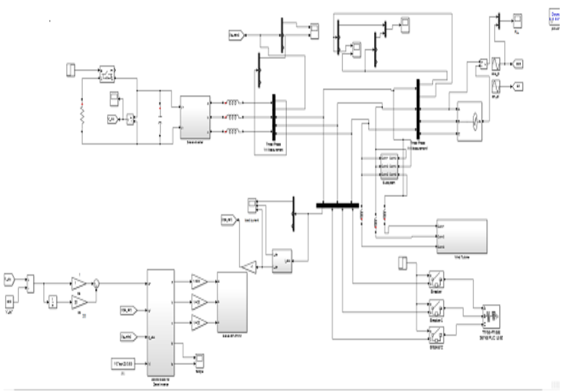
Figure 3.1 in the detection method load current Ia, Ib, Ic of three phase instantaneous rective and harmonic current detection method, in which Ia, Ib, Ic is a three-phase load currents, Udcrefis DC side voltage reference value

4. MATLAB Simulation

The Simulink model library includes the model of Conventional Source, Asynchronous Generator, STATCOM, Non-Linear Load, Inverter, Grid Voltage, Battery, Line Series Inductance and others that has been constructed for simulation. The simulation parameter values for the given system are given in Table 4.1

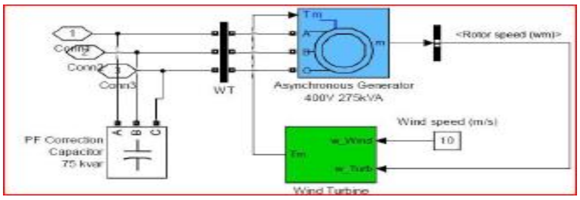
Table 4.1
System Parameters

1	Grid Voltage	3-Phase, 420 V, 50 Hz
2	Induction Motor	340.kVA, 420V, P = 4, Rs = 0.02, Rr = 0.025, Ls = 0.08H, Lr = 0.0H
3	Inverter parameters	DC link Voltage = 405V, DC link Capacitance = 2010µF, Switching frequency = 2.5kHz
4	IGBT Rating	Collector Voltage = 1220V, Forward Current = 50A, Gate Voltage = 25V
5	Load Parameter	Non-linear Load = 20kW



4.2 MATLAB Simulation of Current Controller

4.3 MATLAB Simulation of Wind Turbine:



.Figure 4.3 Simulation Models of Wind Energy System

5.RESULTSAND DISCUSSION :-

Simulation of wind energy system connected to the grid is carried out in MATLAB/Simulink environment. Following two cases are analysed as follows:

5.1 Wind connected to grid without STATCOM

In this case, simulation of defined system is carried out without using STATCOM and waveforms are analysed. The current and voltage waveform shown in the graph fig. 6.1 in this graph wind power generation station is connect to grid ,we can observed discontinuous waveforms due to integration of voltage and current are not in same phase,it is seen that the total harmonics distortion(THD) without use of STATCOM with FET analysis for grid connected system wind energy system of current is found to be 10.30%.

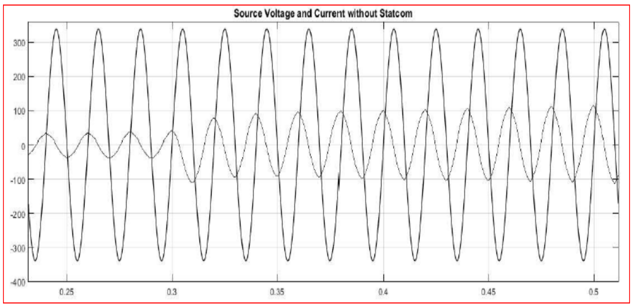
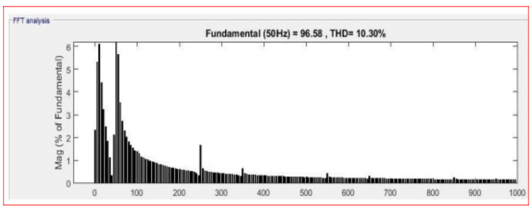


Figure 5.1 Source Voltage and Current of Phase A (without STATCOM)



International Journal of Research
Available at https://edupediapublications.org/journals
e-ISSN: 2348-6848
p-ISSN: 2348-795X
Volume 06 Issue 06
May 2019

Figure 5.2 FFT analysis of source current

5.2 Wind connected to the grid with STATCOM

In this case, simulation is carried out using the STATCOM control to analyse effect of this on the system. The current and voltage waveform of phase shown in the figure6.3 it is observed that the source current waveform are in phase with the source voltage after connection of STATCOM. Fig 5.4 in the presents the wind energy system is connected to the grid with STATCOM fed from FET analysis for the source current waveform with STATCOM is 1.27%.

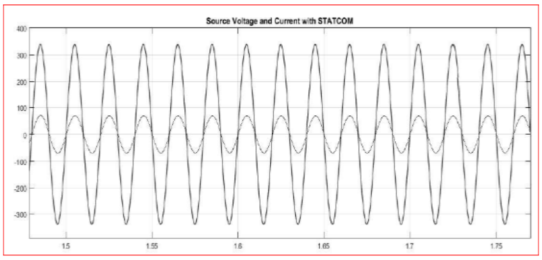


Figure 5.3 Source voltage and current with STATCOM

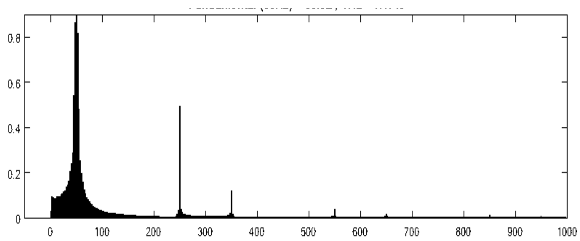


Figure 5.4 FFT analysis of source current with STATCOM

In the DC link voltage regulates the source current in the grid system, so the DC link voltage is maintained constant across the capacitor as shown in figure 6.5. The current through dc link capacitor indicating the charging and discharging operation

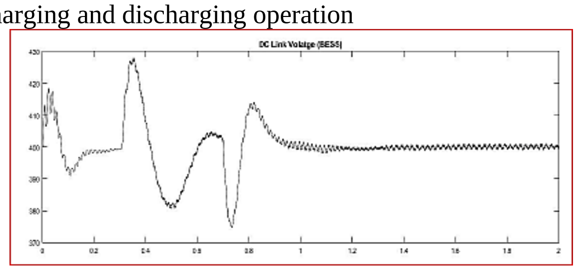


Figure 5.5 DC link Voltage

6. Conclusion:

The control of VSI based Direct Current controls carried out using MATLAB/Simulink. Results depicts THD, active and reactive power of grid connected wind energy system dynamic performance.

6.1 Conclusions

1-The DC current control scheme for power quality improvement to grid connected wind energy system with linear or nonlinear load.

2- thus the waveform of voltage and current are distorted on both sides in wind energy system in source current on the grid is affected due to the effects of nonlinear load and wind generator,

3-STATCOM-BESS based SIMULINK MODEL for grid connected wind energy system is

Proposed. The harmonic part of load current is cancel out.

4-It maintains the source voltage and current in phase and supports the reactive power Demand for the wind generator and load at PCC in the grid system.

5- It is demonstrated that the THD after using STACOM has been improved considerably and is within the norms of the IEC standards.

6-The 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.

6.2 Suggestions for future work

STATCOM-BESS based control has the capability of improving power quality as demonstrated already. However, work can be done to make the switching period of STATCOM faster and reliable. Also, improving quality of the battery is one of the major areas which can further improve performance of proposed controller.

REFERENCES

1. Atul S. Nikhade1,Snusha R. Dharmik, “Power Quality Improvement by Using Direct CurrentControl Method of STATCOM – A Review” ,International Journal of Science and Research (IJSR), pp-205-208, vol-4, no-2, April 2015.

2. Bhim Singh, Sabha Raj Arya, “Design and control of a DSTATCOM for power quality improvement usingcross correlation function approach” International Journal of Engineering, Science and Technology, Vol. 4, No. 1, 2012, pp. 74-86, March-2012.

3. B.T.Ramakrishnarao, B.Eswararao, L.Narendra, K.Pravallika, “A Statcom-Control Scheme for Power Quality Improvement of Grid Connected Wind Energy System” International Journal of Engineering

Science and Innovative Technology (IJESIT), Volume 2, Issue 3, May 2013.
4. Daniel W. Hart, Book on "Power Electronics" McGrew-Hill, page 357-362, 2011.
5. K. S. Hook, Y. Liu, and S. Atcitty, "Mitigation of the wind generation integration related power quality issues by energystorage," EPQU J., vol. XII, no. 2, 2006
6. MathWorks. http://www.mathworks.com
7. N. Rajkumar, C. Sharmeela, "Modeling and Simulation of PWM based STATCOM for Reactive Power Control", ISSN (onlne), pp 100-109, Vol-2, no-1, January 2014
8. P. Venkata Kishore and S. Rama Reddy, "Power Quality Improvement Using Multiple Statcoms", The International Journal Of Engineering And Science, pg 101-108, 2014.
9. S. K. Khadam, M. Basu and M. F. Conlon ,"Power Quality in Grid connected Renewable energy Systems: Role of Custom Power Devices", International Conference on renewable Energies and Power Quality, March 2010
10. Sharad W. Mohod ,Mohan V. Aware "A STATCOM-Control Scheme for Grid Connected Wind Energy System for PowerQuality Improvement" IEEE systems journal,vol.4,no.3,pp. 346-352, september-2010.
11. S. Venkateshwaran, G. VijayaGowri" STATCOM with TBESS to improve the Power Quality in Grid Connected Wind Energy System" International Journal of Advanced Technology & Engineering Research, Vol.2, no.2 pp.40-47, Nov-2012.
12. Saurabh S. Kulkarni, Naveen Kumar Mucha "A Matlab/Simulink Model for the control scheme utilized toimprove power quality of Wind Generation System connected to Grid" International Journal of Innovative Research in Advanced Engineering, Vol.1, no.6, pp.418-423, July-2014.
13. S.K.Sethy, J.K.Moharana, "Design, Analysis and Simulation of Linear Modelof a STATCOM for Reactive PowerCompensation with Variation of DC-link Voltage" ,International Journal of Engineering and Innovative Technology (IJEIT), pp183-189, Vol-2, no-5, November 2012.
14. S. Heier, Grid Integration of Wind Energy Conversions. Hoboken, NJ: Wiley, 2007, pp. 256–259.
15. Wind Turbine Generating System—Part 21, International standard-IEC61400-21, 2001.
16. Wikipedia. http://en.wikipedia.org/wiki/Renewable_energy_in_India
17. Power quality improvement IEEE System journal vol.4 no.3 september2010.
18. Polly Thomas - Received B-Tech in Electrical & Electronics from St. Joseph‟s College of Engineering and Technology , Palai Kerala under the Mahatma Gandhi University in 2010
19. International Journal of Computer Applications (0975 – 8887) Volume 145 – No. 8, July 2016.
20. P.S. BHIMRAO gernalised power electronics.
21. A. Sannino, "Global power systems for sustainable development," in IEEE General Meeting, Denver, CO, Jun. 2004.

22. K. S. Hook, Y. Liu, and S. Atcitty, "Mitigation of the wind generation
integration related power quality issues by energy storage," EPQU J.,vol. XII, no. 2, 2006.

23 R. Billinton and Y. Gao, "Energy conversion system models for adequacy
assessment of generating systems incorporating wind energy,"
IEEE Trans. on E. Conv., vol. 23, no. 1, pp. 163–169, 2008, Multistate.
24. Wind Turbine Generating System—Part 21, International standard-IEC61400-21, 2001.