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Power Quality Improvement by using 48 pulse Statcom in the Wind Energy Conversion System

Praveen Kumar Gavel¹, Dr. Shailendra Verma², Shivaji Kashyap³, Bhupesh Kashyap⁴

M. Tech Scholar, Department of EE, CCET, CSVTU BHILAI, C.G, India¹

Head of Department, Department of EE, CCET, CSVTU BHILAI, C.G, India²

M. Tech Scholar, Department of EE, CCET, CSVTU BHILAI, C.G, India³

M. Tech Scholar, Department of EE, CCET, CSVTU BHILAI, C.G, India⁴

ABSTRACT: In wind energy conversion system power quality is one of the major issues. The frequency and voltage profile variations are the severe issue due to unlike conditions like variable wind speed. These effects also arise the reactive power and to resolve this issue a STATCOM based wind energy conversion system is modelled in this work and a comprehensive study on the effects on the buses of the utility before and after deployment of the STATCOM for the same wind based generation system connected with the utility. After the analysis of simulation results we can see that the present technique of reactive power compensation and improves the PQ and the voltage sag and current harmonics efficiently and with better reliability.

KEYWORDS: STATCOM Static compensator. SAPF shunt active power filter, FACTS Flexible AC transmission system, Harmonics reduction, nonlinear loads, and Asynchronous machine.

I.INTRODUCTION

As the electricity requirements are increasing day by day so the transmission system stability as well as thermal stability are the main concern. The security and reliability of transmission system should be improved. The new transmission system rights construction is somewhat difficult due to various constraints in the bulk transmission power. Facts devices provides the corrections in functionality of the system and utilize the transmission system in a best possible manner. Some of the facts devices are STATCOM, SVC, UPFC etc. and these devices cause trouble in the power system protection. Fast control on the reactive power allow secure loading of transmission lines. From all the facts devices the static compensator STATCOM is a shunt reactive compensator. The reactive power drawn or supplied by the STATCOM can be varied by varying the magnitude of converter output voltage. Ideally the output voltages of the converter are in phase with the corresponding bus voltages. It is advantageous to connect STATCOM at midpoint of transmission line as power transfer and voltage support has been improved in the transmission system [1]-[4].

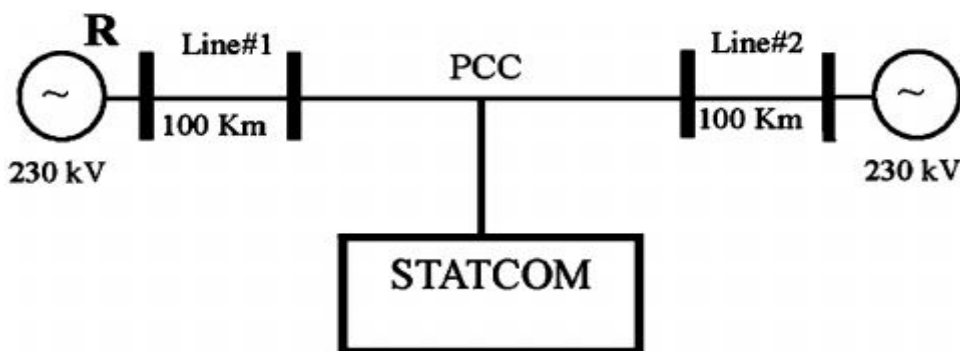


Fig. 1 Typical Statcom connected with the transmission system

II. WIND TURBINE MODELLING

A wind turbine has been modelled with this basic configuration of 15 m/s of standard wind speed along with the pitch control system design with the help of PI controller for the maximum power point tracking and also connected with the induction generator and provides three phase outputs from this whole generator system. After this system the outputs are processed by connecting transformer and other systems representing long and short transmission lines designed by the suitable parameters. A 48 pulse statcom has also been connected at the point of common coupling for the shunt reactive power compensation.

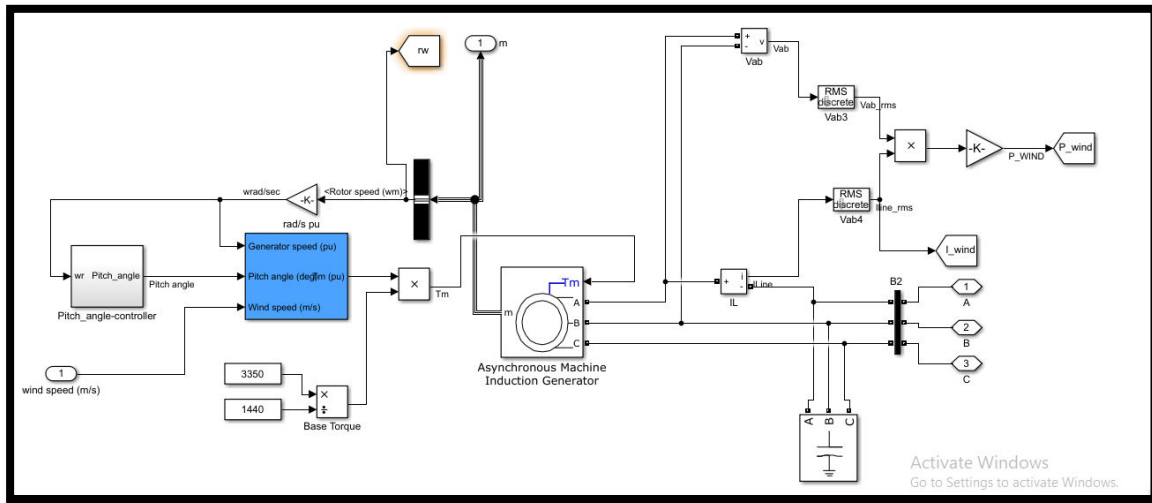


Fig. 2 Wind generator Model

III. STATCOM

Harmonic extraction based on the synchronous reference frame is accomplished by a series of mathematical calculations of three phase load currents which is conducted in dq0 direct quadrature zero reference frame. Park transformation is applied to convert three phase load current from abc frames to dq0 frames. Here dq frames are determined by the reference phase which is delivered by a synchronizer. In dq frames fundamental component will appear as DC signal, and the harmonic component will appear as ripples. A low pass filter will be used for the separation of fundamental component and harmonic component. Finally the desired reference signal is generated by using extracted harmonic components.[11][12]

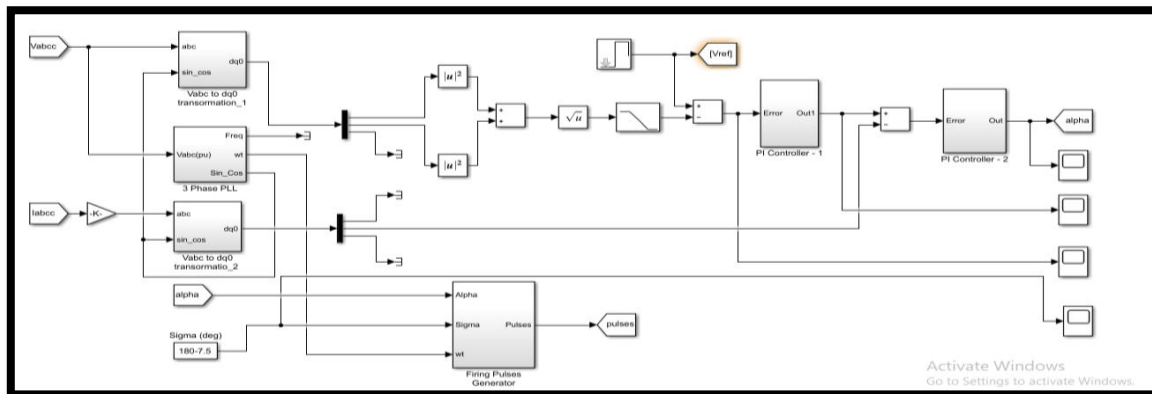


Fig. 3 Statcom Control

IV. ASSUMPTION AND MODEL DESCRIPTION

In this proposed work wind energy conversion system designed and connected with the selected parameters are connected to the transformer as well as resistive and inductive filter with a transmission line represented as a bus for the measurement. At this point of common coupling the 25 MVar capacity 48 pulse STATCOM has been connected. Further connections has been established for the long transmission line with the suitable filters. A three phase fault has been implanted at the time of 1.0 to 1.02 seconds for the analysis of fault clearance in this system.

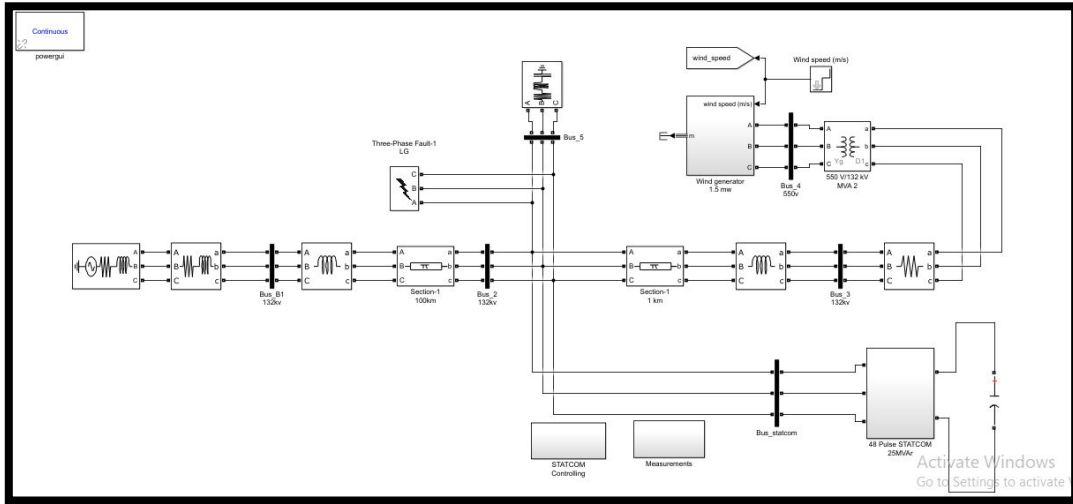


Fig. 4 Proposed model of statcom coupled with transmission system

V. RESULT AND DISCUSSION

After modelling the simulation has been done in Matlab simulink. At the first stage the whole model simulated with statcom and after disconnecting the statcom the difference in the voltage current and power in various buses has been measured P and Q graphs shown below. The statcom performance and wind generator performance represented by the output waveforms.

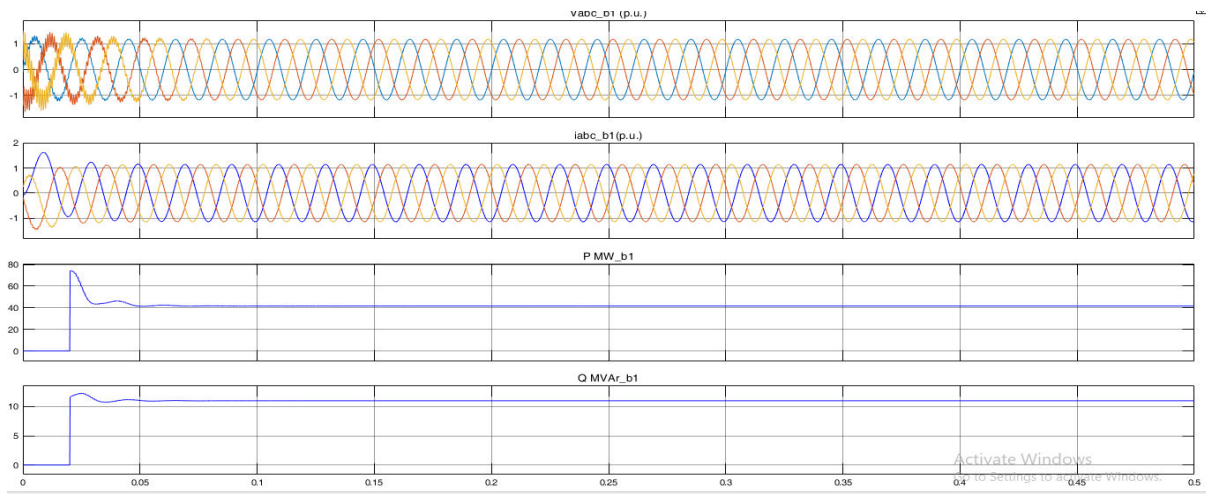


Fig. 5 Bus 1 with Statcom

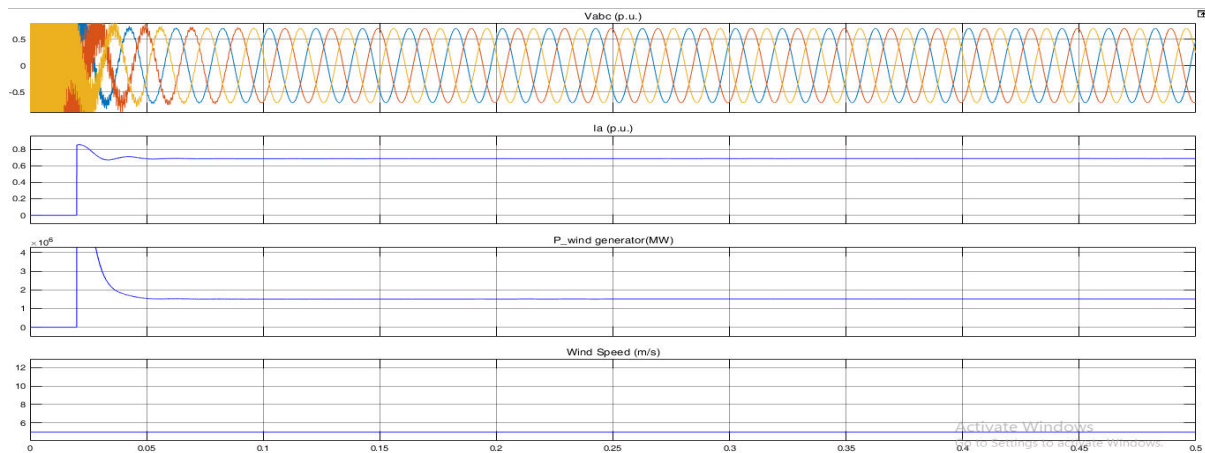


Fig. 6 Wind generator patterns

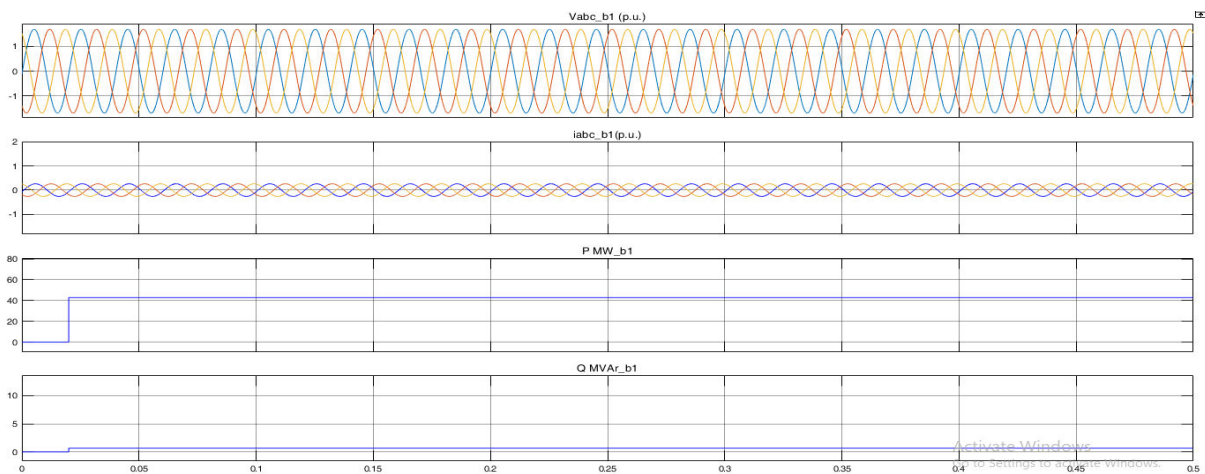


Fig. 7 Bus 1 without statcom

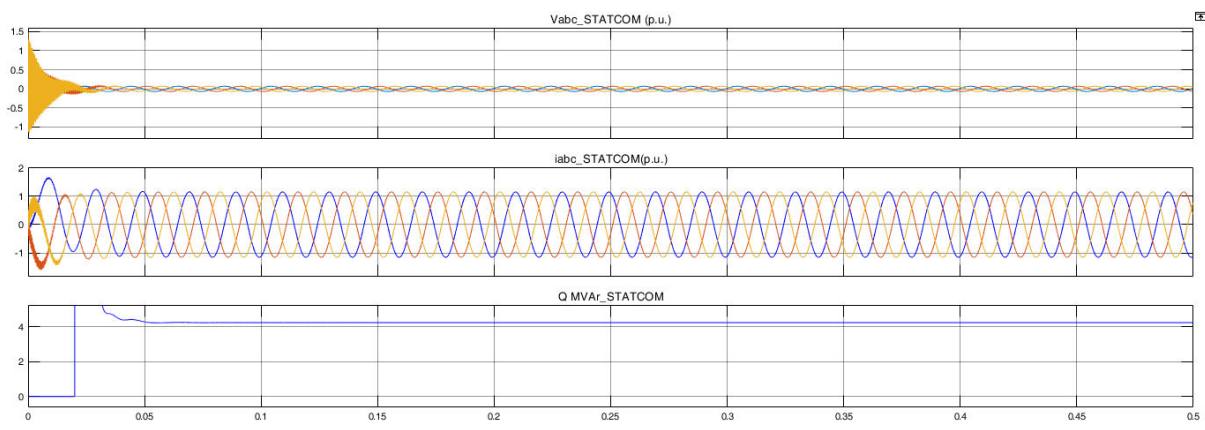


Fig. 8 Statcom parameters

V.CONCLUSION

As it seems from the simulation results that when the model being simulated with statcom the active power values are near by 40 and reactive power value near 11. After disconnecting the statcom we can see that the reactive power decreases near unity. So the statcom here injects the reactive power in the system without disturbing the active power values, three phase voltage and current. From the wind generator outputs the 1.8 MW outputs generated from the generator and the voltage and current waveforms are sinusoidal as filters of suitable parameters are connected in the transmission system.

Under fault condition resistance decreases and reactance increases with statcom as compared to the case without statcom connected in the system. As the wind farms and other renewable sources of energy are the main source of harmonics injection in the transmission system it is necessary to use static compensators to neutralize the undesirable effects caused by the harmonics.

VI.FUTURE WORKS

In the next phase we can work for some other Facts devices like SVC and UPFC in the designed system to have an analysis of power quality improvements by introducing faults and various other disturbance just to know that which device will be suitable for this kind of wind and solar related projects included lots of harmonics in the system.

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