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Power Quality Improvement Using Istatcom (Improved Statcom) With DFIG

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***Abstract*-In tradition power compensation devices and controlling techniques many disadvantage like only analyzing lower stability citeraia.one other hand our proposed ISTATCOM (Improved STATCOM) provide higher stability and lower losses. These are simulating MATLAB2015A software using Simulink. In this research work also gives a more stabilize DFIG system to controlling of power compensation ISTATCOM.**

***Keywords*-Voltage regulation, Voltage balancing, Load Compensation, STATCOM, Wind farm, SSR, Subsynchronous Resonance, Induction Generator, Frequency Scanning, Eigenvalue analysis.**

I.INTRODUCTION

The New and Renewable Energy resources are proposed by Ministry of New and Renewable Energy sources and Energy Development agencies to balance the need for the energy in the forthcoming years. The exploitation and development of various forms of energy and making energy available at affordable rates is one of the major thrust areas. Conversion of energy resources, environmental protection and sustainable developments are the three major changes of the world. One important issue is to satisfy the energy needs of people without causing rapid depletion of natural energy resources and degradation of the environment. Now-a-days wind energy has the most exploitable potential of renewable energy and has attracted great interests in recent years. Large wind farms have been installed or planned around the world and the power rating of the wind turbines are increasing. Wind generator is the crucial equipment to use wind energy[1-5].

II.POWER QUALITY

The accomplishment of the goals of the industry becomes possible, because the industries today extensively explore the innovative technologies which have evolved into technological developments. Continuous production can be ensured only when production optimization and getting maximum profits with minimized production costs are the projected objectives. The modern equipments for production and process operate at high efficiency and require stable, fault-free and uninterrupted supply of power of high quality during the production process for the successful operation and functioning of their machines. Absolute precision in designing such machines which are sensitive to the slightest variations in supply of power must be ensured. Such category includes adjustable speed drives, devices of automation and the components of power electronics. Any failure in providing the necessary output of quality power may at times result in a total shutting down of the industries which in turn might lead to enormous financial losses to the industry concerned[6-7], [8].

III.VOLTAGE STABILITY

Voltage stability has become one of the main concerns to maintain system security in power system operation and planning. Controlling modern power systems has become very difficult due to increased demand and consequential increase in power flow.
Today, most power systems are operating near their steady-state stability limits, with the risk of reaching voltage instability. Literature survey reveals that most of the black-out through-out the world is caused by voltage instability. There is therefore a great need to improve the voltage stability for system security. The various types of Stability are analyzed by Kundur (1993). Voltage stability is the ability of a power system to maintain acceptable voltages at all buses in the system under normal operating conditions (Steady State conditions) and/or after being subjected to a disturbance. In power system operation and planning, voltage stability is now one of the main concerns to maintain system security.

IV.STATIC SYNCHRONOUS COMPENSATOR (STATCOM)

The complexity of the modern power system increases corresponding to the challenges of meeting the ever-growing demand and need for additional electrical energy. Some power systems in present times experience control and stability of voltage as limiting factors during the process of their planning and operation. There are a range of considerations and constraints hindering the option of constructing new transmission lines. Consequently, there is a direct need to maximize the utilization of the existing

facilities of transmission. There is a need to control the bus voltage over a specific range under steady state. Hence, there is the need for an appropriate control of voltage and reactive power in order to obtain significant benefits in the operation of the power systems, including reduction of voltage gradients, efficient utilization of transmission capabilities and increase of stability margins. The function of voltage control in transmission and the levels of distribution can be obtained through the means of various control measures and operating techniques. Some technologies offering solutions can employ a series voltage injection, or a shunt reactive current injection at strategic locations of the power system [1]. Any occurrence of disturbance triggers changes in system's voltage and the restoration to the normal reference values directly correspond to the excitation system's dynamic responses and the control devices employed. Gate Turn-off (GTO) devices have been commercially available during the last decade having enhanced capabilities to handle high power along with the increased employment of various other categories of power-semiconductor devices, for instance, IGBTs, which have led to the evolution of the controllable reactive power sources making use of the electronic switching converter technology[1]. These devices of power electronics facilitate the devices of power electronics to enable the design of solid-state shunt reactive compensation equipment depending on switching converter technology. The emerging technologies provide significant additional advantages in comparison to the existing ones in the specific areas of reduction of space and performance.

V.MOTIVATION

The motivation of this thesis is to elaborate on the methods to maintain voltage stability. The proposed controllers should be fast and accurate such that control signals can be sent to appropriate locations quickly and effectively. Even though the rotor speed varies with in the specified range the terminal voltage should be maintained stable and also due to variations in the load side the load voltage should be maintained stable. Hence, it is proposed in the thesis about the enhancement of the power generation and voltage stability using various modern schemes.

VI.OBJECTIVES OF THE RESEARCH

In electric power systems, the load demand is seldom constant, but increasing day by day. It is difficult to change transmission utility with the increasing demand. It is essential to improve steady state voltage stability limit and utilize the existing transmission facility closer to its maximum steady state stability limit. A fast acting device is needed to operate the large power system closer to its maximum steady state stability limit. One of the fast actingdevice FACTS can increase the transmission line capacity by improving stability limit and maintain the bus voltages when they are optimally placed in the power system. Considerable research work has been carried out to optimize the various objectives without considering the cost of FACTS devices. But allocation of more FACTS devices without considering their cost to achieve one or more objectives is not advisable. In this research work, a cost effective objective function is proposed for optimizing the following mentioned objectives, considering the cost of FACTS devices:

- Minimize the voltage deviations in the system
- Minimize power system total loss
- Minimize possible FACTS devices sizes and
- Maximize loadability limit

6.1. Fundamentals of Dfig System

Wind industry is becoming one of the world's fastest growing energy sectors nowadays, helping to satisfy global energy demand, offering the best opportunity to unlock a new era of environmental protection, and starting the transition to a global economy based on sustainable energy. Wind turbines based on doubly fed induction generators have attracted particular attention because of their advantages such as variable speed constant frequency operation, reduced flicker and independent control capabilities for active and reactive powers. Active power from the generator is determined by the turbine control and must of course be within the capability of the turbine generator system.

VII.PROPOSED ISTATCOM

A STATCOM is one of the famous and important members of the FACT family. It has a very special ability to absorb reactive power and provide reactive power, and again absorbing real power in and providing real power out of the system. The STACOM is a shun compensated device .the STATCOM can provide 3-phase controlled waves of Various parameters like the phase angle ,frequency, voltage magnitude etc. it is actually a kind of a solid state switching device which have the capability to generate and accept real power and reactive power independently . Here the STATCOM has the heart of the device is the VSI that is the voltage source inverter. A static capacitor is used to provide the constant dc voltage supply to the STATCOMs voltage source inverter. The STATCOMs outer terminal is connected through a leakage reactance to the system or the main voltage bus that is to be connected. And here we have the constant power of the dc voltage is being supplied by the chosen well designed capacitor which can give a constant dc voltage to the VSI terminal of the STATCOM. The unique ability of the STATCOM to absorb the reactive power and the real power when needed with the fast response makes it a special device.

Here we can look for the STATCOM for the following purposes as listed below,

- To control of the dynamic voltage in a power system and in distribution system
- Used to treat during the power oscillation damping condition
- The device can be also be utilized to treat the transient stability of the power system
- Sometime the voltage flickering control can be easily be done through IT
- v. The uniqueness in the STATCOM is that it can exchange both active power and reactive power with the system with a connected line exchange with the dc energy system
- The STATCOM can be considered a very similar device just as it is a synchronous machine.

VIII.RESULT AND SIMULTIONS

1. Matlab 2015a 64 Bit (Intel-8gb) Srf Simulink Modeling:

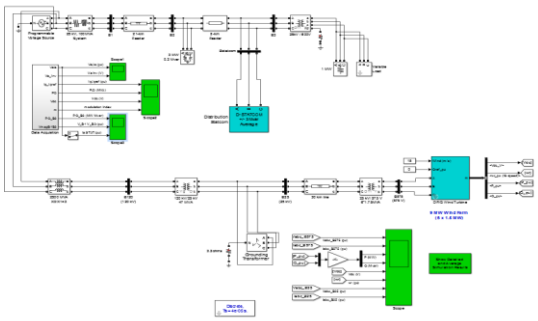

Fig.1 STATCOM based DFIG MATLAB modeling.

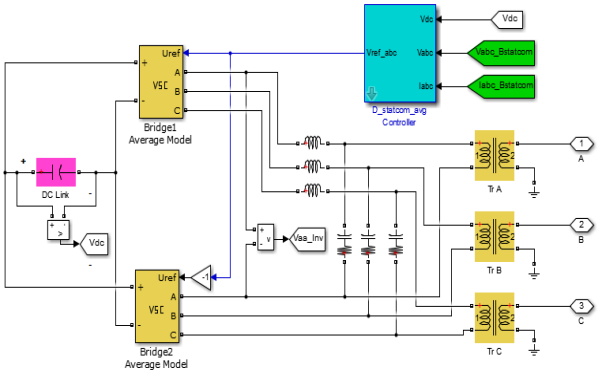

Fig.2 Subsystem of STATCOM.

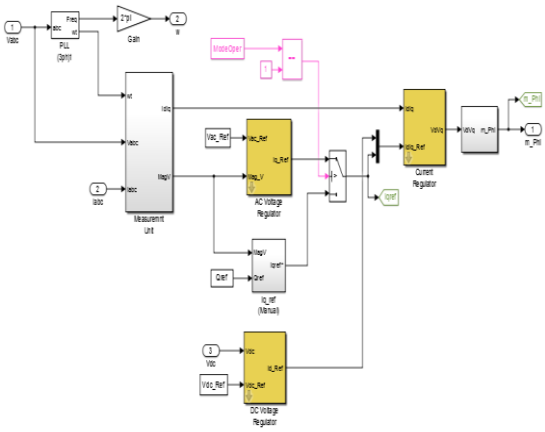

Fig.3 Subsystem of power compensation block.

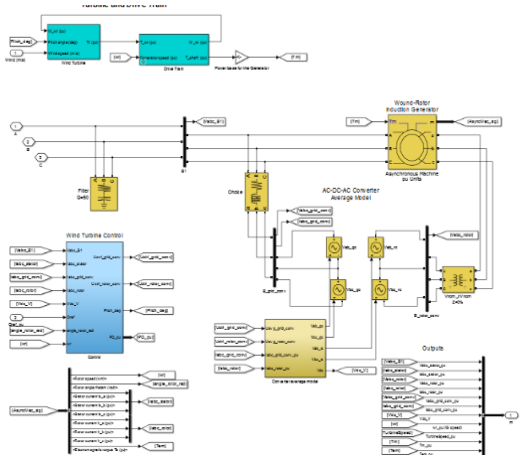

Fig.4 STATCOM controller.

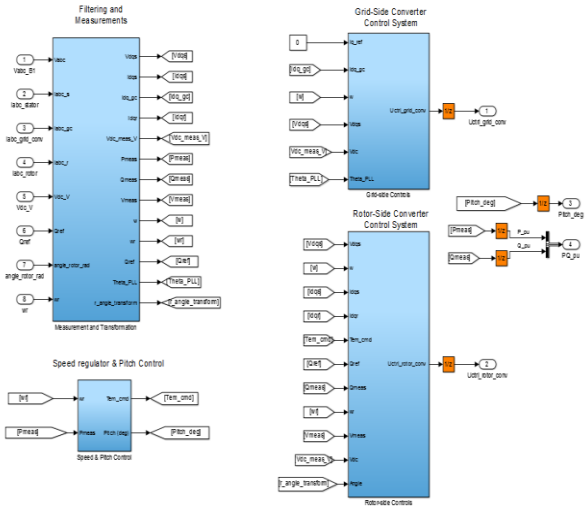

Fig.5 Subsystem of controlling Approach.

2. Result Outcomes

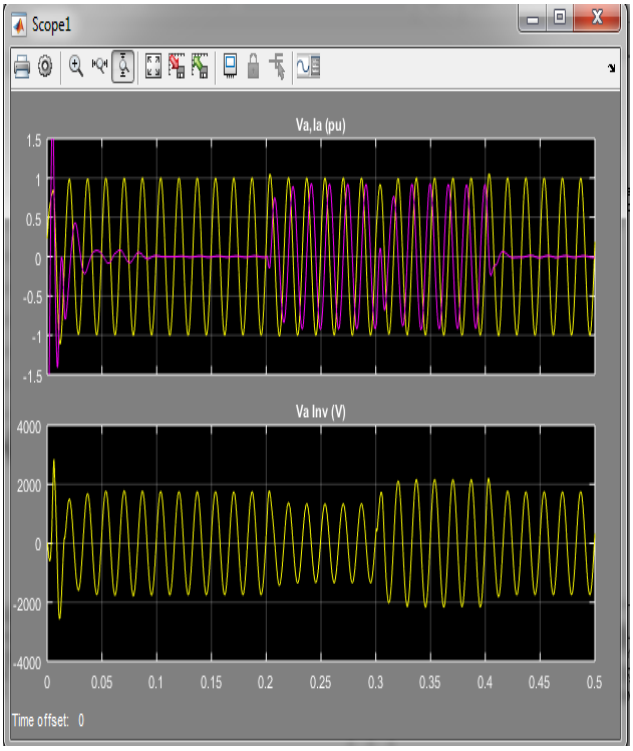

Fig. 6Va,Inv and Va,Ia with respect to time outcomes.

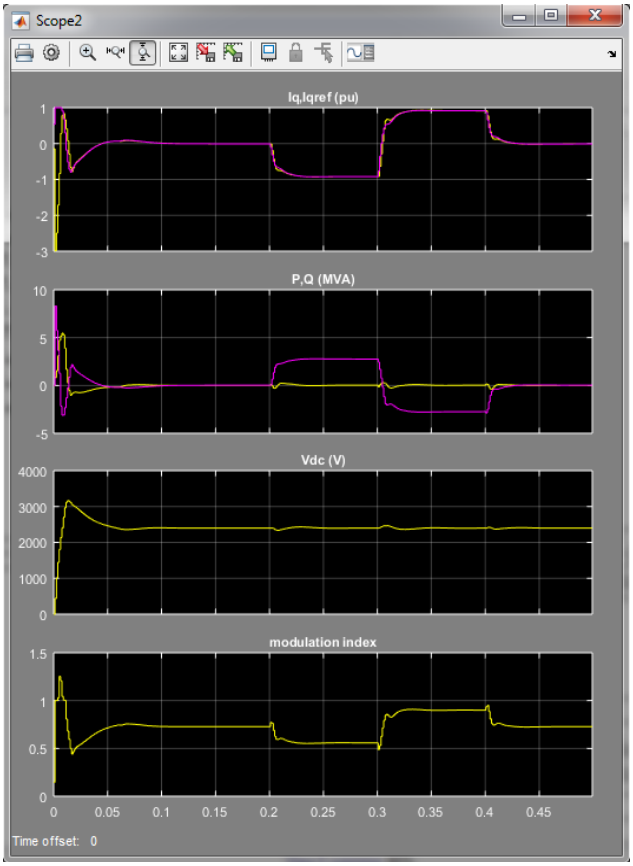

Fig.7Vdc,Iq and PQ with respect to time outcomes.

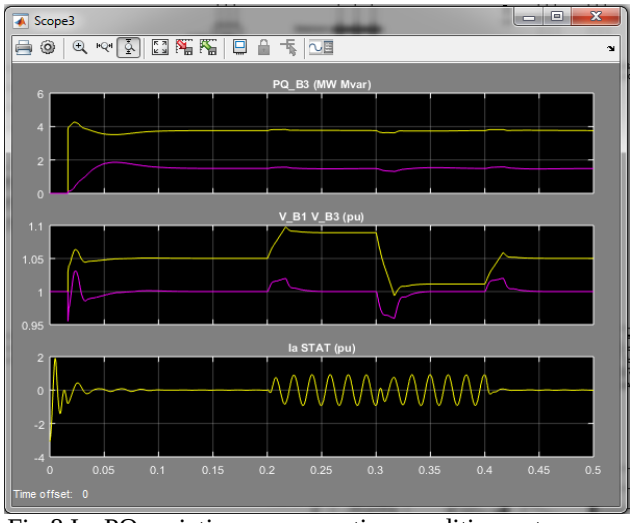

Fig.8 Ia, PQ variation compensation condition outcomes.

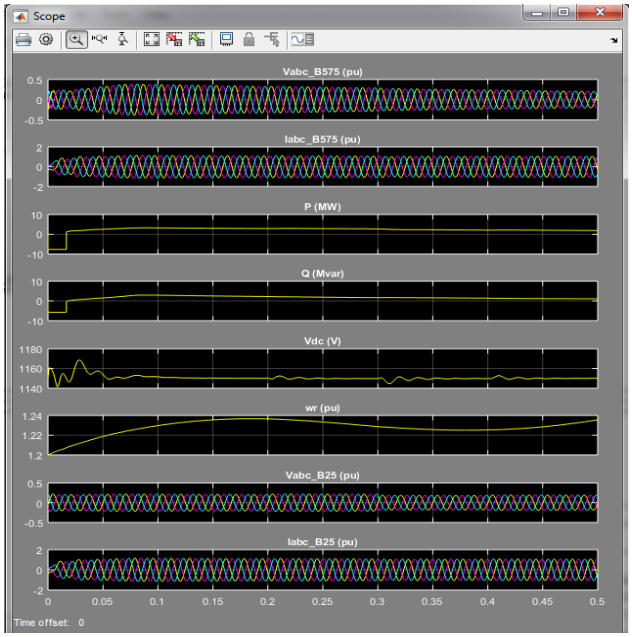

Fig.9 Three phase voltage, power, loss factor and current outcomes.

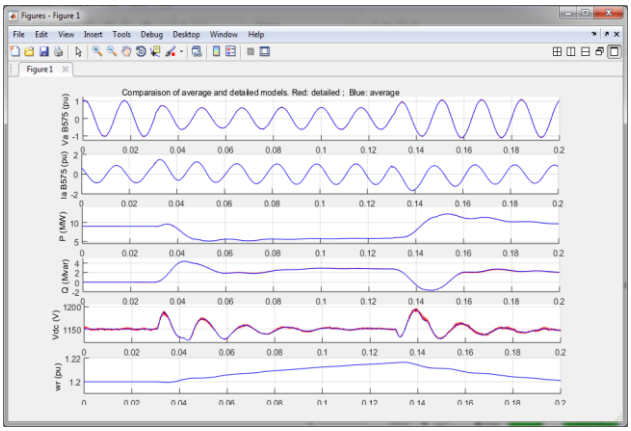

Fig.10 comparison of power variation model.

IX. CONCLUSION

The research work presented in the thesis mainly deals with analysis and development of fuzzy and PI voltage controller for self-excited induction generator based on STATCOM. The modeling and simulation of ISTATCOM has been carried out for different types of loads. The MATLAB based model of SFR is developed in q and d stationary reference frame. The SFR develops its terminal voltage with the help of excitations capacitors. But with application of load, terminal voltage falls down from its rated value. A STACOM based voltage regulator is developed for regulating the SFR voltage in MATLAB. The proposed scheme for maintaining the voltage of SFR constant is simple and easy to implement. The STATCOM improves the voltage regulation by injection of compensation currents.

The voltage control stability of STATCOM (static synchronous compensator) was analyzed. Maximum response rate of STATCOM is always expected to meet the power system performance requirements, but its control loop might become unstable under certain circumstances. The factors influencing the stability margin of the StATCOM voltage control loop were described, including the strength of the power system viewed from STATCOM, the inherent resonance of power network, the operation point of STATCOM, the phase lock loop and the load. The phase compensation method to enhance the stability of STATCOm voltage regulating loop was presented. Theoretical analysis in frequency domain, numerical simulation and dynamic model experiment were performed.

9.1. Scope for Future Work

The voltage regulations of self-excited induction generator using STATCOM have been investigated for various loads (linear/non-linear) with PI and controller for improving the performance of SFR in standalone application. However further research work can be carried out for better operation of SFR. The areas in which further work can be done are as follows

- The SFR-STATCOM system can be developed for dynamic load also which increases the flexibility of controller as it can be used for any type of load linear or non-linear, static or dynamic, balanced or unbalanced.
- The STATCOM based controller can be developed for three phase SEIG feeding single phase load using controller because controller gives better dynamic response as compared to PI controller.
- Voltage regulation for SFR driven by variable speed prime movers using STACOM can be developed.
- In standalone application using wind energy conversion system, the performance of STATCOM based controller may be investigated using maximum power point tracking.

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