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REVIEW ON ANALYZING THE PERFORMANCE OF D-STATCOM WITH RENEWABLE ENERGY SOURCES

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***Abstract*:**. Distribution static compensator is used to compensate the source currents which are affected by the harmonics due to unbalanced and non-linear loads. Here a PV based inverter is used as a shunt active power filter to mitigate the current harmonics. The theory of synchronous reference frame is used to generate the three phase reference currents. Hysteresis current controller (HCC) is used to generate the switching pulses for the gate drives of the grid interfacing inverter. The inverter act as a shunt active power filters to inject the compensated current to the system. The total harmonic Distortion (THDs) of the source currents are reduced by using shunt active power filter (APF). The THDs of the distribution system with and without APF are compared. The whole work is been done in MA TLAB/SIMULINK To repay the reactive power misfortunes in the transmission line and any place in the electrical influence framework, we have completed the writing survey of the different papers and embraced the distinctive procedures to defeat this issue. We have utilized the shunt and series arrangement strategies, in which the compensator like capacitor will be given in parallel and in series to the inductive load. Since there is dependably a voltage and current transient upon the changing the capacitor steps. Henceforth we adopted the FACTS (Flexible AC Transmission Systems) gadgets to beat the responsive force remuneration issue. The studies for the different FACTS gadgets were completed and we discovered the STATCOMs (Static Synchronous Compensators) is the present day and the most productive approach to conquer the responsive force pay. The different strategies were done for the STATCOMS. The genuine investigation was completed in MATLAB and its scientific outflow was inferred utilizing diverse routines for calculation.

***Index Terms* - Power quality, Voltage sag, Voltage swell, Interruption, MATLAB simulatio ,STATCOM, DSTATCOM etc**

I. INTRODUCTION

Fossil fuels are our main source of energy and they are depleting. Fossil fuels are non-renewable and environmentally damaging. Due to increasing air pollution, global warming concerns, diminishing fossil fuels and their increasing cost have made it necessary to look towards renewable sources as a future energy solution [1]. There are many Renewable Energy Sources (RES) such as wind, solar, tidal power, biomass etc. Solar energy has great potential to supply energy with minimum impact on the environment, since it is clean and pollution free. In finding solutions to overcome a global energy crisis, the Photo Voltaic (PV) system has attracted significant attention in recent years. The government is providing incentives for further increasing the use of grid connected PV systems. Conventionally, grid connected Photo Voltaic energy conversion systems are composed of an inverter. Renewable energy sources (RES) integrated at distribution system is known as distributed generation (DG).After generation, we need to integrate it with already existing power system by using power electronic devices. Generally, current controlled voltage source inverters are used to interface the intermittent RES in the distributed system. A few control strategies for grid connected inverters incorporating PQ solution have been proposed. The inverter acts as an active inductor at a certain frequency to absorb the harmonic current[2]. But the exact calculation of network inductance in real time is difficult and may decrease the control performance.[4]A control technique for renewable interfacing inverter based on p-q theory is proposed. In this work, load and the inverter current sensing is required to compensate the load current harmonics. The extensive use of these non-linear loads causes harmonic injection into the system which affects the quality of the power supply [3]. These harmonics current causes problems like equipment overheating, supplementary losses, EMI related issues and damage devices etc. Harmonics are introduced into the system by diode or thyristor loads. These harmonics are to be filtered to make the system behavior as per the proposed operation. In order to eliminate these harmonics and load devices by using some controlling techniques like p-q theory. In this work, a Photovoltaic based inverter is used as a shunt active power filter (APF) to compensate these current harmonics and current unbalance due to unbalanced and non-linear loads. This APF is connected in shunt to the system as it injects current for harmonic compensation for enhanced power quality. The recent advances in the power semiconductor technology have led to the development of high power switches such as IGBTs, GTOs and thyristors which has enabled the practical implementation of active power filters. Different types of active power filters such as shunt, series and shunt series/series-shunt have evolved (Singh et aI, 1999). These filters applied to power distribution networks are referred as custom power devices [5], [3].Here this PV based

inverter is connected in shunt with the system. Synchronous reference frame theory controlling technique is used to generate the reference signals. Hysteresis current controller is used to generate switching pulses to drive the gates of the PV based grid interfacing inverter. Thus with the use of the HCC control technique, the inverter will keep the supply current balanced. Most of the power quality problems are due to harmonics, unbalance and low power factors in the load currents. Hence, these problems can be mitigated using D-STATCOM and it can be implemented practically

II. OBJECTIVES

This work proposes the MATLAB SIMULINK model of DSTATCOM which is used for the improvement of power quality at distribution level. The major objectives of this work are summarized as follows:

- To study the model of DSTATCOM along with its controller.
- To investigate the performance of DSTATCOM using dqo transformation control scheme for different loads like active load (wind turbine coupled with asynchronous generator which acts as both source and load) and non-linear load (FOC induction motor drive load).

III. MOTIVATION

- Improvement of the quality of the power.
- Improvement of system power factor.
- Reduction of the losses in the network.
- Shirking of penalty charges for the over the top use of the reactive power particularly in industry where they utilize expansive induction motors.
- Reduction of cost and generate higher revenue for the customers.
- Improvement of the voltage regulation of the power system
- Increase the power availability.

IV. PROBLEM STATEMENTS

The impedance of transmission lines and the requirement for lagging VAR by most machines in a creating framework brings about the utilization of reactive power, in this way influencing the steadiness furthest reaches of the framework and in addition transmission lines. Pointless voltage drops lead to expanded misfortunes which needs to be supplied by the source and thus prompting blackouts in the line because of expanded weight on the framework to convey this fanciful influence. Therefore we can gather that the remuneration of reactive power mitigates every one of these impacts as well as aides in better transient reaction to blames and aggravations. As of late there has been an expanded concentrate on the systems utilized for the pay and with better gadgets included in the innovation, the remuneration is made more viable. It is all that much obliged that the lines be diminished of the commitment to convey the receptive force, which is better given close to the generators or the heaps. Shunt compensation can be introduced close to the load, in a dispersion substation or transmission substation.

V. LITERATURE REVIEW

First we have conducted various searches on how to compensate reactive and then by using what we can do so efficiently. We have concluded that there are numerous equipments under FACT devices which helps in compensating reactive power. Then after going through various papers and surveys, we concluded that Static Synchronous Compensator compensates reactive power in most efficient way. STATCOM is a very important controller under FACTS devices and it helps in controlling voltage. First STATCOM which was put in operation was in Japan during 1980 which utilizes power commutated thyristors and works at 20MVar [10]. KEPCO and Mitsubishi Motors introduced a ±80MVar STATCOM during 1991. STATCOM have numerous forms, however in most reasonable applications it utilizes the inverter which can likewise be known as a Voltage Source Inverter (VSI) in 3-stage design as the essential square. The essential hypothesis of VSI is to create a situated of controllable 3-stage yield voltages/ streams at the crucial recurrence of the AC transport voltage from a DC info voltage source, for example, a charged capacitor or a DC vitality supply gadget. By fluctuating the extent and stage edge of the yield voltage and current, the framework can trade dynamic/responsive power between the DC and AC transports, and direct the AC bus voltage.

VI. PROPOSED SYSTEM

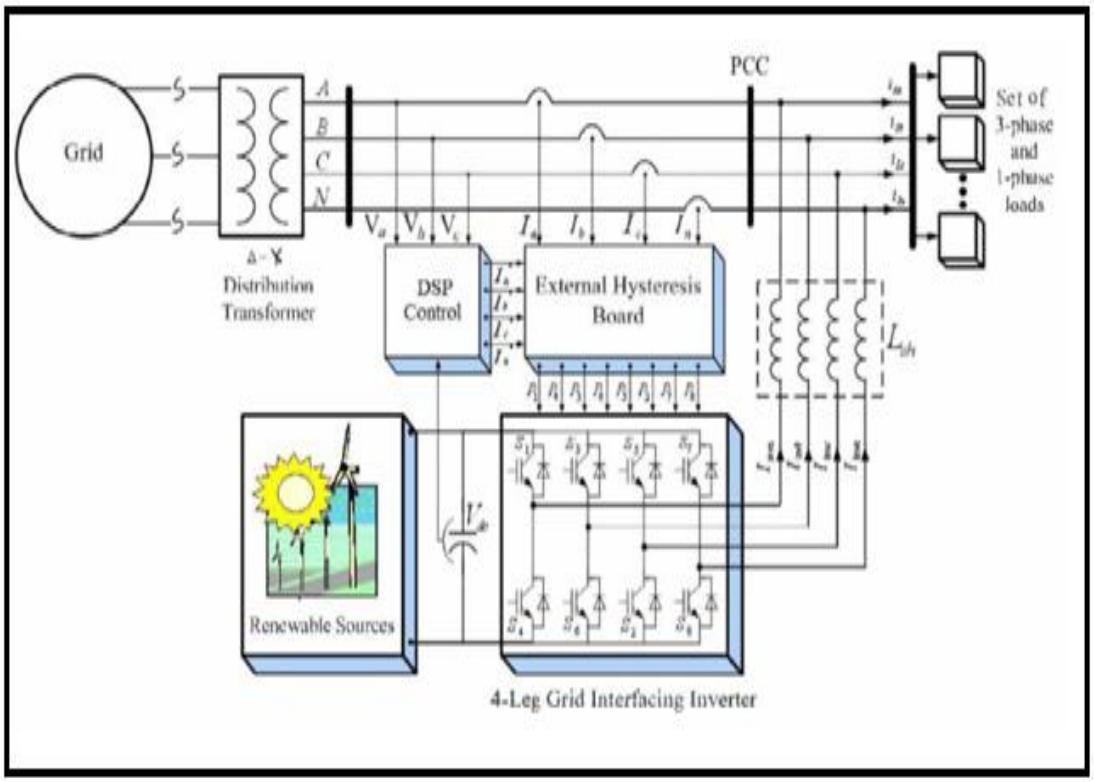

Figure 1:- Proposed System

The above system consists of a photovoltaic cell as a RES connected to the dc-link of a grid interfacing inverter as shown in Figure 1 The voltage source inverter (VSI) interfaces the renewable energy source to the grid and delivers the generated power.

- Photovoltaic Energy Panel

PV cell is an energy conversion device, which is used to convert the solar energy into an electrical energy and the amount of electrical energy produced depends upon solar irradiation and temperature.

- Voltage Source Current Controlled Interfacing Inverter

A voltage source current inverter is a power electronic device which is connected in shunt with the system. The function of this inverter is to convert the dc voltage into a balanced three phase ac voltage. If the inverter output voltage is greater than the existing system voltage then the inverter acts in capacitive mode. The switching device used in this voltage source inverter is an IGBT.

- Control Technique for Grid Interfacing Inverter as Shunt

Active power filter

The turn ON and turn OFF instants of the inverter switches should be such that the load and the connected RES could be appeared as a balanced load to the system. For this type of control, we need to monitor the output of dc link capacitor continuously and is compared with the reference voltage V de *. The difference between the reference and actual voltages will go through a voltage regulator, whose final output gives an active current component 1m. By multiplying this peak value(1m) with three unit sine vectors (Ua, Uh and Uc) which are in phase with the three source voltages will generate the reference current (la *, Ih * and Ie *). The reference grid neutral current (In *) is set to zero being the instantaneous sum of balanced grid currents. The synchronizing angle (9) obtained from phase locked loop (PLL) [I] is used to generate unity vector template

- Hysteresis Current Control

In this work, the hysteresis current control operation is used to control the operation of the VSI. The gate control signals for the grid interfacing inverter to act as a shunt active filter for compensating current harmonics is given by hysteresis current control signals.

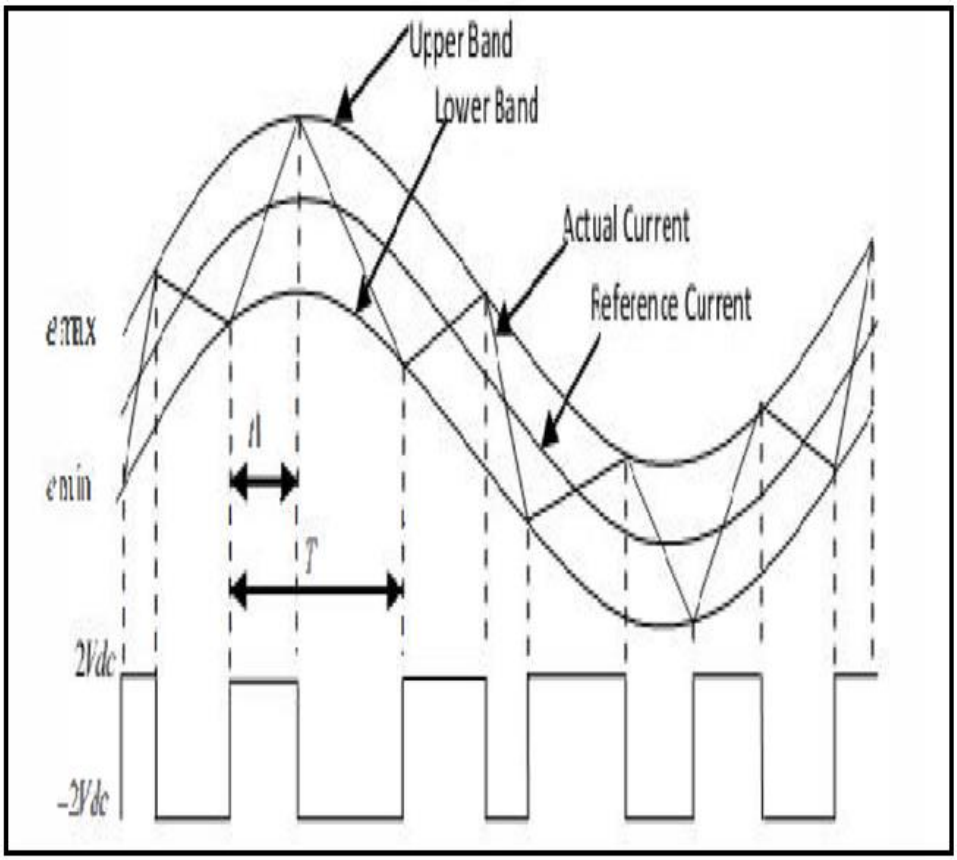

Figure 2:- Waveform of Hysteresis Current Control

An error signal laerr is used to control the switches in a voltage source inverter. The difference between the desired current la'and the current being injected by the inverter la is taken as error. If the error exceeds the upper limit of the band, the upper switch of the inverter is turned OFF and the lower switch is turned ON, which implies that the current starts decreasing. If the error crosses the lower limit of the band, the lower switch of the inverter is turned OFF and the upper switch is turned ON, which implies that the current starts increasing and gets back into the band. The upper and maximum values of the error signal are emin and emax respectively. The range of the error signal is emax - emin directly controls the amount of ripple content in the current output from VSI

VII. METHOD OF EVALUATION

The system modeling and efficiency analysis is achieved by the following design & analysis methodology:
a. Study, modeling and simulation of shunt devices.
b. Application of Shunt devices to improve power system performance using MATLAB/Simulink software.
c. Study of impact of various parameters of Shunt devices on system performance.
The impact of STATCOMs on the studied power system will be shown and compared on the basis of simulation and analytical results.

VIII. CONCLUSION

The performance of a shunt active filter is studied by using multi-function grid interfacing inverter under various load conditions. The power quality problems like current harmonics, current unbalance due to unbalanced and nonlinear load connected to the PCC is compensated effectively by using shunt active power filter (APF). The hysteresis current controller is used to generate the switching pulses for the gate drives of grid interfacing inverter.

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