Power of quality improvement using STATCOM with renewable energy sources

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Abstract- **Static Compensator (STATCOM) is a device that combines a voltage source converter and a renewable energy source to enhance static & dynamic voltage control in distribution & transmission systems. It's a power control that works with reactive power. In the electronic and electrical industries, power quality continues to play a significant role. Voltage flicker and harmonics are a device that can be used to calculate power efficiency. In most distribution systems, STATCOM is connected. The IGBT is a low-loss power switch with a quick turn-off. THD is calculated in this article, and STATCOM is used to minimize disturbances in voltage and current waveforms.MATLAB/SIMULINK is used to pretend and validate the distribution system with STATCOM as well as the control scheme for power quality enhancement.**

Keywords- PV system, DC to DC Boost Converter, STATCOM, UPQC, DVR, PQ.

I. INTRODUCTION

New electronic power controllers, such as facts & devices custom power ,are being implemented to optimize the use of the existing power framework restrictions. The user end benefits from law harmonics, voltage profiles improved, fewer interruptions power & lower control losses, among other things, when custom power arrangements are set up. Since the DVR, UPQC &, D-STATCOM are converter-based FACTS controllers, are useful in control framework operation and control, modeling, and analysis of these FACTS controllers is of excessive interest. Remarkably, control flow estimation is one of the most commonly performed repetitive power network estimations, which can be used in the preparation of energy frameworks and operational arranging, & process regulator [1,2]. However, it has been discovered as much attention has been previously been waged to the impact on the "D-STATCOM" displaying the pay of power variety issues such as voltage appropriation feeders, load pay in unequal distribution systems, voltage fluctuations, and power factor revision [3-5]. Since the execution of D-STACOM is dependent on the control algorithm, all previous studies have considered DSTACOM control calculation or displayed switching control scheme. As a result, several control plans are reported in the literature [6]. On a substantial Distribution system, the impacts of (D-STATCOM) have been demonstrated by the announced models for (D-STATCOM) in the past used in a 2-transport system distribution [7]. The phasor graph technique iSTATCOM fs used to infer the grade of the D- or current remuneration in comparison [8]. However, D-STATOCM was implemented on branches in this model, and its technique is suitable for this situation.

Given the general structure of STATCOM in this paper, it is reasonable to assume that the STATCOM modeling and spoke to with a voltage source-synchronous with the most severe & least voltage sizes limits with the end goal of energy stream investigation. PQ bus is the mode of transport for which the-STATCOM is connected. Since the best installing position and STATCOM rating are two important factors in the selection and voltage configuration of a STATCOM in a distribution network, this study radially lists the best areas for a STATCOM. As a result, a backward/forward load flow calculation was performed to process the sensible framework STATOM's execution control.

II. THE STATCOM MODEL FOR POWER FLOW ANALYSIS

"STATCOM" and DSTATCOM Operational Principle A inverter, connecting transformer & a vitality storage or capacitor are usually included in a "STATCOM". Via the coupling transformer, the STATCOM is shunt attached to a power source. [1, as shown in Fig.1]. If a STATCOM is attached to a dispersion framework, it is referred to as DSTACOM (Distribution-STACOM), and The setup remains the same. The most simple delivery network controller is a STACOM. Since the

1990s, it has been used to precisely monitor framework voltage, reduce voltage harmonics, improve voltage profile , power factor redress & load compensation. To raise the dynamic rating in the capacitors range, an exact capacitors filter may be used in parallel with 'STATCOM'."STATCOM" can temporarily inject active power despite reactive power by connecting to an energy storage unit. (When there are brief interruptions or significant voltage sags). As a result, instead of energy storage, STATCOM contains a capacitor for steady-state applications, & re-active powers are shared amongst the AC system & STATCOM. [9-11].

III. SYSTEM STRUCTURE

There are typically two major link types for STATCOM mounted in a medium distribution network, namely, connected via a customized step-down coupling transformer and directly connected to the AC grid (also called transformer-less STATCOM). Because of the lower voltage of the secondary windings, the current of the secondary windings can exceed many thousands of amperes, making the customized transformer difficult to build for STATCOM. Furthermore, the AC filter is needed for harmonic elimination. Three-step three-lag converters were constructed for transformer-less STATCOM. For medium voltage applications, it does not need step-down transformers and performs well. Even if we use the costly high voltage IGBT, the number of cells is still too high (HV IGBTs, 3300 V or 4500 V).

A simulation model is developed by using the MATLAB/Simulink Sim Power System toolbox to test the latest connection approach for STATCOM. The STATCOM is made up of a three-phase, three-lag converter (as seen in Fig.). To regulator the STATCOM for reactive power compensation, the control flow is used. Figure 6 depicts the performance. STATCOM is linked to the arrangement of the system at t=0.02s. The voltage and current are in a stage after about 20 milliseconds. STATCOM has a good compensation output and a fast dynamic response speed, according to the simulation results.

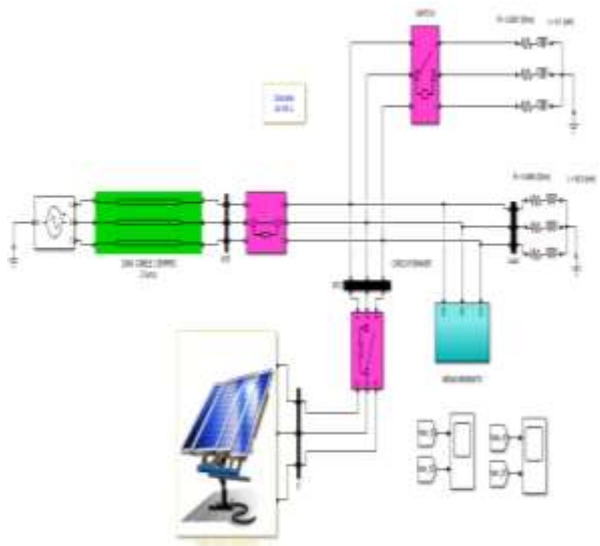

Fig.1.Matlab Circuit

IV. CONTROL SCHEME

The control systems of a STATCOM is predominantly applied in the accompanying advances:

- Framework factors measurements & signal molding.
- Signals for reference compensation are extracted.
- Generation of switching system firing angles.

Figure2. Shows the schematic diagram of "STATCOM" control. The proper pulse generation width modulations (PWM) the most vital part is firing of STATCOM regulator & it greatly affects its compensation destinations, homeless people and also enduring state execution. Since a STATCOM imparts several ideas to those of a "STATCOM" at the level of transmission, some control schemes have been directly applied into a STATCOM, fusing "PWM" switching relatively than (FFS) central frequency switching (FFS) techniques.

A PWM bases conveyance static compensator offers speedier capacity & response for the harmonic end. There are 3 techniques for STATCOM for control factor adjustment and harmonic mitigation based. His schematic graph of phase change regulator has appeared in a figure. In this technique. The compensation is achieved without the use of reactive power estimations by calculating the RMS voltage at the load point[7, 8]. The pulse width modulation sinusoidal scheme is used for a constant switching frequency. In comparison to the deliberate framework RMS current or the reference current, the fault signal is fed to the corresponding simple (PI) regulator, which creates a plot for selecting the essential stage phase amongst the VSC the AC terminal voltage & voltage output to generate the desired timing signal needed to control the 'PWM' generator, such angle is related to the 'phase angle of the balanced voltage supply, which are presumed to be evenly spaced at '120' degrees.The DC is used in this scheme.

a separate battery source was used to keep the voltage constant

In the case of linearly changing loads, Since the source current and source voltage are in phase, the system's power factor is corrected; however, if a nonlinear load occurs, finish compensation is not achieved (current source THD 2.39 percent) This method, on the other hand, is far from difficult to introduce, can provide limited power of reactive pay with-out harmonic concealment, it has the accompanying.

Dis-advantages

- Since the regulator does not use a self-sufficient DC transport, a huge DC source is needed for a precharge capacitor.
- The supply step angle is measured over the fundamental only with a 'balanced source supply' and RMS voltages assumed.
- In the case of nonlinear loads, there is only partial compensation no harmonic suppression.

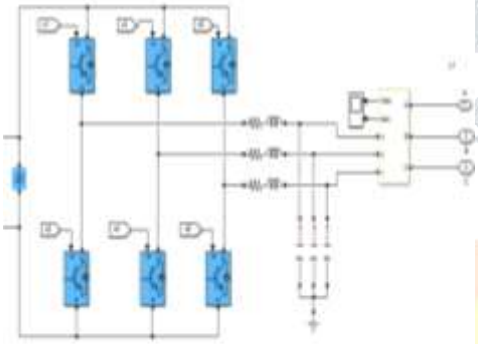

Fig.3.Three Phase inviter

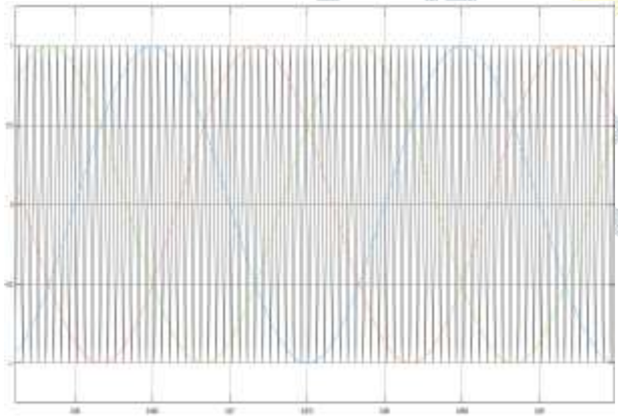

Fig.4.PWM Scheme

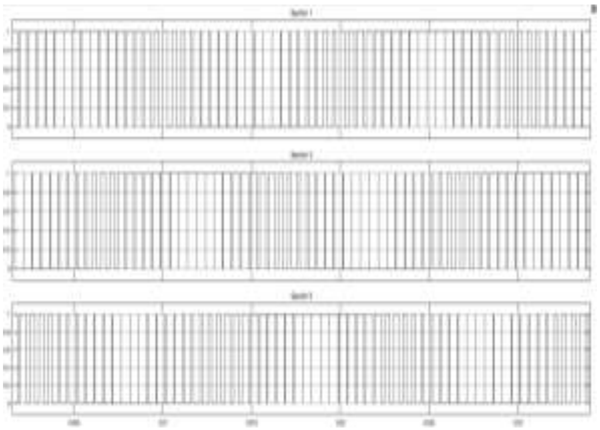

Fig.5.Firing Pulses for different Power Switch

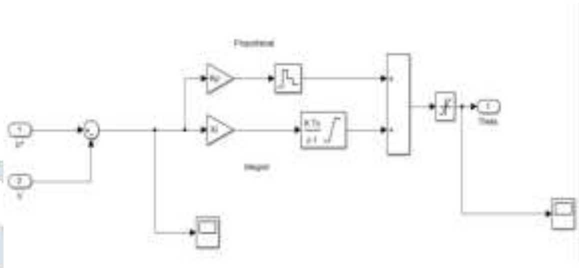

Fig.6.PID controller

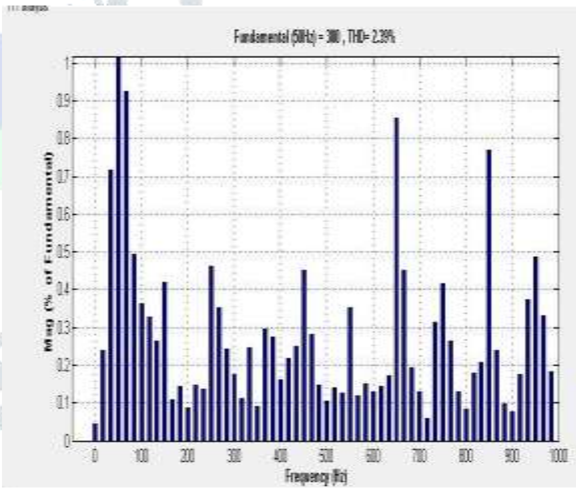

Fig.8.Voltage FFT Analysis

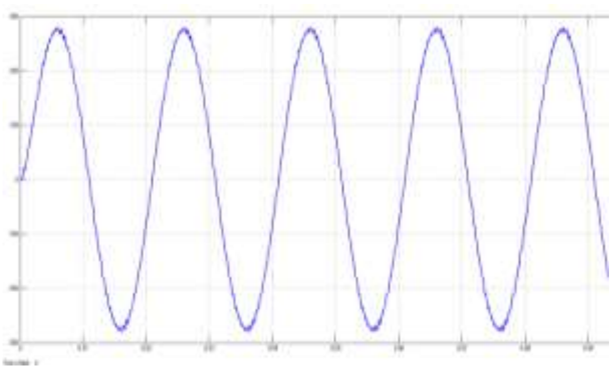

Fig.9.Multi-level Inverter current waveform

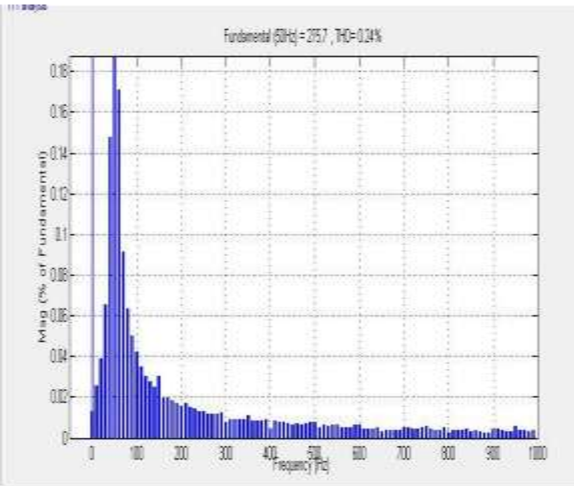

Fig.10.Current FFT Analysis

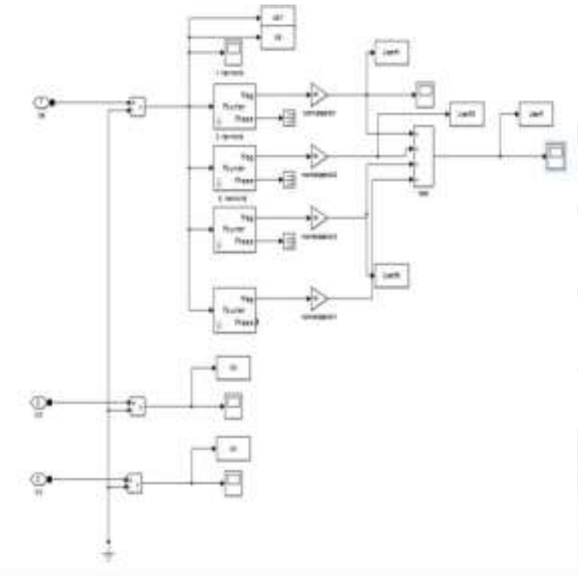

Fig.2.Mitigation Measurement circuit

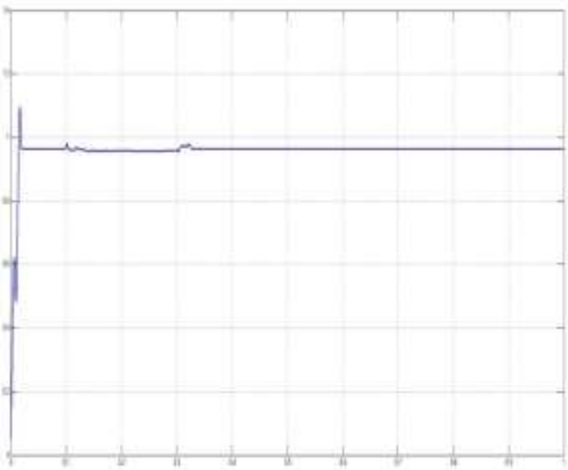

Fig.11.Mitigation behavior of a circuit

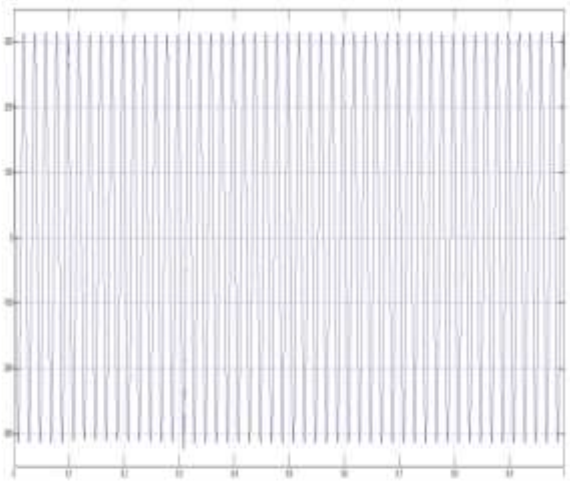

Fig.12.Load behavior of the circuit

Table. 1.

S.No	Elements	Specification
1	Inverter Input voltage	120 V
2	Refrence Frequency	50 Hz
3.	Carrier Frequecncy	2e3
4	IGBT Switch	7
5	Ac voltage	400 v
6	Transition times (s)	[0.1 0.3]

V. CONCLUSION

This paper gave a brief overview of (power devices) that have to be mounted in distribution networks of power to eliminate several power quality fluctuations, such as flicker and power factor reduction voltage sag/swells and current harmonics, dip. These control electronics devices are used in distribution systems to secure the entire plant, loads, and feeders. In both distribution and transmission, The DSTATCOM Distribution Static Compensator is a shunts-related device that can provide excellent power performance. Meanwhile, the Unified Power Quality Compensator (UPQC), which can direct both current and voltage-related problems, is the answer to energy gadgets. This system was fully integrated to create a custom power field.

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