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Power System Voltage Stability Improvement using Intelligent DSTATCOM Technique

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Abstract - The growth of industry manufacturers and populace, electric power quality turns out to be increasingly vital. The developing amount of power electronics-based equipment has profoundly affected the nature of electric power supply. Presently a day, customers require great power supply for their sensitive loads. Voltage flicker has in this way been an essential power quality worry for supply utilities, regulatory agencies and clients [1-2]. Erratic variety in reactive power requests prompt a fluctuating voltage drops over the impedance of a dispersion framework which brings about voltage change at the point of common coupling (PCC). Traditionally, for essentially inductive supply framework, power quality can be enhanced by utilizing receptive power control techniques. These undesirable power quality issues can be alleviated by interfacing controlled devices either in arrangement or shunt to the load. A couple of such devices are dynamic voltage restorer (DVR) and Distribution Static Compensator (DSTATCOM). Both these gadgets require voltage source converters to palatable operation. Numerous topologies have been proposed in later past for voltage source converters in many published literatures.

A DSTATCOM is a fast response, strong state control controller that gives flexible voltage control at the point of coupling (PCC) to the utility distribution feeder for mitigations of power quality change. On the off chance that it is combined with energy storage system (ESS).The DSTATCOM can momentarily repay voltage sags by directing the load voltage utilizing the infused current from the converter and the voltage crosswise over equivalent inductance.

In this paper , DSTATCOM has been demonstrated with Photovoltaic Energy Storage System and mimicked in MATLAB/SIMULINK condition for enhancing the power quality of distribution systems with linear loads and static non-linear loads and the outcomes are discuss.

Keywords - Power Quality, DSTATCOM, Custom Power Device, Total harmonics Distortion , Voltage Sag /swell

I. INTRODUCTION

Electricity supply assumes a vital part in the economic development and technology headway all through the world. Recently, with the growth of industry manufacturers and population, electric power quality becomes more and more important. The quality and reliability of power supplies relates closely to the economic growth of a country. Be that as it may, power quality disturbances, for example, hangs, swells, flicker, sounds, voltage imbalance and so forth; make a ton of issues in accomplishing a solid and quality power supply.

An appropriation static compensator or DSTATCOM is a quick reaction, solid-state power controller that gives adaptable voltage control at the point of coupling (PCC) and it is a voltage source

converter (VSC) based power electronic device which is associated in parallel with the framework to the utility distribution feeder for alleviations of power quality issue. In the event that it is combined with energy storage system (ESS), it can trade both active and reactive power with the appropriation framework by varying the adequacy and phase angle of the converter voltage as for the framework voltage. The outcome is a controlled current move through the interfacing inductance amongst DSTATCOM and the distribution system.

In this paper , power devices, the part of DSTATCOM has been researched to enhance the nature of devices under various conditions. DSTATCOM creates capacitive and inductive responsive power inside. Its control is quick and has the ability to give satisfactory responsive pay to the framework. DSTATCOM can be adequately used to control voltage for a progression of little enlistment engines loads, which draw substantial beginning streams of full appraised current and may influence working of other sensitive loads, associated with the framework [3-4].

II. LITERATURE REVIEW

The problem of voltage sags and swells and its severe impact on sensitive loads is well known. To take care of this issue, custom power gadgets are utilized. One of those gadgets is the dynamic Voltage restorer (dVr), which is the most proficient and viable present day custom power gadget utilized as a part of energy conveyance systems. its allure incorporates bring down cost, littler size, and its quick unique reaction to the unsettling influence. this paper portrays dVr standards and voltage rebuilding techniques at the point of common coupling [5]..

This paper concentrates on the control procedures utilized for Distribution Static Compensator. Distributed static compensator is a device utilized for power quality improvement. Here we considered voltage source converter based disseminated static compensator. It depicts to control dissemination Static Compensator utilized at the circulation end. The stage move control and AC transport/DC connect voltage plans have been consolidated to control DSTATCOM utilized at the appropriation end. Marks [6].

With the development and advancement of power electronics devices lately, changes in the situation in the field of controlling and taking care of the power quality issues have been extremely successful. Realities gadgets are the extraordinary approach [7].

In this article Power Quality is one of a noteworthy requirement in control framework transmission and distribution. Presently a day's the greater part of the vitality was devoured by us. The abnormal growth of Electric Energy consumers, power demand is also being increased. In the meantime the inaccessibility of non-renewable energy sources and the cost of age, transmission and usage are expanded. Thus, the power producer restricts to decrease the cost of energy age. At the same time the producer contemplates that, to get great nature of energy and to limit the power duty. To meet the two closures we go for hybrid power age framework. To actualize Hybrid power system, it has a few issues, for example, Protection, Synchronization, Power Quality, and so forth., in this paper we concentrated on different strategies for control quality change Techniques in hybrid control frameworks [8].

III.POWER QUALITY PROBLEMS

Power Quality is a term that implies diverse to various individuals. Power quality is "The arrangement of voltages and framework plan so the client of electric power can use electric vitality from the dissemination framework effectively without obstruction or interference". Institute of Electrical and Electronic Engineers (IEEE) standard IEEE 1100 characterizes control quality as "the idea of driving and establishing delicate electronic hardware in a way reasonable for the equipment "

[9-10]. A wide meaning of energy quality outskirts on framework dependability, dielectric determination on hardware and channels, voltage unbalance in three-stage frameworks, long-term outages, power electronics and their interface with the electric power supply and numerous different ranges.

3.1 Problems Regarding Power Quality

Power Quality (PQ) related issues are of most concern these days. The perfect power supply voltage would maintain a steady magnitude and a sinusoidal wave shape without any interruptions. Any phenomena that will alter this ideal situation are classified as a disturbance. The growing amount of power electronics based equipments has had a profound impact on the quality of electric power supply.

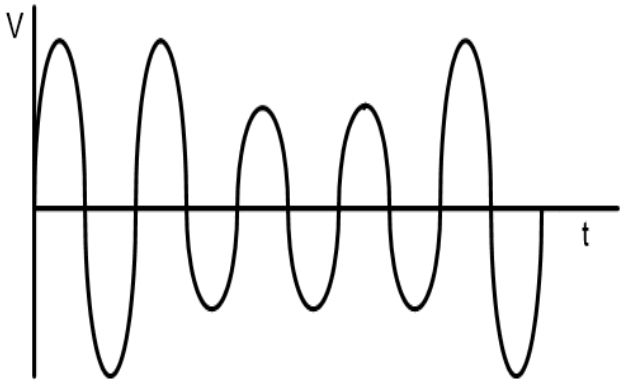

Fig.1: Voltage Sag [1]

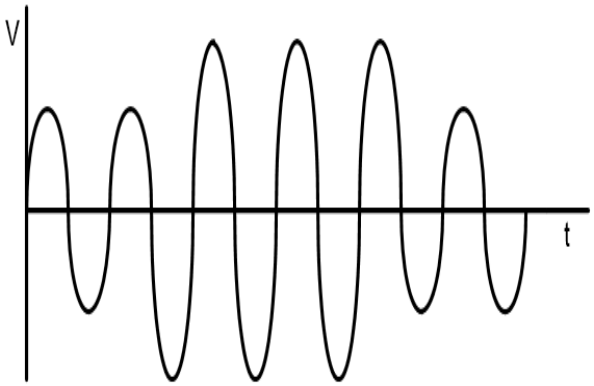

Fig. 2: Voltage Swell [2]

3.2 Effects of Poor Quality on Power System Devices

- Harmonic precariousness might be caused by expansive and unpredicted symphonious sources, for example, furnaces.
- Additional losses of transmission lines, cables, generators, AC motors and transformers may occur due to harmonics.
- Failure of power system components and customer loads may occur due to unpredicted disturbances such as voltage and or current magnifications due to parallel resonance and Ferro-resonance.
- Malfunction of controllers and protective devices such as fuse and relays is possible.
- Utility companies are particularly concerned that distribution transformer may need to be de rated to avoid premature failure due to over-heating.

3.3 CUSTOM POWER DEVICES

This paper of energy electronic loads has raised much concern about power quality issues caused by sounds, distortions, interferences, and surges. The utilization of electronic devices increment the power quality issue Equipment, for example, expansive mechanical drives (e.g., cycloconverters) produce fundamentally high voltage and current (between sub-) harmonics and make broad voltage fluctuation.

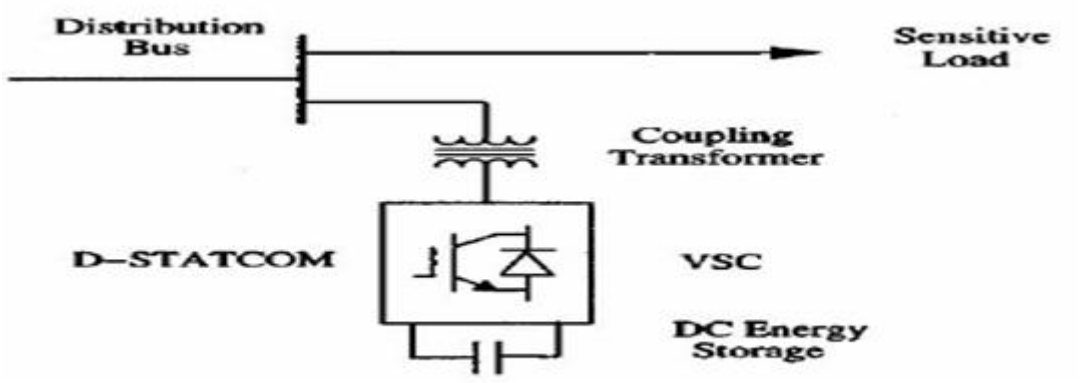

Fig 3 Distributions STATCOM (DSTATCOM)

Compensation-custom power devices include

- Distributions STATCOM (DSTATCOM),
- Dynamic voltage restorer / regulator (DVR), and
- Unified power quality conditioner (UPQC)

IV. DISTRIBUTION STATCOM

In the distributed energy area the utilization of Voltage Source converters for grid interconnection is basic practice today. The following stage in STATCOM development is the mix with vitality storages on the DC-side. The performance for power quality and balanced network operation can be improved much more with the combination of active and reactive power [11-12].

4.1 Basic Configuration of DSTATCOM

Schematic representation of the DSTATCOM is shown in fig 4.The general configuration of DSTATCOM consists of: Voltage Source Converter

- Energy Storage Device
- L-C Passive Filter
- Coupling Transformer
- Control Block

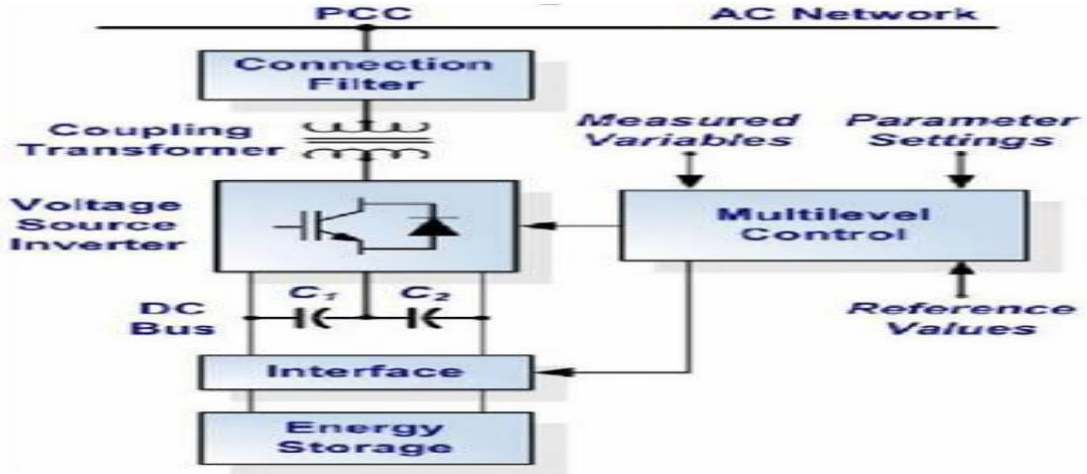

Fig.4: Schematic Representation of the DSTATCOM

4.2 Location of DSTATCOM

The DSTATCOM is connected in shunt with distribution system as shown in fig.5.Here in this figure three distribution feeders are considered. These feeders are feeding different sensitive loads.

DSTATCOM is connected at the point of common coupling to inject current into the system when any non-linearity occurs due to these loads.

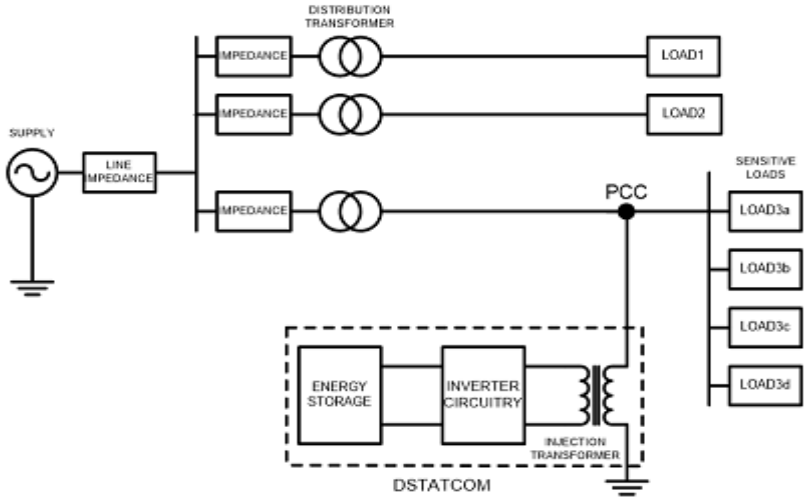

Fig.5: Typical Location of DSTATCOM in Distribution System

V. MATLAB SIMULINK RESULTS

In this paper Power system analyzed with direct and non straight load under same blame conditions under various blame conditions.

5.1 distribution networks

In this work, effectiveness of DSTATCOM to repay the load current music in distribution networks under different working states of following conveyance networks is done:

- Distribution network having static linear load
- Distribution network having static non-linear load

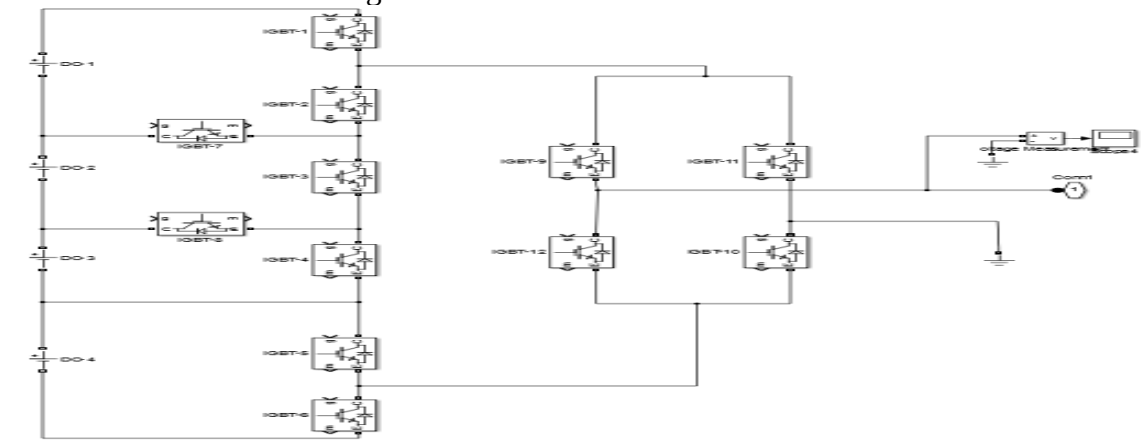

Fig.6.Multi-level Inverter Model

TABLE 1.SYSTEM PARAMETERS

System Parameters	Value
Reference frequency	50 Hz
Carrier frequency	3000 Hz
DC Source	E_1=100v E_2=200v `E_3=100v E_4=100v

TABLE .2.Modes and Switching States

	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	T11	T12
4v	1	0	0	0	0	1	0	0	1	1	0	0
3v	1	0	0	1	1	0	0	1	1	1	0	0
2v	1	0	0	0	1	0	0	1	1	1	0	0
V	1	0	1	1	1	0	1	0	1	1	0	0
0	0	1	1	1	1	0	0	0	1	1	0	0
-v	1	0	1	1	1	0	1	0	0	0	1	1
-2v	1	0	0	1	0	0	0	1	0	0	1	1
-3v	1	0	0	0	1	0	0	0	0	0	1	1
-4v	1	0	0	0	0	1	0	0	1	0	1	1

5.2 SWITCHING SCHEME

In this section, a switching procedure is developed so that the topology can be modulated with the multi carrier sine pulse width modulation (PWM). Works at a middle of the intermediate switching frequency which is more noteworthy than the basic recurrence in fig 7.

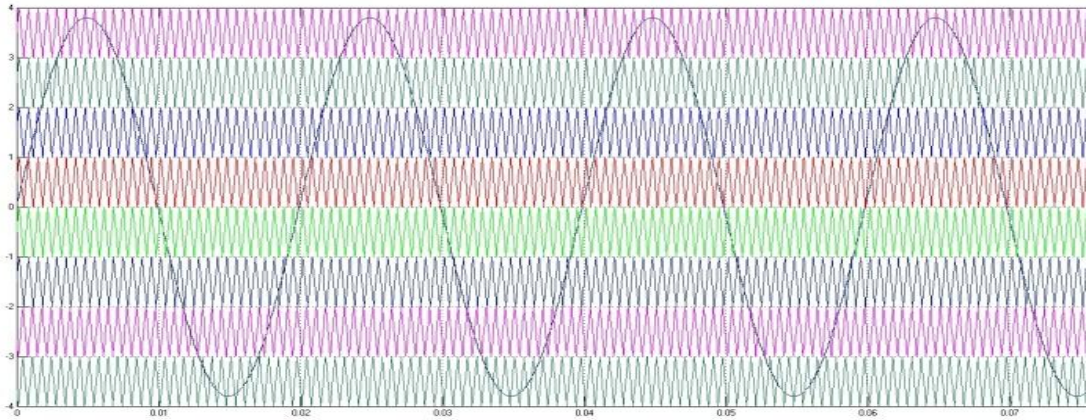

Fig.7 Reference and carrier waveform for nine level inverter

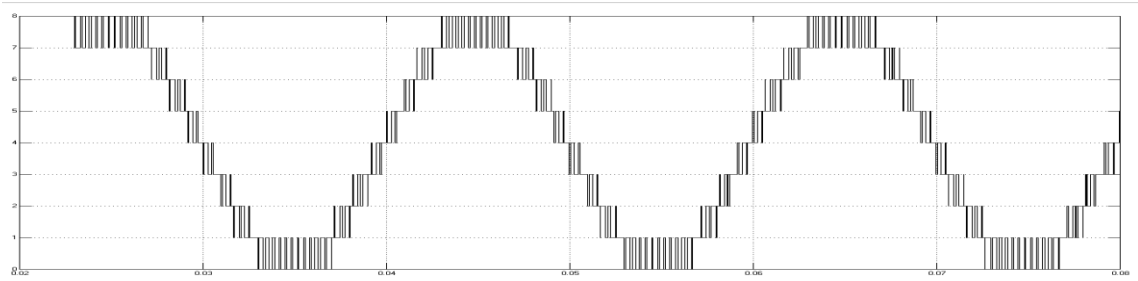

Fig.8 Aggregated Altered signal

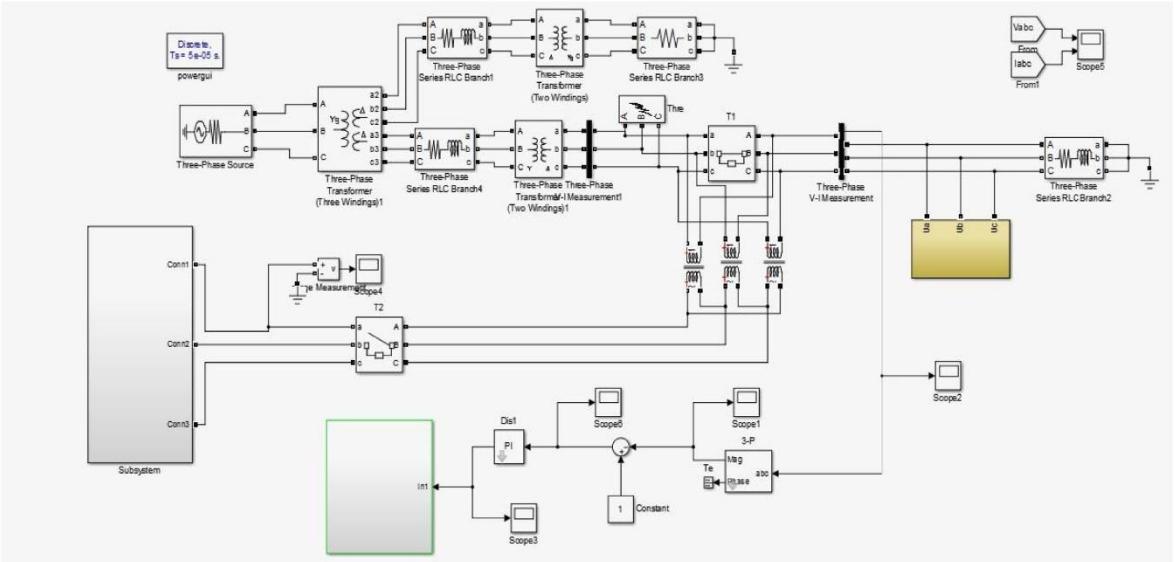

Fig.9 MATLAB Simulink modal of DSTATCOM

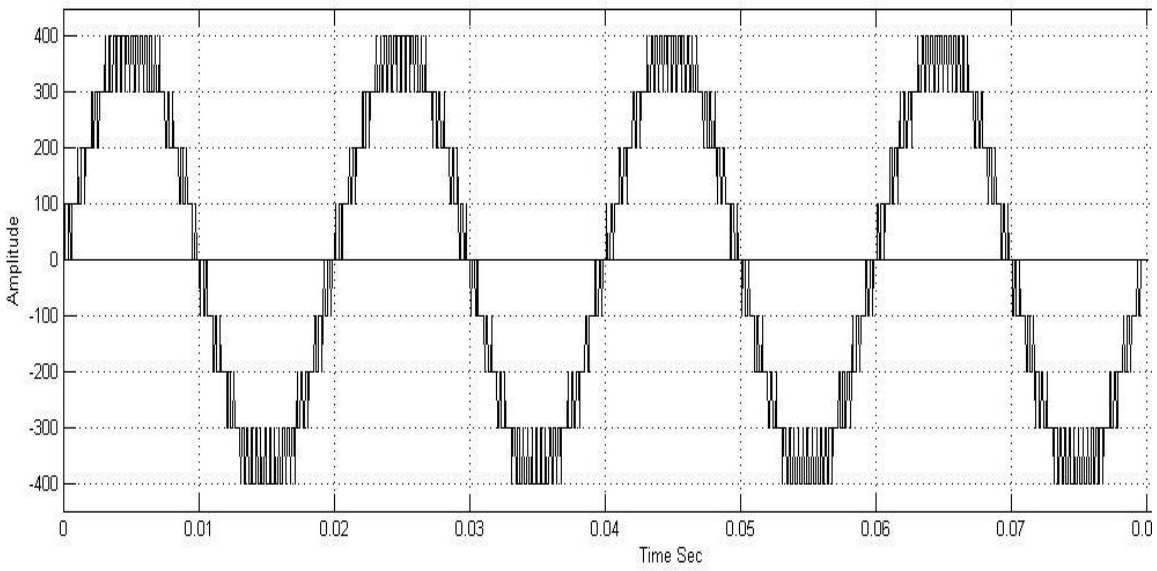

Fig.10. 9-level inverter output Voltage

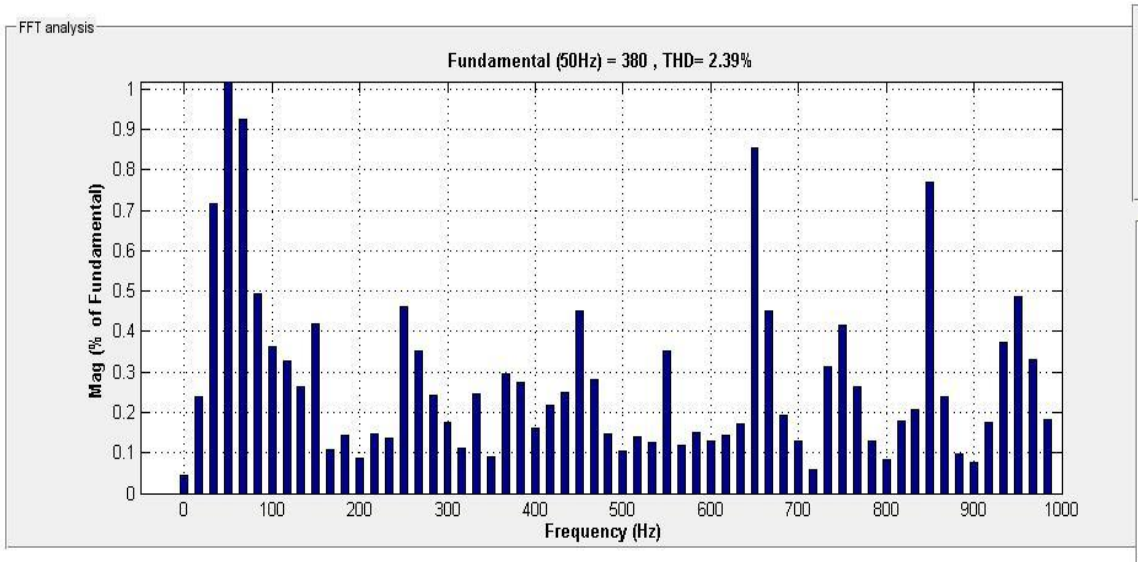

Fig.11. Total Harmonics Distortion

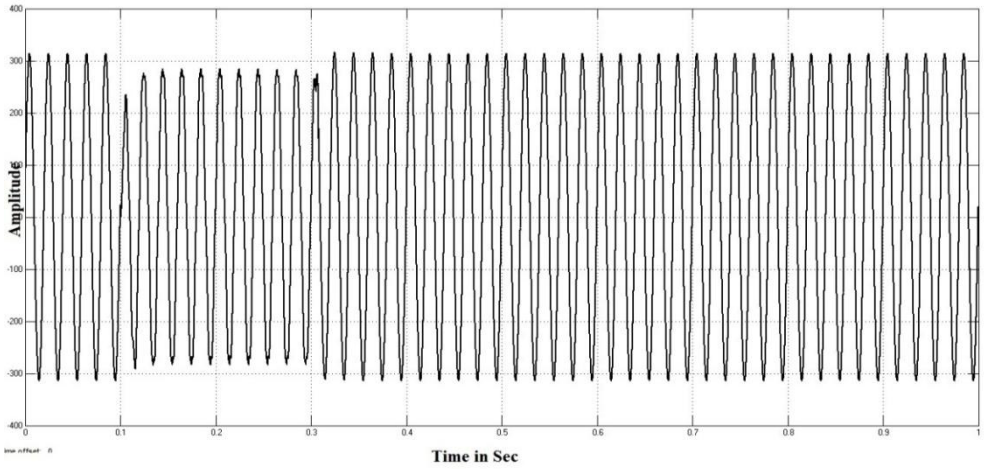

Fig.12.Injected voltage

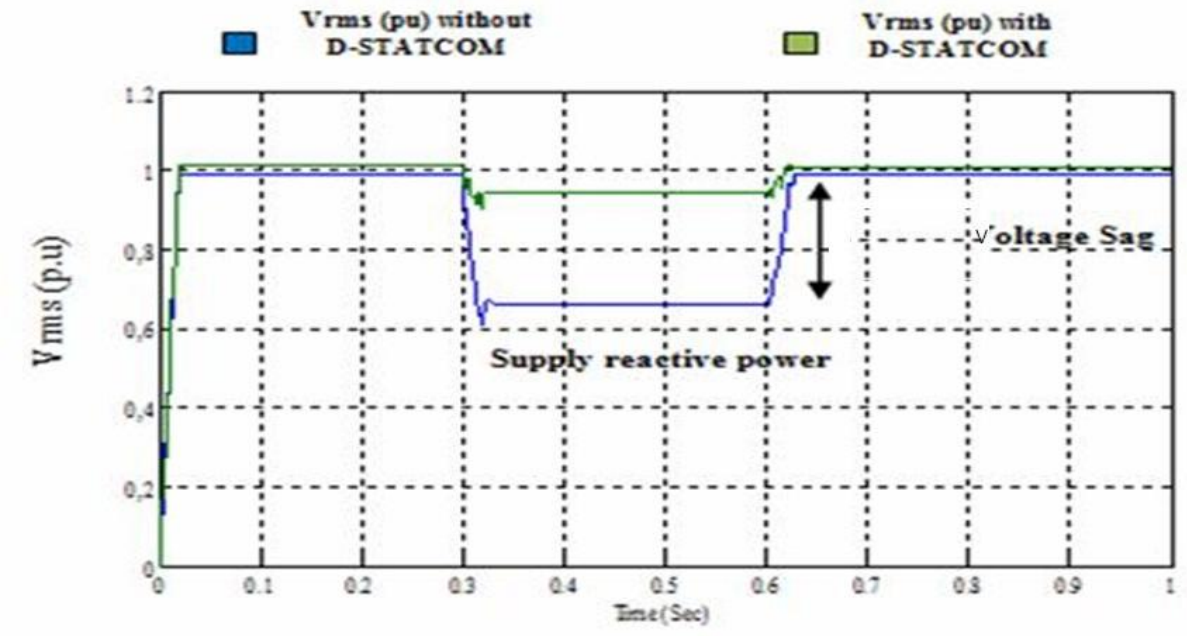

Fig.13.Variations of Supply

VI. Conclusion

This thesis has provided a brief summary of DSTATCOM circuit topology (and their analysis. DSTATCOM circuit has its own mixture of advantages and disadvantages and for any one particular application, one topology will be more appropriate than the others. Frequently, topology is chosen in view of what has gone some time recently, regardless of the possibility that that topology may not be the best decision for the application. The advantages of the body of research and nature inside the engineering group may exceed other technical disadvantages.

In the third paper , we have discussed of carrier based PWM modulation techniques. There are many modulation techniques for multi level inverters. In any case, bearer based regulation procedure is simple and proficient. The PWM output spectra were ascertained from essential operation simulated utilizing MATLAB.

The simulation results for DSTATCOM circuit topology with nine-level CHB inverters are presented in paper. Their harmonic analysis is also discussed. In this work, DSTATCOM has been modeled and simulated in MATLAB/SIMULINK environment. The operation of DSTATCOM has been investigated for active load and non-linear load drive. Simulation shows the effectiveness of DSTATCOM in a distribution network non-linear load. PI controller has been used to generate the switching signals. It is clear from comparison of THD analysis that DSTATCOM effectively removes the harmonic content from the source current under normal working condition and effectively able to balance the source current under load perturbation condition. Hence, it is concluded that DSTATCOM has a large scope in improving power quality levels in distribution systems.

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