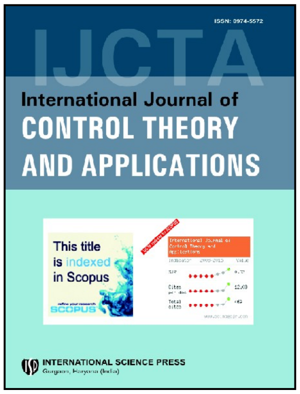

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Improvement of Power Quality Problems Based on Distribution-statcom by Using Spwm Technique

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Abstract: This paper deals with analytical performance of D-STATCOM for elaborating the power quality problems depend on the SPWM technique. Power quality is a developing method of non standardized voltage, current & frequency. Here the main problem with power quality is voltage dip and voltage swell. TO overcome the power quality problem FACTS devices are used. The commonly used FACTS devices are D-STATCOM, DVR and UPQC. Here we are considering D-STATCOM which gives more efficient and effective results in power distribution network. By using the DSTATCOM the power factor can be improved. In D-STATCOM voltage source converter is used and it is controlled by SPWM technique. The analytical performance of D-STATCOM is designed by using MATLAB software.

Keywords: FACTS devices, power quality problems, PWM techniques, voltage dip and voltage swell, VSC, D-STATCOM.

1. INTRODUCTION

In present day's PLC and electronic drives are used in modern industrial devices. These drives give interruptions due to its sensitivity. It becomes low with stand capability to PQ problems those are under voltage, over voltage& harmonics. At presently the most common interruption is voltage dip in the manufacturing equipments. Voltage braking at a load is accomplished by reactive power booster at load PCC. D-STATCOM vaccine a current into a system to legitimate the voltage dip and voltage swell. Thus the PQ apparatus are dc-dc converters associate in shunt or series with the line. The design of this complicated system that incorporates both power devices and control system is realized. For regulating the voltage D-STATCOM is one of the most commonly used device. It is one of the FACTS devices. It provides reliable distribution PQ system. By using the parallel of voltage step up technology the voltage dip and voltage swell are compensated. The D-STATCOM is used to adjust the voltage up to 25KV of the distribution network. D-STATCOM is mainly applicable for sensitive loads. Cosine of phase difference between source voltage and current is called electrical power factor. Represented by $\cos\Phi$.

It is ranging from 0 to 1.

COSΦ = Real power /apparent power.

Real power =VI COSΦ

Reactive power = VI SINΦ

Apparent Power = VI

For transferring the given power current is inversely

Proportional to power factor. As the P.F is poor current flow in the conductor increases, which increases the losses.

2. POWER QUALITY PROBLEMS

PQ problem is widely appearing on the electrical networks. The commonly occurring power quality problems are flickering, interruptions, harmonic distortion, transients, voltage dip, voltage swell. The main sources of PQ problems are large motor starting, various faults, and lightning. From these high currents are produced and at the line voltage drop is high due to this if leads to voltage sag on capacitive loads and open circuits high voltage will be develop. This leads to voltage swell.

The main objectives of voltage dip and voltage swell are as follows:

1. Grid system is unreliable.
2. Some electronic equipments are not suit for local supply.
3. Switching of heavy loads.
4. Loads are not balanced on 3-phase devices.
5. Long distance from a distribution system with the unbalanced loads.

(A) Elucidation to power quality issues

To mitigate power quality issues there are mainly two apprizes one of the apprizes is executed from user side called as load precise to power disruptions, owing the operation under in fecund voltage interpretation. Another apprizes is to place the FACTS devices, that counter act a power systems disruptions. However, with establishment of power system and deviate trends toward distribution and generation user side elucidations will plays a main role in bettering the quality of supply.

At the user side elucidations

Generally there is a definite method while engaged to the industrial consumers to satisfy operational characteristics.

1. Determining the no. and nature of sag that occurs from the transmission system faults.
2. Determining no. and nature of sag that occurs from the distribution system faults.
3. Determining the equipment sensitivity to the voltage dip generation in the above two steps.
4. Evaluating the various elucidations, in order to get the better performance at the end user side.

Different solution equipments available at the end user are:

1. Ferro resonant transformer.
2. Magnetic synthesizer.
3. Active series compensators.

4. Online UPS.
5. Offline UPS.
6. Hybrid UPS.
7. Motor-Generator set.
8. Flywheel energy storage system.
9. Super conducting magnetic energy storage device.
10. Static and fast transfer switch.

3. DISTRIBUTION STATCOM (D-STATCOM)

D-STATCOM is designed having energy storage system, a 2 level converter and a transformer connected in parallel to the system. A 2 level converter that converts DC to 3phase AC output. Due to the inductance of transformer the injected voltage and ac system voltages are in phase. The resulted ac output depends on the controller in order to control the absorption or injection of reactive power. Thus a 2 level converter connected in parallel with a system provides the following functions

I. Controlling of reactive power.
II. Elimination of harmonic currents.
III. Voltage control.

The voltage control is done by using an indirect controlled converter. The transformer used is for filtering and stepping up or stepping down the voltage level.

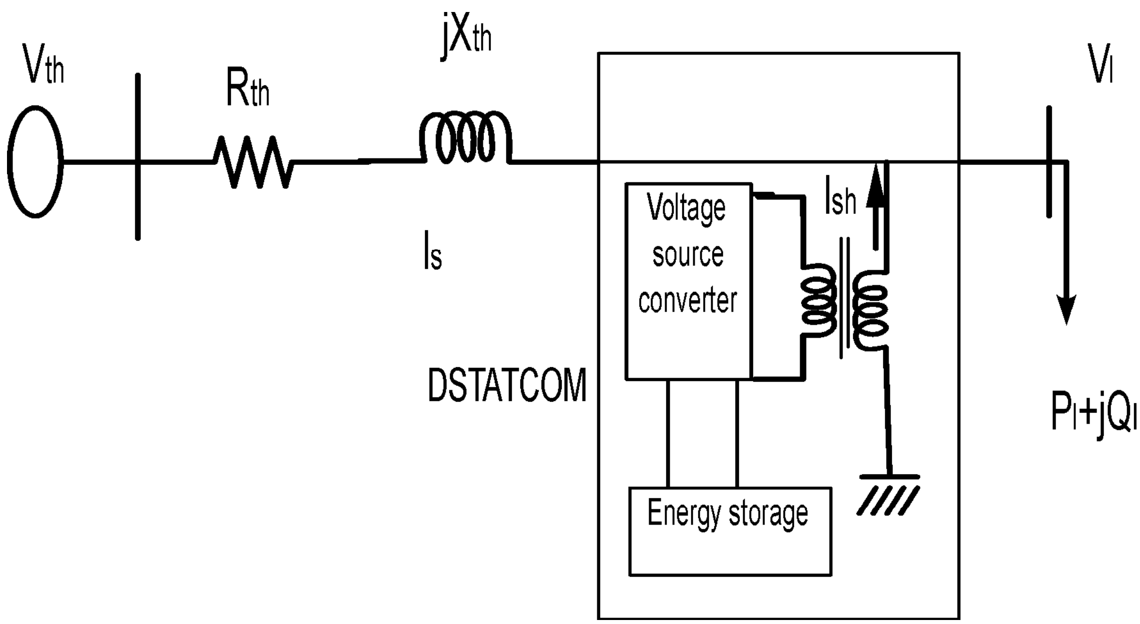

Figure 1: The basic model of a D-STATCOM for common power applications

In Fig (1) above, The parallel connected branch current I_{sh} modify the voltage dip. This I_{sh} value guarded by altering AC output of converter equations.

The parallel injected current Ish is

$$I_{SH} = I_L - I_S$$

Where

$$I_S = \frac{V_H - V_L}{Z_{TH}}$$

Therefore

$$I_{SH} = I_L - I_S = I_L - \frac{V_H - V_L}{Z_{TH}}$$

(Or)

$$I_{SH} \angle \eta = I_L \angle -\theta - \frac{V_{TH}}{Z_{TH}} \angle(\delta - \beta) + \frac{V_L}{Z_{TH}} \angle -\beta$$

The complex power injection of DSTATCOM is expressed as

$$S_{SH} = V_L I_{SH}^*$$

Thus the performance of D-STATCOM depends on Zth for correcting voltage dip. When Ish is in quadrature with VL (load voltage) required voltage correction is attained without active power injection.

Voltage Source Converter (VSC): VSC is a solid state electronic agent that can converts dc to 3-phase ac output voltage. The voltage formed is inserted into the ac discontinuous system, to sustain the load voltage at chosen voltage allusion (mentioned). They are intensively used in flexible speed drives, and also be utilized to relieve voltage dip and swell. Thus VSC is used for ultimate substitution of voltage or lacking voltage in the network. This lacking voltage is defined as the distinction within the formal voltage and actual voltage. This block is generally depend on energy arcade, supplying system with a dc voltage.

The vital block diagram of VSC is shown below

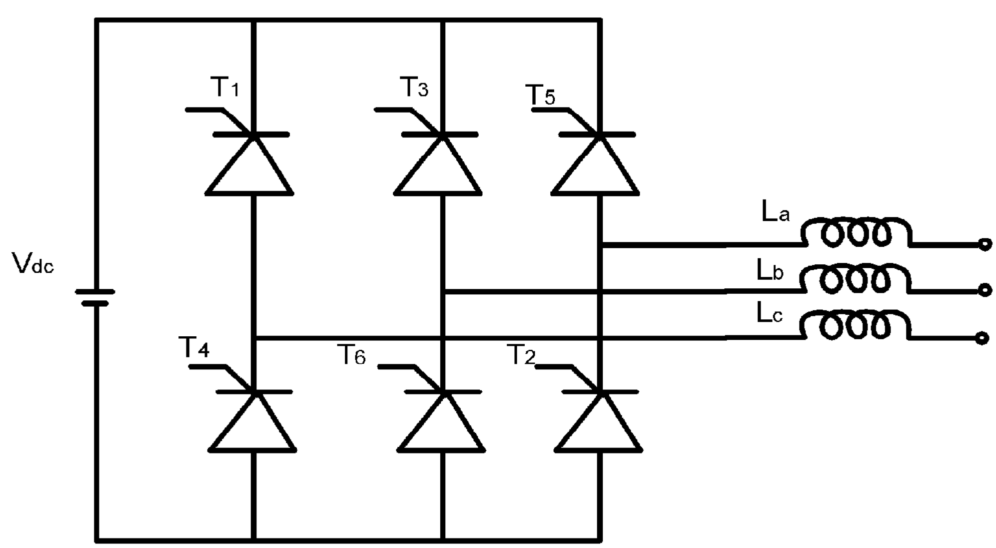

Figure 2: Basic schemes of voltage source converter

Sinusoidal PWM depend management scheme for VSC: In this the major plan of this management technique is to maintain steady state voltage amplitude at load side. The regulation technique only finds the Vrms at load connection, i.e. no need of apparent power.

The voltage source converter switching plan is depend on SPWM method to provide good reply and integrity.

To catalog the fault response and to decrease it to zero, we are using PI controller. In this SPWM technique the(Sinusoidal signal) control voltage is examine with carrier signal(triangular), in order to produce gate pulses for VSC. The major specifications of the SPWM technique are

i. Magnitude modulation ratio M_O of control voltage

ii. Frequency modulation ratio M_f of carrier signal

$$M_O = \frac{V_{control}}{V_{tri}}$$

$V_{Control}$ = Magnitude of control signal

V_{tri} = Magnitude of carrier signal

$$M_f = \frac{F_S}{F_f}$$

F_S = Frequency of switching

F_f = Fundamental frequency

For getting the primary voltage component at load end, we are using 450HZ. So M_f becomes

$$M_f = \frac{450}{50} = 9$$

The modulation angles S is applied to SPWM generator between the phases A and B, C angles are moved by 240 degrees and 120 degrees. The operating conditions and symmetrical network are considered.

4. SIMULATION OUTCOMES

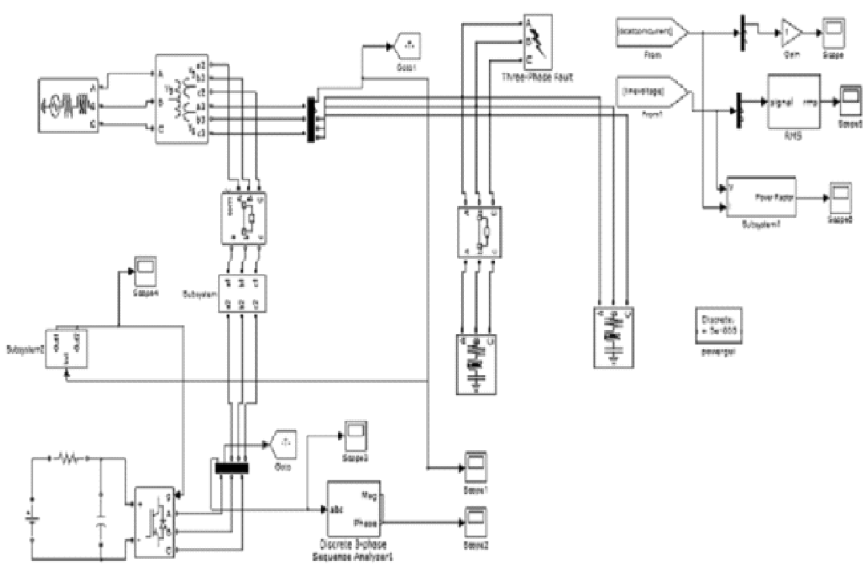

Figure 3: Simulation circuit with DSTATCOM

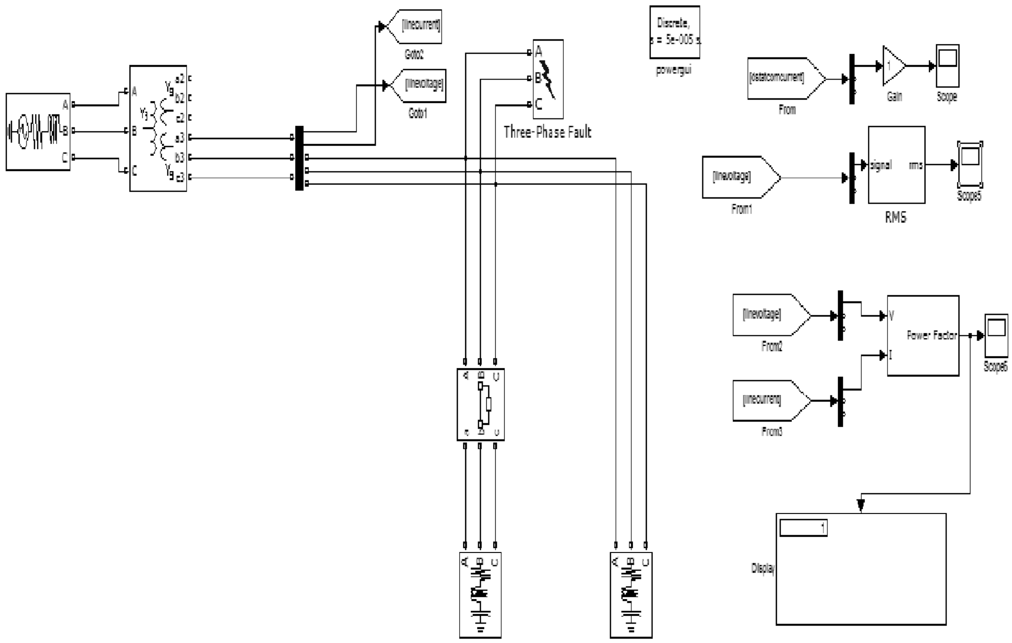

Figure 4: Simulation circuit without DSTATCOM

D-STATCOM outcome

Fig . (3) test scheme utilized to bring the several D-STATCOM simulations are given. This scheme consists of230 KV AC, 50HZ generating system, indicated by thevinin's equivalent deliver into primary side of 3-Ö transformer. An alternating load is connected at secondary side (11KV) and 2 level D-STATCOM is at tertiary winding of transformer to give voltage support.

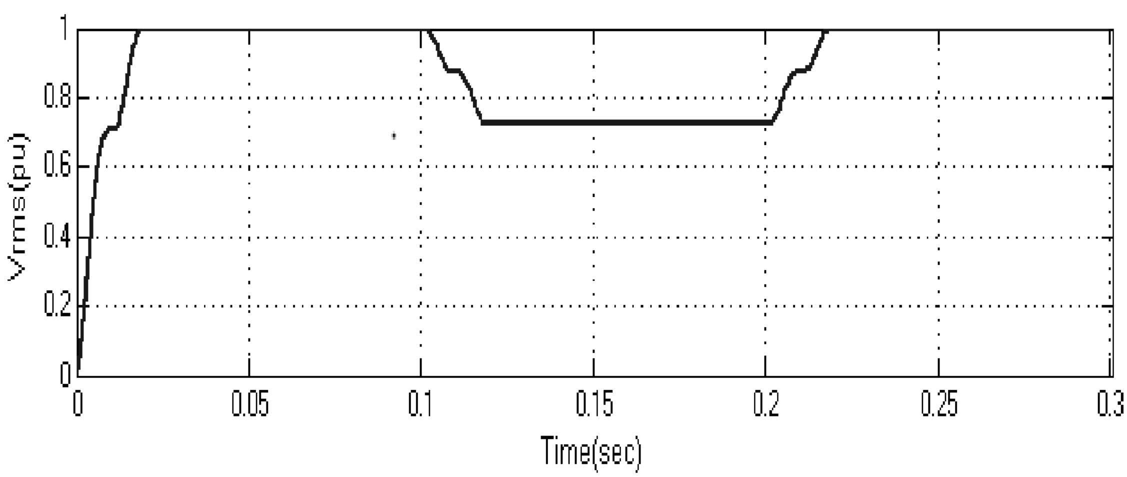

Figure 5: Line– ground fault without D-STATCOM

From the above Fig (5), it shows that the simulation of Vrms at load point with L-G fault without DSTATCOM. The L-G fault is inserted to the line and R_f of 0.2ohms in the duration of 0.1s to 0.2s. In this voltage dip at the load end is observed at 20% to the Vref.

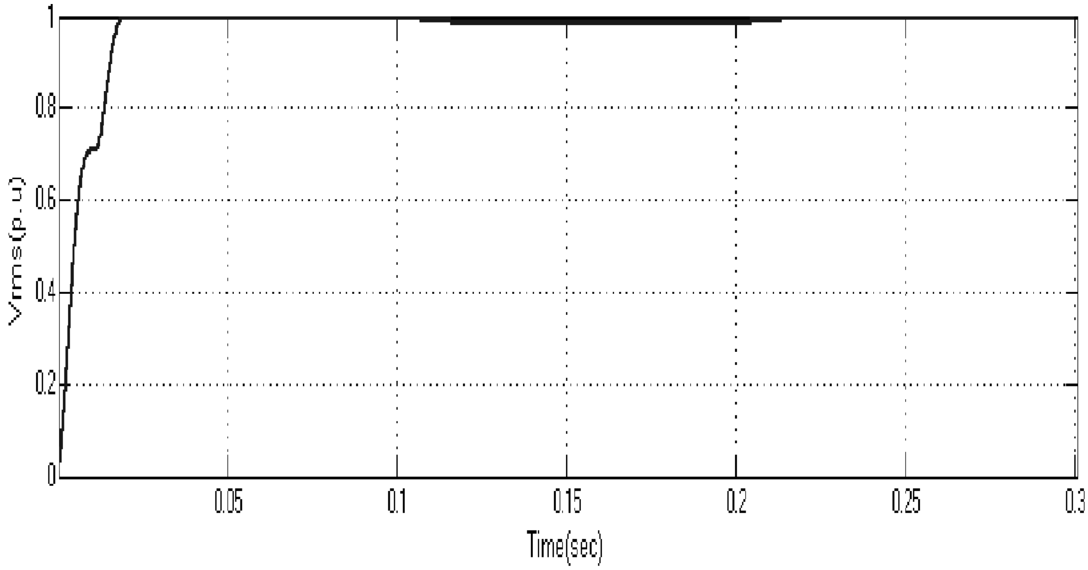

Figure 6: Line – ground fault with DSTATCOM

From the above Fig (6), it shows that the simulation of Vrms at load point with L-G fault with DSTATCOM. Here also if we observe in the simulation output the voltage dip is reduced by connecting the DSTATCOM. The Vrms at the precise load end is sustained up to 99%.

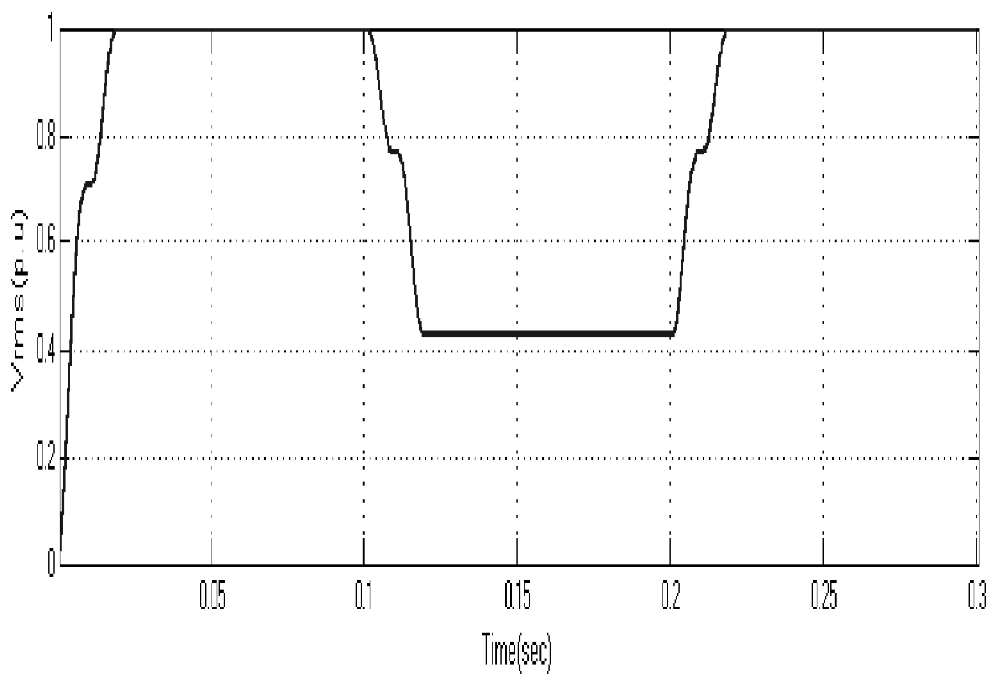

Figure 7: 3-phase to ground fault without D-STATCOM

From the Fig. (7) shown the simulation of Vrms at the point of load for 3-phase ground fault i.e. L-L-L-g fault without D-STATCOM.in this we are considering fault resistance of 0.2ohms, period is ranging from 0.1s to 0.2s. The observed voltage dip at the load end is 30% to Vref.

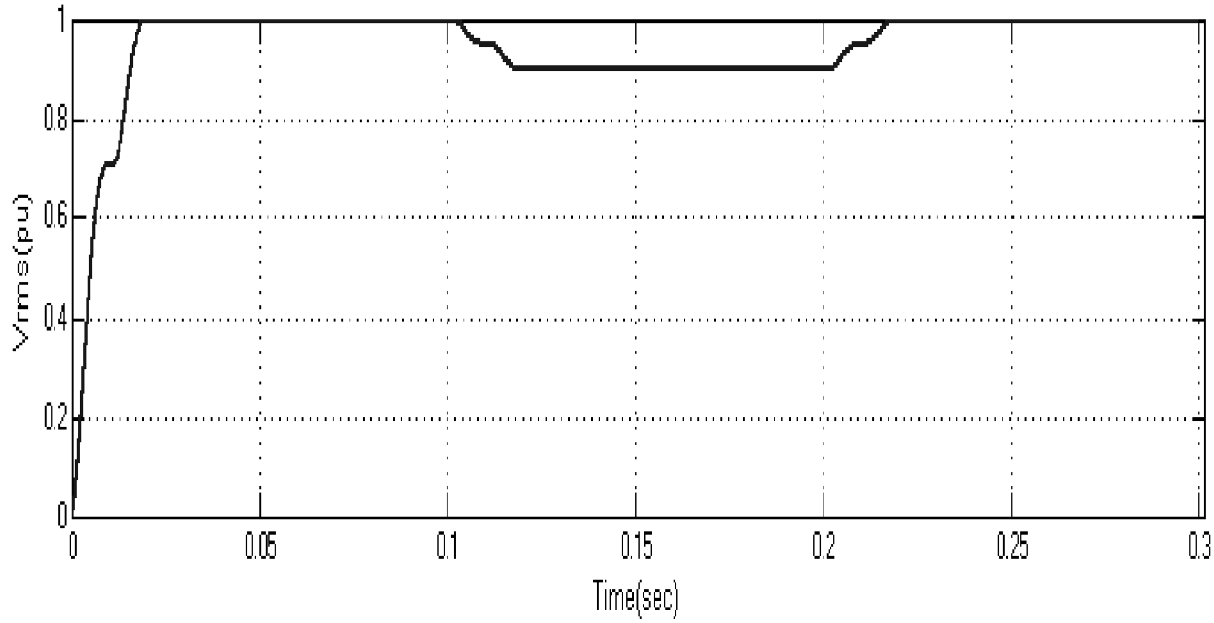

Figure 8: 3- phase to ground fault with DSTATCOM

From the fig (8) shown the simulation of Vrms at the point of load for 3-phase ground fault i.e. L-L-L-g fault with D-STATCOM. Form the simulation circuit we can observe that the voltage dip is reduced completely and also the Vrms at precise load end is sustained up to 99%.

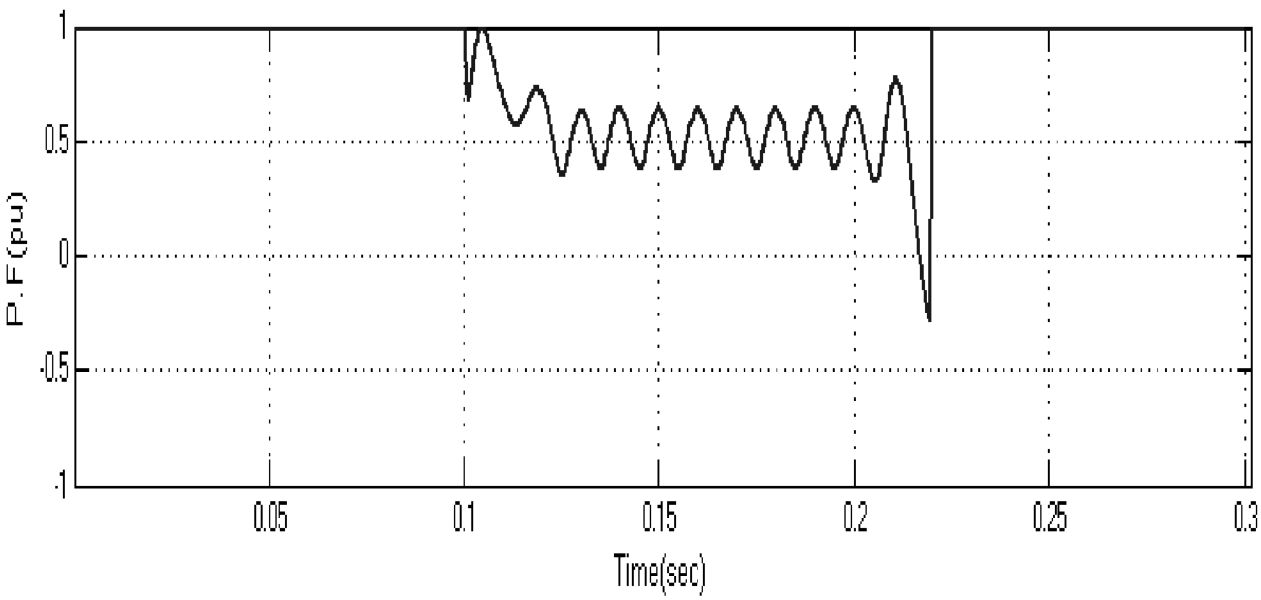

Figure 9: P. F without DSTATCOM

From the above Fig (9) we can observe that the power factor without D-STATCOM is not improved. i.e the power factor is lagging power factor. The observed power factor is 0.3.

From the above Fig (10) we can observe that the power factor with D-STATCOM is improved. i.e the power factor is unity power factor. The observed power factor is 1.

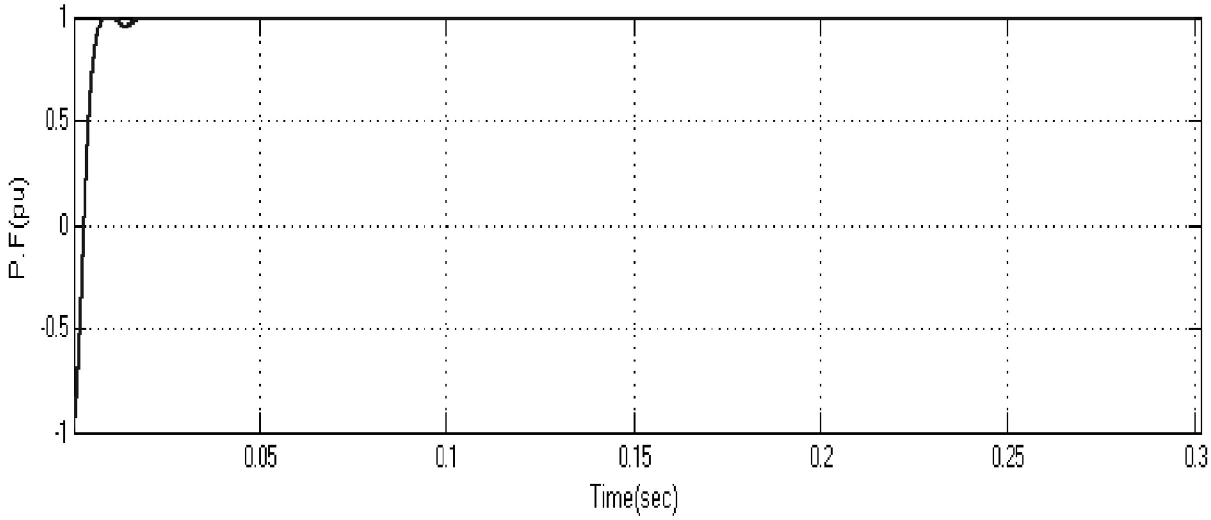

Figure 10: P. F with DSTATCOM

5. CONCLUSION

In this paper we are introducing D-STATCOM. The power quality problems are major issues in now days. In order to reduce power quality problems those are reducing or increasing in voltage magnitude. To solve this problem we are designing a D-STATCOM with FACTS devices, such as DVR, UPFC. By using D-STATCOM the power factor is unity. With the usage of SPWM technique VSC is implemented in D-STATCOM, where it releases current into system for modifying PQ problems. From the MATLAB results we can observe, the D-STATCOM gives good voltage control capabilities.

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