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Mitigation of Power Quality Issues and Improvement for D-Statcom in Distribution System: A Review

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Abstract: **In distribution system, Power Quality problems affecting sensitive equipment's. There are different types of problems in power quality. These problems are power factor, reactive power compensation and harmonic distortion. Different types of FACT devices are used. These FACT devices are SVC, STATCOM, IPC, DVR, UPFC, TCSC, TCPST and DSTATCOM. D-STATCOM is a custom power device which is installed in parallel with distribution system. Regarding problems of power quality, these devices are used but for getting better response, D-STATCOM is used. There are various modulation techniques and also control techniques are available for implement these problems. These techniques are PWM, SPWM (modulation techniques) and other techniques are Phase Shift Control, d-q theory, Synchronous Reference Frame (SRF) model etc. And with reference frame model using PI controller the DSTATCOM can be controlled. DSTATCOM is used to reduce harmonic distortion, reactive power compensation and power factor improvement. In this paper we control the Voltage Source Converter (VSC) for mitigate harmonic distortion and reactive power compensation. The simulation was carried out with the help of SIMULINK & MATLAB software.**

Keywords: **reactive power compensation, D-STATCOM, Voltage Source Converter (VSC), PWM, SPWM.**

I. INTRODUCTION

In the early days of power transmission the problems like voltage deviation during load changes and power transfer limitation were observed due to reactive power unbalances. Most of the AC loads are consuming reactive power due to presence of reactance. Heavy consumption of reactive power causes poor voltage quality. Today these Problems have even higher impact on reliable and secure power supply in the world of Globalization and Privatization of electrical systems and energy transfer. The development in fast and reliable semiconductors devices (GTO and IGBT) allowed new power electronic configurations to be introduced to the tasks of power Transmission and load flow control. The FACTS devices offer a fast and reliable control over the transmission parameters On the other hand the custom power is for low voltage distribution, and improving the poor quality and reliability of supply affecting sensitive loads. Custom power devices are very similar to the FACTS. Most widely known custom power devices are DSTATCOM, UPQC, DVR among them DSTATCOM is very well known and can provide cost effective solution for the compensation of reactive power and unbalance loading in distribution system. DSTATCOM injects a current into the system to correct the power factor and reactive power compensation. Harmonics are reduced by using PWM technique. These power quality devices are power electronic converters connected in parallel or series with the lines and the operation is controlled by a digital controllers. The modeling of these complex systems that contains both power circuits and control systems can be done different bases. One of the power electronic solutions to the voltage regulation is the use of a D-STATCOM. DSTATCOM is a class of custom power devices for providing reliable distribution power quality. The DSTATCOM applications are mainly for sensitive loads that may be drastically affected by fluctuations in the system voltage.

II. DISTRIBUTED STATIC COMPENSATOR (DSTATCOM)

The Distributed Static Compensator (DSTATCOM) is used in distribution system for reactive power compensation and to reduce harmonics. DSTATCOM is connected in parallel with transmission lines. For example if we are transmitting 1000 kv through transmission lines and at receiver end we are receiving 800 kv that means losses are there. These may be reactive power, voltage sag and harmonics. So we use DSTATCOM for reactive power compensation and also mitigate the voltage fluctuations. For the faster control Voltage Source Converter (VSC) is used with Pulse Width Modulation (PWM) to mitigate the voltage fluctuations. And DSTATCOM is used to mitigate harmonics, power quality improvement and reactive power compensation in distribution system.

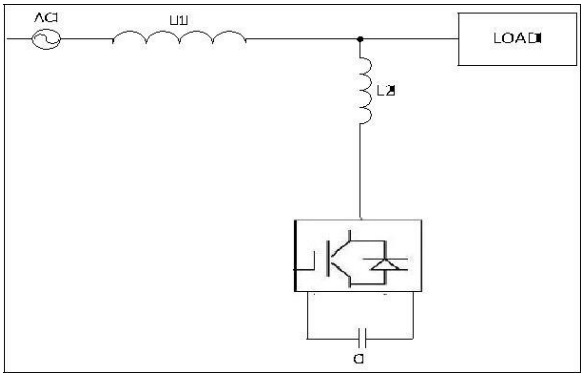

Figure 1: Block Diagram of DSTATCOM

III. VOLTAGE SOURCE CONVERTER

A Voltage Source Converter (VSC) is called as power electronic device, this device can generate a sine voltage with any required frequency, phase angle and also for magnitude. In variable-speed drives, Voltage source converters are most widely used and also be used to decrease the voltage drops. The VSC is used to inject the 'missing voltage' for completely replace the voltage. The 'missing voltage' is the difference between the transient wave and the actual sine wave. The converter is a solid state electronics device that supplies DC to the converter. The VSC is an energy storage device. The VSC is used with DSTATCOM for power quality problems like as harmonics and fluctuation.

IV. POWER QUALITY

In present days this is a big issue of Power Quality in the distribution system. Before discussing about Power Quality, first we have to know that what Power Quality is. In distribution system suppose we are transmitting 1000KV through transmission lines with other system like feeder. And at the receiving end we are getting 800KV so that means there are losses in transmitting and receiving or we can say in easy words the Power Quality is decreasing. This term is used to describe electric power that drives an electrical load and the load's ability to function properly. Without the proper power, an electrical device (or load) may malfunction, fail prematurely or not operate at all. There are many ways in which electric power can be of poor quality and many more causes of such poor quality power.

V. SOLUTION FOR POWER QUALITY IMPROVEMENT

For Power Quality improvement several FACT devices are used. These FACT devices are SVC, STATCOM, IPC, DVR, UPFC, TCSC, TCPST and DSTATCOM. And in this project DSTATCOM is used for power quality improvement. It is connected parallel with transmission lines. Using DSTATCOM the main motive is reactive power compensation, power quality improvement and THD.

VI. OPERATING PRINCIPLE OF DSTATCOM

There are the two stages over excited and under excited in synchronous machine that provides leading current and lagging currents respectively in two stages. And why are we talking about synchronous machine because DSTATCOM's working principle is quite similar to synchronous machine. DSTATCOM can exchange the active power and as well as the reactive power with an external DC source. There are two stages of exchanging of active power and real power. Interchange of Reactive Power: For generating reactive power there are two conditions (i) the system voltage should be less than voltage source converter's output voltage. (ii) DSTATCOM should be act as a capacitor. And in this case the current is lagging.

Interchange of Active Power: For the switches DC capacitor provides the active power. To maintain constant capacitor voltage for AC system the active power interchange is needed. And to make the constant capacitor voltage this active power of DC source will be given to AC system but for that case the system voltage will be guided by output voltage of VSC. So this interchange of active power and reactive that provides voltage regulation in distribution network. DSTATCOM provides reactive power for reactive power compensation and power factor unity. For load balance the active power is provided from the input

VII. SIMULATION RESULTS

In this paper the simulation results shows the power quality improvement using DSTATCOM at transmission lines. In this paper the THD has been reduced and reactive power compensation. Because DSTATCOM used in many applications now a days and the Simulink model as follows

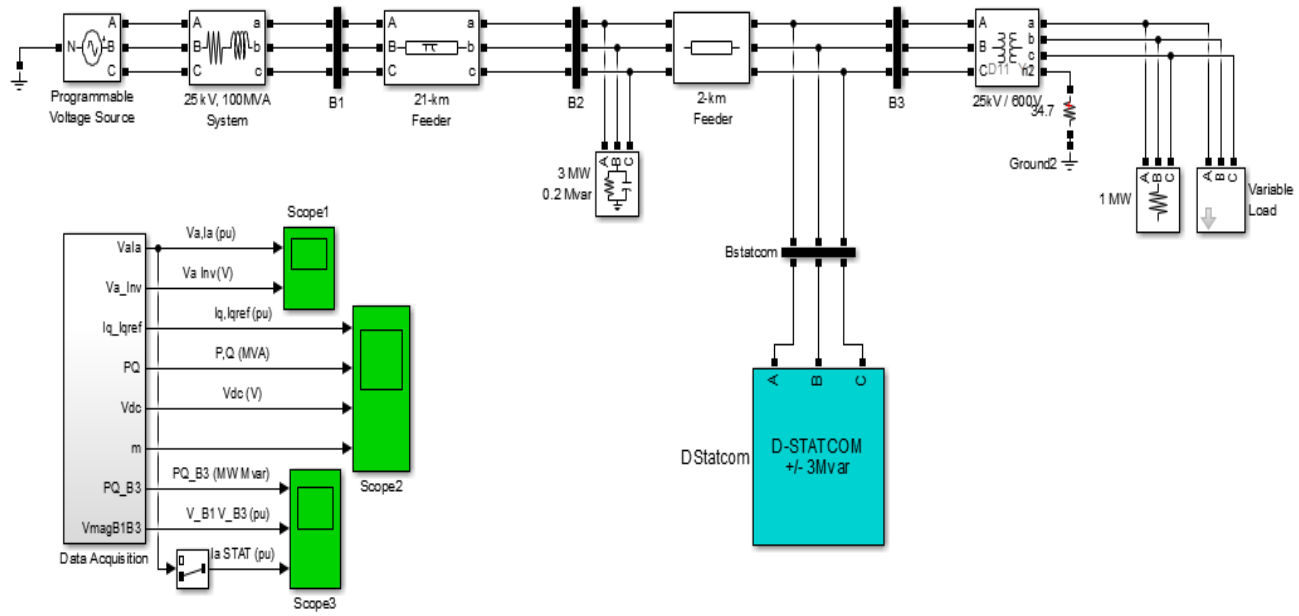

Figure 2: Simulink Test Model Using DSTATCOM

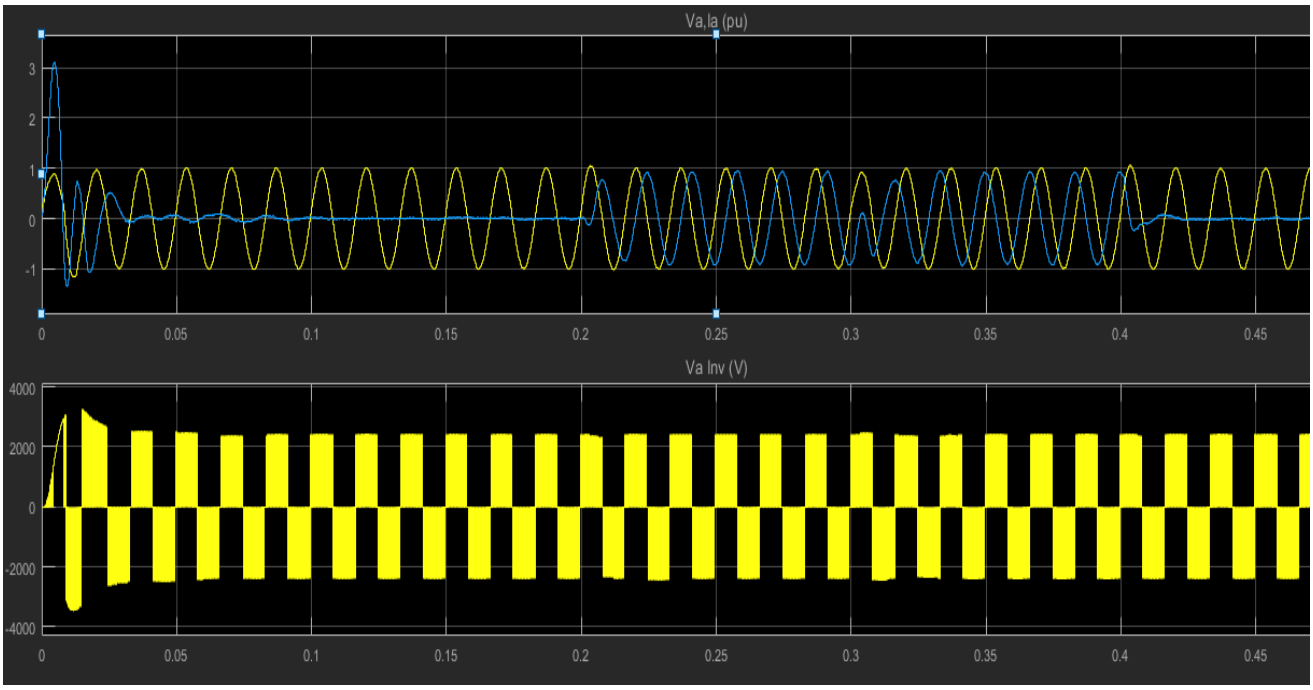

Figure 3: Source Current in Three Phase

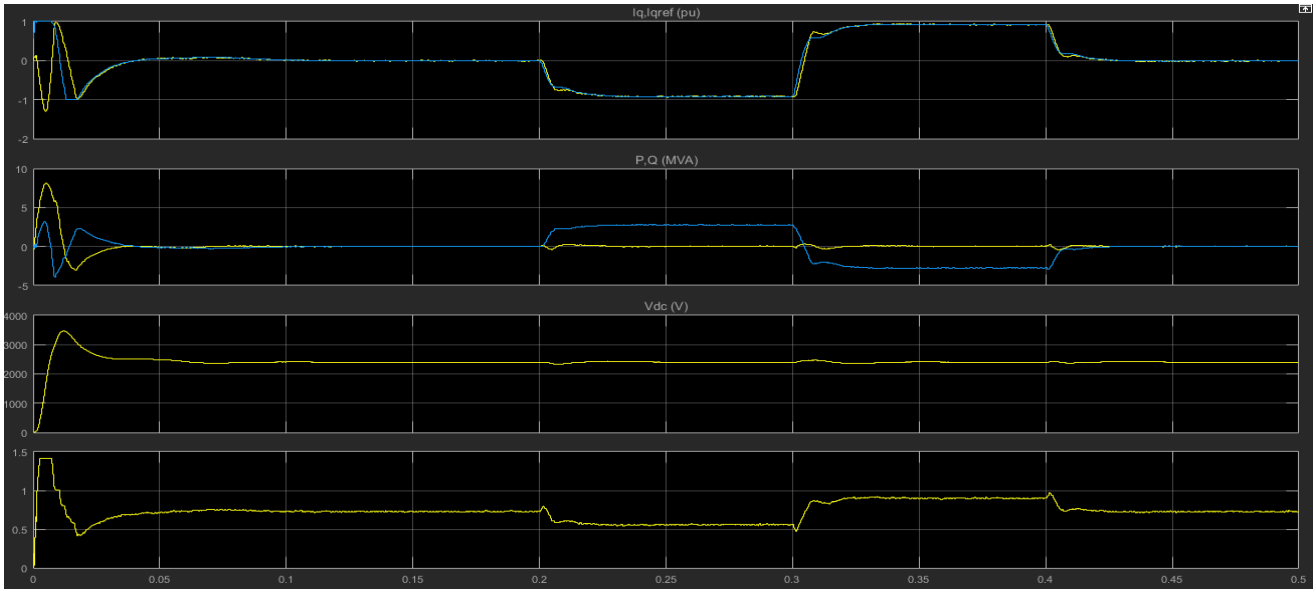

Figure 4: Harmonics Variation In Source Current

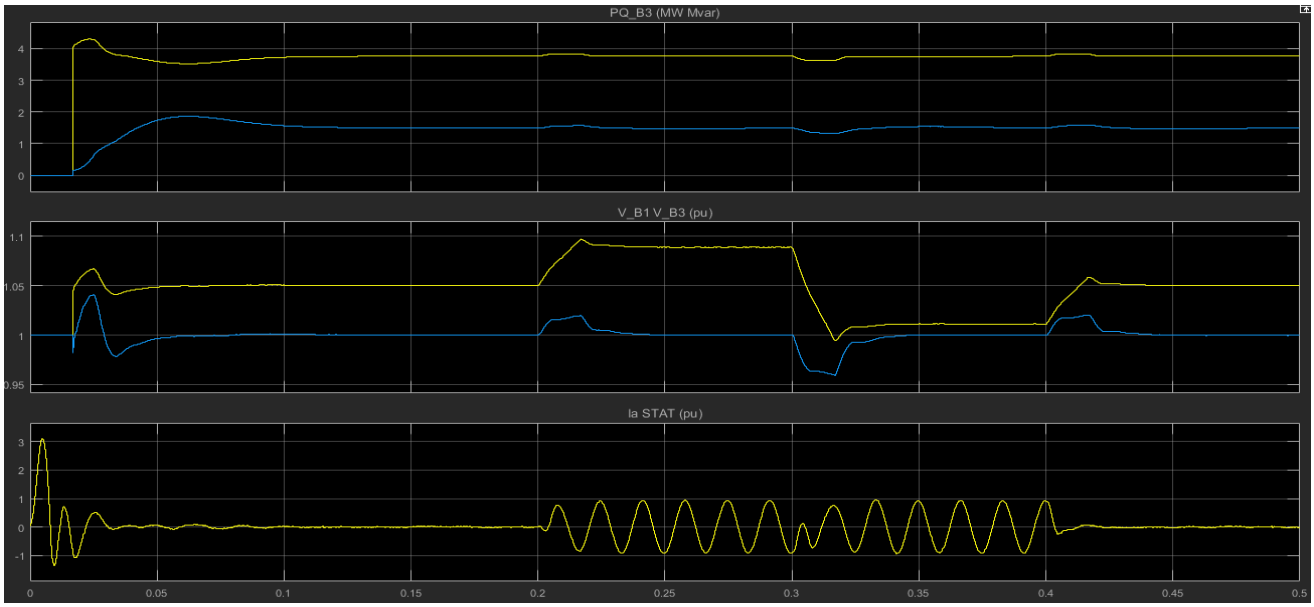

Figure 5: Distribution System performance with D-STATCOM

VIII. CONCLUSION

In this paper the modeling and simulation shows for power quality improvement using DSTATCOM. In this paper the complete configuration and working principle of DSTATCOM are mentioned. The main purpose was to improve the power quality and total harmonic distortion. And the results shows that DSTATCOM is capable to improve the power quality, reactive power compensation and also for total harmonics distortion. DSTATCOM belongs to FACTS devices and these devices have different configuration but now a day's DSTATCOM is using in custom power device because it gives better response than other FACT devices. The concept of DSTATCOM is similar to STATCOM but in addition DSTATCOM can also be used for reactive power compensation.

REFERENCES

[1] Bhattacharya Sourabh, "Applications of DSTATCOM Using MATLAB/Simulation in Power System", Research Journal of Recent Sciences, Vol. 1(ISC-2011), 430-433 (2012).

[2] Kiran Kumar Pinapatruni and Krishna Mohan L, "DQ based Control of DSTATCOM for Power Quality Improvement", VSRD-IJEECE, Vol. 2 (5), 2012, 207-227.

[3] R.Vinotha and Mrs.Poongodi.K.K, "Power Quality Improvement Using D-Statcom", International Journal Of Innovative Research & Development, Vol 2 Issue 4, April 2013, ISSN: 2278 – 0211 (Online).

[4] Amit Jain & Aman Behal, "Voltage Regulation with STATCOM's: Modeling Control and Result", IEEE Transactions on Power delivery, Vol.21, No.2, April 2006.

[5] Arindam Ghosh and Gerard Ledwich, "Compensation of Distribution System Voltage using DVR", IEEE Transactions on Power delivery, Vol.17, No.4, October 2002.

[6] Hideaki Fujita and Hirofumi Akagi, "The Unified Power Quality Conditioner: The Integration of Series-and Shunt Active Filters", IEEE Transactions on Power Electronics, Vol.13, No.2, March 1998.

[7] Saheb Hussain.MD, B.K.V. Prasad, & K. Satyanarayana "Power Quality Improvement Using Active Power Filters", International Journal of Engineering Science and Advanced Technology, ISSN: 2250-3676, Volume- 1, Issue-1, 1-7.

[8] SharadW. Mohod and Mohan V. Aware, "A STATCOM Control Scheme for Grid Connected Wind Energy System for Power Quality Improvement", IEEE Systems Journal, Vol.4, No.3, September 2010.

[9] N. Srinivasa Rao and Dr G.V. Siva Krishna Rao, "Modeling and Simulation of D-STATCOM for Power Quality Improvement", International journal of Engineering Research and Development, ISSN: 2278-067X, Volume 1, Issue 12(July 2012), PP.33-40.

[10] Sung-Min Woo, Dong-Seok-Hyun, "Simulation of DSTATCOM for Power Quality Improvement using H-Bridge Converter", IEEE Transactions on Power Electronics, Vol.11, No.1, January 1996.

[11] Daniel Sharon, Juan-Carlos Montano, Antonio Lopez, Manuel Castilla, Dolores Borras and Jaime Guierrez, "Power Quality Factor for Networks Supplying Unbalanced Non-linear Loads", IEEE Transactions on Instrumentation and Measurement, Vol:57, Issue:6, June 2008, Pages:1268-1274.

[12] A.Ekstrom and Y.Jiang, "General analysis of harmonic transfer through power converters",IEEE Transactions Power Electronics ., Vol.12,No.2,pp.287-293,Mar.1997