

# “Voltage regulation using DSTATCOM in distribution grid for enhancement of power quality ”

Mr.Ashish Vallabhakar  
PG Student

Department of electrical engineering  
Tulsiramji Gaikwad-Patil College of Engineering &  
Technology, Nagpur

Prof. Radharaman Shaha  
HOD

Department of electrical engineering  
Tulsiramji Gaikwad-Patil College of Engineering &  
Technology, Nagpur.

**Abstract—** In the planned paper, Distribution Static Compensator (DSTATCOM) is employed as a transformer in Distribution Grid. the facility quality of the Distribution Grid can be improved by voltage regulation victimisation totally different management techniques. within the planned paper, management techniques, including the PI management, DQ management and Voltage management victimisation Minimum Power Point trailing (mPPT) are analyzed and simulated. The simulation is finished for distribution grid with and while not DSTATCOM throughout fault. Simulation with DSTATCOM is finished for three totally different management techniques and its performances are compared. The mPPT avoids the circulation of unessential reactive compensation for voltage regulation by operative at the Minimum point (mPP). Comparative analysis is made for DSTATCOM with the various management techniques during fault condition. The simulation of distribution Grid for voltage relation victimisation DSATCOM is distributed victimisation MATLAB Simulink.

**Keywords-** DSTATCOM, Minimum Power Point Trailing (mPPT), Power Quality, Voltage regulation.

## I. Introduction

Due to the wide use of power electronic based mostly equipment's within the electricity client community, power quality has become the key challenge to the researchers. as a result of all automatic equipment's draw reactive power and inject harmonics into the distribution system thus accountable to the poor power quality[3]. thanks to limitations and environmental problems with standard energy sources, continuous efforts area unit occurring to extend the utilization of renewable energy sources for generation of electric power . Some researchers have come back up with new solutions within the space of renewable energy sources in terms of power quality improvement whereas addressing distribution systems. At the distribution facet , use of machine-controlled, computing devices is increasing day by day like Personal computers, printers, scanners, fax machines etc. and lots of different nonlinear hundreds, thus power quality has become major concern among the electrical utilities. These form of power electronic based mostly sensitive hundreds inject

harmonics into the road and accountable to the wave shape distortions that results poor power issue conjointly.

All the power quality mitigation controllers which are used in distribution systems known as custom power devices (CPD's)[1,3]. Among all controllers, DSTATCOM is barely answer of power quality problems[1,2]. DSTATCOM is shunt connected device, and it's wide used as power quality mitigation device. The performance of DSTATCOM depends upon the management algorithms [1] those are used to generate reference source current. Throughout this paper PV based DSTATCOM is used to that the DC voltage regulation is in addition, vital which will vary with the irradiation level. To manage the DSTATCOM, dq and pq based algorithms[7] are used Simulation results demonstrate the effectiveness of controller of DST ATCOM for reactive power compensation, harmonic reduction and wares exploit below the unbalanced conditions.

## II. Literature review

[1] S.S.Pawar, A.P.Deshpande and M.Murali, "Modelling and simulation of DSTATCOM for power quality improvement in distribution system using MATLAB SIMULINK tool," *2015 International Conference on Energy Systems and Applications*, Pune, 2015, pp. 224-227

In this paper, a reduced rating voltage-source converter as a distribution static compensator is proposed for power-quality improvement in the three-phase four-wire distribution system. The proposed DSTATCOM using synchronous reference frame theory is employed for the compensation of reactive power, harmonics currents, neutral current, load balancing and the voltage regulation the point of common coupling. The performance of the DSTATCOM is validated through simulations using MATLAB software with its simulink and power system block set toolboxes.

[2] V.F. Pires, A.Cordeiro, D.Foito and J. F. Silva, "Control of Bidirectional Quadratic DC-DC Converters for

Storage Support of DC Power Grids," 2018 7th International Conference on Renewable Energy Research and Applications (ICRERA), Paris, 2018, pp. 227-232, doi:10.1109/ICRERA.2018.8566946.

Many applications need a DC bus supporting connections to many renewable energy sources, storage systems and hundreds. However, because of the intermittent nature of renewable energy sources and cargo variations it's essential to stabilize the voltage of the DC bus. typically, battery is employed to support the DC bus voltage, however their continuous charge and discharge sport can have an affect on his period of time. Thus, the utilization of a storage system primarily based in super capacitors provides a remarkable different to stabilize the DC power system. During this context, this work presents a study of a storage system primarily based in super capacitors combined with a bidirectional quadratic DC-DC device to support the DC bus. A full style of the controllers for the quadratic device is additionally given. The behavior of the system are tested through many simulation results.

[3] G. Varshney, D. S. Chauhan and M. P. Dave, "Performance analysis of photovoltaic based DSTATCOM using SRF and IRP control theory1," 2015 1st International Conference on Next Generation Computing Technologies (NGCT), Dehradun, 2015, pp. 779-783, doi:10.1109/NGCT.2015.7375226.

The Power quality has become one in every of the foremost very important issue to each electrical utilities and finish level users of electrical power. Automation has fully modified the load nature because of widespread use of power electronic based mostly drives like adjustable speed drives, Energy economical lighting, PC's, workplace accessories etc. All power electronic based mostly sensitive equipments area unit the key fatalities of power quality issues like voltage Sag, Swell, wave shape distortion, Poor power issue etc. during this paper, three section three wire Distribution Static Compensator (DSTATCOM) that is fed by electrical phenomenon (PV) array is projected for power quality improvement. The DSTATCOM could be a 3 leg voltage supply electrical converter (VSI) with a DC link capacitance.

Photovoltaic module is employed to stay regulate the specified voltage at DC link. the ability quality improvement is achieved in terms of reactive power compensation, Power issue correction, Harmonic reduction, DC voltage management. during this paper, the performance of DSTATCOM is shown for Power issue correction (PFC) and nil voltage regulation (ZVR) modes mistreatment d-q and p-q theories of management. The effectiveness of the PV based mostly DSTATCOM is verified with simulation results. The simulation is dispensed on MATLAB software package mistreatment Simulink and PSB toolboxes.

[4] B. Shivashankar1, B. Satyavani, "Neutral current compensation using Zig-Zag Transformer with D-Statcom", International Journal of Mathematical Sciences, Technology and Humanities, 113 (2014) 1221-1227.

In this paper, a replacement topology of DSTATCOM is planned consisting of a two-leg VSC for power quality

improvement in three-phase four-wire distribution systems. The DSTATCOM in conjunction with a zig-zag device is employed for the compensation of reactive power for the voltage regulation or power issue correction in conjunction with elimination of harmonic currents, load exploit and neutral current compensation at the aim of common coupling (PCC). The performance of the planned DSTATCOM system is valid through simulation victimization MATLAB code with its Simulink and grid Block set toolboxes.

[5] Nisha G. K., Member, IAENG, Ushakumari S. and Lakaparampil Z. V., "Harmonic Elimination of Space Vector Modulated Three Phase Inverter", *Proceedings of the International MultiConference of Engineers and Computer Scientists 2012*, Vol II, IMECS 2012, March 14 - 16, 2012, Hong Kong.

This paper proposes SVPWM switched DSTATCOM for power issue and voltage sag compensation. The paper presents the simulation studies on SVPWM switched DSTATCOM in power issue management mode. It conjointly provides the mathematical model of DSTATCOM in voltage sag compensation mode. The MATLAB simulation results shows that the area vector PWM strategy are often used for power issue and voltage compensation.

[6] B. Kumara Swamy, P. Nageshwar Rao, "Simulation of A Space Vector Pwm Controller For A Three-Level Voltage-Fed Inverter Motor Drive", *International Journal of Advanced Trends in Computer Science and Engineering*, Vol.2, No.1, Pages : 363 - 372 (2013)

This paper presents Distribution Static Compensator (DSTATCOM) sculptured within the MATLAB SIMULINK tool chest for the mitigation of the facility quality problems within the distribution system. DSTATCOM is one amongst the custom power device employed in distribution system for power acquisition. DSTATCOM is developed for the compensating reactive power demanded by non-linear and unbalanced load. Conjointly power issue of the supply is improved and therefore, the Total Harmonic Distortion within the supply current is reduced. DSTATCOM will correct voltage sag, swell, unbalance by injecting the reactive current into the system. Fast reactive power theory is employed for getting reference supply current for dominant DSTATCOM. The performance of the DSTATCOM by victimization the IRP theory for unbalanced and non-linear load is incontestable with the MATLAB simulation results.

### III. Existing system

Exiting system with DSTATCOM is the most versatile device. However, the DSTATCOM is not widely applied in utility grids, Exiting system with and Without PV source as input is mostly preferred. Exiting system shown in fig.1.

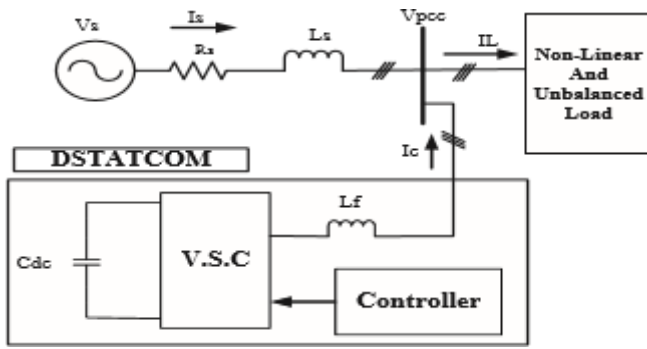


Fig.1.Existing System

The objective of this paper is to design and analyze the transformer and active damping controllers to scale back harmonics and losses within the distribution grid for the development of power quality. It consists of a distribution grid that consists of renewable energy sources like wind, solar, battery, etc. area unit connected to load at shopper finish. The voltage regulator is connected at the purpose of Common Coupling ( $V_{pcc}$ ) to reduce the harmonics which can be generated due to the non-linear loads. Transformer may be a switch controller that depends on the load voltage.

The advantages of the proposed system are as follows:

1. Harmonics injected due to non-linear loads will be suppressed.
2. It compensates all voltage disturbances.
3. Voltage fluctuations due to varying power input can be reduced.
4. Increases voltage quality and grid capability.
5. It tackles power quality problems by providing harmonic elimination, load equalisation and voltage regulation based on the load demand.

#### iv. Proposed system

Proposed system introduces a replacement thought of DSTATCOM that Use typical FACTS and D-FACTS devices. The DISTRIBUTED POWER-FLOW CONTROLLER (DPFC) provides the likelihood of management all system parameters, like line electrical phenomenon and power angle, mitigate sag, swell and Harmonics. At an equivalent time, it provides higher reliability and lower value

A distribution feeder connected to unbalanced and non linear load is shown within the below Fig. shows the essential configuration of PV primarily based DST ATCOM. DST ATCOM is 3 section 3 leg voltage supply electrical converter connected in shunt with load and its DC aspect is fed through the PV array. The DSTATCOM is connected to the road via interfacing resistances and inductors. Modeling and simulation of PV array is finished in MATLAB,  $R_s$  and  $L_s$  represents supply resistance and supply inductance. The nonlinear load is completed by connecting the 3 section diode rectifier to a Resistive-Inductive load (R-L). Unbalanced load is completed by connecting totally different values of impedances in 3 phases. 3 section voltage supply device (VSC) act because the DSTATCOM that contains the six insulated gate bipolar semiconductor device (IGBT) and anti parallel diodes area unit connected to every IGBT[4]. DC aspect of the Voltage

supply device (VSC) consists of a PV supply that is employed to keep up constant voltage for the shift operation of the IGBT switches.. Interfacing electrical device, LF is connected on the AC aspect of the voltage supply

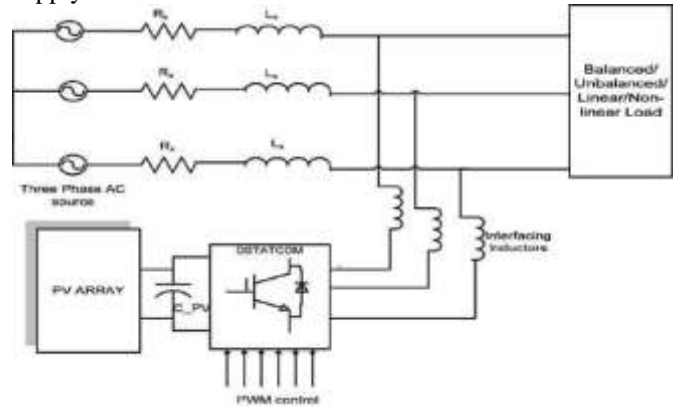


Fig.2.Proposed System

#### v. Objectives

Design and simulation of VSC(Voltage source converter) based DSTATCOM for the compensation of power quality problems to make the distribution system more efficient using MATLAB software.

- I. Main objective of project to eliminate the power quality problem
- II. To minimize the sag using DSTATCOM
- III. To minimize swell using DSTATCOM
- IV. To Reduce harmonics using DSTATCOM
- V. To design PV based DSTACOM to solve Power Quality Problem

#### VI. Research Methodology/ Planning of Work

Shows the fundamental configuration of PV based mostly DSTATCOM. DST ATCOM is 3 part 3 leg voltage supply electrical converter connected in shunt with load and its DC aspect is fed through the PV array. The DSTATCOM is connected to the road via interfacing resistances and inductors. Modeling and simulation of PV array is finished in MATLAB,  $R_s$  and  $L_s$  represents supply resistance, and supply inductance. The nonlinear load is accomplished by connecting the 3 part diode rectifier to a Resistive-Inductive load (R-L). Unbalanced load is accomplished by connecting totally different values of impedances in 3 phases. 3 part voltage supply device (VSC) act because the DSTATCOM that comprises the six insulated gate bipolar semiconductor device (IGBT) and opposed parallel diodes are connected to every IGBT[4]. DC aspect of the Voltage supply device (VSC) consists of a PV supply that is employed to keep up constant voltage for the change operation of the IGBT switches. Interfacing electrical device,

low frequency is connected on the AC aspect of the voltage supply.

A distribution feeder connected to unbalanced and non linear load is shown in the above Fig.2.

The proposed work is planned to be carried out in the following manner:

1. Study of basic concepts of Distributed Power flow Controller.
2. Finding the problems from conventional system by surveying literature.
3. Design the distribution System.
4. Design and study of DPFC.
5. Analysis of the proposed topology.
6. Study of the control strategies of system.
7. Design and Implementing a PV system for DSTATCOM in a system.
8. Simulation of the model can be done in MATLAB software.Evaluation of the performance.

## VII. Conclusion

The power quality improvement using Dstatcom will be simulated in the MATLAB Simulink and related waveform will be observed

Without DSTATCOM ( Waveform observe)

- a) sag
- b)swell
- c) Harmonic

With DSTATCOM ( Waveform observe)

- a) sag
- b)swell
- c) Harmonics

With and without DSTATCOM result Compare

## References

- [1] S. S. Pawar, A. P. Deshpande and M. Murali, "Modelling and simulation of DSTATCOM for power quality improvement in distribution system using MATLAB SIMULINK tool," *2015 International Conference on Energy Systems and Applications*, Pune, 2015, pp. 224-227
- [2] V. F. Pires, A. Cordeiro, D. Foito and J. F. Silva, "Control of Bidirectional Quadratic DC-DC Converters for Storage Support of DC Power Grids," *2018 7th International Conference on Renewable Energy Research and Applications (ICRERA)*, Paris, 2018, pp. 227-232, doi: 10.1109/ICRERA.2018.8566946
- [3] G. Varshney, D. S. Chauhan and M. P. Dave, "Performance analysis of photovoltaic based DSTATCOM using SRF and IRP control theory1," *2015 1st International Conference on Next Generation Computing Technologies (NGCT)*, Dehradun, 2015, pp. 779-783, doi: 10.1109/NGCT.2015.7375226
- [4] B. Shivashankar1, B.Satyavani, "Neutral current compensation using Zig-Zag Transformer with D-Statcom", *International Journal of Mathematical Sciences, Technology and Humanities*, 113 (2014) 1221-1227
- [5] Nisha G. K., Member, IAENG, Ushakumari S. and Lakaparampil Z. V., "Harmonic Elimination of Space Vector Modulated Three Phase Inverter", *Proceedings of the International MultiConference of Engineers and Computer Scientists 2012*, Vol II, IMECS 2012, March 14 - 16, 2012, Hong Kong.
- [6] B.Kumara Swamy, P.NageshwarRao, "Simulation Of A Space Vector Pwm Controller For A Three-Level Voltage-Fed Inverter Motor Drive", *International Journal of Advanced Trends in Computer Science and Engineering*, Vol.2 , No.1, Pages : 363 - 372 (2013)
- [7] S. Saragar and C. L. Bhattar, "Modelling and Designing of LCLR Filter for Power Quality Improvement in Microgrid", *IEEE Sponsored 9<sup>th</sup> International Conference on Intelligent Systems and Control(ISCO)2015*.
- [8] Mahesh Illindalaand Giri Venkataramanan , "Frequency/Sequence Selective Filters for Power Quality Improvement in a Microgrid" *IEEE TRANSACTIONS ON SMART GRID*, 2012 IEEE.
- [9] Dr. H.P. Tiwari, Pradeep Anjana and Dr. Vikas Gupta, "Power Quality Improvement of Micro-Grid Using APF's With APC Theory", *IEEE International Conference on Recent Advances and Innovations in Engineering (ICRAIE 2014)*, May 09-11,2014, Jaipur, India.
- [10] K. Prabaakaran, N.Chitra and Dr.A.Senthil Kumar, "Power Quality Enhancement in Microgrid - A Survey", *2013 International Conference on Circuits, Power and Computing Technologies [ICCPCT-2013]*.
- [11] R. T. Hock, Y. R. De Novaes and A. L. Batschauer, "A voltage regulator based in a voltage-controlled DSTATCOM with minimum power point tracker," in *Proc. IEEE Energy Convers. Congr. Expo.*, Sep. 2014, pp.3694-3701.
- [12] R. T. Hock, Y. R. De Novaes and A. L. Batschauer, "Frequency Compensation for Stand Alone Voltage-controlled DSTATCOM," in *Proc. Brazilian Power Electron. Conf. And Southern Power Electron.Conf.*, Dec. 2015, pp. 1-6.
- [13] Quentin Tabart, Ionel Vechiu, Aitor Etxeberria, and Seddik Bacha, "Hybrid Energy Storage System microgrids Integration For Power Quality Improvement Using Four Leg Three Level NPC Inverter and Second Order Sliding Mode Control", DOI 10.1109/TIE.2017.2723863, *IEEE Transactions on Industrial Electronics*.
- [14] Epsita Das, Ambarnath Banerji and Sujit K. Biswas, "State of Art Control Techniques for DSTATCOM", *2017 IEEE Calcutta Conference (CALCON)*.
- [15] G. Gupta1, W. Fritz2 and M.T.E. Kahn3, "A Comprehensive Review of DSTATCOM: Control and Compensation Strategies", *International Journal of Applied*

Engineering Research ISSN 0973-4562 Volume 12, Number  
12 (2017) pp. 3387-339

[16] T. Esmar e P. Chapman, "Comparison of Photovoltaic Array Maximum Power Point Tracking Techniques," IEEE Transactions on Energy Conversion, vol. 22, n. 2, pp. 439-449, 2007.

[17] A. Al-Diab e C. Sourkounis, "Multi-tracking single-fed PV inverter," em MELECON 2010 - 2010 15th IEEE Mediterranean Electrotechnical Conference, 2010.

[18] S. Jain e V. Agarwal, "Comparison of the performance of maximum power point tracking schemes applied to single-stage grid-connected photovoltaic systems," IET Electric Power Applications, vol. 1, n. 5, pp.753-762, 2007.

