



Review On Voltage Sag/Swell Mitigation With STATCOM FACTS Device In Transmission Line

¹Ms. Puja J. Ghorale, ²Prof. Amit V. Mohod · ³Prof. Parag R. Jawale

¹Department Of Electrical & Power (E & P) Engg. PLITMS Buldhana, ²Department of Electrical & Power system Prof. RAM Meghe COE & Management Amravati, ³Department Of Electrical & Power (E & P) Engg. PLITMS Buldhana,

Abstract

To repay the reactive power misfortunes in the transmission line and any place in the electrical influence framework, we have completed the writing survey of the different papers and embraced the distinctive procedures to defeat this issue. We have utilized the shunt and series arrangement strategies, in which the compensator like capacitor will be given in parallel and in series to the inductive load. Since there is dependably a voltage and current transient upon the changing the capacitor steps. Henceforth we adopted the FACTS (Flexible AC Transmission Systems) gadgets to beat the responsive force remuneration issue. The studies for the different FACTS gadgets were completed and we discovered the STATCOMs (Static Synchronous Compensators) is the present day and the most productive approach to conquer the responsive force pay. The different strategies were done for the STATCOMS. The genuine investigation were completed in MATLAB and its scientific outflow was inferred utilizing diverse routines for calculation. Study of FACTS devices like STATCOM and SVC is being presented in this paper. These device have allowed as to compensate reactive power and mitigate problems occurring in transmission lines. This thesis present the analysis of Static Synchronous Compensator for single phase AC transmission line and also compared the results with Static VAR Compensator and tabulated their differences. Also the analysis of STATCOM for three phase AC transmission line has also been performed accordingly. Principle of operation of Static Synchronous Compensator and PWM techniques have also been employed in simulation of STATCOM, which are briefly presented in this paper. We have also done basic mathematical formulation for STATCOM. These thesis basically present the operation of STATCOM to compensate reactive power when connected to single or three phase AC transmission lines.

Keywords: Power quality, D-STATCOM, Voltage Sag, Voltage Source Converter (VSC), Energy storage system.

I. INTRODUCTION

Generation of power and its transmission is a perplexing procedure, obliging waging of numerous components in power system when coupled to amplify the yield. One of the principle parts to form a significant part is the reactive power in the transmission system. It is obliged to keep up the voltage to convey the dynamic power in the lines. Burdens like engine burdens and different burdens oblige different reactive power in there operation. To enhance the execution of air conditioning force systems, we have to deal with this reactive power in a proficient way and it is called as reactive power remuneration. There are two viewpoints to the issue of reactive power remuneration: load remuneration and voltage support. Load remuneration comprises of change in force component, adjusting of genuine force taken from the supply, good voltage regulation, and so on of extensive changing burdens. Voltage bolster comprises of decrease of voltage change in a transmission line. These types compensation can be realized in two way: series and shunt compensation. These adjust the parameters of the framework to give improved VAR compensation. A shunt compensation is one where capacitors are employed in parallel with the transmission line and act like a synchronous condenser and absorb or supply reactive power. A series is one where inductor or capacitor are employed in series to supply required power. Mostly shunt compensation are employed nowadays in FACT devices.

Flexible AC Transmission (FACT) devices are static equipments which helps in not only for compensating reactive power but also control one or more AC transmission parameters. Flexible AC Transmission Devices includes Static synchronous compensator, Thyristor switched reactor, Static synchronous series compensator, Thyristor switched capacitor, Thyristor switched series reactor. All these equipment are static instruments, so there is no dynamic effect. Static synchronous compensator (STATCOM) basically includes a DC power capacitor, a converter (may act as rectifier when reactive power is being absorbed and as an inverter when reactive power is being supplied to the transmission system), step up transformer, series inductors etc.

II. II MOTIVATION

The following are the motivation for carrying out this project

1. Improvement of the quality of the power.
2. Improvement of system power factor.
3. Reduction of the losses in the network.
4. Shirking of penalty charges for the over the top use of the reactive power particularly in industry where they utilize expansive induction motors.
5. Reduction of cost and generate higher revenue for the customers.
6. Improvement of the voltage regulation of the power system.
7. Increase the power availability.

III LITERATURE SURVEY

First we have conducted various searches on how to compensate reactive and then by using what we can do so efficiently. We have concluded that there are numerous equipment's under FACTS devices which helps in compensating reactive power. Then after going through various papers and surveys, we concluded that Static Synchronous Compensator compensates reactive power in most efficient way. STATCOM is a very important controller under FACTS devices and it helps in controlling voltage. First STATCOM which was put in operation was in Japan during 1980 which utilizes power commutated thyristors and works at 20MVar [10]. KEPCO and Mitsubishi Motors introduced a ± 80 MVar STATCOM during 1991.

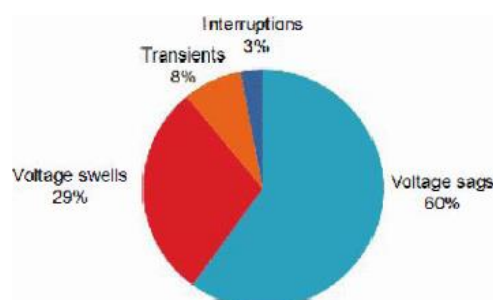
STATCOM have numerous forms, however in most reasonable applications it utilizes the inverter which can likewise be known as a Voltage Source Inverter (VSI) in 3-stage design as the essential square. The essential hypothesis of VSI is to create a situated of controllable 3-stage yield voltages/ streams at the crucial recurrence of the AC transport voltage from a DC info voltage source, for example, a charged capacitor or a DC vitality supply gadget. By fluctuating the extent and stage edge of the yield voltage and current, the framework can trade dynamic/responsive power between the DC and AC transports, and direct the AC bus voltage.

IV CHALLENGES

In the tenure of carrying out the project, we faced many challenges. However because of the constant guidance from our project supervisor and help from the resource person we could overcome every challenges we faced. Off course we came across many minor and major challenges, out of which some are mentioned bellow and discussed how we overcome each challenges. While doing the analysis of the STATCOM in the Multisim. We were not able to connect the three phase transformer to the power system, to which we have to supply the reactive power drawn by the inductive load. But after doing the polarity test for the transformer, we could overcome this challenge. Initially after completing complete circuit for the converter, this converter is not acting as inverter, when reactive power to be supplied to the system and the converter is not acting as rectifier, when excess reactive power to be drawn from the power system when capacitive load is connected to the power system. But after consulting the resource person, we knew all thyristors, which we have used in the converter should be triggered with PWM (pulse width modulation). The problem that we encounter was the whole STATCOM output. We were not able to get the complete sinusoidal three phase output from the STATCOM. Since after doing trial and error method by changing the capacitor value at the DC side of the converter and correspondingly changing the inductor and setting capacitor initial value to 50 V. we could obtain the optimum value of capacitor and inductor after which we could obtain the complete three phase sinusoidal wave from the AC side of the converter. Hence the STATCOM is now ready to draw and supply the reactive power to the power system.

V PROBLEM STATEMENT

The impedance of transmission lines and the requirement for lagging VAR by most machines in a creating framework brings about the utilization of reactive power, in this way influencing the steadiness furthest reaches of the framework and in addition transmission lines. Pointless voltage drops lead to expanded misfortunes which needs to be supplied by the source and thus prompting blackouts in the line because of expanded weight on the framework to convey this fanciful influence. Therefore we can gather that the remuneration of reactive power mitigates every one of these impacts as well as aides in better transient reaction to blames and aggravations. As of late there has been an expanded concentrate on the systems utilized for the pay and with better gadgets included in the innovation, the remuneration is made more viable. It is all that much obliged that the lines be diminished of the commitment to convey the receptive force, which is better given close to the generators or the heaps. Shunt compensation can be introduced close to the load, in a dispersion substation or transmission substation.



Percentages of problems in power quality

VI POWER QUALITY

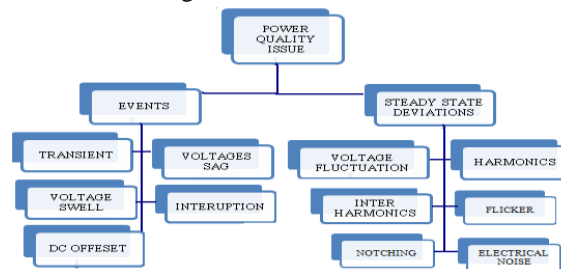
Overview:

Electric Power quality is a term which has captured increasing attention in power engineering in the recent years. The term power quality refers to maintaining a sinusoidal waveform of bus voltages at rated voltage and frequency. Power quality areas may be made according to the source of the problem such as converters, magnetic circuit non linearity by the wave shape of the signal such as harmonics, flicker or by the frequency spectrum (radio frequency interference). Power quality is simply the interaction of electrical power with electrical equipment. Power quality is the cause, and the ability of the electrical equipment to function in the power quality environment is the effect. Various sources use the term “power quality” with different meaning. It is used synonymously with “supply reliability,” “service quality,” “voltage quality,” “current quality,” “quality of supply” and “quality of consumption [13].

1. Low power quality problems Service entrance switchboard, lighting power distribution panel.
2. Moderate power quality problems HVAC power panels.
3. High power quality problems Panels supplying adjustable speed drives.

Power Quality Issues

Power quality problems have many names and descriptions. Surges, spikes, transients, blackouts, noise, voltage sag, voltage swell, interruption, dc offset are some common descriptions .In order to increase the reliability of a power distribution system, many methods of power quality problems have been following:



VII OBJECTIVES

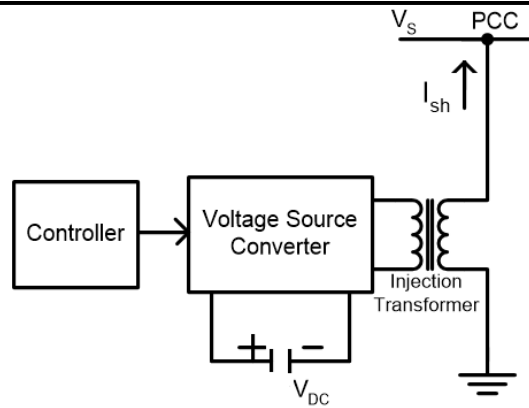
The primary objective of this project is to compensate the reactive power via Flexible AC Transmission System Devices. Out of many FACTS devices, we have streamline on the STATCOM (Static Synchronous Compensator) and the SVC (Source Voltage Converter). Since these two techniques of compensating the reactive power is recent and most efficient way of compensating the reactive power.

- 1) First objective is to theoretically understand the reactive power compensation through shunt and series compensation and basic mathematical formulas.
- 2) To compensate the reactive power in single phase AC system by both STATCOM and SVC.
- 3) To do the analysis of STATCOM and SVC in single phase AC system in Simulink.
- 4) To do the comparison of STATCOM and SVC.
- 5) To compensate the reactive power in three phase AC system by using STATCOM

VIII STATCOM

Static Synchronous Compensator is one of the static component device and comes under the family of FACTS devices. It can absorb or supply reactive power in the single or three phase AC systems. A transmission network reactive power can be compensated using Static Synchronous Compensator. It also helps in preventing fluctuations in the transmission system like sudden voltage increase (voltage swell), sudden voltage decrease (voltage sag), transients etc.

A STATCOM comprises of a three phase inverter utilizing SCRs, MOSFETs or IGBTs, a DC capacitor (which when charging will absorb reactive power and while discharging will supply reactive power), a connection reactor whose purpose is to link the inverter output to the AC supply side, channel parts to channel out the high recurrence segments because of the PWM inverter. From the DC side capacitor, a three stage voltage is produced by the inverter. This is synchronized with the AC supply. The connection inductor interfaces this voltage to the AC supply side. This is the essential standard of operation of STATCOM. A D-STATCOM, which is schematically portrayed in Fig. 6 comprises of a two level voltage source converter (VSC), a dc vitality stockpiling gadget, a coupling transformer joined in shunt to the dispersion organize through a coupling transformer. Such setup permits the gadget to retain or produce controllable dynamic and receptive force. The D-STATCOM has been used predominantly for regulation of voltage, remedy of force component and end of current sounds. Such a gadget is utilized to give consistent voltage regulation utilizing a by implication controlled converter. In this venture, the D-STATCOM is utilized to manage the voltage at the purpose of association.



Basic model of a Distribution STATCOM

CONCLUSION

In this work, the investigation on the role of Distribution Static Synchronous Compensator (DSTATCOM) can compensate the voltage sag and swells conditions. In order to achieve improved power quality levels simulated with or without DSTATCOM connected to the distribution system. The Simulation results show that the DSTATCOM can compensate the voltage sag and swell conditions. In this thesis work, mitigate Voltage Sag condition and Power Quality improvement on 25 % in fault resistance 0.20Ω with DSTATCOM and in fault resistance 0.40Ω mitigate Voltage Sag condition and Power Quality improvement on 30 % with DSTATCOM. It can be concluded that DSTATCOM improves the power quality and remove the voltage sag condition in distribution network.

REFERENCES

- [1] Manoj nair "Power quality" text book balaji learning published Edition: 11 is bn no. 978-81-910618-6-4.
- [2] C8-12,"DSTATCOM (Distribution Static Compensator)", 24/08/2007 VIGO (Spain).
- [3] N.G. Hingorani and L. Gyugyi, "Understanding FACTS: Concepts and Technology of Flexible AC Transmission Systems", 1st edition, The Institute of Electrical and Electronics Engineers, 2000.
- [4] B. K. Prusty & S. M. Ali. "Power quality issue and its parameters measurement technique with improvement feature in a distribution system." ISSN (Print) : 2319 – 2526, Volume-2, Issue-1, 2013.
- [5] Dr. S.M. Ali B.K.Prusty M.K.Dash S. P. Mishra. "Role of facts devices in improving power quality in a grid connected renewable energy system." Journal of Engineering Research and Studies E-ISSN0976-7916.
- [6] Hendri Masdi, Norman Mariun Senior MIEEEE, S.M.Bashi MIEEEE, A. Mohamed Senior MIEEEE, Sallehuddin Yusuf MIEEEE "design of a prototype d-statcom for voltage sag mitigation."
- [7] Veeraiah Kumbha, N. Sumathi "Power quality improvement of Distribution lines using DSTATCOM under various loading conditions." International Journal of Modern Engineering Research (IJMER) www.ijmer.com Vol. 2, Issue. 5, Sep.-Oct. 2012 pp-3451-3457 ISSN: 2249-6645.
- [8] Ch. Siva Koti Reddy, Dr. P.Linga Reddy. "A DSTATCOM-Control Scheme for Power Quality Improvement of Grid Connected Wind Energy System for Balanced and Unbalanced Non linear Loads." International Journal of Modern Engineering Research (IJMER) www.ijmer.com Vol.2, Issue.3, May-June 2012 pp-661-666 ISSN: 2249-6645.
- [9] Ravilla Madhusudan,Ramamohan Rao "Modeling and simulation of a Distribution STATCOM (DSTATCOM) for power quality problems voltage sag and swell Based on sinusoidal pulse width modulation (SPWM)".IEEE-International conference on advances in engineering ,science and management (ICAESM-2012)March 30,31,2012.ISBN: 978-81-909042-2-3©2012 IEEE.
- [10] Dr. Alka Singh, Dr. Bhim Singh. "An application of iterative learning control applied to distribution static compensator system." ITM Gurgaon, IIT Delhi.
- [11] Irena Wasiak, Rozmyslaw Mienski, Ryszard Pawelek, Piotr Gburczy. "Application of DSTATCOMcompensators for mitigation of power quality disturbances in low voltage grid with distributed generation."9th International Conference Electrical Power Quality and Utilisation Barcelona 9-11 October 2007.
- [12] Pradeep Kumar, Niranjana Kumar & A.K.Akella. "Review of D-STATCOM for Stability Analysis."IOSR Journal of Electrical and Electronics Engineering (IOSRJEEE), ISSN: 2278-1676 Volume 1, Issue 2 (May-June 2012), PP 01-09.
- [13] Dr. S.M. Ali B.K.Prusty M.K.Dash S. P. Mishra. "Role of facts devices in improving power quality in a grid connected renewable energy system." Journal of Engineering Research and Studies E-ISSN0976-7916.
- [14] S.Sundeeep, Dr. G. MadhusudhanaRao "Modelling and Analysis of Custom Power Devices for Improve Power Quality" International Journal of Electrical and Computer Engineering (IJECE) Vol.1, No.1, September 2011, pp. 43~48 ISSN: 2088-8708.
- [15] Pull venkata kishore, S.Rama reddy and P.V.Kishore. "Modelling and simulation of 14 bus system with D-STATCOM for power quality improvement." Indian J.Sci.Res.3 (1): 73-79, 2012.
- [16] P.Suman Pramod Kumar, N.Vijaysimha, C.B.Saravanan. "Static synchronous series compensator for series compensation of ehv transmission line."International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering Vol. 2, Issue 7, July 2013 ISSN (Print): 2320 – 3765 ISSN (Online): 2278 – 8875.
- [17] Hariyani Mehul p"Voltage stability with the help of D-STATCOM." National Conference on Recent Trends in Engineering & Technology 13-14 May 2011 B.V.M. Engineering College, V.V.Nagar, and Gujarat, India.
- [18] Yueqiu Wang, Jie Tang, Xionger Qiu "Analysis and Control of D-STATCOM under unbalanced voltage condition" 2011 International Conference on Mechatronic Science, Electric Engineering and Computer August 19-22, 2011, Jilin, China.

[19] S. Elango Dr. E.Chandra Sekaran“Mitigation of voltage sag using Distribution Static Compensator (D-Statcom).” 978-1-61284-764-1/11/\$26.00 ©2011 IEEE.

[20] Sambugari Anil Kumar, D. vanurrappa “Voltage Dip mitigation in Distribution System by Using DStatcom” Journal ofEnergy Technologies and Policy www.iiste.org ISSN 2224-3232 (Paper) ISSN 2225-0573 (Online) Vol.1, No.1, 2011.

