



Performance Analysis And Result Of Voltage Sag/Swell Mitigation With STATCOM FACTS Device In Transmission Line

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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 devise 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.

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.

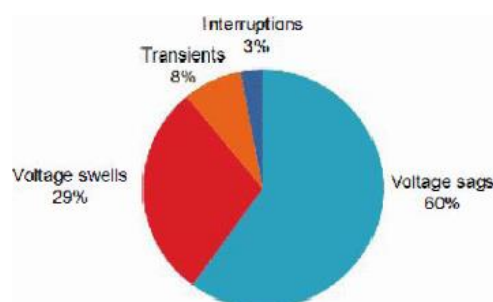
STATCOM have numerous forms, however in most reasonable applications it utilizes the inverter which can likewise be known as a Voltage Source Inverter (VSI) in 3-stage design as the essential square. The essential hypothesis of VSI is to create a situated of controllable 3-stage yield voltages/ streams 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

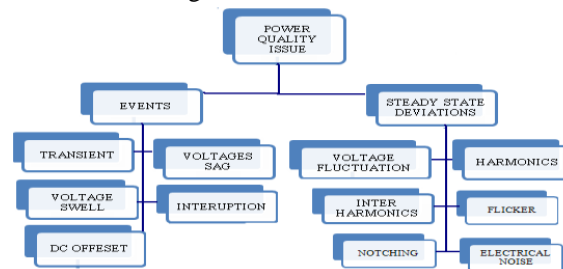
Overview:

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:

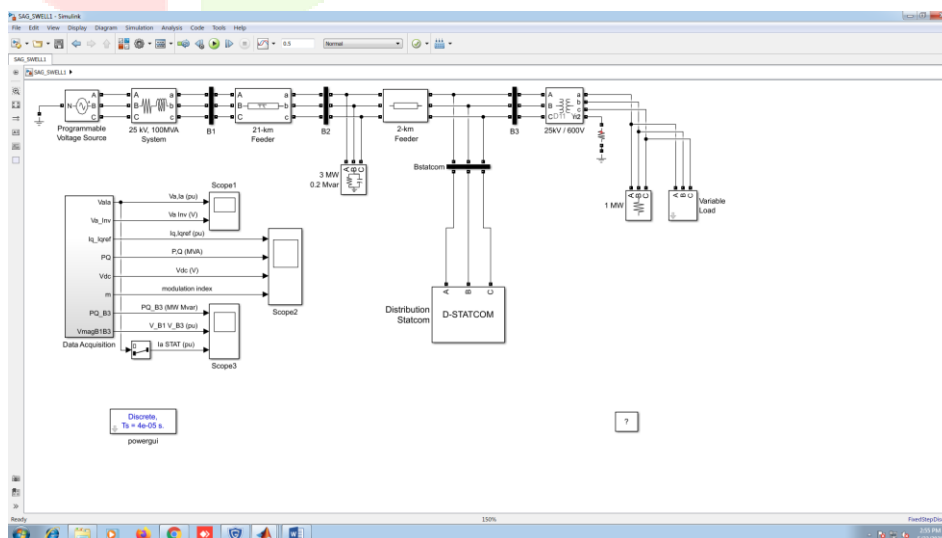


VII OBJECTIVES

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 SIMULATION MODEL FOR THE SYSTEM

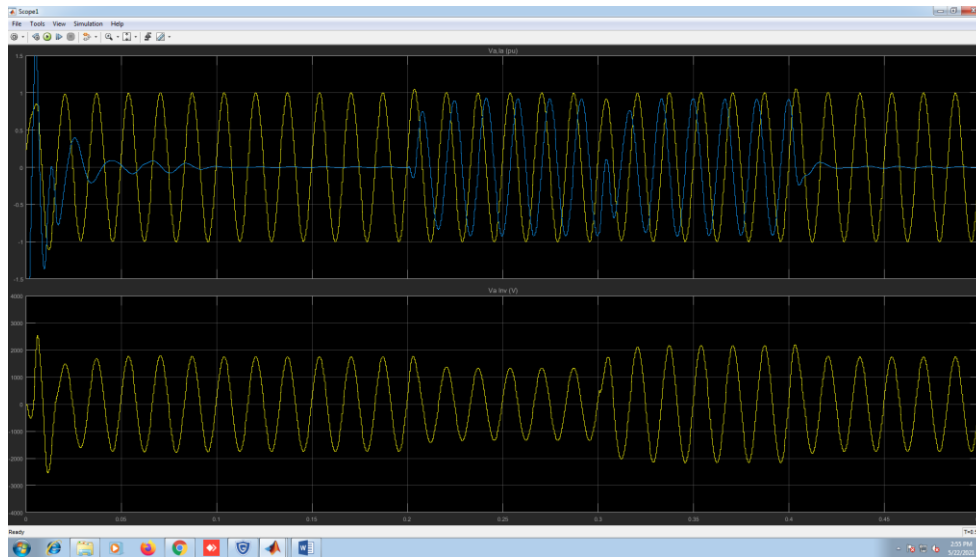


Description

A Distribution Static Synchronous Compensator (D-STATCOM) is used to regulate voltage on a 25-kV distribution network. Two feeders (21 km and 2 km) transmit power to loads connected at buses B2 and B3. A shunt capacitor is used for power factor correction at bus B2. The 600-V load connected to bus B3 through a 25kV/600V transformer represents a plant absorbing continuously changing currents, similar to an arc furnace, thus producing voltage flicker. The variable load current magnitude is

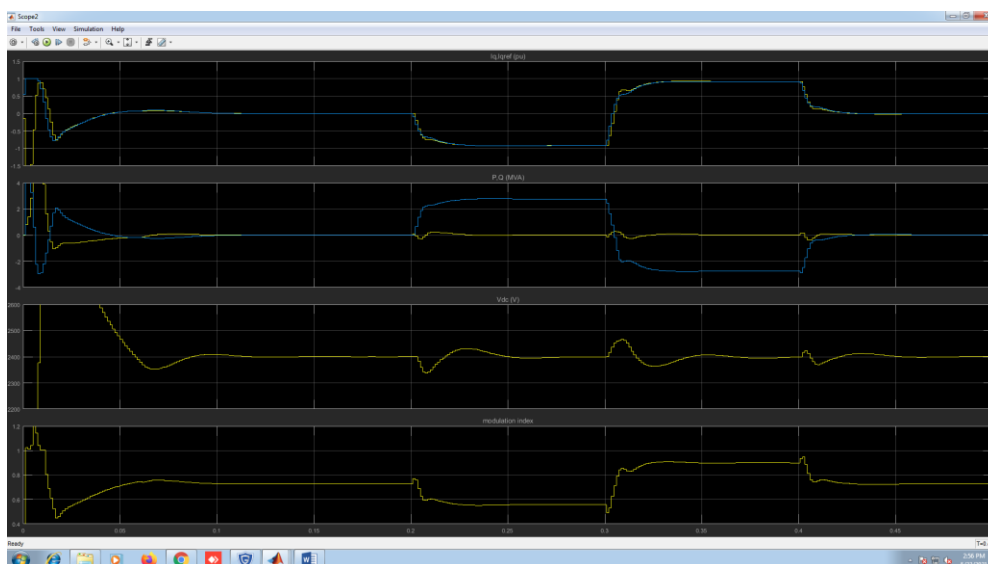
modulated at a frequency of 5 Hz so that its apparent power varies approximately between 1 MVA and 5.2 MVA, while keeping a 0.9 lagging power factor. This load variation will allow you to observe the ability of the D-STATCOM to mitigate voltage flicker.

The D-STATCOM regulates bus B3 voltage by absorbing or generating reactive power. This reactive power transfer is done through the leakage reactance of the coupling transformer by generating a secondary voltage in phase with the primary voltage (network side). This voltage is provided by a voltage-sourced PWM inverter. When the secondary voltage is lower than the bus voltage, the D-STATCOM acts like an inductance absorbing reactive power. When the secondary voltage is higher than the bus voltage, the D-STATCOM acts like a capacitor generating reactive power.



During this test, voltage of the Programmable Voltage Source will be kept constant and you will enable modulation of the Variable Load so that you can observe how the D-STATCOM can mitigate voltage flicker. In the Programmable Voltage Source block menu, change the "Time Variation of" parameter to "None". In the Variable Load block menu, set the Modulation Timing parameter to [Ton Toff]= [0.15 1] (remove the 100 multiplication factor). Finally, in the D-STATCOM Controller, change the "Mode of operation" parameter to "Q regulation?" and make sure that the reactive power reference value Qref (2nd line of parameters) is set to zero. In this mode, the D-STATCOM is floating and performs no voltage correction.

Run the simulation and observe on Scope3 variations of P and Q at bus B3 (1st trace) as well as voltages at buses B1 and B3 (trace 2). Without D-STATCOM, B3 voltage varies between 0.96 pu and 1.04 pu (+/- 4% variation). Now, in the D-STATCOM Controller, change the "Mode of operation" parameter back to "Voltage regulation" and restart simulation. Observe on Scope 3 that voltage fluctuation at bus B3 is now reduced to +/- 0.7 %. The D-STATCOM compensates voltage by injecting a reactive current modulated at 5 Hz (trace 3 of Scope3) and varying between 0.6 pu capacitive when voltage is low and 0.6 pu inductive when voltage is high.



CONCLUSION

It has been discussed that voltage sag problem is very common and can create problem for consumer good and industrial application. So a DSTATCOM has been modeled using voltage regulation technique and it is found to be good in compensating voltage sag condition. The DSTATCOM can compensate the voltage. The power quality problems such as voltage dips, swells and interruptions, consequences, and mitigation techniques of custom power electronic devices D-STATCOM. The design and applications of D-STATCOM for voltage sags, interruptions and swells, and comprehensive results are presented. The simulations carried out showed that the DSTATCOM provides relatively better voltage regulation capabilities. It was also observed that the capacity for power compensation and voltage regulation of DSTATCOM depends on the rating of the dc storage device.

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