Simulation in the Distribution System and comparing by Using D-STATCOM and DVR are connected to Grid during voltage sag Problems

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ABSTRACT:- D-STATCOM is a compensation device that is used to control the flow of reactive power in distribution systems. Most of the loads in this system, being of inductive nature, consume more reactive power. As a result, the power factor of the load deteriorates and this limits the flow of active power in the line. The document aims to develop a D-STATCOM, based on the voltage source converter, which injects the reactive power into the distribution line. The output voltage of D-STATCOM is brought to the system voltage to control the generation of VAR. The implementation of D-STATCOM through the use of the PI controller is carried out in MATLAB / Simulink.

Keywords: D-STATCOM, voltage source converter (VSC), reactive power.

1.1 INTRODUCTION –

FACTS devices provide fast and reliable control of transmission parameters, such as voltage, line impedance and phase angle between the emitting end and the final receiving voltage. On the other hand, the customized power device is used for the low voltage distribution and improves the quality of the power thanks to which the system becomes reliable. Customized feeding devices are very similar to FACTS devices. The best known custom power devices are D-SATCOM, UPQC, DVR among them. D-STATCOM is well known as it can provide a cost-effective solution for the compensation of reactive power. A FACTS is a device based on power electronics that maintains the quality of energy by maintaining a better energy flow and controls the dynamic stability of the system by changing system parameters such as voltage, phase angle, impedance. The Distributed Static Compensator (D-STATCOM) is used in this document. A D-STATCOM is an electronic power supply device powered by VSI that is routed to the network to mitigate harmonics and other power quality problems. The performance of the D-STATCOM depends on different control algorithms that are used for the extraction of reference currents and to provide impulses to the VSI gate terminals. A review of the lierature on different types of studies on D-STATCOM was carried out. The D-STATCOM is highly effective in providing charge voltage regulation; however, maintaining the charging voltage at the nominal value has several undesired effects from the customer's point of view. With voltage of 1p.u. At the load point, DSTATCOM forces the load to always work at nominal power. The STATCOM used in the distribution systems is called DSTATCOM (Distribution-STATCOM). You can exchange both active and reactive power with the distribution system by varying the amplitude and phase angle of the converter voltage with respect to the line terminal voltage.

2.1 Principle of DSTATCOM: -

A D-STATCOM (Static Distribution Compensator), which is shown schematically in Figure 1, consists of a two-level voltage source converter (VSC), a DC storage device, a coupling transformer connected in bypass to the distribution network through a transformer coupling. The VSC converts the DC voltage in the storage device into a set of three-phase AC output voltages. These voltages are in phase and combined with
the AC system through the reactance of the coupling transformer. Proper adjustment of the phase and magnitude of the D-STATCOM output voltages allows effective control of the active and reactive power exchanges between the D-STATCOM and the AC system. Such configuration allows the device to absorb or generate controllable active and reactive energy.

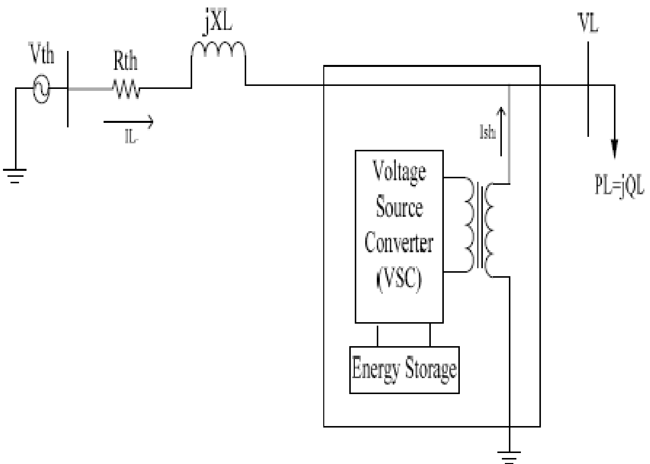


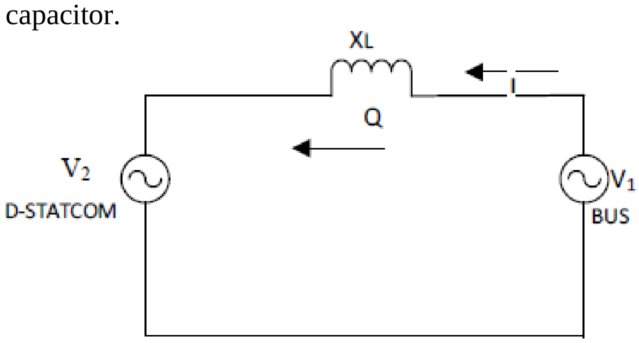
Fig. 2.1 Schematic diagram of D-STATCOM

The VSC connected in shunt with the AC system provides a multifunctional topology that can be used for three completely different purposes: 1. Voltage regulation and reactive power compensation; 2. Correction of the power factor; 3. Elimination of current harmonics. Here, said device is employed to provide continuous voltage regulation using an indirectly controlled converter. As shown in Figure 1, the current injected in Ish corrects the voltage drop by adjusting the voltage drop across the impedance Z of the system. The value of Ish can be controlled by adjusting the output voltage of the converter.

2.2 Operation of D-STATCOM

D-STATCOM is a bypass device used to regulate the system voltage when generating and absorbing reactive power. The network is connected to D-STATCOM through the transformer and D-STATCOM consists of a PWM inverter and a PWM inverter consisting of two IGBT bridges. On the DC side of the inverter, a capacitor provides DC voltage and that capacitor draws power from the grid for the load. The D-STATCOM controller provides control of the DC link voltage and the bus voltage. The main function of D-STATCOM is to synchronize the bus voltage through the generation and absorption of reactive power, as well as a static thyristor compensator (TSC). The transfer of reactive power between the network and D-STATCOM is possible through the leakage reactance of the coupling transformer through the use of a secondary voltage in phase with the primary voltage (network side). The secondary side is D-STATCOM and the primary side is the network. There are two conditions for the operation that are (also shown in Figure 1):

(1) If the bus voltage is higher than the secondary, then the D-STATCOM absorbs the reactive power as an inductor.
(2) If the bus voltage is less than the secondary voltage, then the D-STATCOM generates reactive power as a capacitor.



(a)

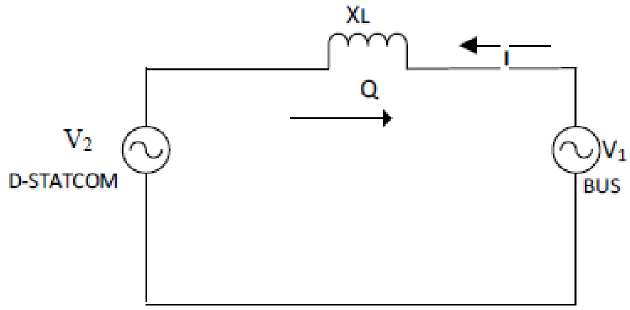


Figure 2.2 D-STATCOM operation (a) inductive operation (b) capacitive operation In steady-state condition, D-STATCOM produces a small active power to compensate for inverter losses and the bus voltage drives the inverter voltage at a small angle .

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3.1 It can be described in the following points:

The DSTATCOM is a device that is considered as a controlled source of current. The most fundamental purpose of a voltage source converter (VSI) is to generate AC voltages in sinusoidal forms with a negligible harmonic disturbance that occurs from a DC voltage source. The processes in the operation of D-STATCOM are those mentioned above: the voltage of the AC bus voltage system (Vs) first matches the voltage of the VSI voltage.

(1) The D-STATCOM acts as an inductance connected to the terminals of the AC system, when the voltage (Vc) of the VSI is lower than the voltage of the AC bus. (second)

(1) Or, otherwise, the AC system sees the DSTATOM as a capacity connected to its terminals, that is, the magnitude of the AC bus voltage <Vc

(2) There will be no reactive power exchange if both voltages Vc and the AC bus voltage are equal. The DSTATCOM supplies real power to the distribution system from its available power source or DC. This is achieved by calibrating the phase angle of the AC power system with the phase angle of the D-STATCOM. When the phase angle of the AC power system leads the VSI phase angle, the DSTATCOM absorbs the actual power of the AC system, if the phase angle of the AC power system is delayed in the VSI phase angle, the D-STATCOM supplies real power to the AC system. "(Kumar .S et al, 2011). The operating principle of a D-STATCOM can be seen in Figure 1.

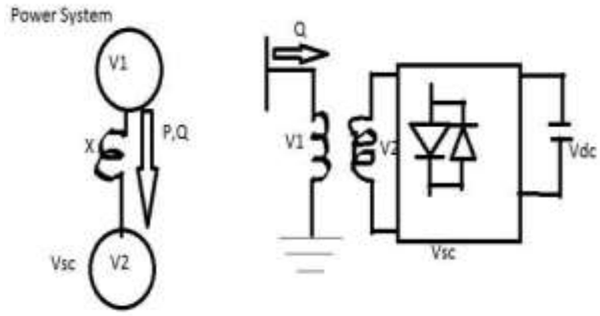


Figure3.1: Operating principle of a D-STATCOM

3.2 VOLTAGE SOURCE CONVERTER (VSC): -

A voltage source converter is an electronic power device that is connected in shunt or parallel to the system. It can generate a sinusoidal voltage with any required magnitude, frequency and phase angle. The VSC used to completely replace the voltage or inject the "missing voltage". The "missing voltage" is the difference between the rated voltage and the actual voltage.

Proper adjustment of the phase and magnitude of the D-STATCOM output voltages allows effective control of the active and reactive power exchanges between the D-STATCOM and the AC system. In addition, the converter is generally based on some type of energy storage, which will supply the converter with a DC voltage

3.3 CONTROLLER: -

The objective of the control scheme is to maintain a constant voltage magnitude at the point where a sensitive load is connected, under the perturbations of the system. The control system only measures the r.m.s voltage at the load point, that is, no reactive power measurements are required. The switching strategy of VSC is based on a sinusoidal PWM technique that offers simplicity and good response. As custom power is a relatively low power application, PWM methods offer a more flexible option than the fundamental frequency switching (FFS) methods favored in FACTS applications. In addition, the high switching frequencies can be used to improve the efficiency of the converter, without incurring significant switching losses.

3.4 Control system of a D-STATCOM

Figure 2, the composition of a control system is represented.

• The sequence of part V5 of the primary voltage of phase 3 is coordinated and combined with the phase locked circuit (PLL). The quadrature and the components of the direct axis are calculated with the help of the outputs (angle Θ = ωt) of the PLL. The shaft components are currents and voltages of 3-φ AC and are shown in Figure 2.4 as Id, Iq and Vd, Vq.

• The q and d parts of the AC positive sequence voltage are calculated with the help of measuring systems and also help regulate Vdc. The regulation loop on the outer side is for regulating voltages that consist of a DC regulator and AC voltage. I qref is known as the reference current and is the output of the AC voltage regulator (Iq = quadrature current with voltage that is needed to control reactive power flow). Id ref (where Id is the current that is in phase with the voltage that controls the active power flow) is produced by the DC voltage regulator.

• The current regulation device forms the internal circuit of current regulation. The phase and magnitude of the voltage generated by the pulse width modulator converter (V2d V2q) acquired from the reference currents Iqref and Idref produced by the voltage of the AC and DC voltage regulator (when operating in control mode) voltage). The type advance regulator helps the current controller to predict V2, which is the voltage output (V2d V2q), from measurement V1. (V1d V1q) and also find the transformer leakage reactance

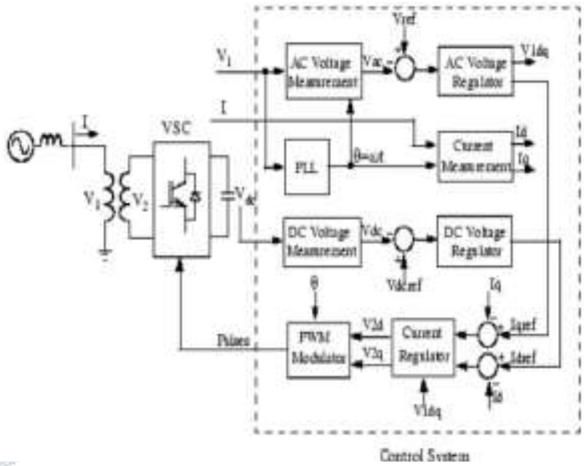


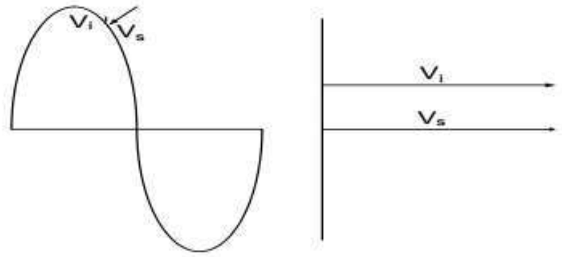
Figure 3.4: block diagram of the control system

3.5 Modes of operation of a DSTATCOM

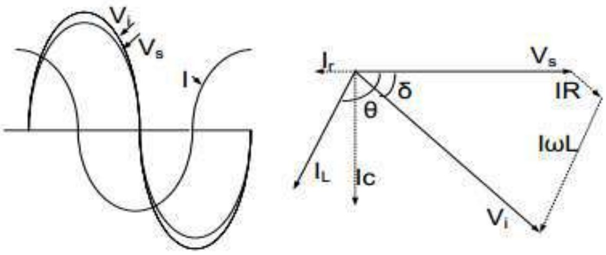
Figure 3, 4 represents three modes of operation of D-STATCOM with its output current known as I, which changes according to Vi. If Vi = Vs, then the reactive power will be 0 and also the D-STATCOM will not produce or reduce the reactive power. Whenever Vi is greater than V, the D-STATCOM will represent an inductive reactance in its terminal. The current known as I moves through the reactance of the transformer from the D-STATCOM system to the A.C system, and the equipment will generate capacitive reactive power. When Vs is more than Vi, the D-STATCOM is seen by the system as a capacitive reactance. When the flow of the current comes from the system A.C. for the D-

STATCOM it will result in the absorption of the inductive power.

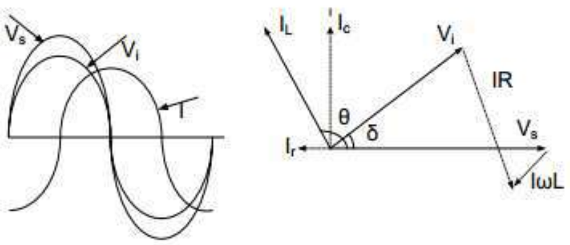
In Figure 3.5, we see that part (a) shows the No load mode (Vs = Vi), part (b) shows the Capacitive mode (Vi> Vs), part (c) shows the Inductive mode (Vi < Vs)



(a)



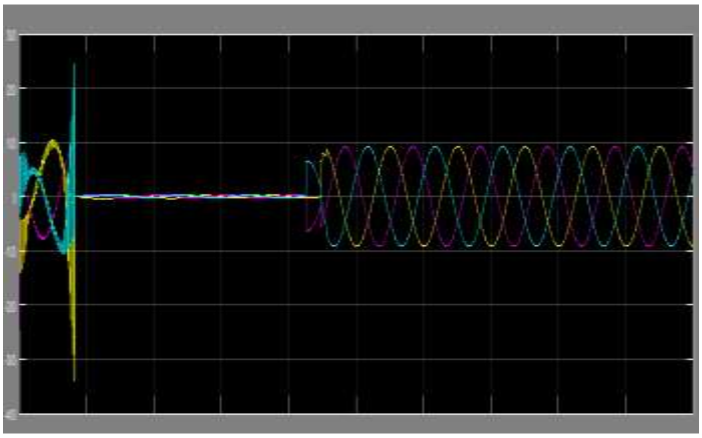
(b)

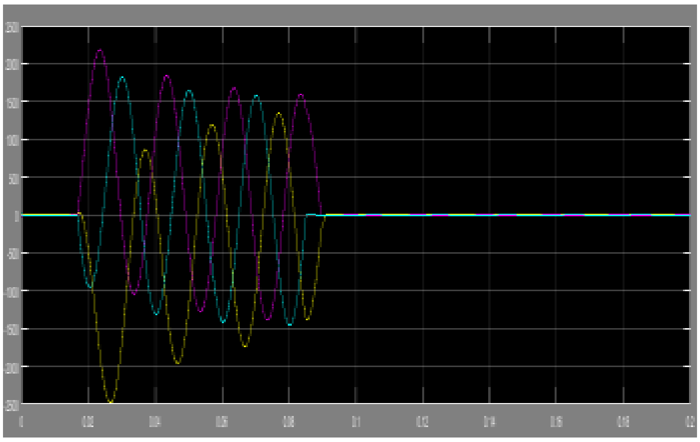


(c)

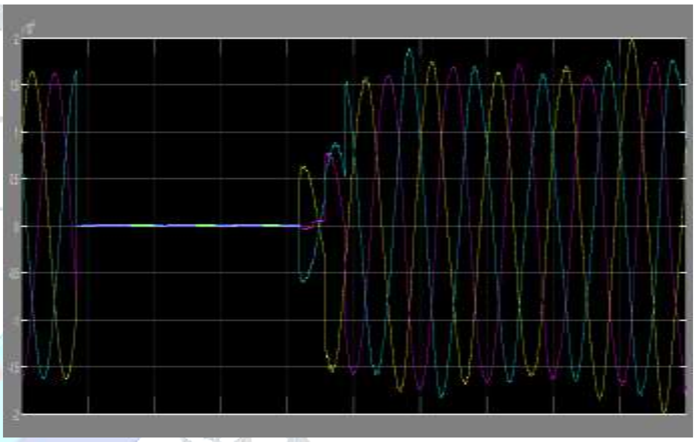
Figure 3.5: shows different modes of operation

4.1. RESULTS OF THE SIMULATION: -





4.1.2 Fig. 4.1.1 Waveform of Voltage, Current



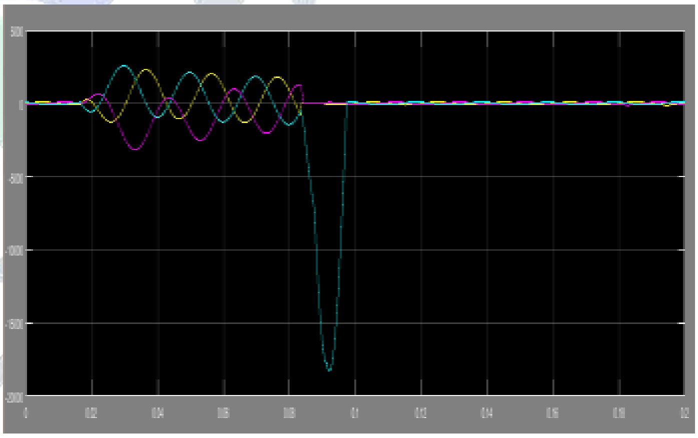


Fig. 4.1.2 Waveform of Voltage, Current

5. CONCLUSION AND FUTURE SCOPE:-

Mitigation devices based on power electronics provide a successful response to voltage drop problems. In this document, the comparison of DVR and D-STATCOM is done using the power system toolboxes MATLAB / Simulink and sim. The control of DVR and DSTATCOM is done through the use of an IP controller. The results of the simulation clearly represent the performance of the distributed static compensator and the dynamic voltage restorer for the attenuation of the voltage sag, caused by the occurrence of faults in the distribution systems. From these simulation results, we can analyze that the Dynamic Voltage Restorer offers a higher result than the distributed Static Compensator and can also reduce the harmonics that occur in the transmission line. DVR is one of the fastest and most effective flexible AC transmission devices.

5.1. APPLICATIONS OF D-STATCOM

to. It is used to provide insulation to the distributed power generation of the power system to improve the second power quality. It is also used in brushless permanent magnets and non-permanent magnet machines to improve the quality of energy. A D-STATCOM based on three-legged VSI is used in four-wire four-wire distribution systems. To improve the penetration of Photo Voltaic with the use of the D-STATCOM custom feed device.

5.2. IMPROVEMENT AND BENEFITS

The following points show the improvement and the benefits. It provides a quick response to second system disturbances. Provides smooth control of tension in a wide range of operating conditions. Dynamic voltage control is achieved in the distribution system. It provides transient stability in the system. It is the ability to control both reactive and active power (with a DC power supply available).

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