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Review of D-STATCOM using VSC & PWM in Power Quality Improvement

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ABSTRACT: Distribution Static Compensator is a shunt device. D-STATCOM is generally used to improve power quality problems in distribution network system. D-STATCOM is a device used in correction of power factor and maintaining distribution voltage and mitigating harmonics in a distributions network. D-STATCOM is also used for Grid Connected Power System network, for voltage fluctuations, voltage dips, voltage swell etc. D-STATCOM is also used in voltage profile mostly solutions apply nowadays to improved power quality of electric distribution network according to the some desire of power quality like harmonics, fluctuation and flicks of voltage, unbalance of 3-phase voltage and current frequency deviation and voltage regulation.

K**eywords:** D-STATCOM, VSC, PWM, PLL, ESS, CT

I. INTRODUCTION

Static Compensator is connected to the grid network; it is provide dynamic voltage regulation in the system disturbances and balance the reactive power of high and fluctuating industrial areas used loads. D-STATCOM has ability to the generating and absorbing variable reactive power as discrete values of fixed and switching shunt capacitors and reactors. With the continuously variable reactive power supply, the voltage at the D-STATCOM bus maybe maintained smoothly over a wide range of system operation conditions. This entails the reduction of distribution network losses and provided of reliable power quality of the electric energy or users. D-STATCOM is varying vital method used to the problem of voltage flickers. The unbalanced reactive power and causes most significant fluctuating reactive power demand, it is necessary to continuously measure or reactive power compensate rapidly changes reactive power compensation D-STATCOM uses voltage source converters(VSC) to improve productive similar to a traditional SVC while voltage flickers mitigation due to vary fast response time. Similar to SVC and the D-STATCOM can be used to restore voltage and current. For the Improved Grid Voltage Control, and to voltage fluctuations generated by the loads.

A. Benefits

- Increased Power Transfer Capability.
- Improved Grid Voltage Stability.
- Improved Grid Voltage Control.
- Improved Power Factor.
- Eliminated Flicker.
- Harmonic Filtering.
- Voltage Balancing.
- Power Factor Correction
- Furnace/mill Process Productivity Improvement
- Additional flexibility in Grid Operation

B. Other applications

- Power Quality (Flicker Mitigation, Voltage Balancing)
- Grid Voltage support

II. BASIC PRINCIPLE OF D-STATCOM

A. D-STATCOM

A D-STATCOM is a controlled reactive power, which includes a Voltage Source inverter and a DC link capacitor C connected in shunt capable of generating and absorbing reactive power. The Operating principles of a D-STATCOM are based on the power electronic device.

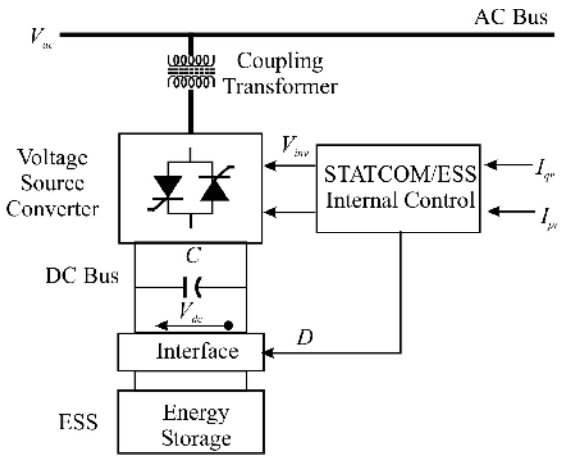


Fig. 1. Basic structure of D-STATCOM.

The AC terminals of the VSC are connected to the Point of Common Coupling (PCC) through an inductance, which could be a filter inductance or the leakage inductance of the Coupling transformer, as shown in figure 1. The DC side of the converter is connected to a DC capacitor, which is carried the input ripple current of the converter and is the Reactive energy storage element. This capacitor could be charged by a battery source or (ESS), or could be recharged by the converter itself. If the output voltage of the VSC is equal to the AC terminal voltage, no reactive power is delivered to the system. If the output voltage is greater than the AC Terminal voltage, the D-STATCOM is in the capacitive mode of operation. The quantity of reactive power flow is proportional to the difference in the two voltages. It is Correction cannot be achieved simultaneously. For a D-STATCOM used for voltage regulation at the PCC, the compensation should be such that the supply currents should lead the supply voltages; whereas, for power factor Correction, the supply current should be in phase with the supply voltages. The control strategies studied in this paper are applied with a view to studying the performance of a D-STATCOM for power factor correction and harmonic mitigation.

B. Basic Configuration and Operation of D-STATCOM

The D-STATCOM is a three-phase and shunt connected power electronics based device. It is connected near the load at the distribution systems. The major components of a D-STATCOM are shown in Fig. 2. It consists of a dc capacitor, three-phase inverter (IGBT, thyristor) module, ac filter, coupling transformer and a control strategy. The basic electronic block of the D-STATCOM is the voltage-sourced inverter that converts an input dc voltage into a three-phase output voltage at fundamental frequency

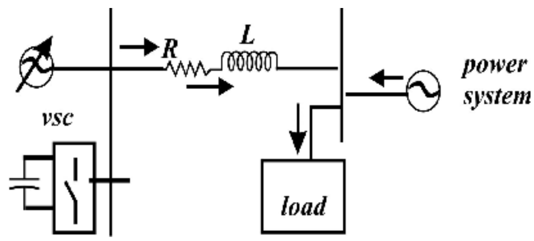
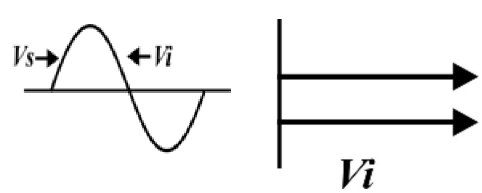


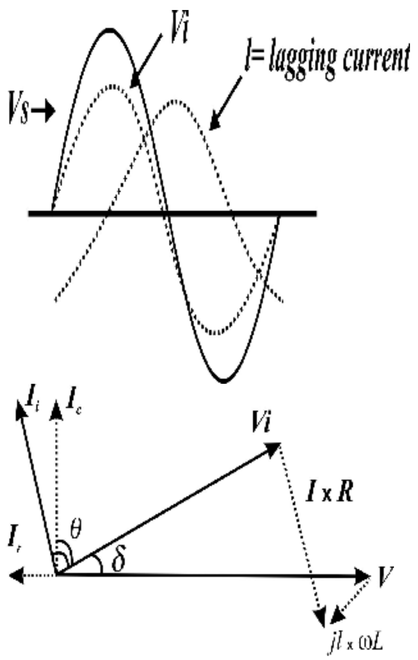
Fig. 2. Basic Building Blocks of the D-STATCOM.

The D-STACOM employs an inverter to convert the DC link voltage Vdc on the capacitor to a voltage source of adjustable magnitude and phase. Therefore the D-STATCOM can be treated as a voltage-controlled source. The D-STATCOM can also be seen as a current-controlled source Figure 2 shows the inductance L and Resistance R Which represent the equivalent circuit elements o f the step-down Transformer and the inverter will is the main component of the D-STATCOM. The voltage VI is the effective output voltage of the D-STATCOM and d is the power angle. The reactive power output of the D-STATCOM inductive or capacitive depending can be either on the operation mode of the D-STATCOM. The construction controller of the D-STATCOM is used to operate the inverter in such a way that the phase angle between the inverter voltage and the line voltage is dynamically adjusted so that the D-STATCOM generates or absorbs the desired VAR at the point of connection. The phase of the output voltage of the thyristor-based inverter, Vi, is controlled in the same way as the distribution system voltage, Vs.

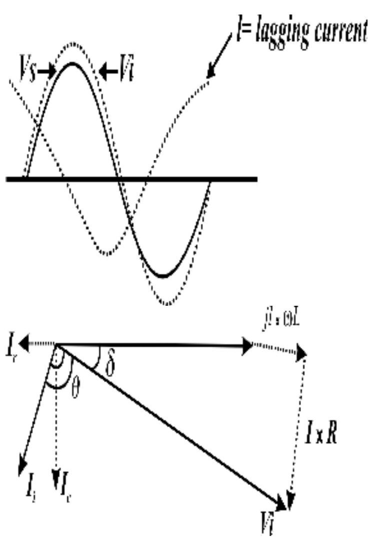
III. OPERATION MODES OF D- STATCOM



(a) No lode mode Vs = Vi If Vs = Vi then I = 0.



(b) Inductive mode Vs > Vi, If Vs > Vi then I is apper to be leading current since the magnitude of the current can be controlled continuously by adjustint Vi,the D-STATCOM will function as a capacitive reactance continuously controllable.



(c) Capacitive mode Vs < Vi. If Vi < Vs then I apper to be lagging current this mode. The D-STATCOM will function as a reactor whose inductive reactance is contineously controllable.

Fig. 3. L, C Phaser Blocks of the D-STATCOM.

A. Commonly Used Solutions to Improve Electric Power Quality

There is improving voltage deviation of electrical power system. The most effective solution is reactive power compensation, as Static Var Compensator (SVC) - divides Thyristor Controlled Reactors (TCR) and Thyristor Switched Capacitors (TSC), Static Var Generator (SVG), Active Power Factor Correction Circuit (APFCC), Voltage Source Converter (VSC), Pulse-With Modulation (PWM). A large number of solutions have been selected to solve the problem of fluctuations and flicks of voltage and almost all these solutions simultaneously have the function of harmonic suppression.

B. Voltage Source Converter (VSC)

A voltage source converter is very significant part of power electronics device. It can be generate sinusoidal voltage, frequency, phase angle and required magnitude. It is also used in Adjustable-speed drive. Voltage source converter is most importantly used to mitigate voltage dips, voltage swell. The VSC is used to completely replace the voltage or to inject the missing voltage. The missing voltage is the difference in actual voltage and the nominal voltage. The VSC is generally based on few kinds of energy storage device. It will supply the convert with a DC voltage. The VSC solid-state electronics operation in the converters worked in switched to get the desire output voltage. The voltage source converter mostly used in voltage flicker and current harmonics in power quality improvement. The converter rating, series-connected IGBT valve are arranged in three-phase two-level or three-level Bridge. IGBT valves used in place of diodes for neutral point clamping and each IGBT position is individually controlling or monitoring with fiber optics and embedded with integrated anti-parallel, free-wheeling diodes. The rating of each IGBT voltage of 2.5kv or current up to 1500A. PWM switching frequencies for the VSC rated range 1to2 kHz. PWM frequencies range depending on the converter topology, frequency and application. The main aim is to improved power quality in object with D-STSTCOM ready to providing quickly to subsequent voltage disturbances. The voltage reference in limit and works with a Delay of typically 2 to 4 min. and the performance output of +1.2 to -1.2 MVAR. And rated output of 0.5 MVAR per min. The objective ensure with voltage flicker can be reduced by 48% to 50%. The D-STATCOM based on control to mitigate voltage dips, voltage flicker is presented with the use kalman filter.

IV. CONCLUSION

The performance of D-STSTCOM using voltage-sourced converter (VSC) with Pulse width modulation (PWM) provides a faster control in given object. The proposed method is employed to control directly the switching patterns of power electronic switches of the D-STATCOM. The compensator inject power is proportional to the network disturbance to improve the voltage profile. The voltage regulation in the distribution feeder is improved by connecting shunt compensator. Finally, D-STATCOM performance is power factor correction, voltage regulation, harmonic elimination and load balancing with the liner and non-liner loads.

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