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Compensation Of Reactive Power And To Reduce Harmonics By Using STATCOM

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Abstract

Continuous demand in power because of that load increase in power system. Demand increase with respect to the power quality is reduced. Voltage stability problems occurs in heavily loaded system. This paper deals with the performance, analysis and operating principal of FACTS device which is known as STATCOM. Static Synchronous Compensator (STATCOM) inject only reactive power and reduce harmonic distortion. STATCOM in capacitive mode inject reactive power and in inductive mode absorb reactive power.

Keywards: *voltage source converter ; statcom; PI controller*

1. Introduction

Power generation and transmission is a complex process in power system. One of the main component to form a major part is the reactive power in the system. Two types of load in a system. One is Linear load and other one is non linear load. In linear load drop of voltage is created and non linear load harmonics voltage produced. Power quality can be improved by reducing harmonics distortion in the system. To improve the performance of ac power system we need reactive power to manage the system in efficient way and this is known as reactive power compensation. To operate the power system in flexible manner for that a controlling device is required which is known as Flexible AC Transmission system (FACTS) technology.

In recent year, capacitor bank is replaced by STATCOM. STATCOM known as Static Synchronous Compensator. STATCOM has number of advantage over capacitor bank. Statcom is shunt connected to the AC system. In inductive mode statcom absorb reactive power to the ac system. In capacitive mode statcom inject reactive power into the ac system and the stability of the power system is increase. It is used for voltage compensation at receiving end of transmission line. A shunt connected voltage source converter coupling to inductor connected to the ac system. There are two aspects in power system to the problem of reactive power compensation: Load compensation and voltage support.

Load compensation consist of improvement in power factor, better voltage regulation and balancing real power drawn from the system. Voltage support consist of reduction of voltage fluctuation at a given terminal in a transmission line. The statcom regulates the voltage magnitude at its terminal by controlling the amount of reactive power injected into or absorbed from the power system. When the system voltage is low, the STATCOM generate reactive power (STATCOM capacitive). When the system voltage is high, the STATCOM absorb reactive power (STATCOM inductive). So the shunt controller is therefore a good way to control voltage in and around the point of connection through injection of reactive current (lagging or leading) alone or a combination of active and reactive current for a more effective voltage control and damping of voltage dynamics. AC power sources generates the reactive power. In the first quarter part of AC cycle, capacitor or reactor stores the reactive power (var) and in the next quarter cycle, the reactive power gets returned back to the AC power source . Thus the reactive power moves back-and-forth between AC source and capacitor or reactor at a frequency double the rated frequency. So in order to prevent to-and-fro movement of reactive power between the load and source it has to be controlled. Also to adjust the power factor of the system and to maintain the voltage stability we need to compensate reactive power. Due to reactive power compensation techniques the efficiency of transmission increases. Also it regulates the steady state and temporary over voltages and therefore the disastrous blackouts can be avoided. The present paper suggest control the phase angle control and voltage control . By controlling the parameter harmonic distortion can

be reduced and the power quality is improved. From the beginning-to-end, harmonic distorted current are injected into power, power coupling capacitor (PCC), which occured by the non-linear loads. The voltage harmonics produce, when the non-sinusoidal current passes from different impedances in power system the power system devices and component are affected due to propagation of voltage in power system.

2. Operational Principle Of STATCOM

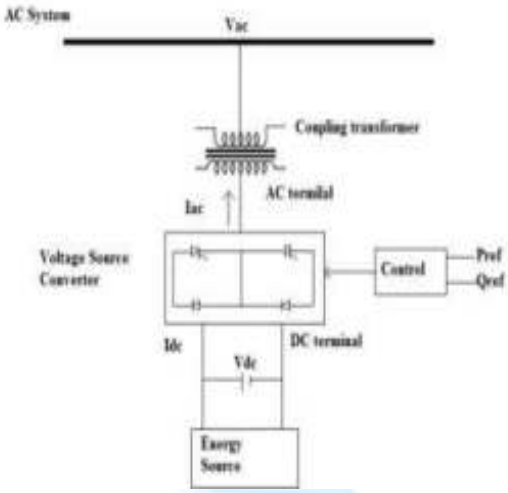

Fig.1 Schematic model of STATCOM

STATCOM is a static synchronous generator operated as a shunt-connected static var compensator whose capacitive or inductive output current can be controlled independent of the ac system voltage. STATCOM inject only reactive power into the ac system. It provides voltage support by generating or absorbing reactive power into the system. Fig .1 shows the schematic model of statcom.Vdc is the dc voltage of statcom. Iac is the statcom output current. Is is the source current of ac system. Pref is the active reference power. Qref is the reactive reference power. The STATCOM generates a balanced 3-phase voltage whose magnitude and phase angle can be adjusted by using IGBT switch or you can say that back-to-back scr thyristor. The statcom is a composed of voltage source conveter with a dc capacitor ,coupled inductor , signal generation and control circuit. In steady state condition voltage is in phase means reactive power flow to the system. When the system voltage is greater than the statcom voltage at this condition reactive power flow from ac system to the statcom and statcom act as inductive mode. When the system voltage is less than the statcom voltage at this condition reactive power flow from statcom to the ac system and statcom act as capacitive mode. When the ac system voltage and the statacom voltage both are same in this time reactive power exchange is zero.

Power factor is the ratio of active power to the apparent power:

$$\cos\theta = \frac{P}{S} \qquad (1)$$

Where,

θ = Angle between voltage and current
P = Active power
S = Apparent power

In the case of perfectly sinusoidal waveform, P, Q and S can be expressed as vector that form a vector triangle such that,

$$S^2 = P^2 + Q^2 \qquad (2)$$

If $\theta = 0$, means $\cos\theta = 1$. From this we can say that power factor is unity and the power quality is improved.

If the reactive power exchange is zero. Then the amount of reactive power can be given as,

$$Q = V1\ \frac{(V1-V2)}{X} \qquad (3)$$

3. Simulation Of STATCOM

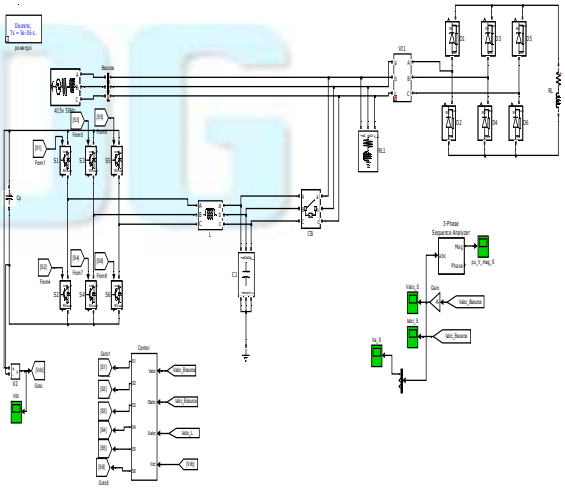

Fig.2. Simulation for statcom in a grid connected system

Fig 2. show the working of statcom .In this statcom inject reactive power into the ac system for power

factor improvement. Harmonics can be reduced by shunt connected statcom to the ac system.

4. Result

Fig. 3 shows the after statcom connected source voltage waveform is sinusoidal.

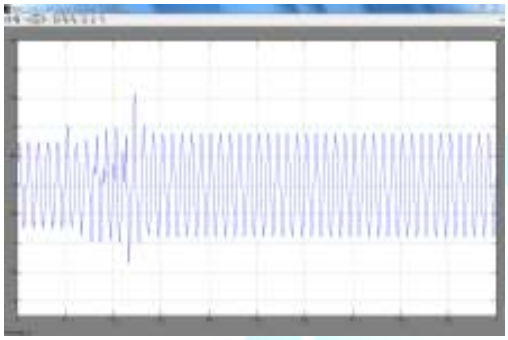

Fig. 3. Phase a source voltage

Fig.4. Shows Constatnt dc link voltage obtain if initial voltage set at constant voltage .

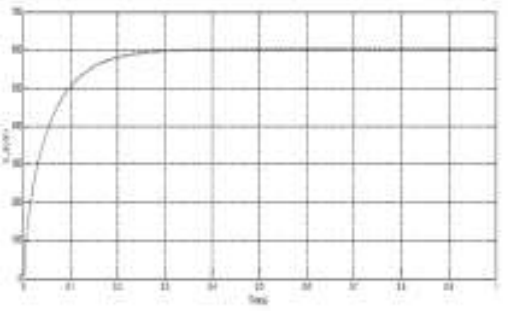

Fig 4. Waveform of constant dc link voltage

Fig 5. Shows the after statcom connected voltage drop is reduced in three phase source voltage.

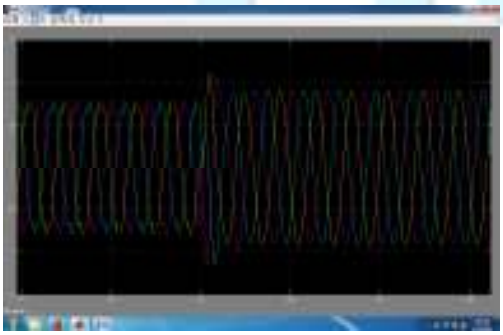

Fig 5. Three phase source voltage statcom connected

Fig.6.shows reactive power into the syatem because of that reactive power are in negative direction. Blue line shows active power and green line shows reactive power.

Fig.6. Waveform of active and reactive power

5.Conclusion

STATCOM is a static synchronous compensator to improve the power quality and harmonics can be reduced. When the system voltage is greater than the statcom voltage at the time statcom absorb reactive power and act as inductive mode. When the system voltage is less than the statcom voltage at the time statcom inject reactive power into the system and statcom act as capacitive mode. Non linear load produce distortion which can be reduced by using statcom shunt connected to the ac system.

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