

Power Factor Improved and Reactive Power Compensation by using STATCOM

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Abstract

In recent year power quality is reduced due to harmonics as well as demand of power generation so for that compensation of reactive power is needed. This paper deals with reactive power compensation techniques. In this paper linear load produce voltage drop and non-linear load produce harmonics is reduced by using STATCOM.

Keywords - voltage source converter; Statcom; PI controller.

I. INTRODUCTION

Now-a-days power system demand is increased day by day with respect to the power quality is reduced. Power quality is reduced due to non-linear load. In a power system two types of load. One is linear load and another one is non linear load. Linear load produce voltage drop in the system and non linear produce harmonic distortion in the system. Voltage stability is affected by reactive power limit of the system. Voltage collapse at the time there are need of reactive power which can be supplied through the FACTS devices. Voltage stability has become an increasingly important phenomenon in the operation and planning of the present day power systems. Load increasing can lead to excessive demand of reactive power, system will show voltage instability. If there are not sufficient reactive power available at the time excessive demand reactive power can lead to voltage collapse. Voltage sag/swell and power interruptions are the most important power quality problems affecting industrial and large commercial customers. Three phase fault much creating a problem in power system. In the past for power factor improvement capacitor bank is used in a power system but the cost of capacitor is increased. In modern power system capacitor bank can be replaced by shunt connected FACTS device which is nothing but the STATCOM. Recent development of power electronics introduces the use of flexible ac transmission systems (FACTS) controllers in power systems. Shunt fact devices play an important role in the power system for injecting reactive power into the ac system. Static synchronous compensator (STATCOM) is a member of FACTS family that is connected in shunt with the system. STATCOM is to support bus voltage for injecting or absorbing the reactive power. Reactive power

compensation improve the voltage stability and power factor improved. Voltage sags lasting only 4-5 cycles can cause a wide range of sensitive customer equipment to drop out. BY using STATCOM is power quality problems can be minimized.

II. STATIC SYNCHRONOUS COMPENSATOR (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. A STATCOM is a controlled reactive power source. It provides voltage support by generating or absorbing capacitor banks. It regulates the voltage at its terminals by compensating the amount of reactive power in or out from the power system.

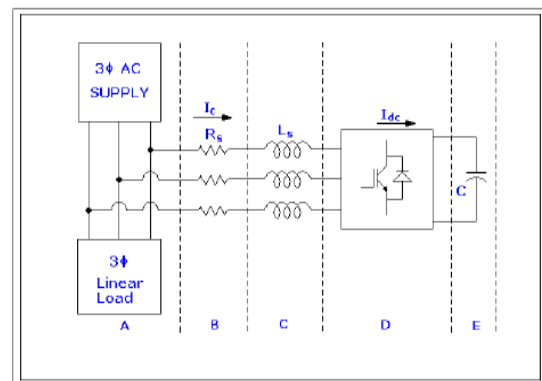


Fig.1: schematic diagram of STATCOM

A. Operating principle

STATCOM is a shunt connected device which inject reactive power into the system at the time of voltage collapse. STATCOM compose of dc voltage connected in parallel with voltage source inverter and inverter is shunt connected to the ac system through coupling transformer. I_c is the capacitive current from the source. I_{dc} is the dc current from the statcom. R_s is the source resistance and L_s is the source inductance. When the ac system voltage is high . It supplies reactive power to the statcom (statcom inductive mode). In this condition voltage are in steady state. When the system voltage collapse transient occur in the system. Statcom inject reactive power into the ac system when the system voltage is low (statcom capcitive mode). Statcom inject reactive power which is helpful for increasing

the power factor and voltage stability. Statcom inject or absorb reactive power into the ac system. When the non-linear load occurred in the system harmonic distortion produced in the power system. Harmonic distortion can be reduced by injecting reactive power flow to the ac system.

B. Equation

In an inductive circuit , we know the instantaneous power to be :

$$p = V_{max} I_{max} \cos \omega t \cos(\omega t - \theta)$$

The instantaneous reactive power is given by:

$$q = \frac{V_{max} I_{max}}{2} \sin \theta \sin 2\omega t$$

From here we can conclude that the instantaneous reactive power pulsates at twice the system frequency and its average value is zero and the maximum instantaneous reactive power is given by:

$$Q = |V| |I| \sin \theta$$

The zero average does not necessarily mean that no energy is flowing, but the actual amount that is flowing for half a cycle in one direction , is coming back in the next half cycle.

III. SIMULATION OF STATCOM

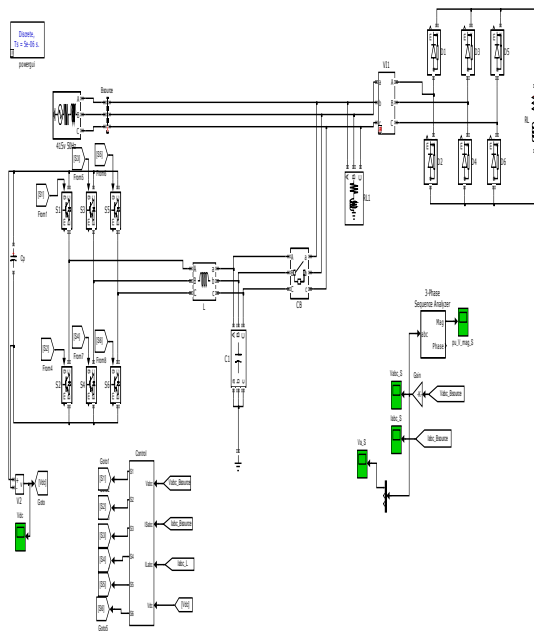


Fig 2. Statcom simulation

Fig.2 shows simulation of statcom.Voltage collapse at the time statcom inject reactive power to the ac system.

IV. RESULT

In a three phase source voltage after statcom connected waveform obtain are in sinusoidal. Stability of the source voltage increased by using statcom as shown in Fig. 3

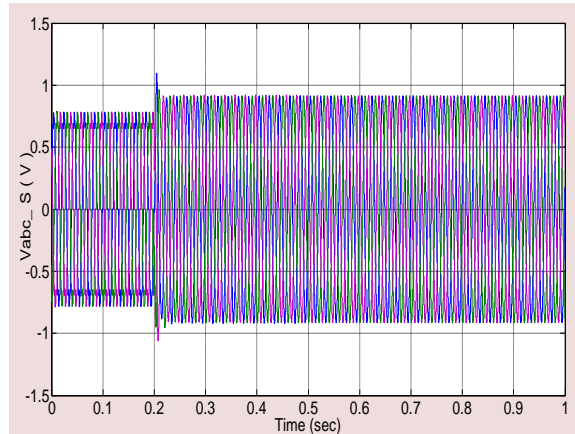


Fig. 3. Threes phase source voltage

Harmonics reduced in the per unit source voltage magnitude after the statcom conneted as shown in Fig.4.

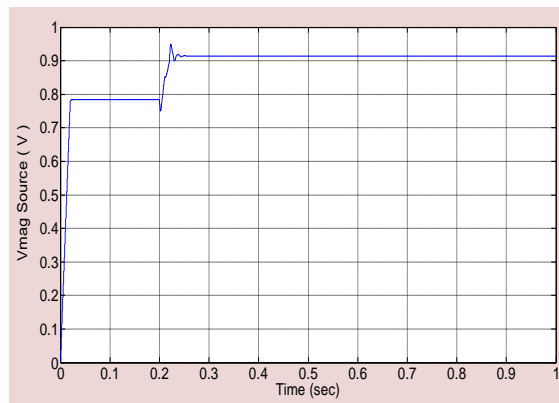


Fig.4. Per unit voltage magnitude source

Blue line shows the active power in the power system. When the system voltage is low in this condition reactive power inject through statcom. Pink line shows the reactive power inject into the system .

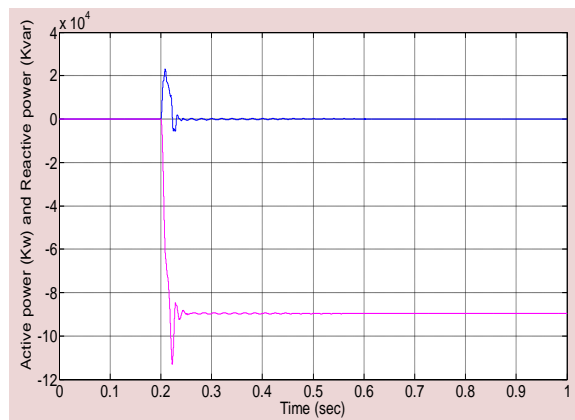


Fig.5. Active power and Reactive power

V. CONCLUSION

When the system voltage is low, statcom act as inductive mode and reactive power flow to the ac system. When the system voltage is high, statcom act as capacitive mode and reactive power flow from statcom to the ac system.

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