



ISSN 2278 – 0211 (Online)

Compensation of Reactive Power and Control of Voltage Profile by Tuned Statcom

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Abstract:

In electrical power system, the power system stability is its capability to recover the steady state condition after some deviation. It is essential to maintain a stable and secure operation of a electrical power system. The FACTS device are used in improve the power system stability and increasing transmission capability. In this paper a regulating shunt fact device- STATCOM is used for reactive power compensation and control voltage profile. The MATLAB simulation is used for this purpose.

Key words: Power system Stability, STATCOM, Reactive power compensation, MATLAB simulation

1. Introduction

Transmission networks of modern power systems are becoming increasingly stressed because of growing demand and restrictions on building new lines. Power Generation and Transmission is a complex process, requiring the working of many components of the power system in tandem to maximize the output. The reactive power is main component of the electrical power system. It is needed to maintain the voltage to deliver the active power through the transmission lines. Loads like motor loads and other loads require reactive power for their operation. The development and use of FACTS controllers in power transmission systems has led to many applications of these controllers to improve the stability of power networks. To enhance the compensation of power systems, we require to be guided by this reactive power in an efficient way and this is known as reactive power compensation.

Load compensation consists of enhancement in power factor, balancing of active power drawn from the supply, better voltage regulation. Voltage support consists of diminution of voltage fluctuation at a given terminal of the transmission line. FACTS Controllers are divided into four categories [1]-[4]:

- Series FACTS Controllers
- Shunt FACTS Controllers
- Combined Series-Series FACTS Controllers
- (Combined Series-Shunt FACTS Controllers)

Two types of compensation can be used: series and shunt compensation.

These modify the parameters of the system to give enhanced VAR compensation. In recent years, static VAR compensators like the STATCOM have been developed. This allows an increase in transfer of complex power through a transmission line, and much better stability by the adjustment of parameters that govern the power system i.e., voltage, current, phase angle, frequency and impedance[7],[9].

The primary objectives of a shunt compensator in a distribution system are as follows:

- Compensation of poor load power factor so that the current drawn from the source will have a nearly unity power factor.
- Suppression of harmonics in loads so that the current drawn from source is nearly Sinusoidal.
- Voltage regulation for the loads that cause fluctuations in the supply voltage.

In this paper section1 gives the introduction of FACTS device and an idea of reactive power comensation.section2 is helpful to understand STATCOM construction and working. Section 3shows the results of the proposed simulation and the last section includes Result, Conclusion and References

2. Statcom: Construction and Working

According to IEEE a STATCOM can be defined as 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 static compensator that it is connected to the grid in shunt for the compensation of reactive power. It is capable to inject or absorb reactive power in a controlled way regardless of the grid voltage. The STATCOM is voltage source converter that from a given input of d.c voltage produces a set of 3-phase output voltages each in phase coupled to the corresponding a.c system voltage through or regulating small reactance. The exchange of reactive power between the converter and the ac system can

Be controlled by varying the amplitude of 3-phase output voltage, E_s of the converter as shown in fig.1. If the $E_s > E_t$ then current flows through the reactance from the converter to the a.c system and converter generates capacitive reactive power for the a.c system. If $E_s < E_t$ then current flows from the a.c system to the converter, the absorbs inductive-reactive power from the system. Adjusting the phase shift between E_s & E_t can similarly control real power exchange between the converter and the a.c system.[10].

Typical applications of STATCOM are:

- Effective voltage regulation and control
- Reduction of temporary over voltages
- Damping of power system oscillations
- Enhancement of steady-state power transfer capacity.
- Enhancement of transient stability margin.
- Control of Flicker.
- Improvement in Power quality

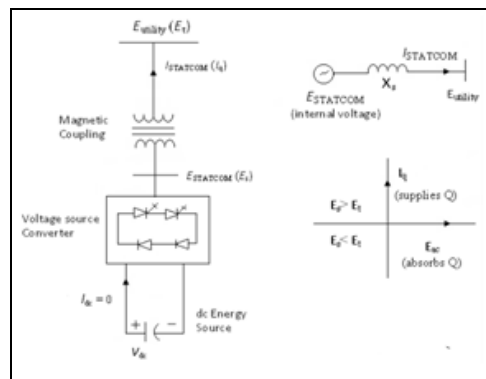


Figure 1: line diagram of STATCOM

3. Results and Simulation

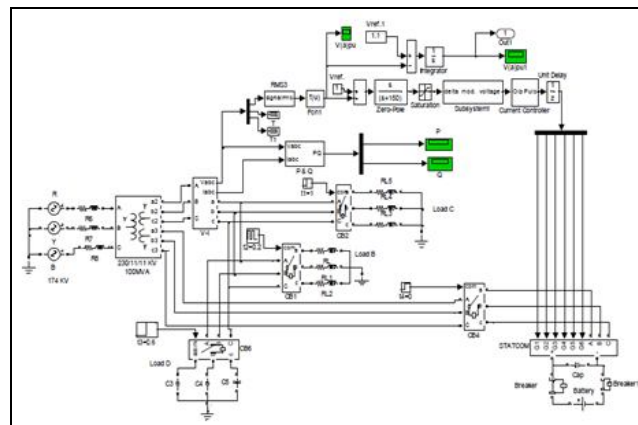


Figure 2: MATLAB simulation modal of tuned statcom

The simulation modal is shown in fig.2. And results areas follow:

3.1. When Statcom Is Not Connected

The circuit breaker4 is used to disconnect the statcom .at 0.1sec, on RL load is joined by CB1.The simulation results is shown in fig.3. It is act of noticing that the system voltage level is to let fall from its existing value of 1.0 pu to 0.7 pu and at 0.3 sec .The circuit breaker3 is connected to a capacitor bank load at 0.6 sec and it is determined that the system voltage level is going to expand. The voltage level is inclined to 1.2 pu from its existing value. The variation in reactive power without STATCOM is shown in fig.5 It is

concluded that there are two way to connected first one when the addition of R1 load at 0.1 and .2 sec then there are the absorption of reactive power is done and second one when addition of capacitive load at 0.6 sec then there are a generation of reactive power is done. On the other hand we can say that the Q is negative at the condition of absorption of reactive power and Q is positive at the condition of generation of reactive power.

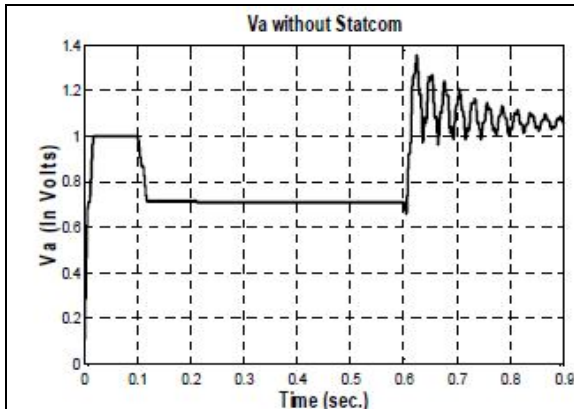


Figure 3: Represent of Voltage t without compensation

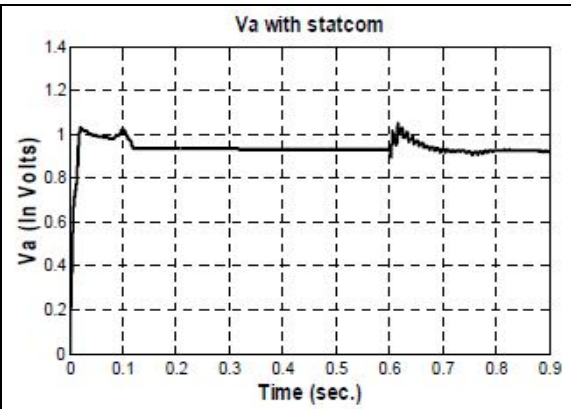


Figure 4: Represent of Voltage with compensation

3.2. When Statcom Is Connected

In this condition, simulation is done when STATCOM is connected with circuit breaker4. The reactive power compensation and voltage profile is shown in fig 4 and 6. From fig 4, it is seen that the hardness of voltage drop as measured due to addition of RL load at 0.1sec. and decreased at 0.2 sec. It is illustrated that the system profile is keep going in between 0.9 to 0.95 pu. From fig 6 It is noticing that absorption of reactive power from 0.1 sec to 0.6 sec

4. Conclusion

This paper explains in detail the principle of STATCOM. STATCOM system can be used for compensation of reactive power in the different load condition. and under misrepresented conditions of mains voltage, it is more reliable and comfortable.

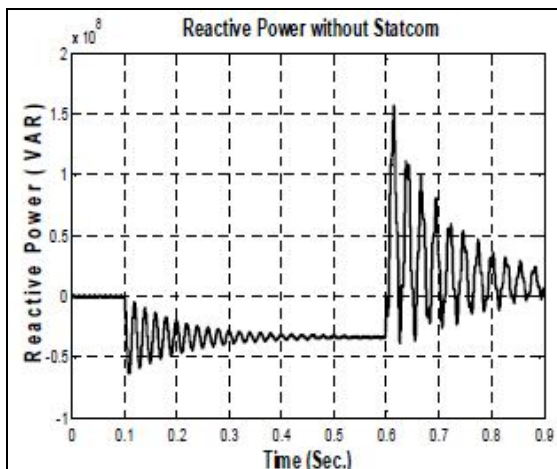


Figure 5: Represent of reactive power without compensation

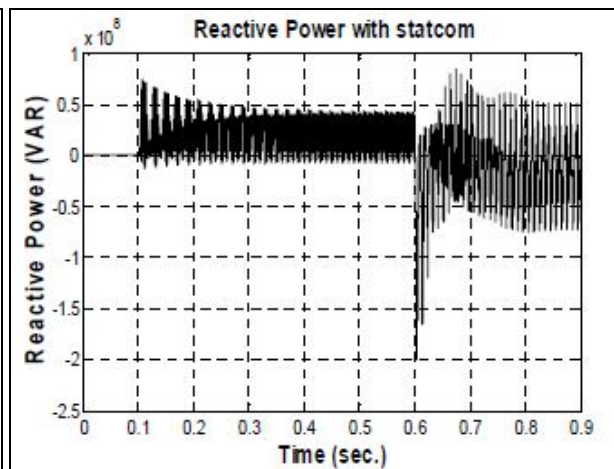


Figure 6: Represent of reactive power with statcom

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