Usage of Static VAR Compensator to Achieve the Voltage Stability during Transmission and Distribution

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Abstract— Transmission and distribution is a very important aspect concerned with the operation of industrial machines and home appliances. Only with the proper transmission and distribution, industrial machines and home appliances can work efficiently. Now a days, because of technology up gradation industrial machines and home appliances are frequently used over long period of time. Because of these loads voltage stability will be disturbed during the transmission and distribution. Voltage stability is nothing but a proper ratio of active power with respect to the reactive power. As load varies from no load to full load, reactive power will also vary according to the load. Once the reactive power increases or decreases from its acceptance value, further it directly affects the voltage stability of the transmission and distribution. In turn which affects the performance of the load. to overcome this problem usage of above proposed system ie static VAR compensator(SVC) is the best solution.

Key words: SVC, FACTs, Thyristor, firing angle

I. INTRODUCTION

As the technology up gradation takes place the electric power system must up grade along with the technology up gradation. Power system should possess accuracy, fast response, reliability and flexibility in the field of power generation, transmission distribution and consumption. Flexible alternating current transmission system (FACTS) are the up graded system capable enough to alter phase angle and voltage in the power system according to load variation ie from no load to full load.

The response of the FACTS controller are fast enough to maintain steady state flow control along with the power system stability enhancement. Static VAR compensator (SVC) is a best controller among several controller available in FACTS. The SVC is one kind of controller which avoids the voltage depression over a significant period of time. As SVC optimizes the reactive power with in acceptance value, hence it is possible to obtain dampened power swing and reduced power loss in the system. However the main objective of this paper is to maximize the voltage stability with the help of static VAR compensator (SVC)

II. SCHEMATIC REPRESENTATION OF STATIC VAR

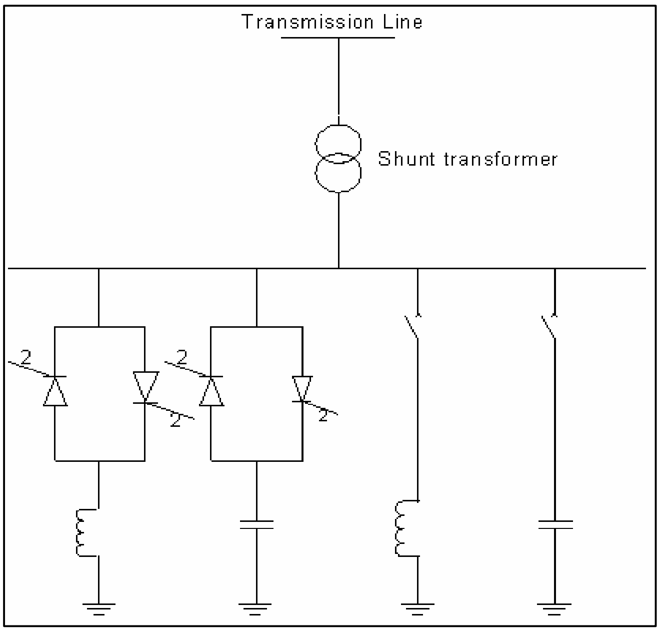

Fig. 1: schematic diagram of SVC

To get a proper impact of SVC over a power system, a appropriate model is vital. SVC is completely constructed with the reactors and capacitors which are operated by thyristor in term which are connected parallel with the capacitor bank. The whole arrangement connected in shunt with the transmission line through a shunt transformer as shown in the fig 2(1), fig 2(2) shows the equivalent circuit of SVC.

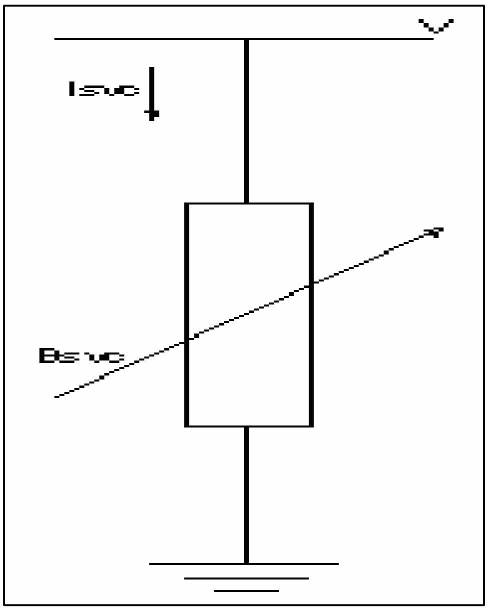

Fig. 2: Equivalent Circuit of SVC

The B(svc) is employed to get automatic voltage control. Since the SVC can be considered as shunt connected variable susceptance it will be easy to achieve fast and automatic response. The equivalent susceptance

B(eq) is calculated with the help of firing angle α of the thyristor, which is usually defined as the measurement of delay angle from the peak of the capacitor voltage with respect to the firing instant.

Demand for reactive power always varies at the bus bar. However the reactive power is a function of square of the bus voltage. Hence as load increases voltage decreases, which in turn reactive power will also decreases. The main advantage of SVC system is that it can absorb the extra or unwanted reactive power from the supply line at the same time it can supply reactive power if it is needed by the supply line. This character of SVC controlled by the firing angle of the thyristor. By controlling the thyristor firing angle we can control the bus voltage magnitude.

III. SCHEMATIC REPRESENTATION OF 230KV POWER SYSTEM WITH SVC CONNECTED AT BUS NO.3

From the fig 3(1) we can make out that a 230kv power network is connected with SVC system at the network is connected with SVC system at the bus no. 3. The power system consists of generator which generates 16kv which in turn stepped up by a transformer to 230kv. This 230kv voltage transmitted through transmission line to bus no.3. the parameters of the generator, SVC and transformers are considered according to the IEEE standard model.

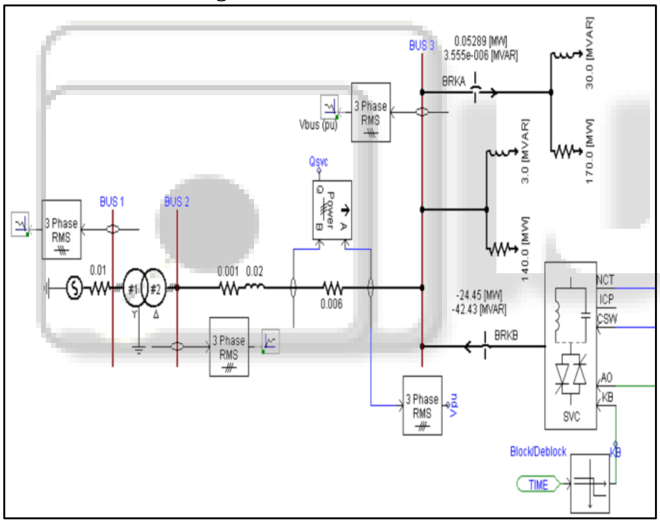

Fig. 3: a 230kV power system with SVC connected at bus3

IV. RESULTS AND DISCUSSIONS

When generator is operated at the position bus no.3 as shown in the fig 3(1) at 4MW and 3 M var, voltage is fixed approximately 230kv. But, when the load is increased gradually to 150 MW and 30M var, voltage drop takes place. Approximately the voltage dropped to 229.151kv. By this we can decide as the load increases correspondingly voltage drop will also increases at bus no.3.

Loads		Voltages in kV	
MW	MVar	Without SVC	With SVC
4	3	229.977	230.350
150	30	229.151	230.618
155	35	229.014	232.048
160	40	228.877	229.065
260	60	228.286	231.154

Table 1: Load variation with and without SVC

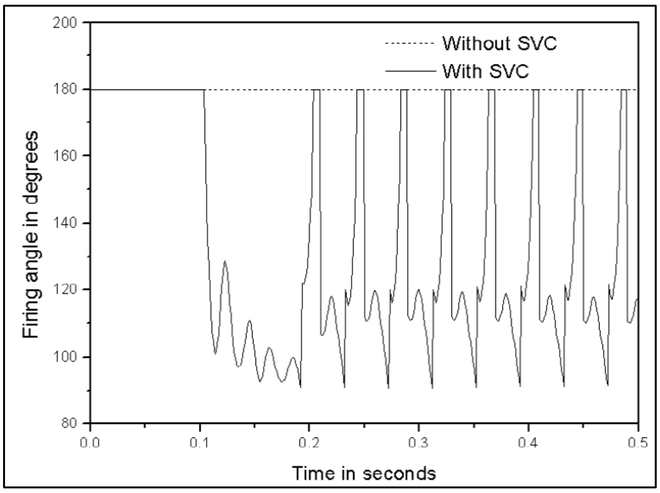

Fig. 4: The firing angle at the load with P = 4MW and Q = 3MVars

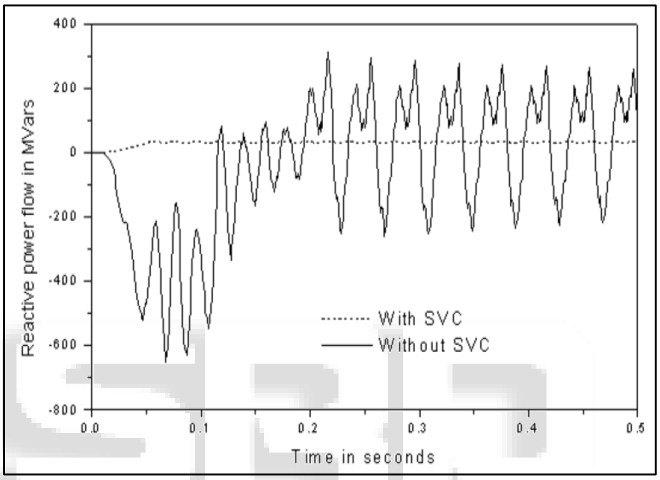

Fig. 5: Reactive power flow at the load with P = 4MW and Q = 3MVars

Hence from the figure and by analyzing the graph, it is very much clear that without SVC at bus no.3 as load increases the voltage decreases. It is also observed that after installation of SVC the voltage magnitude at bus no.3 maintained averagely around 230.65kv even after change in load values.

If firing angle is 90˚= Inductor is active, SVC will be in on mode

If firing angle is 180˚= Inductor is deactive, SVC will be in off mode

Basic operation strategy is to keep the transmission bus voltage with in certain narrow limits defined by a firing angle α limits(90˚< α < 180˚)

V. ADVANTAGES

- Improved tranmission capability
- Improved system stability and availabilty
- Enhancement in power quality
- Transmission losses will be minimum
- Hormonics are reduced to a great extent with the help of SVC
- Imbalance in the system supply can over come by installation of SVC

VI. CONCLUSION

Due the presence of low inertia in the load network or load line may suffer by voltage instability along with severe disturbances. Because of these issues mentioned above the voltage collaps may take place. So care must be taken to overcome from these problems. Among several methods in FACTs the SVC is more suitable to maintain voltage stability and power quality of the bus line.

This paper concludes that the SVC offer much faster support for the voltage recovery, but the initial investment for this SVC system is more. This drawback can be overcome by coupling the load interruption with the SVC. By this coupling, the load interruption is reduced and number of SVC required is also reduced. By considering all these aspects, it is very much clear that usage of SVC to maintain proper voltage stability in bus line during transmission and distribution is more suitable when compared to other systems of the FACTs.

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