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Review on The Study of FACTS Device SVC

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Abstract—: *This paper describes the modeling and simulation of distribution SVC for the improvement of power transfer quality and maintains the voltage profile and power factor improvement. Voltage swag and swell is one of the major problem in power system stability studies because it reduce the voltage profile and makes the system unbalanced. Therefore, the main aim or consideration of this project is to maintain the voltage profile and the mitigation of power quality problems in transmission and distribution system. SVC is one of the shunt connected FACTS controller device which is used for the compensation of power quality problem and maintains the voltage profile and improve power factor and it produces a greater advantages than compensators.*

Keywords—*Voltage profile,Transient Stability, SVC, PSS, MATLAB/Simulink*

I. Introduction

India's energy sector is one of the most critical components of an infrastructure that affects India's economic growth and therefore is also one of the largest industries in India. India has the 5th largest electricity generating capacity and is the 6th largest energy consumer amounting for around 3.4 % of global energy consumption. India's energy demand has grown at 3.6 % over the past 30 years. The consumption of the energy is directly proportional to the progress of manpower with ever growing population, improvement in the living standard of the humanity and industrialization of the developing countries. Very recently smart grid technology can attribute important role in energy scenario. Smart grid refers to electric power system that enhances grid reliability and efficiency by automatically responding to system disturbances. This complexity of power system basically consists of large number of generator,transformer transmission line linear and non-linear load or dynamic loads therefore due to these linear or non-linear or all the above mention electrical equipment the power system becomes unstable or its stability decrease. Therefore, to maintain such the power system stability or becomes the system stable FACTS device are used.Electric power system had expanding unpredictable power system instabilityissue in the past. The requisition of power system became since need of fast and efficient improvement[1]. It is crucial to levitate the power, transmitted alongside the existing transmission departments to compensate this growth.Power system convey generated electric energy from generating station to the end consumerfor the local use. The voltage and frequency should be stable. Power system stability can be defined as "the capability of an electric power system, for a given working circumstance, to recover a state of working synchronization in the wake of being exposed to a physical unsettling influence, with most system variables limited so that for all intents and purpose the whole system remains in place" [2]. The stabilizing is carried out by disintegrating the capacitor, inductors or mix of both after that synchronous condenser, saturated reactor, Thyristor controlled reactor, altered capacitor,thyristor controlled reactor, thyristor exchanged capacitor were utilized; however now STATCOM, VSC, TCSC are used and so on. These gadgets develop the perceptive controlling and quick exchanging power device like MOSFET and IGBT the capacity of quick exchanging makes them practical for giving exact and smooth controlling.

New modelled that are simulated by a software tool or MTLAB/SIMULINK, which is simulated environment in order to get the stable power system. Disintegrate the overall system model into four sub section. In first section the synchronous machine model, Turbine and regulator, Power system stabilizer (Generic and multiband) and excitation system and the second section Load flow bus, SVC, Faults (Single phase or 3 phase), Transformer, distributed parameters line, RLC load are modelled. After that we integrate these four subsections to get the overall system

II. Power System Stabilizer (Pss) Models

In Generic Power System Stabilizer,when power system encounters electromechanical oscillation disturbance in electrical generators, these oscillations are also named as power swing. The power swing is dampedto get the stable system, domain techniques has proven to be very effective also useof small signal frequency.The input of the PSS is w d called deviation in the machine speed or the acceleration power a m e P−P=P, where m P is the mechanical power and e P is the electrical power. The output signal of PSS is the stab V which may be used as additional input of Excitation system. The model of the Generic Power System Stabilizer is modeled and shown in figure 1 by using a nonlinear system.

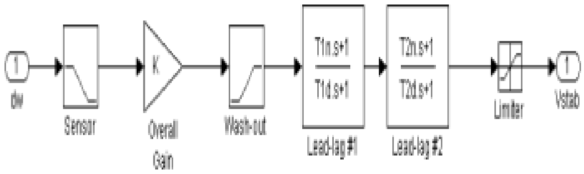

Figure 1. The Block Diagram of the Generic Power System Stabilizer

Low-pass filter, a general gain, a washout high-pass filter, a phase-compensation system, and an output limiter are the different blocks used in the PSS model. The amount of the damping developed by the stabilizer is found by K (General gain). The low frequencies in the deviation in speed signal (w d) is removed by the washout high pass filter. The lag in the phase angle between the excitation voltage and electrical torque is compensated by connecting four first order lead lag blocks in cascade called phase compensation[3,4]. B. Multi – Band Power System Stabilizer The disturbances or power swing in electrical generators must be damped in order to stabilize the system. These oscillations are divided into four main types: 1. Local oscillations: The frequencies of these oscillations are in between 0.8 to 4 Hz. They are the oscillation between the generator and rest of power system. 2. Interplant oscillations: The oscillation between four neighboring generation station is known as interplant oscillation it frequency range is 1 to 2 Hz. 3. Inter area oscillations: These are the oscillation between four big classes of generating plants between four major groups of generating plants it frequency ranges from 0.2 to 0.8 Hz. 4. Global oscillation: The oscillation of all generator in phase is called global oscillation it frequency is below 0.2 Hz [5, 6, 7].

III. Static Var Compensator (Svc)

For controlling the power flow and improvement of the transient stability a static VAR compensator is used which is one of the most participants of FACTS family.A static VAR compensator is a parallel combination of controlled reactor and fixed shunt capacitor. The thyristor switch assembly in the SVC controls the reactor. The firing angle of the thyristor controls the voltage across the inductor and thus the current flowing through the inductor. In this way, the reactive power draw by the inductor can be controlled. The SVC is capable of step less adjustment of reactive power over an unlimited range without any time delay. It improves the system stability and system power factorStatic VAR compensator has no rotating parts and is employed for surge impedance compensation and compensation by sectionalizing a long transmission line.Among the FACTS devices, Static Var Compensator (SVC) provides fast acting dynamic reactive compensation for voltage support under critical condition which might depress the voltage for a significant length of time. The amount of reactive power injected into or absorbed from power system is the key role of SVC to regulate the terminal voltage. SVC generate reactive power (SVC capacitive) when the system voltage is low and SVC will produce SVC capacitive when the voltage of the system is high. The capacitor bank and the inductor bank which are connected to the secondary side of the coupling transformer are changed in order to produce the variation in reactive power. The single-line diagram of a static VAR compensator and a simplified block diagram of its control system is shown in figure 2. The SVC is used in three-phase power systems together with synchronous generators, motors, and dynamic loads to perform transient stability analysis and detect influence of the SVC on electromechanical oscillations and transmission capacity of the power system [3, 4, 8]

$$V = \frac{1}{-B_{C\max}}$$

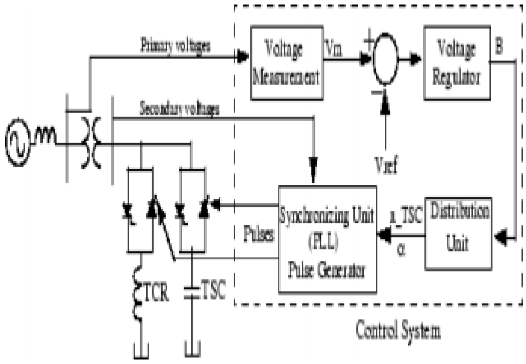

Figure 2. The Single-Line Diagram of a Static VAR Compensator and its Control System

SVC Mode of Operation There are four mode of operation of SVC i. In voltage regulation mode. ii. In VAR control mode (the SVC susceptance is kept constant) The V-I characteristics as shown in figure 3 is obtained when SVC is set to operate in voltage regulation mode.

1) V-I CHARACTERISTIC OF SVC

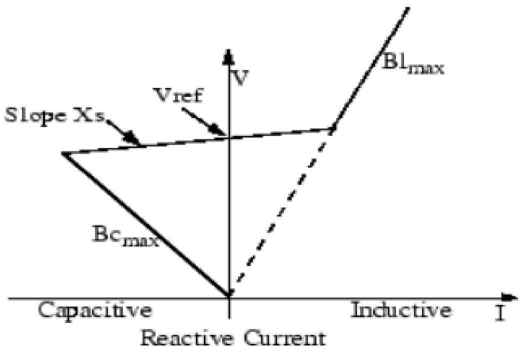

Figure 3. The V-I Characteristics of the SVC

The slope of SVC voltage current characteristics is given by the equation 1

$$slop = \frac{\Delta V_{C\max}}{I_{C\max}} = \frac{\Delta V_{L\max}}{I_{L\max}} \quad (1)$$

The V-I characteristics of SVC is explained by using equation 2, 3 and 4

$$V = V_{ref} + X_s . I \quad (2)$$

Then SVC will be in regulating mode If

$$V = \frac{1}{-B_{C\max}} \quad (3)$$

Now if then SVC will fully capacitive.

$$V = \frac{1}{B_{L\max}}$$

IV. Static Var Compensator (Svc) Modeling

A problem has been taken of four machine model consisting of four three bus model for analysis of transients stability using MATLAB Simulation. To see the effect of the SVC in the system to stabilize the voltage wave form when the system subjected to three phase fault, a four machine system system is developed with three buses as shown in fig. 4.

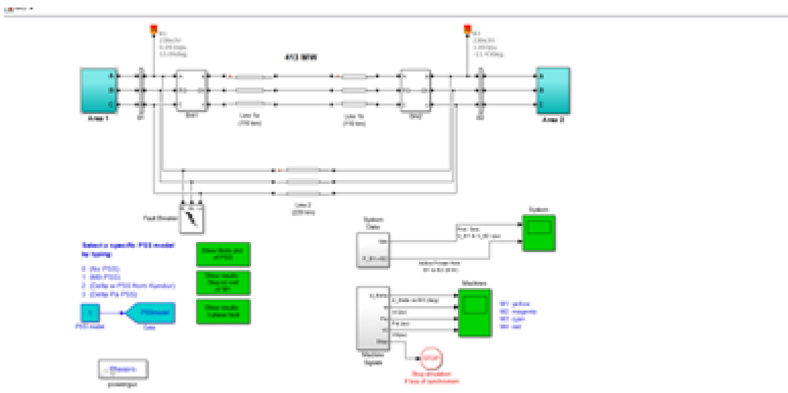

Figure 4. The Simulation of the SVC

V. Conclusion

It is known that the SVCs with an auxiliary injection of a suitable signal can considerably improve the dynamic stability performance of a power system. Therefore SVCs have been applied successfully to improve the transient stability of a synchronous machine. This paper presents the stability improvement of voltage level and real & reactive power in a power system model containing SVC. Simulations carried out confirm that SVC could provide the fast acting voltage support necessary to prevent the possibility of voltage reduction and voltage collapse. Analysis of SVC reactive power output (pu) in response to voltage steps is presented in this paper. This paper inspects actual positive sequence voltage in a system model with or without SVC.

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