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Transient Stability of Two Machine System with Static Var Compensation

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ABSTRACT: Transient stability control plays a significant role in ensuring the stable operation of power systems in the event of large disturbances and faults. This paper focuses on the significant of SVC (Static Var Compensator) to improve the transient stability of power transmission system in abnormal conditions. In the simulation result of model for different conditions with SVC and without SVC and Static Var Compensator (SVC) has effectively been applied to two machine systems for efficiently regulating system voltage and thus increase system load ability. It investigates the effects of (SVC) on voltage stability of a power transmission system at center positions. SVC controlling the reactive power flow to the 700km. line. The model is simulated using the MATLAB/SIMULINK software.SVC is effective in midpoint voltage regulation on transmission line. In paper comparison is also performed between SVC and without SVC under fault condition. The combination of TCR and TSC in the SVC configuration is used. The result shows the reactive power is compensated and system is in stable condition.

KEYWORDS: Static Var Compensator (SVC), Power System Stabilizer (PSS), TSC, TCR, without fault, Multi-Machine System.

I. INTRODUCTION

For many years, one of the major interests that power system should fulfil is satisfying sufficient conditions of stability. This interest is becoming a serious concern [2]. Indeed, in the one hand, the energy market evolution while the weakness of the transmission net due to financial difficulties and high costs of rights, don't make viable the construction of new lines and hence the higher loading of existing transmission lines. Disequilibrium between mechanical and electrical power can be instituted, this can affect rotor speed variations and can lead to a partial or total outage [5]. It is well established that power system stabilizer is the first measure that has been used to improve damping oscillations of power system during electromechanical transients. Stability of this system needs to be maintained even when subjected to large low-probability disturbances so that the electricity can be supplied to consumers with high reliability. The FACTS Technology is not a single high power controller but rather a collection of controllers which can be applied individually or in coordination with other to control one or more of the inter related System parameters like voltage, current, impedance, phase angle and damping of oscillations at various frequencies below the rated frequency. Among all FACTS devices, SVC plays much more important role in reactive power compensation and Voltage support because of its attractive steady state performance and operating characteristics.

II.STATIC VAR COMPENSATOR

A static VAR compensator is a set of electrical devices for providing fast-acting reactive power on high-voltage electricity transmission networks. This is part of the Flexible AC transmission system device family, regulating voltage, power factor and harmonics and stabilizing the system. Unlike a synchronous condenser which is a rotating electrical machine, a static VAR compensator has no significant moving parts. Prior to the invention of the SVC, power factor compensation was the preserve of large rotating machines such as synchronous condensers or switched capacitor banks. Static VAR systems are applied by utilities in transmission applications for several purposes. The primary purpose is usually for rapid control of voltage at weak points in a network. Installations may be at the midpoint of transmission interconnections or at the line ends. Static VAR Compensators are shunting connected static generators / absorbers whose outputs are varied so as to control voltage of the electric power systems. In its simple form, SVC is connected

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with combination of mechanically switched reactor, TCR, TSC, harmonic filter and mechanically switched capacitor configuration as shown in Figure1.

The static VAR compensator is an automated impedance matching device, designed to bring the system closer to unity power factor. SVCs are used in two main situations:-

1. Connected to the power system, for regulate the transmission voltage (Transmission SVC)
2. Connected near large industrial loads, for improve power quality (Industrial SVC)

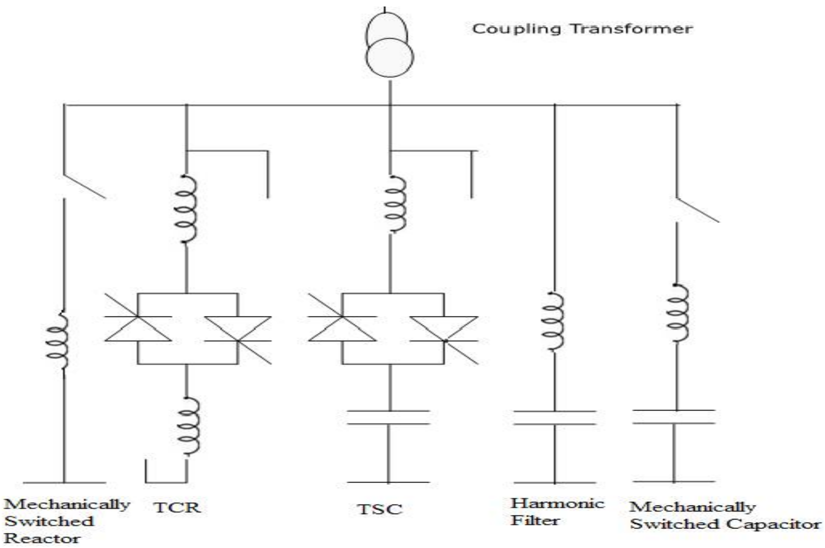

Figure 1 Static VAR Compensator

III.SIMULINK MODEL OF TCR

In this model the synchronized pulse generators firing thyristors Th1 and Th2. Copy two Simulink pulse generators into your system, name them Pulse1 and Pulse2, and connect them to the gates of Th1 and Th2.

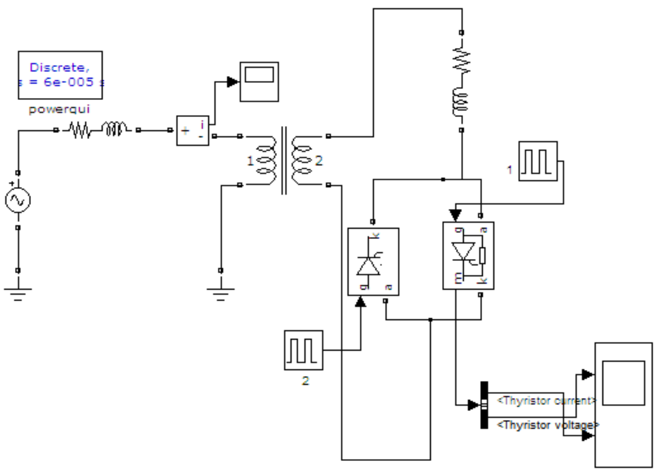

Figure 2 Simulink Model of TCR

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IV.SIMULINK MODEL OF TSC

Now modify and change the TCR branch to a TSC branch. Connect a capacitor in series with the RL inductor and Th1/Th2 valve as shown in Figure3.Contrary to the TCR branch, which was fired by a synchronous pulse generator, a continuous firing signal is now applied to the two thyristors.

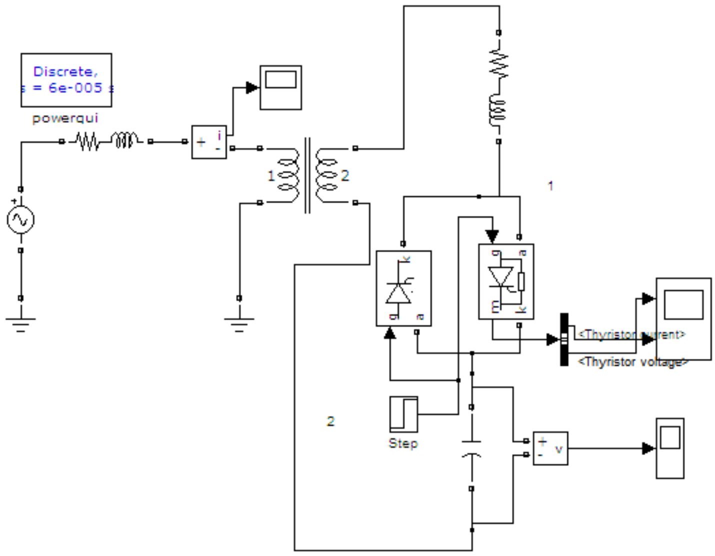

Figure 3 Simulink Model of TSC

V.TWO MACHINE TRANSMISSION SYSTEM WITH & WITHOUT SVC

Case 1 without SVC
A problem has been taken of two machine models consisting of three bus model for transients stability using MATLAB/Simulation. To see the effect of the without SVC in the system voltage wave form when the system subjected to three phase fault, a two machine system is developed with three buses.
Power plants are employed with random generators as shown.
Case 2 with SVC
Power system stability improvements are very important for large scale system. The AC power transmission system has some diverse limits, classified as static limits and dynamic limits. Traditionally, fixed or mechanically switched shunt and series capacitors, reactors and synchronous generators were being used to improve same types of stability augmentation. For many reasons desired performance was being unable to achieve effectively. A problem has been taken of two machine model consisting of two three bus model for analysis of transients stability of power transmission system. 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 two machine system is developed with three buses as shown in Figure5.Power plants are employed with random generators as shown.

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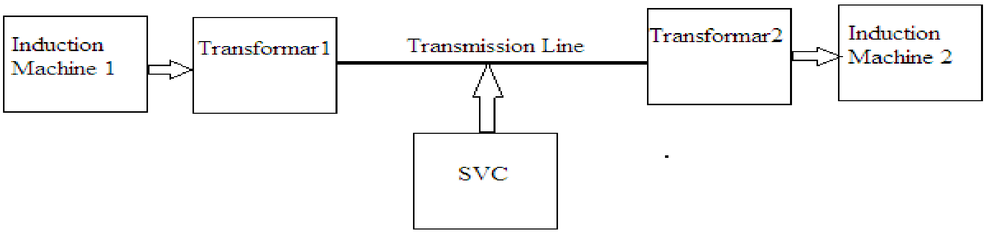

Figure 4 Block Diagram of Transmission System with SVC

VI.SIMULATION RESULT

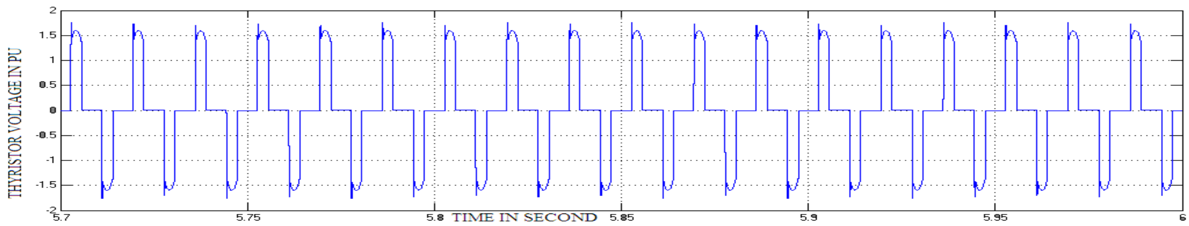

Figure 5 Voltage of TCR

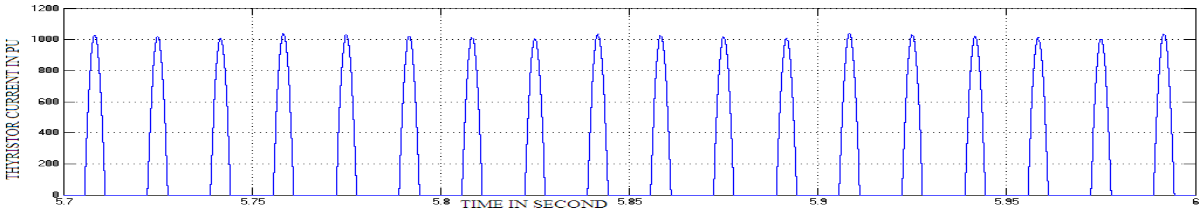

Figure 6 Current of TCR

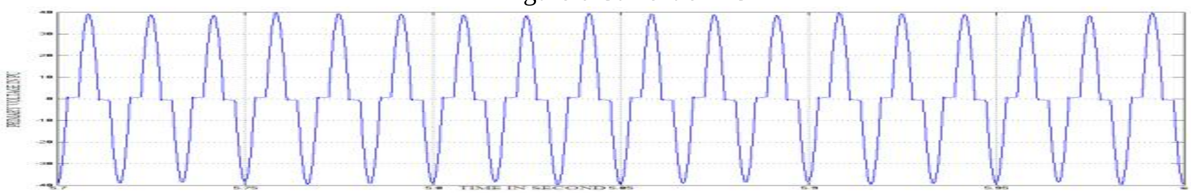

Figure 7 Waveform of Iprim for TCR

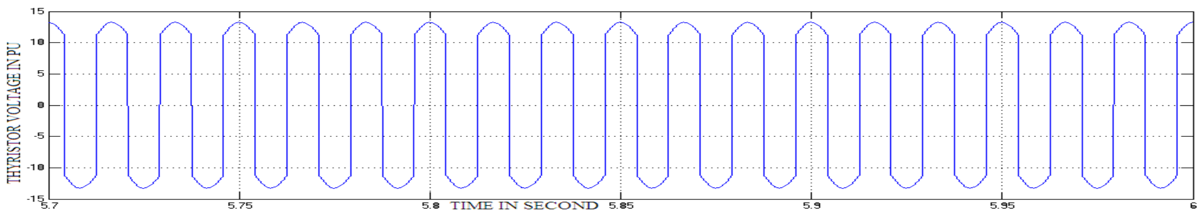

Figure 8 Voltage of TSC

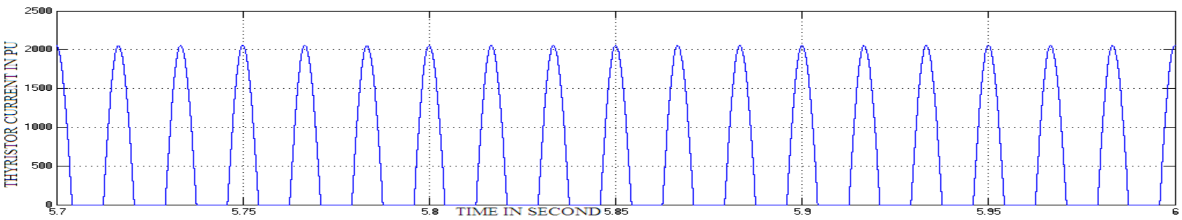

Figure 9 Current of TSC

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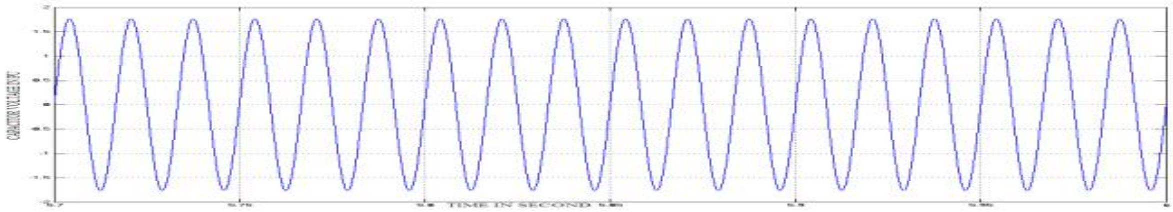

Figure 10 Waveform of Capacitor Voltage for TSC

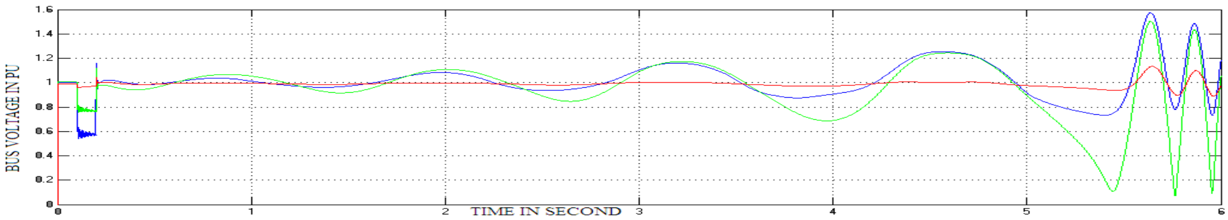

Figure 11 Response curve of line Voltage without SVC

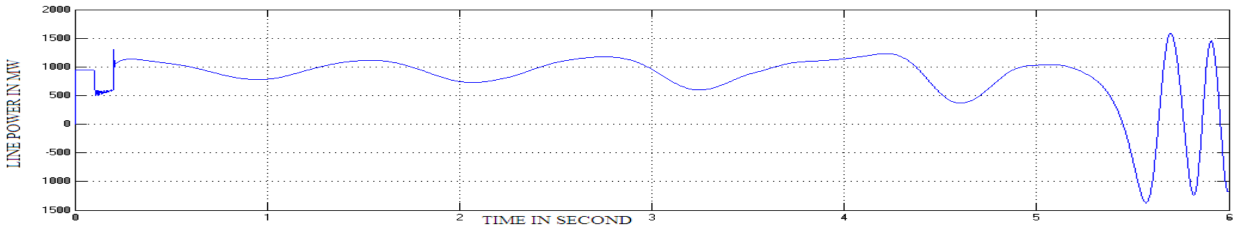

Figure 12 Response curve of line Power without SVC

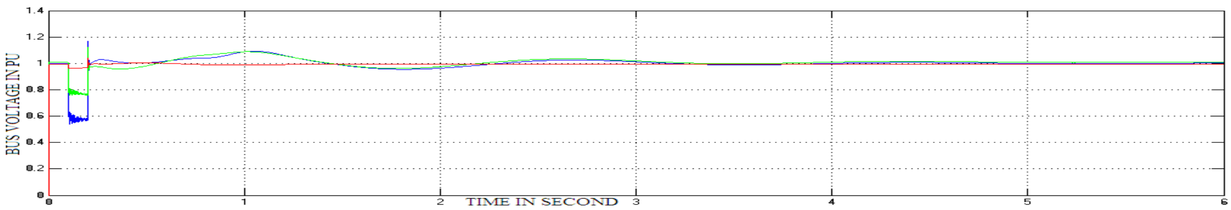

Figure 13 BusVoltage with SVC

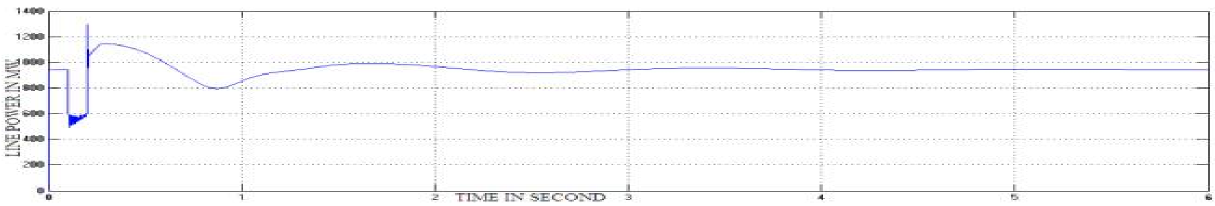

Figure 14 line Power with SVC

VII. RESULT ANALYSIS

From the above simulation results we conclude that SVC not only considerably improves transient stability but also compensates the reactive power in steady state. The SVC is used to control power flow of power system by injecting appropriate reactive power during dynamic state. The best possible location of the FACTS device (SVC) is found to vary with the location of the fault and the operating criteria of the device. We also conclude that if the fault clearing time is less, more stability improvement. On the other hand less transient stability improvement occurs if fault clearing time is more.

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Table 1 Transient Analysis

S. No.	Parameter	Without SVC	With SVC	Conclusion
1	Voltage	1.5763 pu	1.165pu	Transient Reduced Voltage
2	Power	1587.1 watt	1297.3961 watt	Transient Reduced Power

Table 2 Transient Time

S. No.	Without Fault	With Fault
1	Stable	Unstable

VIII.CONCLUSION

The proposed model is oscillation and instable with absence effect of (PSS) & (SVC).Using effects of (PSS) & (SVC) will increase the stability of proposed model after occurred and cleared faults. The selective of (PSS) are capable of proving sufficient damping to the steady state oscillation and transient stability voltages performance over a wide range of operating conditions and various types of disturbances of the system used in proposed model. From the simulation we can conclude that using power system stabilizer we can stabilize our system up to certain limit and maintain the synchronism between the inter connected area and protect the whole power system from cascade tripping which is very serious matter. We can also say that only using PSS we cannot maintain stability but in some cases or condition it is require using SVC to maintain stability

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BIOGRAPHY

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Rakesh Singh Lodhi is guiding research project from last five years. He published many national and international researches. His research areas in M.Tech. FACTS, induction machine. Currently he is working in specialization in electrical power system in Oriental University Indore, Madhya Pradesh, India.