International Journal of Advances in Engineering & Technology, July 2011.
©IJAET ISSN: 2231-1963

MODELING AND SIMULATION OF SVC CONTROLLER FOR ENHANCEMENT OF POWER SYSTEM STABILITY

Alisha Banga[1] and S.S. Kaushik[2]

[1]Lecturer ECE Deptt., Advanced Institute of Technology & Management, Palwal.
[2]Assistant Prof. EEE Deptt., NGF College of Engg. & Technology, Palwal.

ABSTRACT

This paper will discuss and demonstrate how Static Var Compensator (SVC) has successfully been applied to control transmission systems dynamic performance for system disturbance and effectively regulate system voltage. SVC is basically a shunt connected static var generator whose output is adjusted to exchange capacitive or inductive current so as to maintain or control specific power variable; typically, the control variable is the SVC bus voltage. One of the major reasons for installing a SVC is to improve dynamic voltage control and thus increase system load ability. There are the mainly accomplishes work to construct an effective for SVC. Firstly, to design a controller for SVC devices on transmission lines, a Single Machine Infinite Bus (SMIB) system is modeled. In this paper, simple circuit model of Thyristor Controlled Reactor is simulated.

KEYWORDS

FACTs, Matlab/Simulink, SVC Voltage control.

1. INTRODUCTION

The focus of this paper and research is the application of Static Var Compensator to solve voltage regulation and system dynamic performance deficiencies. SVC is thyristor based controller that provides rapid voltage control to support electric power transmission voltages during immediately after major disturbances. Since the advent of deregulation and the separation of generation and transmission systems in electric industry, voltage stability and reactive power-related system restrictions have become an increasing growing concern for electric utilities. When voltage security or congestion problems are observed during the planning study process, cost effective solution must be considered for such problems. One approach to solving this problem is the application of "Flexible AC Transmission Systems" (FACTs) technologies, such as the Static Var Compensator (SVC). In an ideal ac power system, the voltage and frequency at every supply point would be constant and free from harmonics; the power factor would be unity.

Three keys aspects of voltage stability are:
1. The load characteristic as seen from bulk power network.
2. The available means for voltage control at generators and in the network.
3. The ability of the network to transfer power, particularly reactive power, from the point of production to point of consumption.

2. STATIC VAR COMPENSATOR (SVC)

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 shunt 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 as Fixed Capacitor-Thyristor Controlled Reactor (FC-TCR) configuration as shown in Fig. 1. The SVC is connected to a coupling transformer that is connected directly to the ac bus whose voltage is to be regulated.

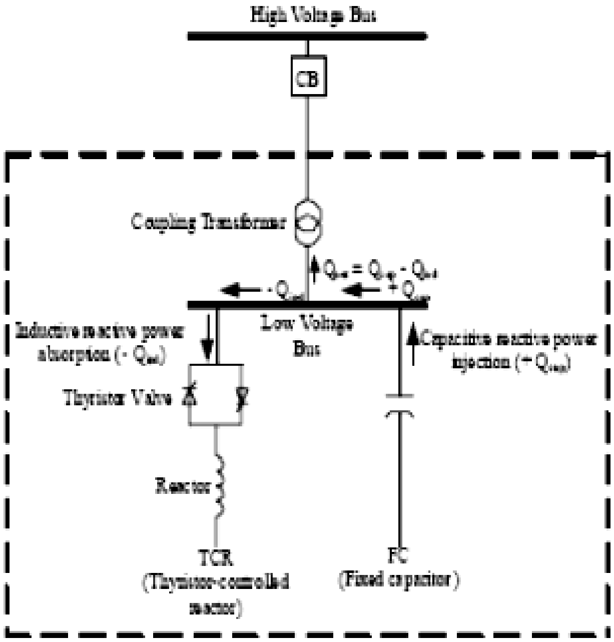

Fig 1: Configuration of SVC

3. MODELING OF SVC

The SVC provides an excellent source of rapidly controllable reactive shunt compensation for dynamic voltage control through its utilization of high-speed thyristor switching/controlled reactive devices. An SVC is typically made up of the following major components:

1. Coupling transformer
2. Thyristor valves
3. Reactors
4. Capacitors (often tuned for harmonic filtering)

In general, the two thyristor valve controlled/switched concepts used with SVCs are the thyristor-controlled reactor (TCR) and the thyristor-switched capacitor (TSC). The TSC provides a "stepped" response and the TCR provides a "smooth" or continuously variable susceptance. Fig. 2 illustrates a TCR/FC including the operating process concept. The control objective of SVC is to maintain the desired voltage at a high voltage bus. In steady- state, the SVC will provide some steady- state control of the voltage to maintain it the highest voltage bus at the pre-defined level. If the voltage bus begins fall below its setpoint range, the SVC will inject reactive power (Q_{net}) into the system (within its control limits), thereby increasing the bus voltage back to its desired voltage level. If bus voltage increases, the SVC will inject less (or TCR will absorb more) reactive power (within its control limits), and the result will be to achieve the desired bus voltage

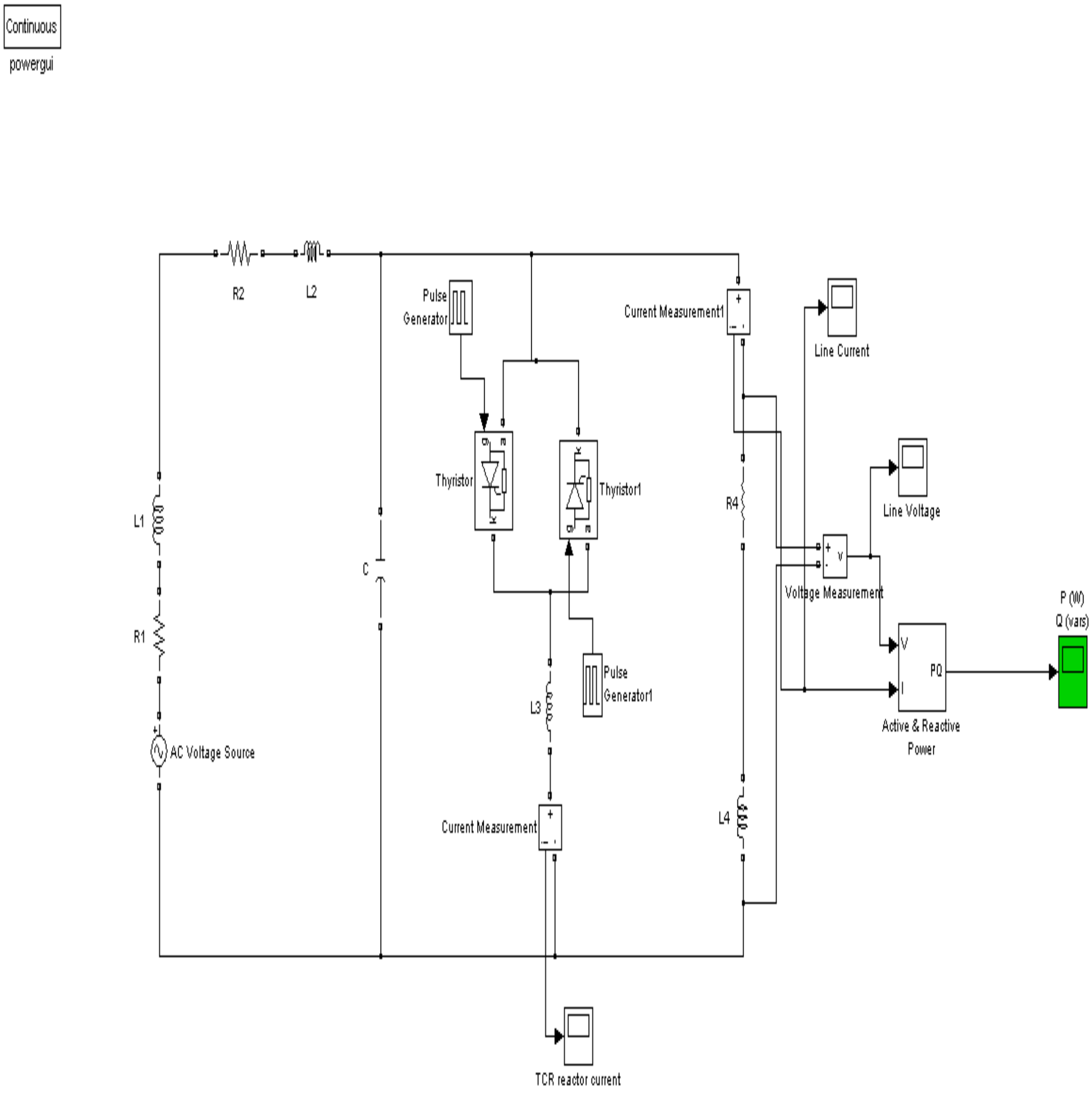

Fig 2: SVC Model

4. SIMULATION RESULTS AND DISCUSSIONS

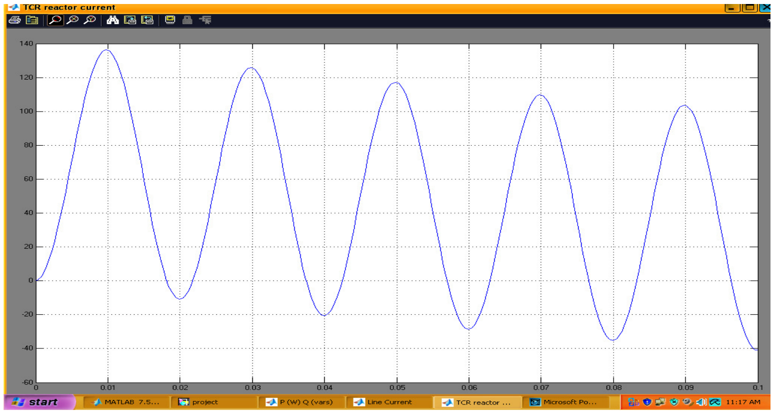

Fig 3: TCR Reactor Current

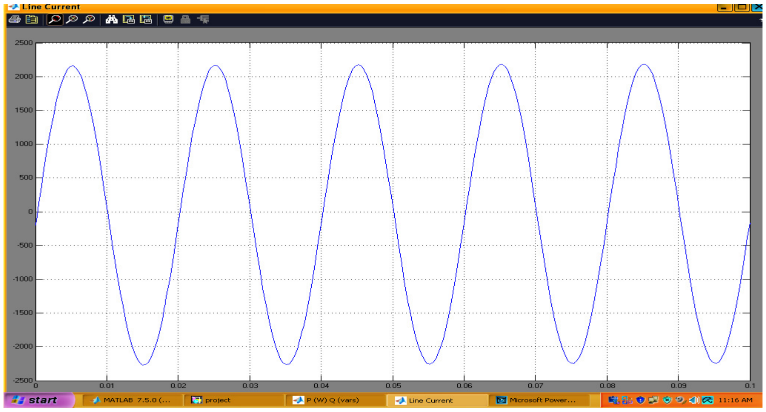

Fig 4: Line Current

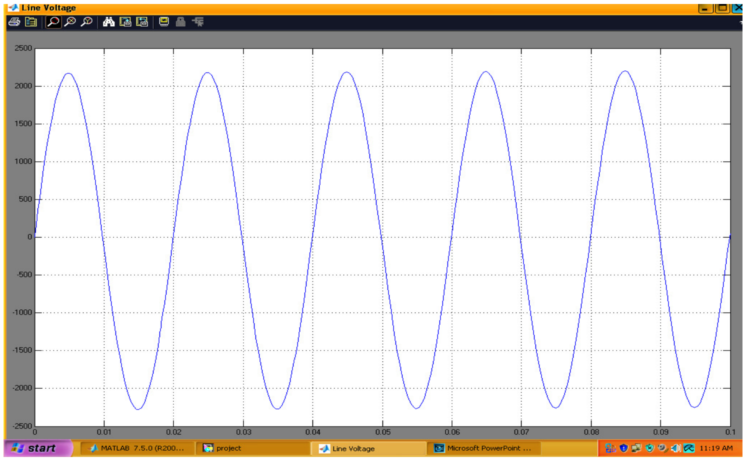

Fig 5: Line Voltage

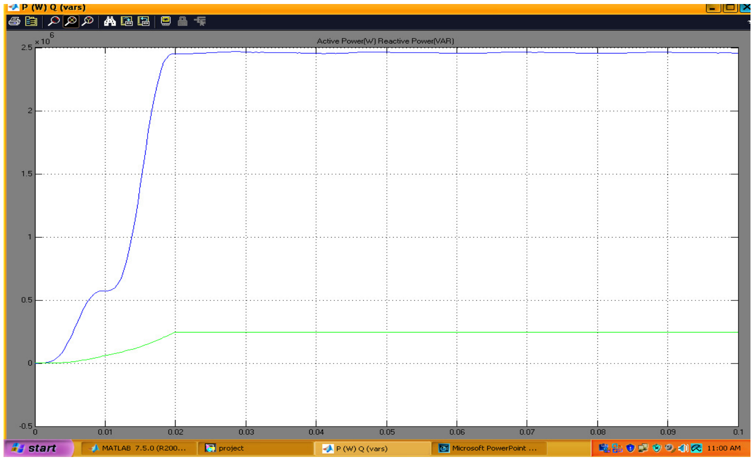

Fig 6: Real And Reactive Power

Above are the figures illustrating the waveforms after simulating the model. If values of the inductor (reactor) or capacitor are changed keeping one of them as constant then corresponding values for reactive power is as shown:

Table 1: Capacitor Constant & inductor varying

C (micro F)	**L (mH)**	**Q(MVAR)**
200	100	2.4685
200	200	2.4752
200	500	2.4756
200	700	2.4781
200	1000	2.4785
200	1400	2.4787

Table 2: Capacitor varying & inductor constant

L (mH)	**C(micro F)**	**Q(MVAR)**
100	200	2.4687
100	400	2.4685
100	800	2.455
100	1000	2.423
100	1200	2.3776
100	1500	2.282

5. TEST RESULTS

From table 1 we can see that if we keep capacitor value as constant and vary the value of inductor then reactive power is increasing and from table 2 we can conclude that if we keep inductor value as constant and vary the value of capacitor then reactive power is decreasing. This shows that reactive power is compensated and hence stability of power system is improved.

6. CONCLUSION

Hence it is concluded that SVC (Static VAR Compensator) will successfully control the dynamic performance of power system and will effectively regulate the system oscillatory disturbances and voltage regulation of the power system. The proposed controller shows better performance and also regulates the active and reactive power along with the voltage stability.

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Authors:

Alisha Banga: BE(ECE) from BSAITM, Faridabad, Post Graduation in Electrical Engg with specialization in Power Systems from Alfalah School of Engg & Technology, Faridabad is working in Advanced Institute of Technology & Management, Palwal.

S.S Kaushik: BE (EEE) From B.M College, Panipat, Post Graduation in Electrical Engg with specialization in Power System & Drives from YMCA, Faridabad is working in NGF College of Engg & Technology, Palwal.