American Journal of Engineering Research (AJER) 2015
American Journal of Engineering Research (AJER)
e-ISSN: 2320-0847 p-ISSN : 2320-0936
Volume-4, Issue-10, pp-160-166
www.ajer.org
Research Paper Open Access

The improvement of voltage stability and reactive power compensation in the two-area system with PSS and FACTS-devices

Mohammad Niyazi[1], AshkanBorji[2], Siroos Hemmati[3]
[1]*Tarah Energy Sepanta Consulting Engineering Company,Tehran,Iran*
[2] *Department of ElectricalEngineeringKermanshah branch, Islamic Azad University, Kermanshah, Iran*
[3] *Department of ElectricalEngineeringKermanshah University of Technology, Kermanshah, Iran*

ABSTRACT:*In fact, The power system stability is the most important feature of the power system. This article discuses about successful application of FACTS-devices and PSS in transmission system. The purpose of using the FACTS-devices and PSS are the regulation of effective voltage and compensation of reactive powering particular system. Power systems are operated near the limits of their stability, fore conomicreasons. Keeping system stability and safe operation are very important. The shunt FACTS-devices have an important role in the stability, increasing of transmition capacity and damping the low frequency fluctuations. In this article FACTS-devices and PSS, a two-area power system have been used for improving of power system stability. For simulation of systems, MATLAB software, has been used.*

Keywords **-**FACTS-*devices* , disturbance, power system stabilizer, compensator, two-area system

I. INTRODUCTION

In recent years, there has been a lot of demands on the power transmission network, and these demands are on the rise, because the number of units of generation and competition between them are increased. Also, the electric power systems is changing to reach flexibility, reliability, quick response and accuracy in the fields of generation, transmission, distribution and consumption. Reactive power control is an important factor in the design and operation of electric power systems. Reactive power compensators such (SVC) and (STATCOM) are devices that is used to improve voltage and control reactive power in AC systems. As well as increasing of the transmission capacity is a result of damping of power fluctuations. Power system stability is one of the most important aspects of the performance of electrical systems and should preserved the frequency and voltage under any disturbance including suddenly increscent of load [1,2]. On the other hand, power system's stabilizer (additional excitation controller) is an auxiliary controller that, to improve the dynamic performance of power system by adding of auxiliary signals to excitation system. The effectiveness of this control method depend on the optimum point and selected proper signal in the power system[3]. In [4] , is examined the improvement of transient stability of two systems with different loading conditions. Flexible AC transmission power system(FACTS- devices) put in the middle of long transmission lines and designed the power system stabilizer for both generation units. That has an important role in the control of damping and distribution of reactive power in system. The analyzes of the performance of SVC and STATCOM withPSS, for improvement of dynamic behavior of the desired system is purpose in this study.

II. FACTS- DEVICES

The Improvement of power systems stability and also increasing of reliability of system is by the use of FACTS- devices [5]. However, the using of these devices, can improve the capacity of transitional power of lines . Thedevices used in this study are include SVC and STATCOM.

A) Static Var Compensator (SVC)

SVC can be used for setting of voltage profile and improvement of capacity of transmission line, and as well as setup itself with change of operation conditions of grid [6]. With proper control of equivalent reactance, is possible regulation of voltage amplitude. In simplest form, a TCR is parallel with the capacitor [7,8]. Figure 1 show a diagram of the SVC .

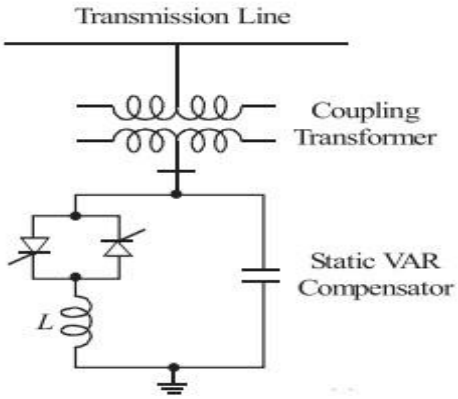

Fig 1.SVC connected to transmission line .

SVC can be operate in following two modes:

1. Voltage regulation mode
2. Reactive power control mode

V-I characteristic in one SVC is shown in figure 2.

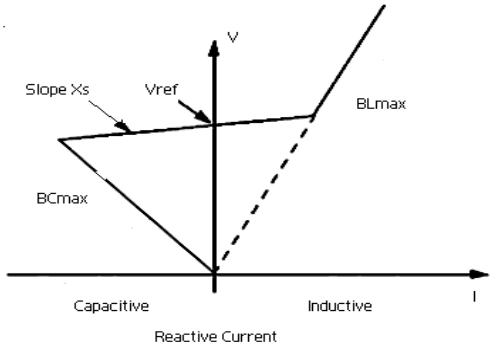

Fig 2. V-I characteristic in SVC

Since ,voltage unstable and even voltage collapse can be occur if reactive power balance are collide in the grid, Connect a SVC in a specific point of grid, to increase transmission capacity and improves dynamic stability of voltage, and preserves the voltage profile in different situations [9].

B) Static Synchronous Compensator (STATCOM]

STATCOM (static synchronous compensator) put on in parallel mode in the grid, and the most application of it is supply of voltage and reactive power. In other words, STATCOM works as a source of variable reactive power in a power system and with injection of reactive power, to prevent from voltage drop and also to increase transitional active power [10]. Figure 3 show v-1 characteristic in the STATCOM compensator [11] , and figure 4 show a schematic base diagram of one STATCOM.

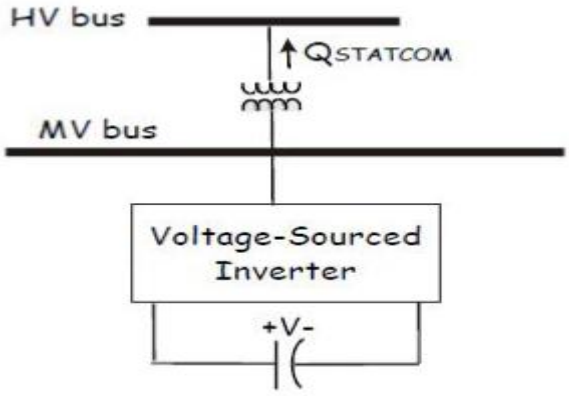

Fig 3.schematic base diagram of one STATCAM.

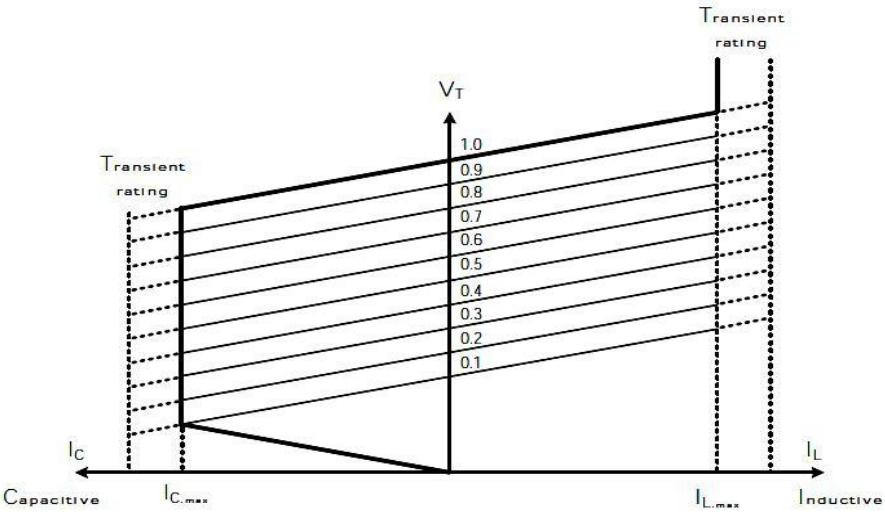

Fig 4.V-I characteristic in STATCOM compensator

In other words because this compensator is an important member of the family of FACTS- devices, has a capabilities such as damping of power fluctuations, improve of transient stability, voltage support and … [12].

III. POWER SYSTEM STABILIZER (PSS)

Power system stabilizer , is the most economic method for attenuating of electromechanical fluctuations. PSS is the most original and the most widely used damping maker in power systems[13]. This stabilizer normally used from signals such as rotor speed , frequency and power of generator, and with to attenuate low frequency fluctuations puts the desirable impact on the small signal stability of system. PSS with the creation of the synchronizing and damping torque coefficients to improve the digression of rotor rotation. In fact,PSS to regulate and optimize the stimulation voltage with the creation of positive and negative voltage in the time needed [14] .figure 4 show a power system stabilizer model[15].

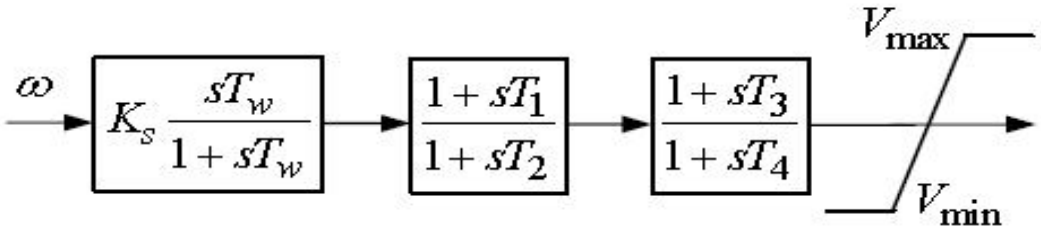

Fig 5.power system stabilizer

To get the proper functioning of stabilizer in a large range of frequencies, has been suggested The use of PSS with several frequency band, [16].

IV. SYSTEM MODELING

To show the improvement of voltage stability and compensation of reaction power by PSS and FACTS- devices that specified in this article, a two-area power system is used [4] . This model that consists of two generation units and a long transmission line, is showed in figure 6.

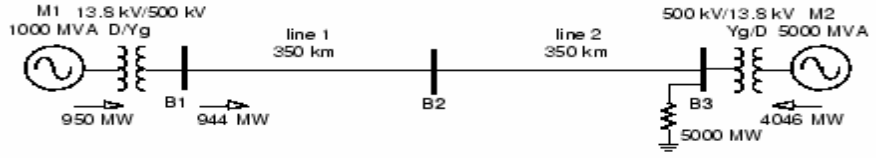

Fig 6.systemunder study

The second bus is considered as connect point of SVC and STATCOM. And both units to supply load. For both generation units, is designed power system stabilizer. For analyze of performance of these devices, was designed one short circuit disturbance in bus B1.

V. SIMULATION RESULT

According to figure 6, a disturbance occurs an the transmission line in B1. after it, system suffers of fluctuation and unstability, and because of flowing of high current, the voltage of this bus is dropped, and also decrease reactive power, meanwhile, the unstability to occur quickly. Figure7 show the effect of disturbance on the dynamic stability

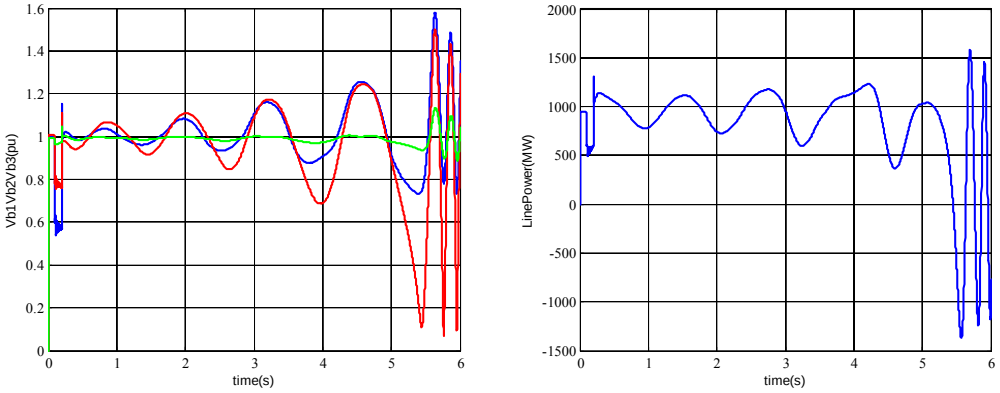

Fig 7.A: the effect of the disturbance on the system

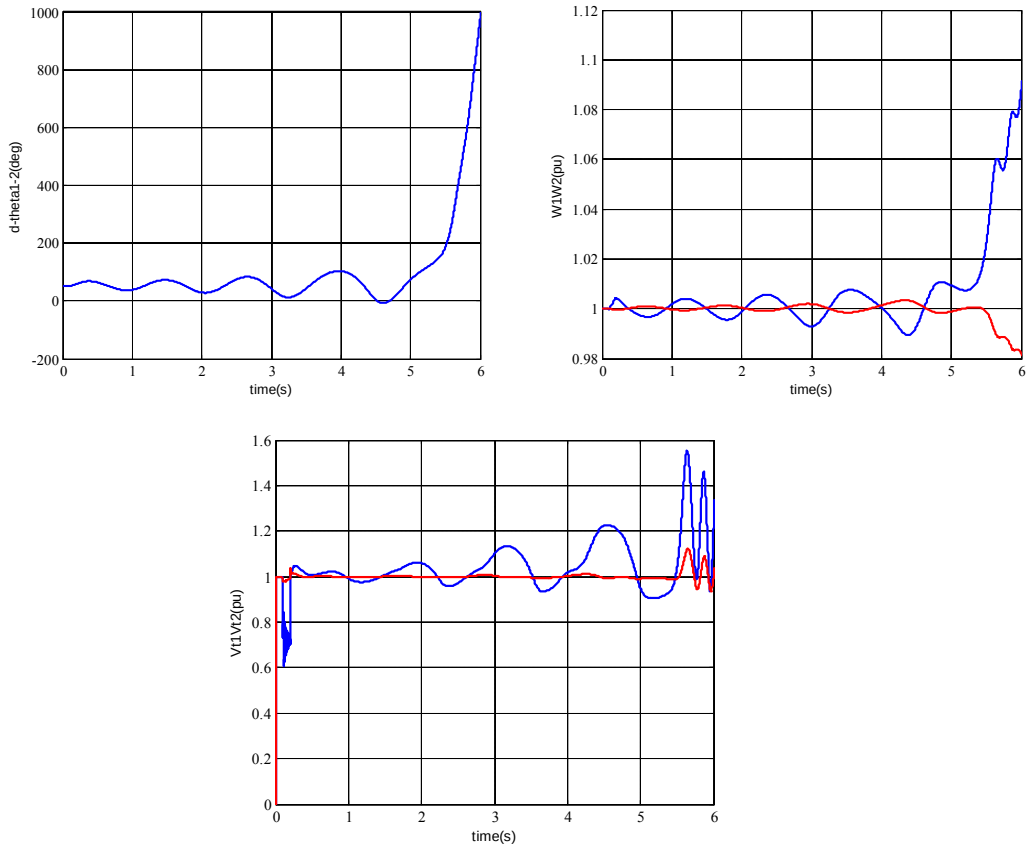

Fig 7.B:the effect of the disturbance on the machines

after analyze of grid with simultaneous placing of SVC in B2 and designing of PSS and simulation of this system, improvement of damping of voltage power fluctuations and also stability are observed. The results are in figure 8.

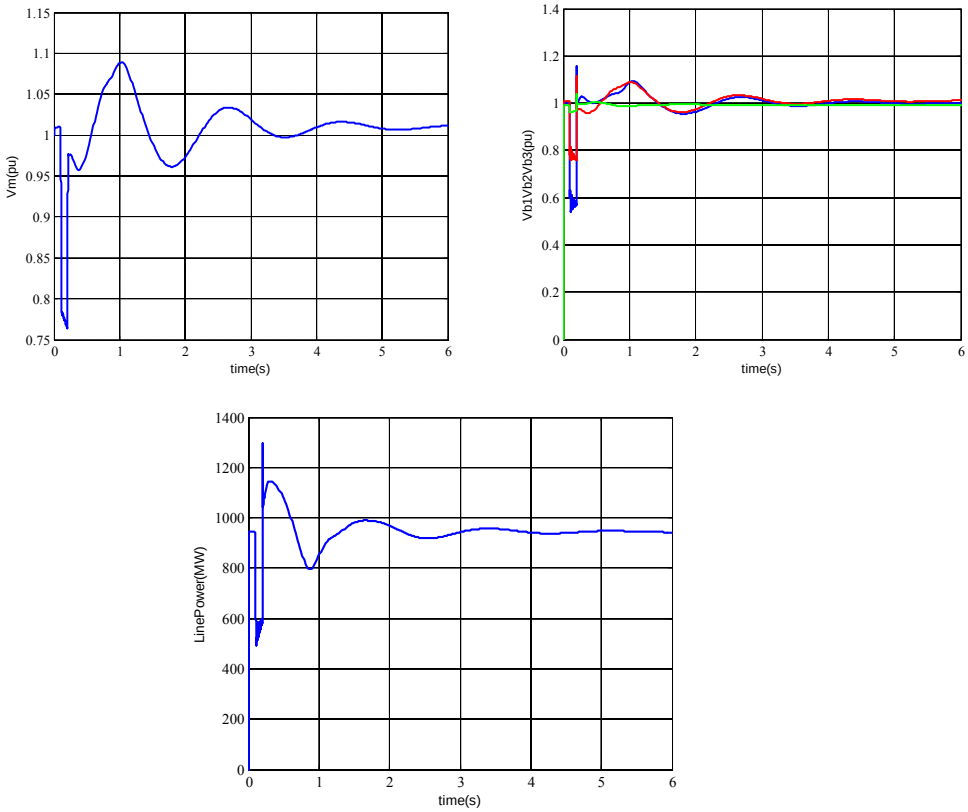

Fig 8.A:synchronous effect of PSS and SVC after disturbance,SVC compensator

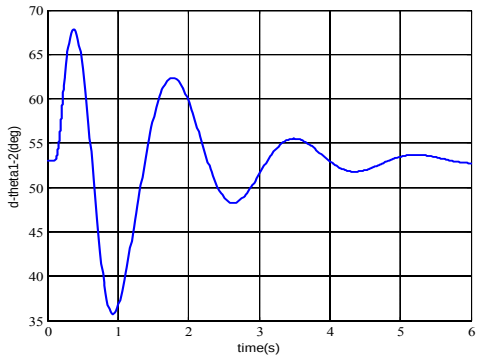

Fig 8.B:synchronous effect of PSS and SVC after disturbance,system

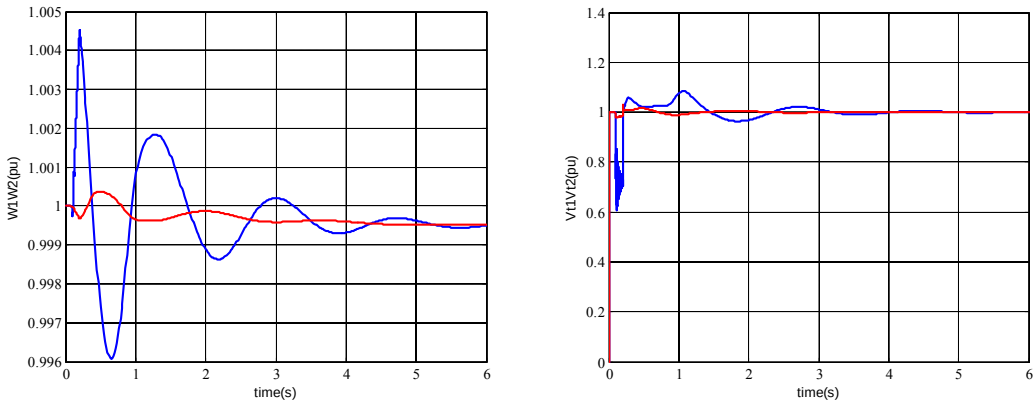

Fig 8.C:synchronous effect of PSS and SVC after disturbance,machines

Now, placing of STATCOM compensator instead of SVC in B2 and synchronous design of PSS, the results reviews after simulation; figure 9 show these results.

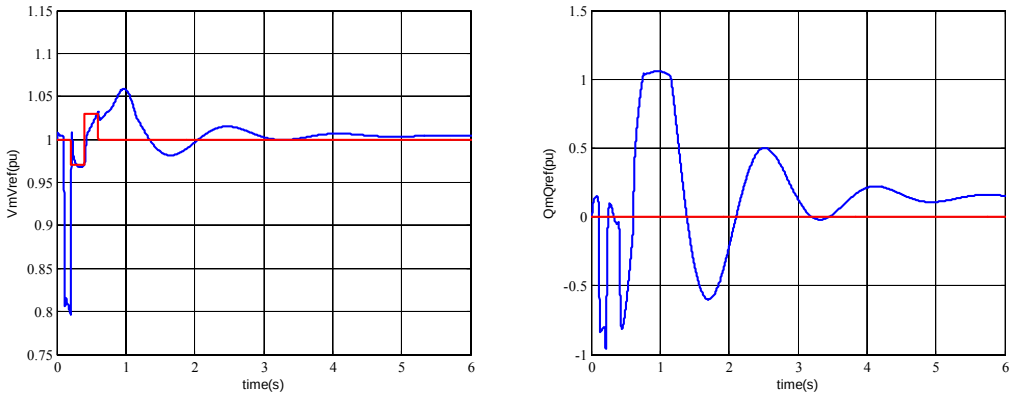

Fig 9.A:synchronous effect of PSS and STATCOM ,STATCOM compensator

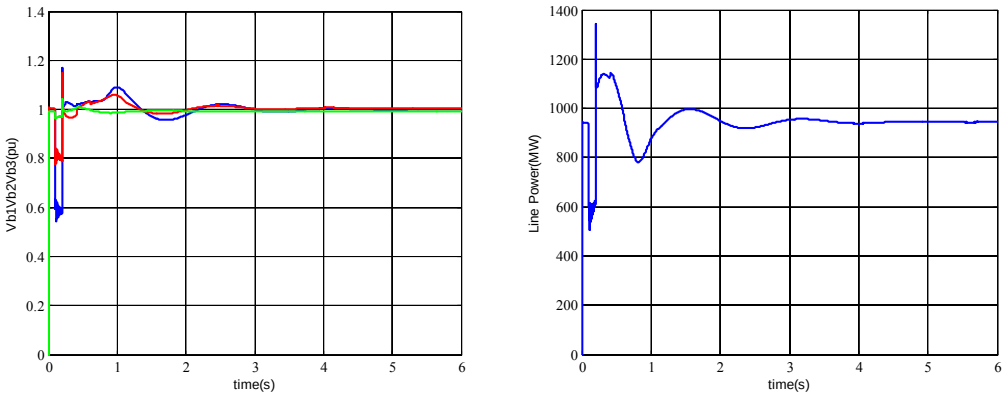

Fig 9.B:synchronous effect of PSS and STATCOM ,system

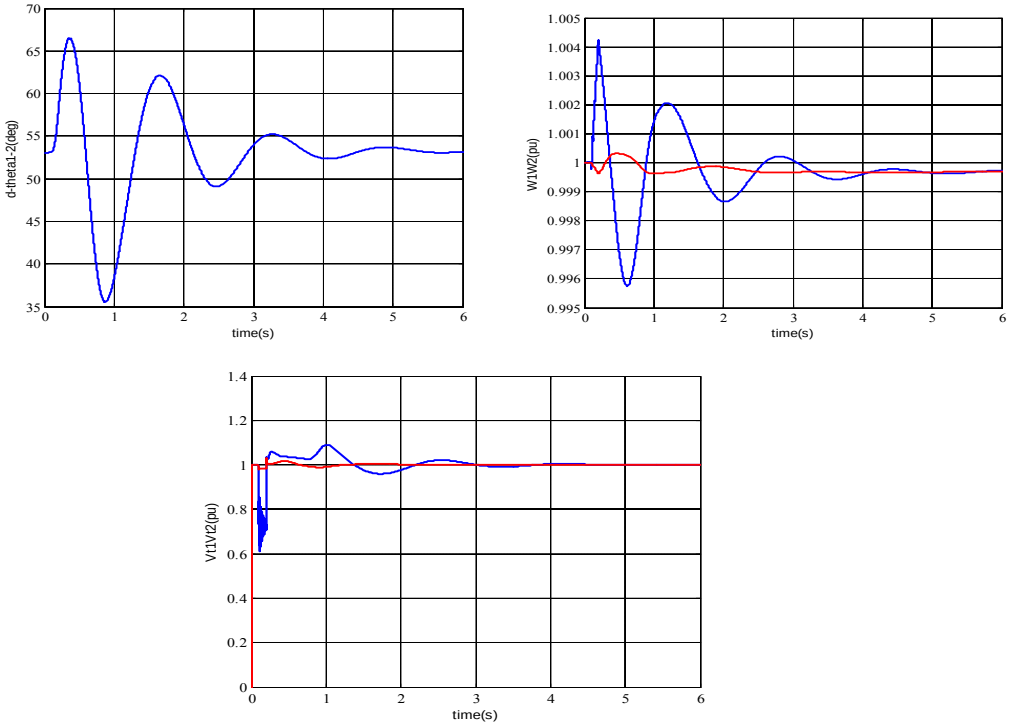

Fig 9.C:synchronous effect of PSS and STATCOM ,machines

VI. Conclusion

In this article, discussed the main of performance of svc and STATCOM to voltage control and design the PSS in particular system. That show PSS and FACTS-devices improve voltage stability and reactive power in power systems.in this study, a first state ,synchronous effect PSS and svc and second state, synchronous effect PSS and STATCOM is analyzed and compared. The result of simulation show effective performance synchronous effect PSS and STATCOM to improve damping fluctuations and dynamic stability of the systems.

REFERENCES

[1]. Al-Awami A. T. , Abdel-Magid Y. L. , Abido M. A. , 2007, "A particle-swarm-based approach of power system stability enhancement with unified power flow controller", Electric Power and Energy Systems, Vol. 29, pp. 251 – 259.

[2]. Anderson P. M. , Fouad A. A. , 1977, "Power System Control and Stability", Ames, IA:Iowa State University . Press

[3]. AtefAly El-Emary, "*Effect of static VAR compensator upon synchronizing Torque coefficient*. " Electric Machines and Power Systems 25:371-386, 1977

[4]. Virk, Pardeep Singh, and Vijay Kumar Garg. "Power System Stability Improvement of Long Transmission Line System by Using Static Var Compensator (SVC). "

[5]. N. G. Hingorani and L. Gyugyi, "Understanding FACTS: Concepts and Technology of Flexible AC Transmission Systems", IEEE Press, New York,1999.

[6]. IEEE TASK FORCE: " *Proposed Terms and Definitions for Flexible AC Transmission Systems (FACTS)*", IEEE Trans. On Power Delivery, vol. 12, No. 4, 2005.

[7]. N. Hingorani, ―*FACTS — Flexible ac transmission systems*,‖ in Proc. IEE5th Int.Conf. AC DC Transmission, London, U. K. , 1991, Conf. Pub.345, pp.1–7.

[8]. N. G. Hingorani and L. Gyugyi, *Understanding FACTS: Concepts and Technology of Flexible AC Transmission Systems*. New York: Wiley, 2000, *vol. I*

[9]. Dr. TarlochanKaur and SandeepKakran, Transient Stability Improvement of long transmission line using SVC, *International Joural of Advanced research in Electrical, Electronics and Instrumentation Enginering, Oct 2012, Vol. 1, Issue 4*

[10]. A. Kazemi H. A. Shayanfar M. A. Rafiee, "Impact of STATCOM and OPF on Power System Voltage Stability Using Modal Analysis and Quadratic Programming", Department of Electrical Engineering Iran University of Science and Technology. 2004.

[11]. Kazemi, A. , S. Jamali, and H. Shateri. "Effects of STATCOM on distance relay tripping characteristic. " *Transmission and Distribution Conference and Exhibition: Asia and Pacific, 2005 IEEE/PES*. IEEE, 2005.

[12]. C. A. Canizares, M. Pozzi, and E. Uzunovic, "STATCOM modeling for voltage and angle stability studies," International Journal of Electrical Power & Energy Systems, vol.25, no.6, pp. 431–441, June . 2003.

[13]. S. M. Abd-Elazim, E. S. Ali, "Coordinated design of PSSs and SVC via bacteria foraging optimization algorithmin a multimachine power system"ELSEVIER. 2013.

[14]. P. Kundur, M. Klein, G. J. Rogers, and M. S. Zywno, "Application of Power System Stabilizers for Enhancement of Overall System Stability", IEEE Transactions on Power Systems, Vol. 4,1989,pp. 614-626.

[15]. P. Kundur, "Power System Stability and .Control", Mc-Grall Hill, New York, 1994.

[16]. I. Kamwa, R. Grondin, G. Trudel, "IEEE PSS2B versus PSS4B: the limits of performance of modern power system stabilizers ", IEEE Trans on Power Systems, Vol. 20, No.2, pp. 903-915, May 2005.