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Roll of PSS and SVC for improving the Transient Stability of Power System

Dhaval N Tailor, Bhavesh Bhalja, Vijay Makawana

***Abstract*: This paper focus on the significant of PSS and SVC(static var compensator) to improve the transient stability of power system in various abnormal condition. This paper shows the simulation result of model for different fault condition with PSS and without PSS and show how the SVC help to improve the stability when PSS is fail to maintain the stability.**

***Keyword:* PSS, static var compensator, simulation model, their result with PSS and without PSS, model with SVC.**

I. INTRODUCTION

Today's world is continuously growing so that generation, distribution and transmission of power is also simultaneously require to increase in same manner to fulfill the requirement. Power system stability may be broadly defined as that property of a power system that enables it to remain in a state of operating equilibrium under normal operating condition and to regain an acceptable state of equilibrium after being subjected to a disturbance.

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. Certain system disturbances may cause loss of synchronism between a generator and the rest of the utility system, or between interconnected power systems of neighboring utilities. Various control methods and controllers have been developed over time that has been used for this purpose.

IN today's power systems reliability and transfer capability are limited by stability constraints such as transient stability and oscillatory stability. Maintaining system stability present new challenges As power systems are operated with more uncertainty than in the past. This stability can be challenged if low frequency oscillations are present in the system. Low oscillations, if present in the system can drive the system to the verge of instability. This brings the need of the PSSs into the power systems which are efficient tools in damping out oscillations in the range of 0.2 Hz to 2.5 Hz. PSSs minimize the small excursions of the oscillations about a steady operating point. The small excursions about an operating point are due to the system being lightly damped. The generators are equipped with PSSs as supplementary control devices, to provide extra damping and improve the dynamic performance. These oscillations result when rotors of generators swing with respect to each other in the same area and with respect to a group of generators in the other areas. Depending on the oscillations of the generators they are categorized into three main oscillation modes - local mode, inter-area mode and intra-area mode.

Depending on their location in the system, some generators participate in only one oscillation mode, while others participate in more than one mode.

Two types of PSS [1], [2], [3] is use in the model

1) Multi-Band power system stabilizer
2) Generic power system stabilizer

In some case PSS are fail to maintain the stability of power system, so that are use the FACT device which give additional support to maintain the stability of power system. So we are show the effect of PSS and SVC in this paper.

II. SYSTEM MODEL

In this paper simulation of two models is shows.

A. Double infeed with fault at midpoint

Circuit Description:

Figure1 show the two-area system used in the study. The system consists of two identical areas. Each area includes two 900 MVA generating units equipped with fast static exciters. All two generating units are represented by the same dynamic model. The machine and the exciter data used in the study are taken from Kundur book of power system stability & control.

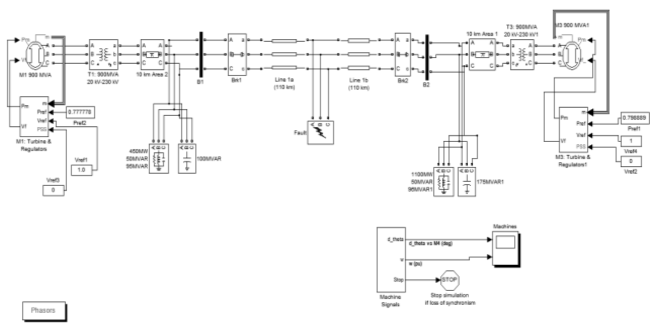

Fig.1.MATLAB model

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* Correspondence Author (s)
Dhaval N Tailor, PG Student of B.V.M college of Engg., V. V. Nagar, Gujarat, India, 9601290378, tailordhaval@gmail.com
Dr. Bhavesh Bhalja, HOD of electrical dept .of ADIT College of Engg. & Tech., New V. V. Nagar, Gujarat, India, 9428488247, bhaveshbhalja@gmail.com
Vijay Makawana, Associate Professor of GCET College of Engg. & Tech., V. V. Nagar, Gujarat, India, 9825783644, vijay911979@gmail.com

Synchronous machine parameter:
Generator 1(GA)
Inertia coefficient H: 6.5, Friction factor F: 0,
Pole pairs: 4
Reactance's: Xd =1.8, Xd' = 0.3, Xd" =0.25
Xq = 1.7, Xq" = 0.55
Initial theta (deg) : 0.966426
Stator resistance: 0.0025
Generator 1(GB)
Inertia coefficient H: 6.5, Friction factor F: 0, Pole pairs: 4
Reactance's: Xd =1.8, Xd' = 0.3, Xd" =0.25
Xq = 1.7, Xq" = 0.55
Initial th(deg) : 0.820102 , Stator resistance : 0.0025
Power system stabilizer (PSS):

1) MB-PSS with simplified settings: IEEE® type PSS4B according to IEEE Std 421.5
2) Conventional Acceleration Power (Delta Pa) PSS

Simulation result:
Without PSS:

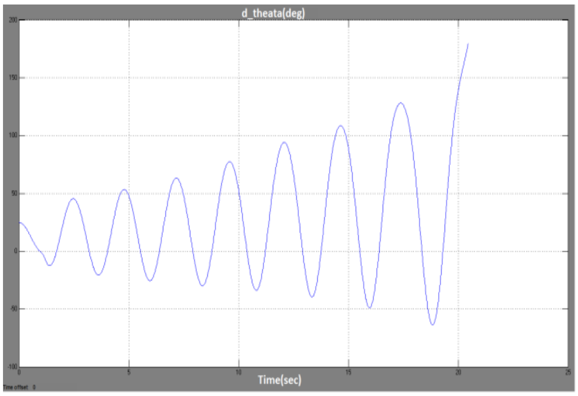

Fig.2.Angle difference

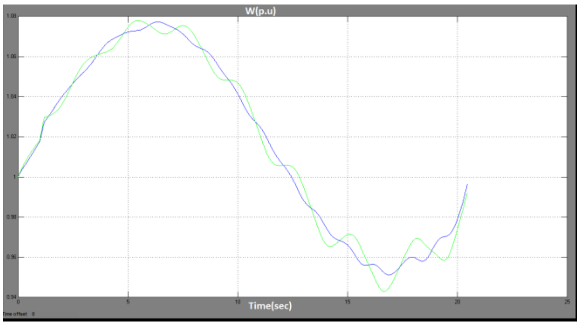

Fig.3.Rotor speed

With genetic PSS:

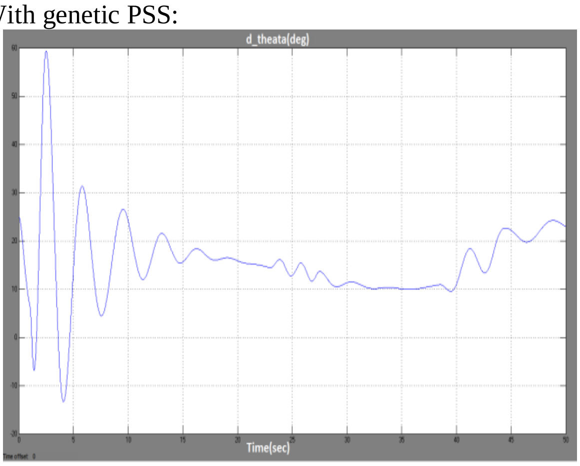

Fig.4.Angle difference

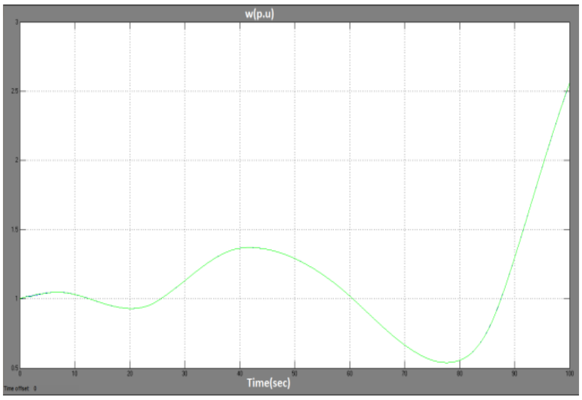

Fig.5.Rotor speed

With MB PSS:

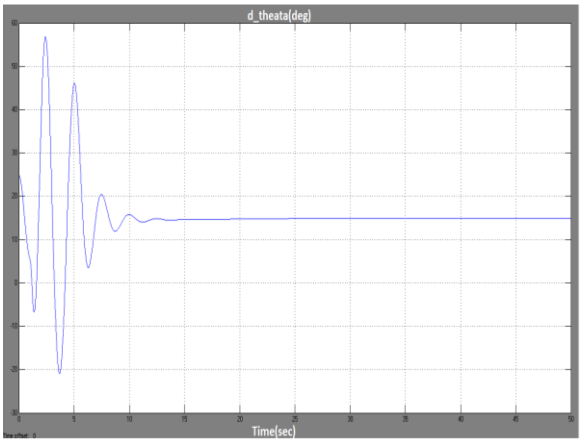

Fig.6.Angle difference

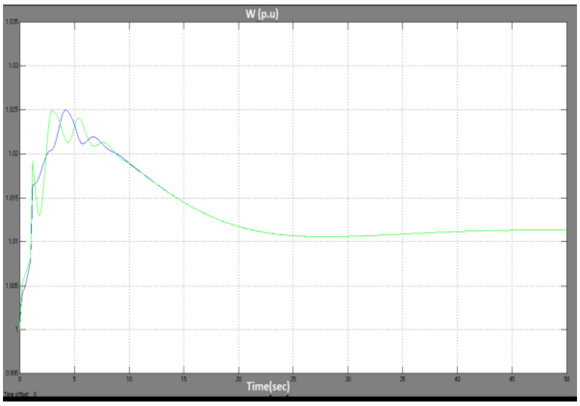

Fig.7.Rotor speed

In waveform d_theta indicate the angle difference between two machines and the W indicate rotors speed in p.u. We can clearly see that in figure 2, 3 if there is no PSS than system can't able to sustain stability and become out of step. In figure 4, 5 see that when we use Genetic PSS system becomes stable but there is low frequency oscillation present. In figure 6, 7 we see that when use MB PSS system may stable with no low frequency oscillation. So MB PSS more accurate compare to genetic PSS.

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B. Double infeed with SVC and fault at generator bus

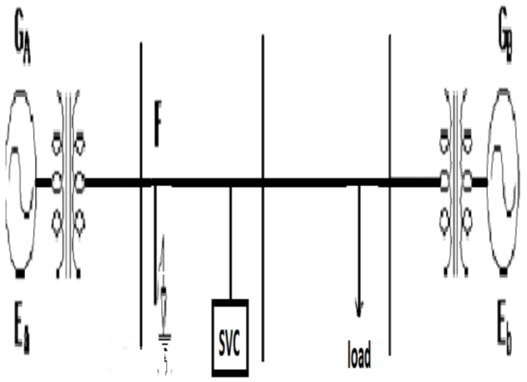

Fig.8.Model with SVC

Circuit description:

A 1000 MW hydraulic generation plant (machine M1) is connected to a load center through a long 500 kV, 700 km transmission line. The load center is modeled by a 5000 MW resistive load. The load is fed by the remote 1000 MW plant and a local generation of 5000 MW (machine M2). In order to maintain system stability after faults, the transmission line is shunt compensated at its center by a 200-Mvar Static var Compensator (SVC) for transient stability solution. The SVC does not have a Power Oscillation Damping (POD) unit. The two machines are equipped with a Hydraulic Turbine and Governor (HTG), Excitation system and Power System Stabilizer (PSS).

In Simulation I have done two type of fault

1) Single line to ground
2) Three line to ground

In this case transient fault occur at 5s to 5.01s.

III. OBSERVATION TABLE

Single line to ground:

	Generic PSS		Multiband PSS	
	Without SVC	**With SVC**	**Without SVC**	**With SVC**
Stable time(s)	12	10	9.2	8.5
Angle deviation in degree	1.18	1.13	1.17	1.13

When compare both the result of PSS with & without SVC, the PSS able to sustain the stability, but using SVC the angle deviation is reduce that show in table.

Three line to ground:

	Generic PSS		Multiband PSS	
	Without SVC	**With SVC**	**Without SVC**	**With SVC**
Stable time(s)	Unstable after 8.13	11.8	Unstable after 8.17	8.5
Angle deviation in degree	Above 120	2	Above 120	1.93

Here we show that if there is three phase transient fault

than Without SVC both PSS not able to maintain the stability. Application of SVC result into the increase ability of system to maintain stability and system remain in synchronism.

IV. CONCLUSION

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 other devices to maintain stability.

Nowadays static devices are widely use in system for compensation of reactive power demand and help to maintain system stability in some transient condition.

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