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Dynamic Stability Analysis by Shunt Connected FACTS Controller

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Abstract: *power electronic based FACTS (Flexible AC Transmission system) devices are established to enhance the power transmitting capacity and also mitigation of oscillatory period of system at the time of fault. With increasing in transmission line loading the parameter of the power system stabilizers has returned in accordance with operation state. Now power system is highly nonlinear so fixed parameter power system stabilizer cannot cope with great change in operating condition providing secure loading power flow control and voltage control in transmission system. This controller provided supplementary stabilizing loop are found. In this dissertation the performance of system is examined for different power system stabilizer at the time of fault, which occurs in power transmission network the oscillation and settling time is compared with the performance of different FACTS controller and proposed which one is best for technical point of view. The case study of two area system is taken for analysis. Fault is created for observation of different parameter of machine and transmission system like rotor angle waveform, settling time, voltage of machine, active power of machine and transmission voltage. The different fault analysis says that FACTS controllers help to improve dynamic stability. Therefore an attempt has been taken to analyze the dynamic stability enhancement in multi machine system by using different FACTS devices. MATLAB simulation is used to do analysis for different system.*

Keywords: *Power System Stability, FACTS, Dynamic Stability, SVC, STATCOM*

I. Introduction

1.1Introduction:

Power system stability is primarily concern with variation in rotor speed, rotor position and generator loads. Power system stability, in general term may be defined as its ability to respond to a perturbation from its normal operation by returning to a condition where the operating is again normal.

Dynamic stability is the ability if power system to remain in synchronism after the initial swing (transient stability period) until the system has settle down to the new study state equilibrium condition. When sufficient time has elapsed after a perturbation, the governors of the prime mover will react to increase or decrease energy input as may be required, to reestablish a balance in between input energy and the existing electrical load. This usually occurs in about 1 to 1.5 second after the perturbation. The period between the time the governor begins to react and the time that steady state equilibrium is reestablish in the period when dynamic stability characteristic of a system are effective. Dynamic stability studies cover longer real time interval, perhaps 5 to 10 second occasionally upto30 second depending on the inertia of system and the characteristics of governor. During this period the governor open or close the valve as required to increase or decrease the prime movers, and the tie line controller to restore tie line flow to normal. Usually when system sense the speed drop, they will act to open the throttle valve to admit more steam into turbine to arrest the decline speed (frequency)and accelerate the system back to normal speed. This still a condition of system unbalanced, because energy input now exceeding the load and the speed will increasing beyond the normal, where the governor again to reduce energy input. As a result, oscillation of energy output and machine rotor energy will occur if the system is dynamically stable, the oscillation will be damped, that is reduce in magnitude, after a few swing then system will settle down to an steady state condition with energy input equal to an electrical load of the system.

1.2 Necessity :

Today large system interconnected with the greater system inertias and relatively weaker ties result in longer period of oscillation after perturbation. Second swing is smaller than first swing but its remain constant and after few swings system may become unstable. So to reduce oscillation FACTS controller is used.

1.3 Theme:

In present situation of multi machine system take special attention. The enhancement of dynamic stability becomes very important for reliability and continuity of power system. Therefore an attempt has been taken to analyze the dynamic stability enhancement in multimachine system by using different FACTS devices. MATLAB simulation is used to do analysis for different system.

II. Power System Stability

Power system stability is the ability of an electric power system, for a given initial operating condition, to regain a state of operating equilibrium after being subjected to a physical perturbation, with most of the system variables bounded so that practically the entire system remains intact [3]

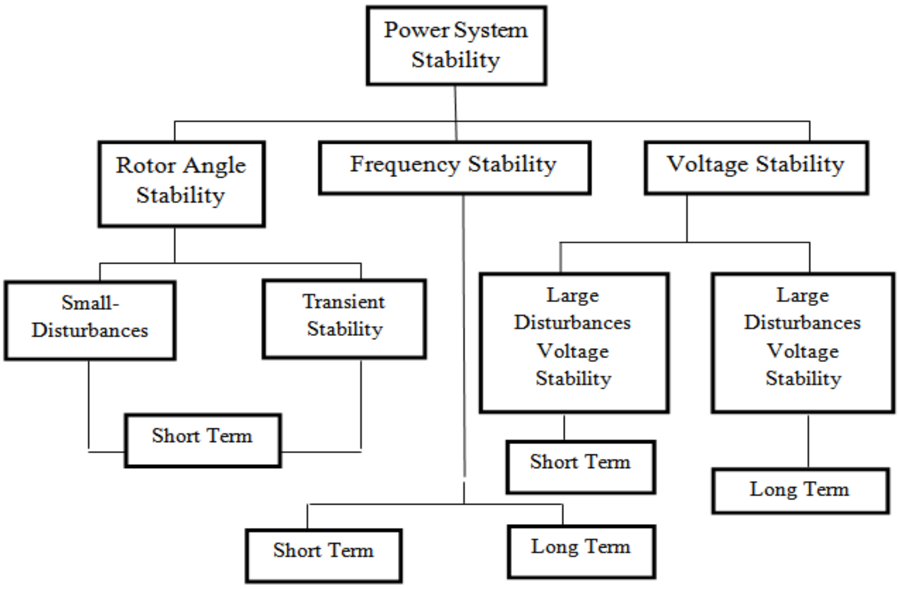

Fig. 2.1 Classification of power system stability [2]

III. Facts Controller

The goal of fusing FACTS is into the power framework lines are like HVDC yet more prominent adaptability are included like enhancing genuine power move capacity in the lines, avoidance of sub-synchronous reverberation (SSR)oscillations and damping of intensity swings [4]. Actualities gadgets have four surely understood sorts which are utilized in many power frameworks on the planet [5]. 'Single ' type controller is the sorts of FACTS that introduced in arrangement or shunt in an AC transmission line, while ' bound together ' type controller are the consolidated converters kind of FACTS controllers like UPFC and HVDC. The accompanying kinds of FACTS gadgets are VSC type based controller. But in this paper tittle only shunt connected FACTS controllers are mention, so only shunt connected FACTS controller should be describe in detail. A shunt connected static VAR absorber whose output is adjusted to exchange capacitive or inductive current so as to control specific parameter of electrical power system.

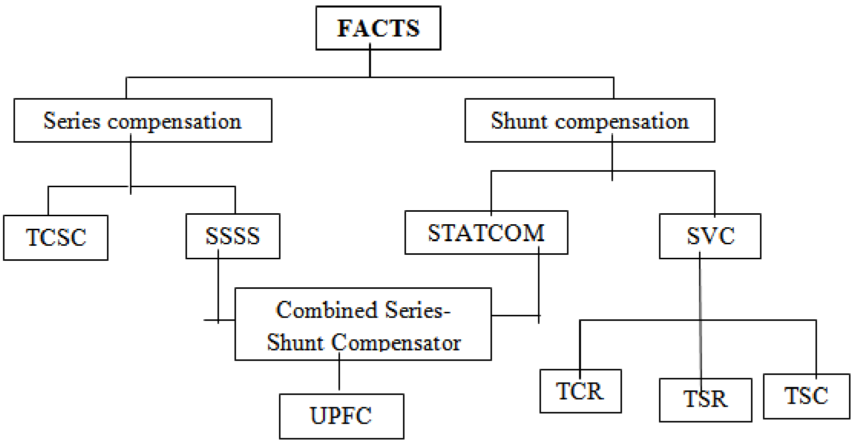

Fig. 3.1 Classification of FACTS devices [6]

3.1 Static VAR Compensator (SVC)

A shunt associated static VAR safeguard whose yield is changed in accordance with trade capacitive or inductive flow in order to control explicit parameter of electrical power framework.
These comprised capacitor bank fixed or switched or capacitor bank and switched reactor bank in parallel. These compensator draw reactive power (leading or lagging) from the line regulating voltage, improve steady state or dynamic stability reduced voltage flicker. In HVDC system, compensator provides the required reactive power and damp out sub harmonic oscillation. It is also called static VAR switches [6].

3.2 Static Synchronous compensator (STATCOM)

Static synchronous compensator worked as shunt associated gadgets that are capacitive or inductive yield current can be controlled autonomous of the air conditioner framework voltage. Its task is partner of SVC. It can be based of voltage and current sourced convertor. STATCOM can be designed to be an active filter to absorb harmonic of system [6].STATCOM copies like a variable inductor or can be a capacitor in shunt or parallel association in the transmission line. This sort of gadget is equipped for impersonating inductive or capacitive reactance in swings to direct line voltage at the purpose of coupling. Shunt controller when all is said in done controls the voltage infusion [7]. The rise of FACTS gadgets and specifically GTO thyristor-based STATCOM has empowered such innovation to be proposed as genuine focused options in contrast to customary SVC. From the perspective of intensity framework dynamic dependability, the STATCOM gives preferable damping attributes over the SVC as it can briefly trade dynamic power with the framework.

IV. Performance Analysis

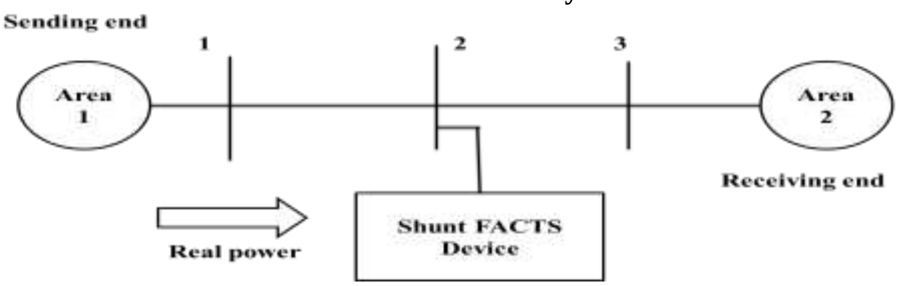

Fig. 4.1 Two area power system with shunt FACTS Devices

Two area systems are to be consider, each individual area consisting of two machines. Rating of all machine= 900MVA, 20KV, resistance of 0.0025 and speed is 3600 rpm. Rating of transformer= 900MVA20/230KV, Length of transmission line from G1 to G2 25km.G2 to load 10km.and transmission line from area one to two 110km. The performance should be done bu MATLAB Simulink.

4.1 Wave form by SVC FACTS Controller

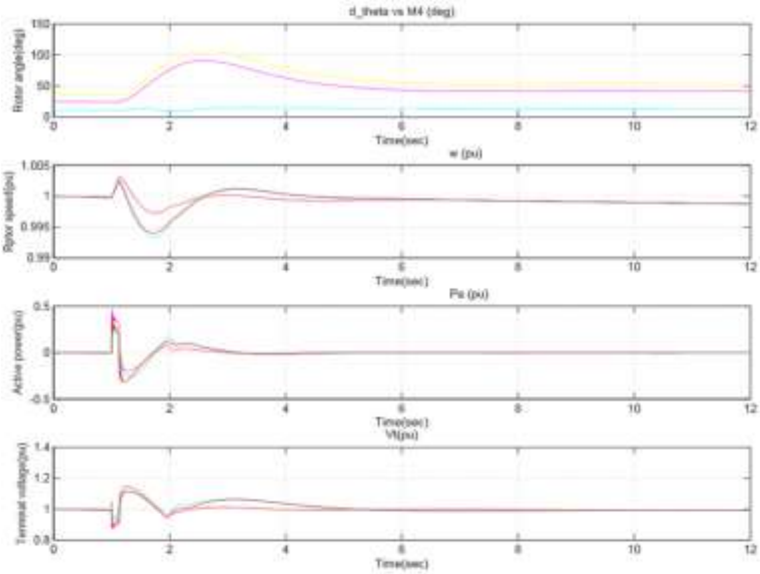

Fig. 4.2 Rotor angle, power and terminal voltage of machine Vs Time

4.2 Wave form by STATCOM FACTS Controller

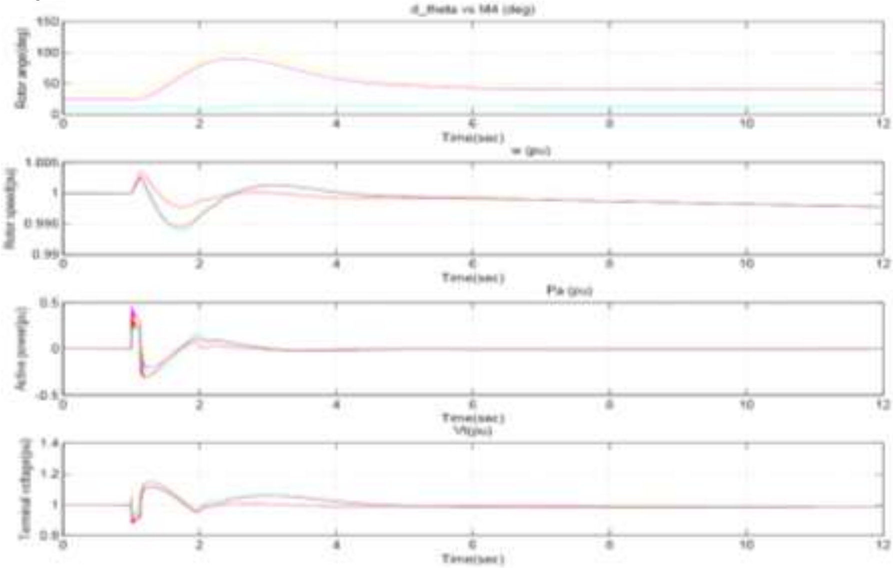

Fig. 4.3 Rotor angle, power and terminal voltage of machine Vs Time

4.3 Result Table

Table. 6.1 Summarized studied of FACTS device at the time of Fault

Measured Parameter	Transmission power(MW)				Rotor Angle(deg)		Rotor speed ω(pu)				Terminal voltage of machine Vt(pu)			
	Pre fault	At Fault	Post fault	Settling time(sec)	Peak value	Settling time(sec)	Pre fault	At Fault	Post fault	Settling time(sec)	Pre fault	At Fault	Post fault	Settling time(sec)
With SVC	420	200	460	6	105	6	1	1.0 03	0.990	6	1	0.9	1.1 5	6
With STATCOM	420	195	455	5.9	100	5.9	1	1.0 03	0.994	5.5	1	0.92	1.2 3	5

V. Conclusion

In this dissertation, various controller of modern power system were discussed and on basis of these controller, need of FACTS devices were presented. The variation of power system oscillation and time period is compared with and without the presence of FACTS devices and power system stabilizers in the event of major perturbation. The performance of one of the FACTS device i.e. STATCOM for dynamic stability enhancement is compared with the performance of other FACTS device i.e. SVC. Controller's sources of info are picked cautiously to give important damping in rotor edge and results are taken through reenactment. Proposed FACTS controllers were actualized in MATLAB/SIMULINK. Recreation results demonstrate that the STATCOM controller introduced with two zone frameworks gives better damping qualities in rotor edge when contrasted with two region framework introduced with SVC.

References

[1]. J.Gokula Krishnan, N.Senthil Kumar, M.Abdullah Khan, On the optimal tuning of FACTS based stabilizers for dynamic stability enhancement in multimachine power systems, IEEE Conference, 2011.

[2]. Kakkar, V., & Agarwal, N. K ,Recent trends on FACTS and D FACTS,. In modern electric power systems (MEPS), proceedings of the international symposium IEEE. pp. 1-8, 2010.

[3]. M.S.Castro, H.M.Ayres, V.F.da Costa, L.C.P.da Silva , Impacts of the SSSC control modes on small-signal and transient stability of a power system, Electric power systems research, Vol.77, No-1, pp.1-9, 2007.
[4]. Galu Papy Yuma and Galu Papy Yuma, Damping of Oscillations of the IEEE 14 bus power system by SVC with STATCOM, IEEE press, 2012.
[5]. J. Barati, A. Saeedian, and S. S. Mortazavi, Damping power system oscillations improvement by FACTS Devices: A comparison between SSSC and STATCOM, World Academy of Science, Engineering and Technology Vol: 4, pp -02-26, 2010.
[6]. Kakkar, V., & Agarwal, N. K ,Recent trends on FACTS and D FACTS, In modern electric power systems (MEPS), proceedings of the international symposium IEEE. pp. 1-8, 2010.
[7]. Nelson Martins, Herminio J.C.P. Pinto, John J. Paserba, Using a TCSC of line power scheduling and system oscillation damping - small signal and transient stability studies, IEEE power system, 2000.
[8]. Muqueem M khan, Tanveer Husaun,M M Ansari, ,Stability enhancement in multimachine power system by FACTS controller,IEEE pp.414-418,2016.