DAMPING OF POWER SYSTEM OSCILLATIONS USING SVC AND STACTOM

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Abstract

Today's Power system is a complex network; the integration of two neighboring power systems by an interconnecting lines may often offer attractive benefits to both parties. Inter-area oscillations are inherent in large interconnected power systems. System outage resulting from these oscillations is of growing concern. Over the last three decades, attention has been focused on power system damping control design to reduce the risks of system outage following undesirable oscillations. Flexible AC Transmission provides unprecedented way for controlling transmission grid and increasing transmission capacity. This paper is Highlighting the concept of the power system transient stability analysis and its improvement by FACTS controllers and this approach can be applied in complex power system network

Index Terms: Damping, FACTS controllers, inter area Oscillations, Power Oscillation, STATCOM, SVC

I. INTRODUCTION

A problem of interest in the power industry at which FACTS Controllers could play a significant role in it is increasing damping of low frequency power oscillations that often arise between areas in large interconnected power grid networks. These oscillations are named as inter-area oscillations, which are generally characterized by poor damping [1-4].The integrated power system therefore is prone to low-frequency "inter-area" power swings, when the equilibrium between generational load balance in each system and the power transfer along the interconnection line is being disturbed. Such disturbances may be caused by loss of a main transmission line. These transient disturbances can be produced by switching operations, load changes, and particularly, loss of excitation and faults.

Ideally, the loads must be fed at constant voltage and frequency at all times. In recent times, the use of FACTS devices has become a common practice to make full utilization of existing transmission capacities instead of adding new lines which are often restricted for economic and environmental reasons [3].

The high- voltage transmission system connects the generating stations and the load centers [8-9]. Interruptions in this network may unstable power flow to the load. Since almost all power systems are interconnected with neighboring systems. So random changes in load are taking place at most of times, with subsequent changes in generation. Synchronism may be frequently lost in that transition period, or increasing oscillations may occur over a transmission line, eventually leading to its tripping.

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 conditions and to regain an acceptable state of equilibrium after being subjected to a disturbance phase shifter, Series capacitor and shunt capacitor are different approaches to strengthen the power system load ability. In earlier days, all these devices were controlled mechanically, which is relatively slow. They are very useful in a steady state operation of power systems but in transient operation, their time response is too low to effectively damp transient oscillations. If mechanically controlled systems were made to faster response, power system security would be significantly improved, allowing the full utilization of system capability while maintaining adequate levels of voltage stability.

II. OBJECTIVE

The objective of this paper is to investigate the power system Transient stability analysis and reducing the oscillation by Flexible AC Transmission System (FACTS) controllers. Here at first we have analysis a demo network with stable and unstable condition.

A stable power system network may be unstable at any moment due to external fault, if the fault is cleared but it will effect the transmission line voltage as well it also effect the connecting generators also. As a result the generator output stability is changed so line voltage is differ from its stability limit and make the system unbalance and unstable. As a result huge amount power loss occurred in the line.

So in this paper we have studied a normal power system and make it abnormal in Case1 by introducing the fault in the system.

In Case2 it is shown how the stability increased by using SVC (Static Var Compensator), in Case3 by using STATCOM (Static Synchronous Compensator) and in Case4 by using double STATCOM (two STATCOMs connected in parallel). We also compared the different FACTS controllers in MATLAB simulation.

III. SIMULATION RESULTS AND DISCUSSIONS

In this case effect of different FACTS controller mainly SVC and STATCOM on transient stability is analyzed in a demo power network. Comparison between effect of SVC and STATCOM and Double STATCOM on two machine system is carried out with and without controller by creating short duration of a three phase to ground fault and line to line fault. Transient stability in two fault condition – three phase to ground fault and line to line fault is studied and analyze the different curves of transient stability with different parametric condition like active power, reactive power, load angle and speed deviations with respect to time and how they are vary with respect to time and get the idea of transient stability and get how the system is different from the actual curve of respective parameter.

A. Case 1: Two Machine System: when System is under three-phase fault and its simulation has studied here

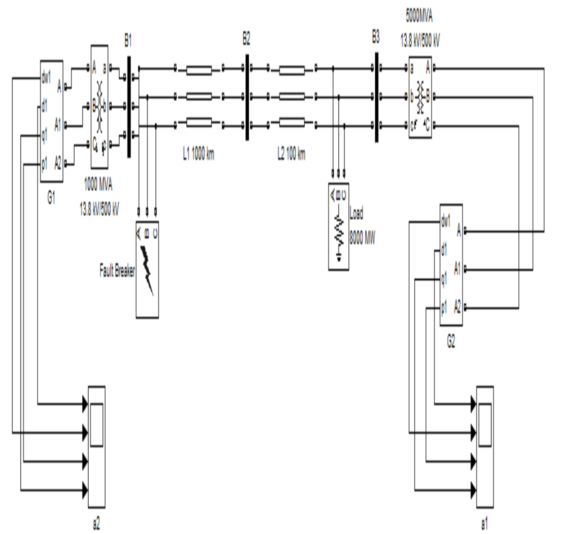

Fig. 1. Simulation Model without any FACTS Controller

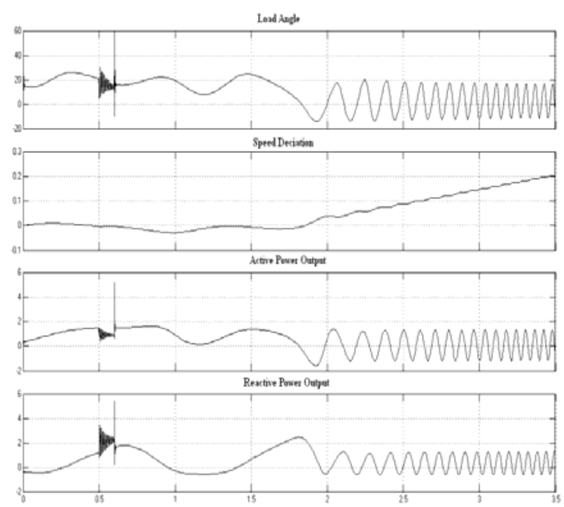

Fig. 2. Output wave form obtained with alternator 1 without any FACTS controllers

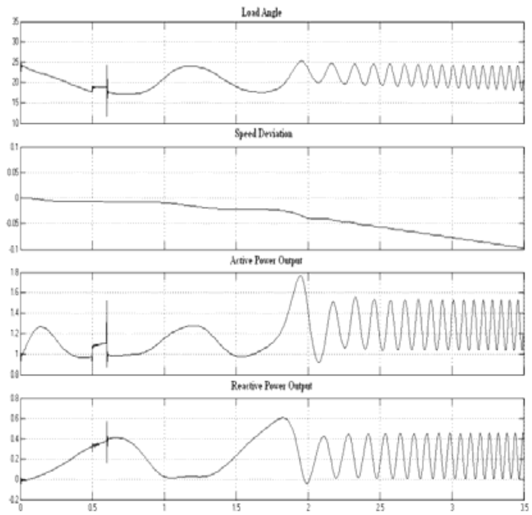

Fig. 3. Output wave form obtained with alternator 2 without any FACTS controllers

The simulation diagram for without using any FACTS controller is shown in Fig. 1. Fig. 2 delineated that the output waveforms of load Angle, speed deviation, active power output and reactive power output of alternator 1 without FACTS Controller. Similarly the output waveforms of load angle, speed deviation, active power output, and reactive power output of alternator 2 without FACTS Controller are depicted in Fig 3. From Fig. 2 and Fig. 3, it is observed that the active power, reactive power, speed and load angle has been changed so transient effect is occur in the network, as a result the voltage stability is differ from its rated value. If these deviation is exits for a long time in a transmission line or alternator our stable voltage is differ from is stability and cannot get desired power output from alternator. It is observed that the alternator active power decreases and reactive power is increases, so unbalance is created in the transmission line as a result power system stability will be hampered, which directly effect to the distribution line and our load. So it is bad effect of power transmission line as well as costly equipment alternator. For that reason we should analysis of faulty network and improvement our stability limit by improving our various parameters, which is highlighted in case2.

B. Case2:- Improvement of stability by using SVC

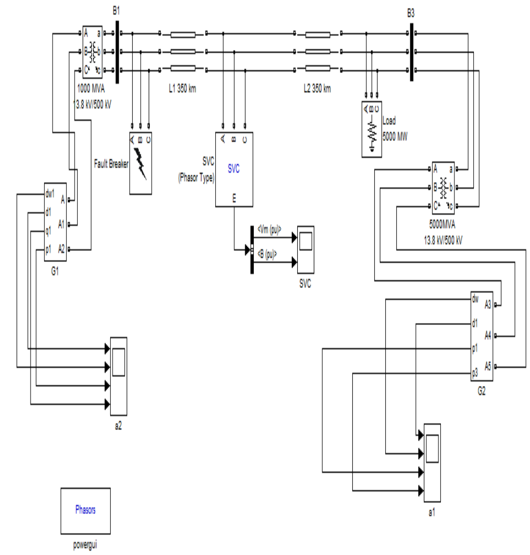

Fig. 4. Simulation Model SVC Controller

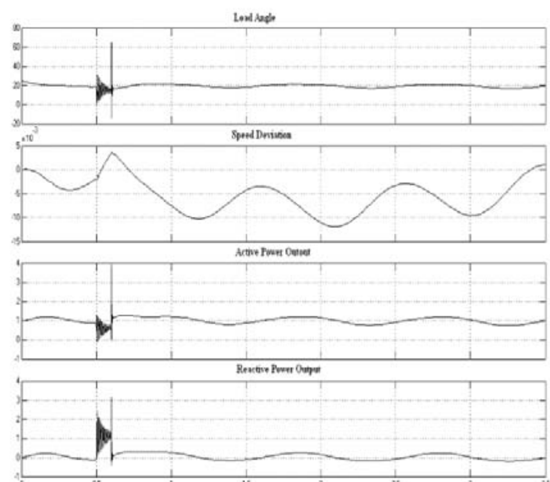

Fig. 5. Output wave forms obtained with alternator 1 with SVC

Fig. 4 represents the simulation diagram by considering static var compensator (SVC). The output waveforms of load angle, speed deviation, active power and reactive power output of alternator 1 with SVC are shown in Fig 5. As well as the Fig. 6 gives the information about output waveforms of load angle, speed deviation, active power and reactive power output of alternator 2 with SVC.

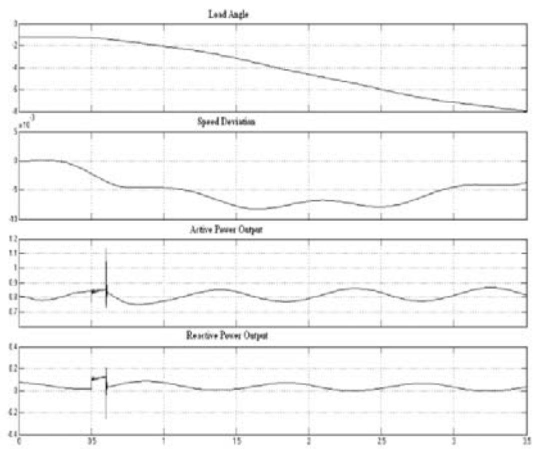

Fig. 6. Output wave forms obtained with alternator 2 with SVC

Case 3:- Analysis and test this model by using STATCOM device which give more accurate result compare than SVC

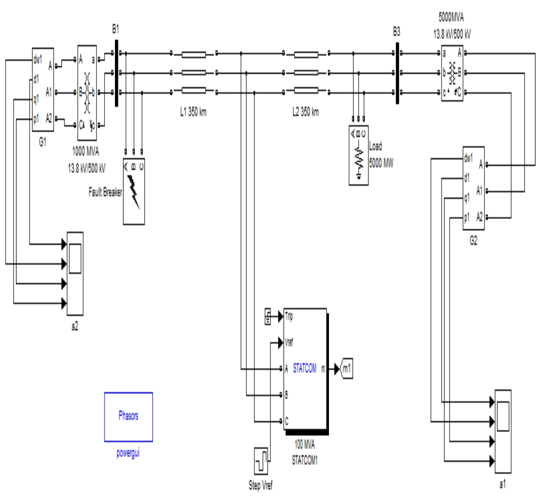

Fig. 7. Simulation Model STATCOM Controller

Fig. 7 represents the simulation diagram by considering synchronous static compensator (STATCOM). The output waveforms of load angle, speed deviation, active power and reactive power output of alternator 1 with STATCOM are shown in Fig. 8. Similarly, Fig. 9 depicts the output waveforms of load angle, speed deviation, active power and reactive power output of alternator 2 with STATCOM. From Fig. 8 and Fig. 9, it is understood that the reactive and active power, speed deviation & rotor angle has been improved, but this is more improved when we connect two STATCOM parallel in the network.

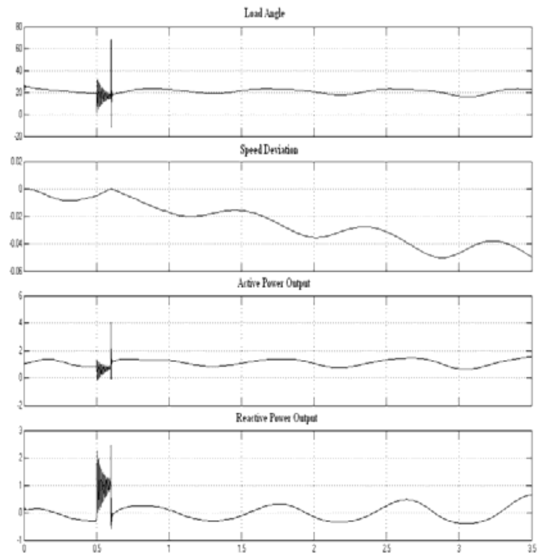

Fig. 8. Output wave forms obtained with alternator 1 with STATCOM

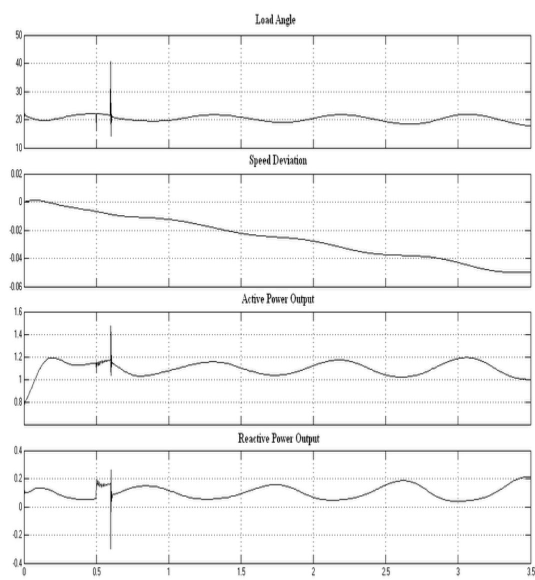

Fig. 9. Output wave forms obtained with alternator 2 with STATCOM

IV. CONCLUSIONS

In this paper, the effect of various FACTS controllers (SVC and STATCOM) is studied and compared their effects and it is identified that after introducing the FACTS controllers, system could be stable depending on their reactive power supply capability. It is also observed that two STATCOMs connected in parallel gives more reactive VAR than SVC. The power system transient stability can be improved by using suitable FACTS controllers placed at appropriate location. Thus results in improve the transient stability and improve the alternators parameters that power system maintained its stability limit through the system operating in a complex synchronous system.

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