TRANSIENT STABILITY ANALYSIS OF POWER SYSTEM WITH FACTS DEVICES

Mubasshir Syed[1], Mrs. Neena Godara[2]
[1]M.Tech Scholar, [2]Professor Alfalah University Dhauj Faridabad

Abstract: The study presents the experimental investigation carried out to evaluate the transient stability of power system with and without FACTS devices. The basic objective of this study was analysis of transient stability for single phase fault and three phase fault. The effect of FACTS devices on transient stability are evaluated in this study. Use of SVC helps in improving the systems voltage stability and other FACTS devices help improve the rotor angle stability and frequency stability. The results of transient stability with and without SVC were obtained and from the study it was clear that the transient stability is improved by using FACTS devices.

1. INTRODUCTION

Transmission networks of present power systems are becoming progressively more stressed because of increasing demand and limitations on building new lines. One of the consequences of such a stressed system is the risk of losing stability following a disturbance. Flexible ac transmission system (FACTS) devices are found to be very efficient in a stressing transmission network for better utilization of its existing facilities without sacrificing the desired stability margin. Flexible AC Transmission System (FACTS) controllers, such as Static VAR Compensator (SVC) and Static Synchronous Compensator uses the latest technology of power electronic switching devices in electric power transmission systems to control voltage and power flow, and play an important role as a stability aid for and transient disturbances in an interconnected power systems. Transient stability involves the study of the power program carrying out a major disturbance. Here we present the improvement of transient stability of a two machine system with a SVC. Transient stability improvement is necessary from the view point of maintaining system security that is the occurrence of a fault should not lead to tripping of generating unit due to loss of synchronism. SVC has the ability of improving stability and damping by dynamically controlling its reactive power output. The transient stability improvement of the two area system with different fault conditions is investigated in this work. The stability of something describes the power of something to come back once again to its steady state when subjected to a disturbance. As discussed earlier, power is produced by synchronous generators that perform in synchronism with the remaining portion of the system. A generator is synchronized with a coach when equally of them have same volume, voltage and stage sequence. We can hence define the power program stability as the power of the power program to come back to steady state without losing synchronism.

2. SIMULATION RESULTS

Three-Phase Fault — Impact of SVC — PSS in Service:

We will now apply a 3-phase fault and observe the impact of the SVC for stabilizing the network during a severe contingency.

First put the two PSS (Generic Pa type) in service. Reprogram the Fault Breaker block to apply a 3-phase-to-ground fault. Verify that the SVC is in fixed susceptance mode with Bref = 0. Start the simulation. By looking at the d_theta1_2 signal in fig 1, we observe that the two machines quickly fall out of synchronism after fault clearing. In order not to pursue unnecessary simulation, the Simulink Stop block is used to stop the simulation when the angle difference reaches 3*360 degrees.

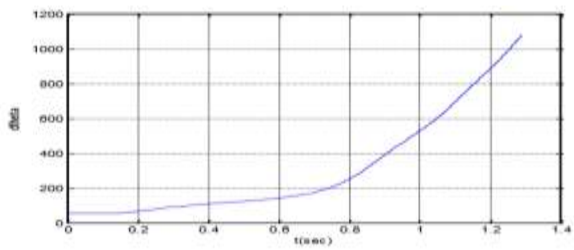

Fig.1 Rotor angle difference for 3 phase Fault when PSS is in service but not SVC

We can see from the graph in fig 2 that the speed of machines is not stable. When the fault occur at 0.1sec ,after fault clearing at 0.2sec the machine speed should have come to stable state but as we have not used SVC the machines loose synchronism after fault clears.

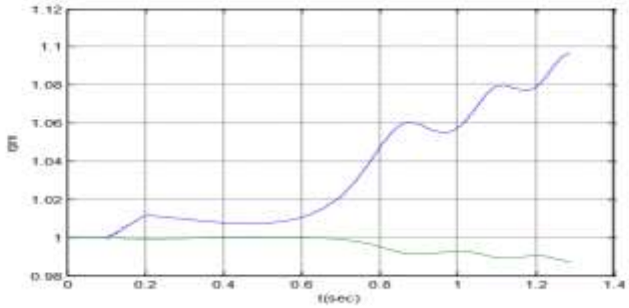

Fig 2 Speed of machines when PSS in service but not SVC

As we have put SVC in the fixed susceptance mode, the voltage at SVC and SVC susceptance are not stable and fixed respectively as shown in figures 3 and fig 4.

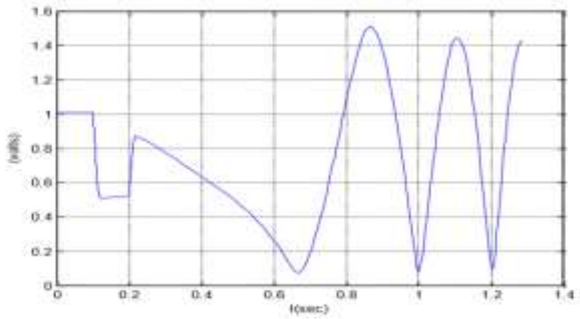

Fig 3 voltage at SVC when Bref=0

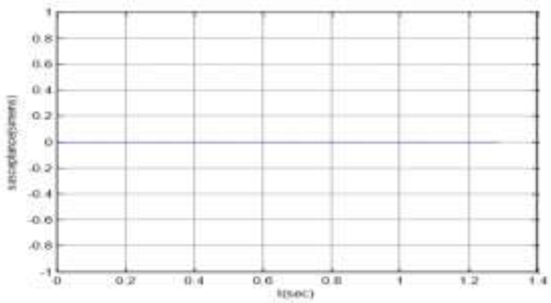

Fig 4 SVC susceptance with Bref=0

Now open the SVC block menu and change the SVC mode of operation to Voltage regulation. The SVC will now try to support the voltage by injecting reactive power on the line when the voltage is lower than the reference voltage (1.009 pu). The chosen SVC reference voltage corresponds to the bus voltage with the SVC out of service. In steady state the SVC will therefore be floating and waiting for voltage compensation when voltage departs from its reference set point.

Restart simulation and observe that the system is now stable with a 3-phase fault.

Fig 5 on the Machines scope shows the rotor angle difference d_theta1_2 between the two machines. This signal is a good indication of system stability.

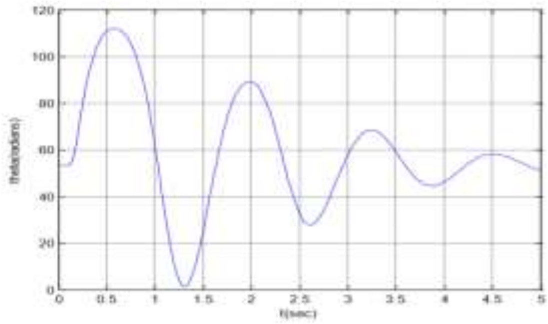

Fig 5 Rotor angle difference when SVC in use

Fig 6 shows the machine speeds. Notice that machine 1 speed increases during the fault because during that period its electrical power is lower than its mechanical power.

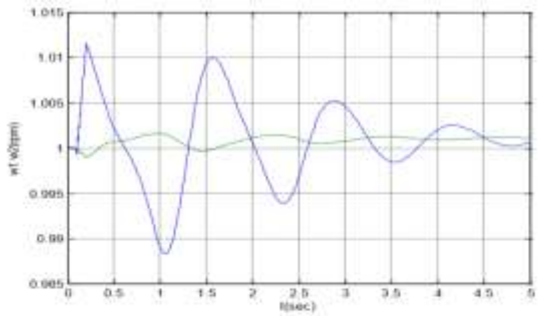

Fig 6 Speed of machines when SVC in use

As now SVC is in voltage regulation mode that means there should be change in voltage at SVC and SVC susceptance which is shown in fig7 and fig8.

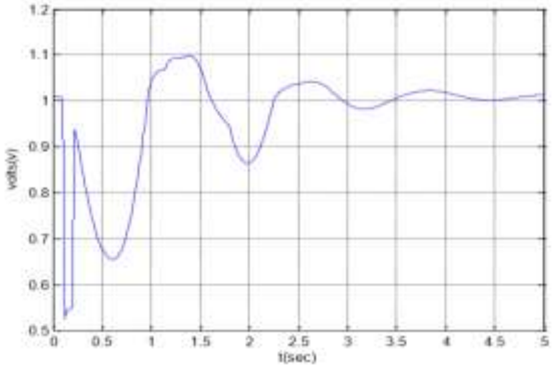

Fig 7 SVC voltage when SVC in voltage regulation mode

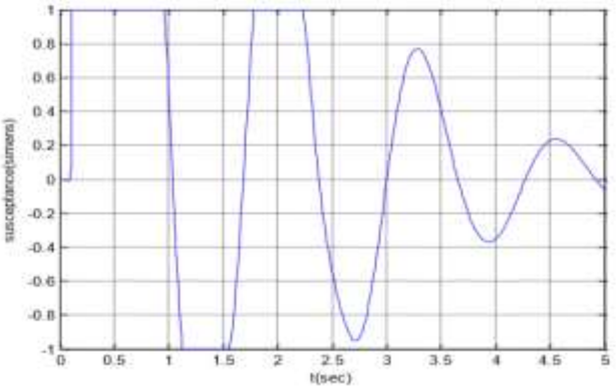

Fig 8 SVC susceptance when SVC in voltage regulation mode

3. CONCLUSION

It is found in the study that the transient stability of the system is highly affected by SVC. After clearing the fault high transients had appeared in rotor angle difference of two machines, in transmission line voltage and power when SVC was not connected in the line. But after connecting SVC in the line, transient period has decreased to a significant value for above parameter of transmission line. Thus it can be concluded that the transient stability of two area power system improves by using SVC. The transient stability of a two machine system was obtained by using the static var compensator and power system stabilizer. The stabilizer improved the damping of oscillations created in the machine by the three-phase fault and the reactive power improvement was done by static var controller by injecting reactive power in the system or receiving the reactive power by the controller. It may be observed that transient balance is significantly suffering from the type of a problem, therefore that the energy program analyst should at the start of a balance examine determine this factor.

Our goal ought to be to improvise techniques to boost transient stability. A phase has been achieved in engineering where the techniques of increasing balance have already been pressed for their limits. With the development to lessen device inertias there's a continuing require to ascertain access, feasibility and applicability of new techniques for sustaining and increasing stability.

- Future study:

The other FACTS devices are present like static synchronous compensator (STATCOM) is the second generation of FACTS controllers that has a very promising future application. STATCOM has several advantages of being small/compact, high response speed. The other is static series synchronous compensator (SSSC) is a complementary second generation FACTS controller, which is simply a series version of STATCOM. The unified power flow controller (UPFC) is the most versatile one that can be used to improve transient stability. The comparison can be made with these FACTS devices concluding which device is more versatile for transient stability improvement. The studies can be extended to power factor improvement by using FACTS devices. There is the possibility that system become unstable after first swing stability. The study can be extended beyond first swing stability to ensure that the the system will be stable after first swing.

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