POWER SYSTEM STABILITY IMPROVEMENT BY FACT DEVICES

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ABSTRACT: To suppress the large disturbance of power system implies to improvement of stability of system. Disturbances lead to out of synchronism of the power system, whose restoring has number of technical and financial problems. So Power system stability improvement is very important and challenging issue for modern interconnected system. In this Paper, FACT devices are introduced to improve the Power system Stability. Flexible ac transmission system (FACTS) devices are found to be every effective in stressing a transmission network for better utilization of its existing facilities without sacrificing the desired stability margin. Flexible AC Transmission System (FACTS) controllers, such as Static Synchronous Compensator (STATCOM) and Static VAr Compensator (SVC), employ 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. This Paper presents the improvement of transient stability of a WSCC- 9 Bus power system with a Static VAr Compensator (SVC) in Power world Simulator . Static VAr Compensator has the capability of improving stability and damping by dynamically controlling its reactive power output. To illustrate the performance of the FACTS controller (SVC), a three machine, nine bus Western System Coordinating Council (WSCC) Multi-Machine Power System has been considered.

KEYWORDS: FACTS, Power world Simulator, SVC, Transient Stability, WSCC 9 BUS Power System.

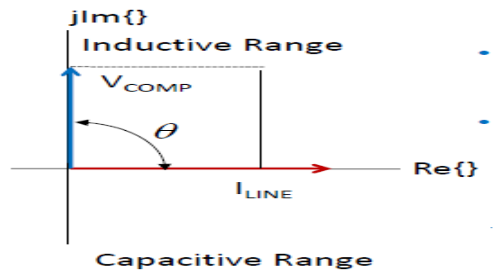
INTRODUCTION

Each generator operates at the same synchronous speed and frequency of 50 hertz while a delicate balance between the input mechanical power and output electrical power is maintained. Whenever generation is less than the actual consumer load, the system frequency falls. On the other hand, whenever the generation is more than the actual load, the system frequency rise. The generators are also interconnected with each other and with the loads they supply via high voltage transmission line. The power system is routinely subjected to a variety of disturbances. Even the act of switching on an appliance in the house can be regarded as a disturbance. However, given the size of the system and the scale of the perturbation caused by the switching of an appliance in comparison to the size and capability of the interconnected system, the effects are not measurable. Large disturbance do occur on the system. These include severe lightning strikes, loss of transmission line carrying bulk power due to overloading. The ability of power system to survive the transition following a large disturbance and reach an acceptable operating condition is called *transient stability*.

Synchronous machines do not easily fall out of step under normal conditions. If a machine tends to speed up or slow down, synchronizing forces tend to keep it in step. Conditions do arise, however, in which operation is such that the synchronizing forces for one or more machines may not be adequate, and small impacts in the system may cause these machines to lose synchronism. A major shock to the system may also lead to a loss of synchronism for one or more machines.

With the growing demand of electric power, the existing transmission lines get increasingly overloaded, leading to various problems associated with stability and maintenance of appropriate voltage levels. A reliable solution of these problems is achieved by resorting to flexible ac transmission system (FACTS).

In this Paper Facts devices SVC is used to improve the transient stability of WSCC 9 Bus system. Power World Simulator has very frequent environment to analyzing the transient stability. In this Paper we will compare the WSCC 9 Bus system stability response without SVC and with SVC.



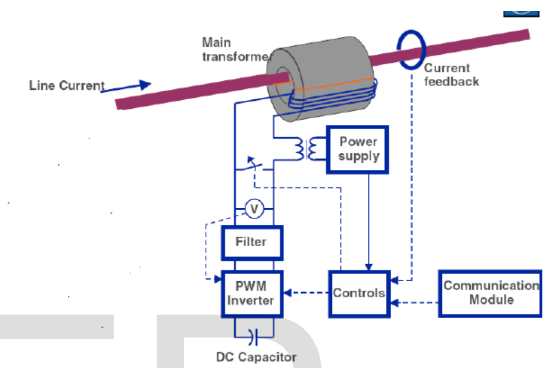
SVC OPERATION

FACT'S DEVICE OPERATION

Flexible AC Transmission Systems (FACTS) – IEEE Definitions

Flexibility - ability to accommodate changes in the system or operating conditions without violating stability margins .

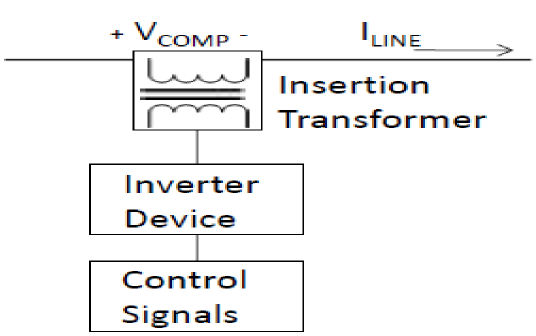
Flexible AC Transmission System incorporates power electronics and other static controllers to enhance controllability and increase transfer capability.



FACT Principal

FACTS Controller provides control of one or more AC transmission system parameter.

The Synchronous Voltage Source (Svs)



A shunt-connected static var generator or absorber whose output is adjusted to exchange capacitive or inductive current so as to maintain or control specific parameters of the electrical power system (typically bus voltage).

Test Example

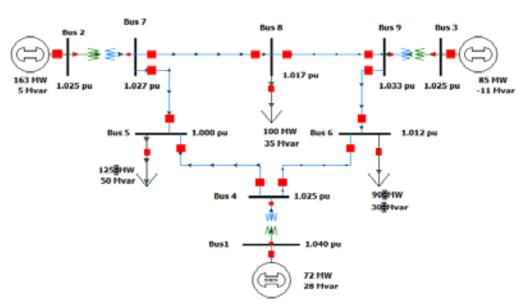


Fig 1.1 WSCC – IEEE 9 BUS POWER SYSTEM MODEL

In this we will investigate the variation in Power angle , frequency mainly due to disturbance in line with and without FACT device. 3- phase balanced fault is inserted between 5-7 bus , the results are

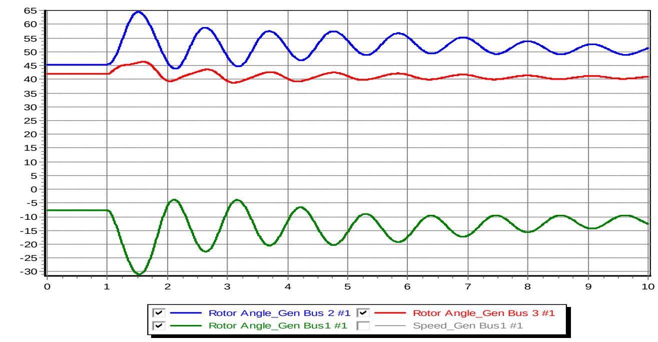


Fig 1.2 Power angle (without FACTS)

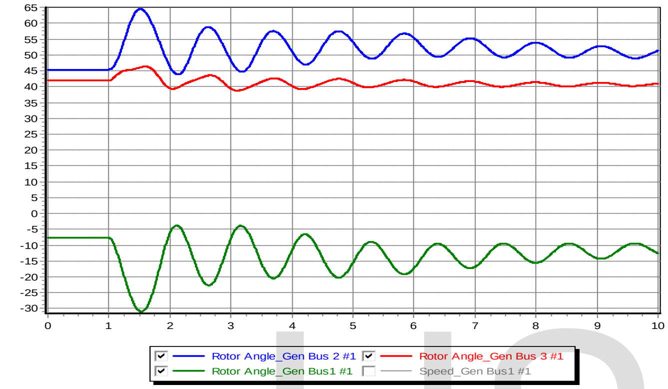


Fig 1.3 Power angle (without FACTS)

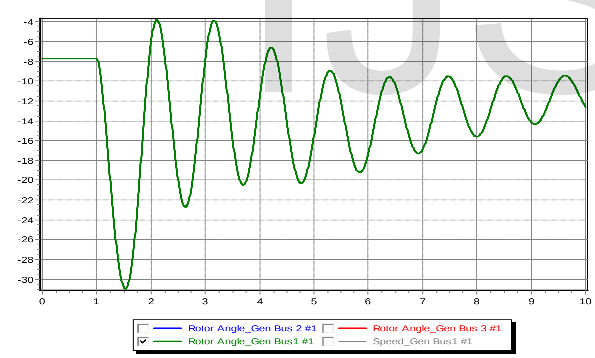


Fig 1.3 (Power angle of Generator 1 without Fact Device)

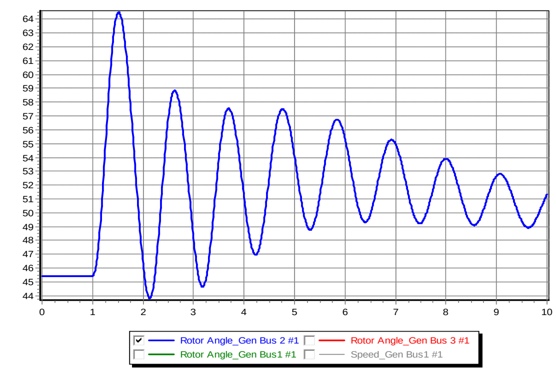


Fig 1.5 (Power angle of Generator 2 without Fact Device)

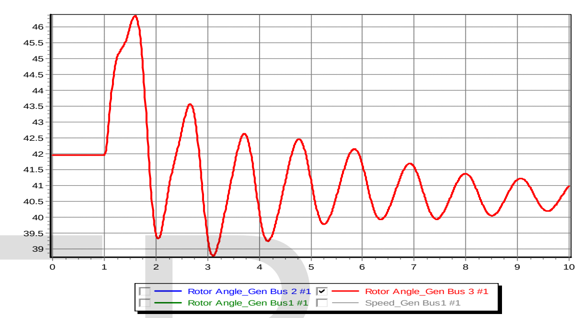


Fig 1.7 (Power angle of Generator 3 without Fact Device)

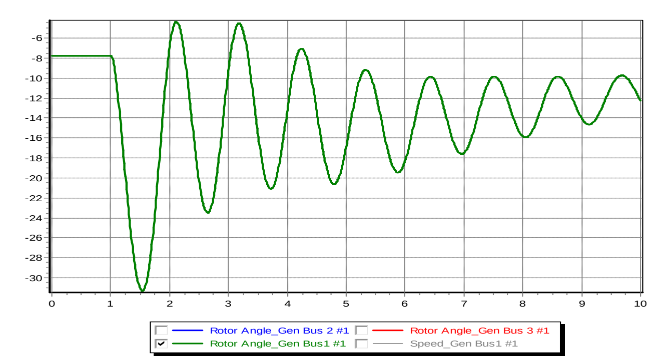


Fig 1.4 (Power angle of Generator 1 with Fact Device)

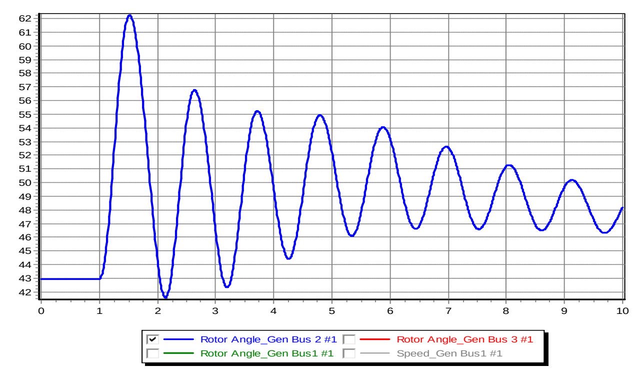


Fig 1.6 (Power angle of Generator 2 with Fact Device)

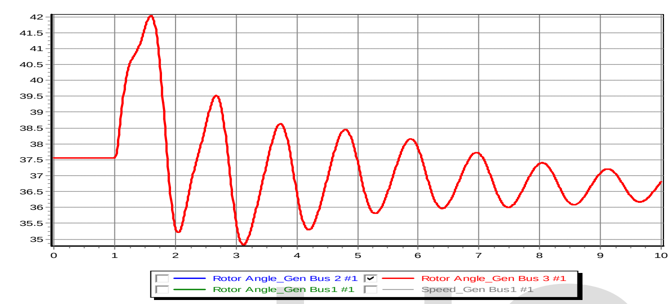


Fig 1.8 (Power angle of Generator 3 with Fact Device)

3 –phase balanced fault is applied at 5-7 line and fault is cleared after 2 cycles , which made clear the response to transient stabililty analysis with and without FACT devices .

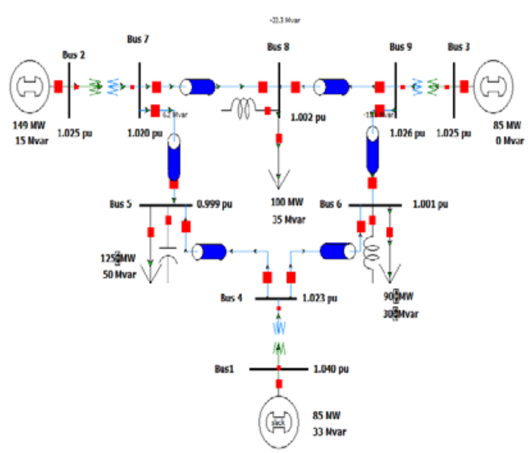


Fig 1.9 WSCC MODEL WITH FACT DEVICE

In this paper, the effect of FACT for improving transient stability of the multi machine power systems investigated. By using FACT, ultimately we control the reactive power of the System. By controlling reactive power, we can improve transient stability. All the results show that the Peak values of power angle, damping are more in case of without FACT devices. But when we modeled system with FACT DEVICES results are quite better. Further, a fuzzy controlled SVC can be implemented on WSCC 9 bus system to improve the stability of system.

Conclusions

The critical segments for the WSCC 9-bus system (WSCC) stability is analyzed with the presence of the SVC in the system. Generator rotor oscillations, frequency variation, power oscillations and voltage variation in the system are compared with and without SVC. It is noted that the SVC damps oscillations in the system around 2 cycles . The simulation results show that, the FACT controller improve the stability performance of the power system and power system oscillations are effectively damped out under severe disturbance conditions. From the power system dynamic stability view point, the FACT provides better damping characteristics than the SVC, as it is able to transiently exchange active power with the system.

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