Power System Stability Enhancement Using Facts Controller

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Abstract It is specifically important to focus on voltage stability analysis of the power system to avoid worst case scenarios such as voltage collapse. The purpose of this dissertation is to identify methods for enhancing the steady-state voltage stability using FACTS devices and determining their impact on real and reactive power losses, improvement of bus voltage magnitude and transmission line loadability. To achieve this, FACTS devices are used in IEEE 5, IEEE 9 and IEEE 30 test bus systems. The results obtained assist in drawing conclusions on the effectiveness of FACTS devices at generator, load and swing buses in terms of matrices such as voltage magnitude profile, PV curves, and active and reactive power losses

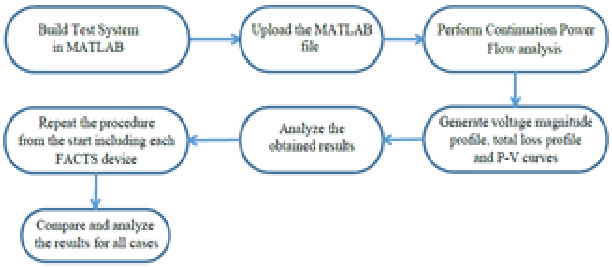
Keywords - FACTS, Steady state voltage stability, reactive power compensation techniques,flexible AC transmission systems.

I. INTRODUCTION

Voltage Stability examination is vital as voltage instability may result in the partial or complete disturbance in the power system. For voltage stability examination, a number of steady-state examination methods such as standard power flow methods, continuation power flow methods, nodal methods and dynamic simulation methods are being used by the electrical utilities.

The reactive power plays an important role in a power system. Basically, an electric power is generated, transmitted and then distributed to the consumers. Transformers, transmission and distribution lines, cables and many common load devices such as motors swing the relationship between current and voltage due to their inherent characteristics. This swing is measured in volt-ampere reactive (VAR). High VAR levels may result in lessening in power transference capability and increase in losses. Low VAR levels may result in voltage sag. Therefore, suitable levels of reactive power are to be sustained for improving the voltage stability of the power system. The bases of reactive power such as conventional devices which are built out of resistance, inductance or capacitance together with transformer, and Flexible AC Transmission System (FACTS) strategies offer adequate reactive power to the system. FACTS devices offer reactive power compensation, and improve voltage stability, transmission ability, power flow control, and working tractability of the power system.

II. SYSTEM MODEL



III. PREVIOUS WORK

After surveying different literatures available in IEEE transactions, journal and conference proceedings on the topic "Power system stability enhancement by using facts controller" it is found that improve voltage stability, transmission ability, power flow control, and working tractability of the power system.

IV. PROPOSED METHODOLOGY

The following method is proposed to study the effectiveness of FACTS devices in improving the voltage stability of a power system. For this purpose, an IEEE 5, IEEE 9 and IEEE 30 bus test system has been taken as a test system. First, the IEEE 5 bus test system is built in MATLAB then IEEE 9 and then IEEE 30. Then, continuation power flow analysis is performed on the system built by using MATLAB. The metrics such as voltage magnitude profile, active and reactive power losses, p-v curves, and maximum load ability point are used to have an understanding of the voltage stability of the system. In the next step FACTS devices such as SVC, STATCOM, and TCSC are included in the system built in MATLAB, one at a time. Again, the continuation power flow analysis is performed for each of the cases individually and the metrics are obtained for each of them. The metrics are to be compared between the each device along with the initial case where no facts device is used. The effectiveness of each device is drawn out from the results obtained from comparing the metrics.

Thus, this study helps in understanding the most efficient FACTS device which can be used for the enhancement of the static voltage stability of a power system.

The test system which is the IEEE 5 and IEEE 9 bus system is built in MATLAB in a format that is compliant with the Simulation. First, the test system is built without including the FACTS devices in it. In Simulation, this MATLAB file is opened and continuation power flow analysis is performed on it. Then, a load flow report provides the voltage magnitude at each bus giving us the voltage magnitude profile. It also provides the active and reactive power losses at each bus and also the total active and reactive power losses of the system. A P-V curve can be drawn at each bus which provides the maximum loadability point of the curve after which the voltage collapses to zero.

Another IEEE 30 bus test system is built in MATLAB including one of the FACTS devices at a load bus in a format that is compliant with the Simulation. In Simulation, this MATLAB file is opened and continuation power flow analysis is performed on it. Then, the load flow report, and p-v curve report gives the variation in the metrics such as voltage magnitude profile, active and reactive power losses at each bus, total active and reactive power losses in the system, and the maximum loadability point. The same FACTS device is included in the system at a generator bus and later at the swing bus and the metrics are obtained as given above. The comparison of the metrics between the no facts case, the facts at load bus case, at generator bus case and at the swing bus case provides us the necessary information in determining the effect of the facts device used on each of the buses and if it is improving the system from the no facts case. This process is repeated for SVC, STATCOM and TCSC and the metrics obtained are compared with each other and also with the no FACTS case.

V. SIMULATION/EXPERIMENTAL RESULTS

In this section author need to describe experimental/simulation results with graphs and appropriate tables.

Table 1. With compensation

S. No.	Bus	Compensation	
		10 MVar	50 MVar
1.	IEEE-5	44	44
2.	IEEE-9	7.9	8.5
3.	IEEE-30	8.9	10

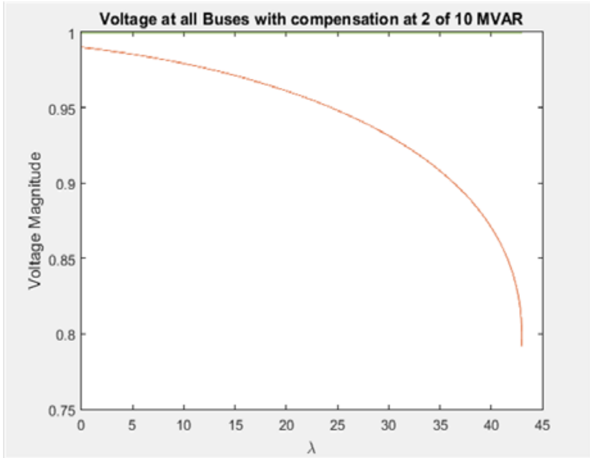


Figure 5.1 Voltage At Ieee 5 Bus With Compensation Of 10 Mvar

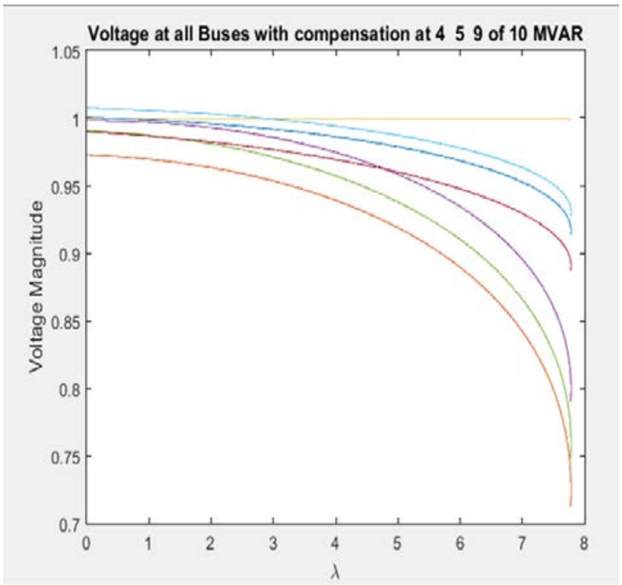


Figure 5.2 Voltage At Ieee 9 Bus With Compensation Of 10 MVAR

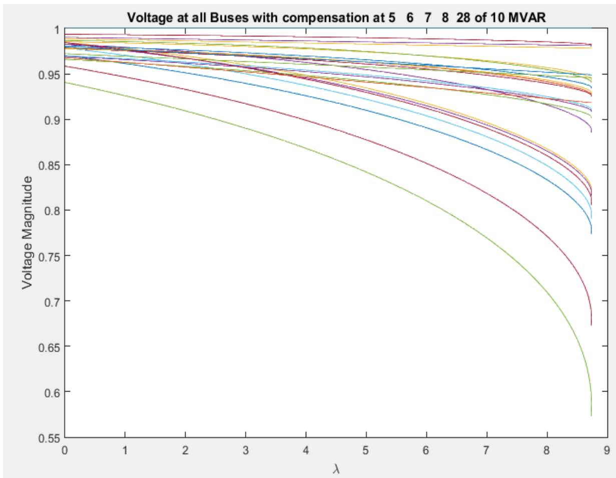


Figure 5.3 Voltage At Ieee 30 Bus With Compensation Of 10 MVAR

VI. CONCLUSION

The conclusions of the research work reported in this dissertation are as follows:

1. The Main Contribution of this work is to enhance Power System Stability by using Facts Controller.

2. The Shunt Compensated Power System has been represented by its equivalent System. The effect of using shunt compensation in enhancing the voltage stability of the shunt compensated power system has been observed..

VII. FUTURE SCOPES

The future scope of the research work reported in the dissertation is as follows:

1. The performance of the proposed scheme can be further studied under large disturbances for enhancing the voltage stability and the dynamic and transient behavior of the system can be investigated further in order to predict the voltage stability.

2. The application of the artificial techniques can be explode to enhance further the dynamic behavior of the system.

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