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Analysis of Different loading condition of STATCOM,SVC and TCSC

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***Abstract*—** The problems of voltage stability of power system are increasing day by day because of increase in power demand. So it is very important to analysis the power system with respect to voltage stability. This paper deals with the voltage stability analysis of IEEE 9 Bus System using STATCOM, SVC and TCSC FACTS controller in PSAT toolbox. These FACTS devices are used for increasing the Maximum Loading Point to enhance the voltage stability. Simulations have been carried out using PSAT (Power System Analysis Toolbox) in Mat lab. The Continuation Power Flow (CPF) method is used to find the weakest bus of the network. Power flow and CPF analysis is done in the PSAT software. The simulations are done for various loading condition of system. This work proposed the most suitable FACTS devices for Voltage Stability Enhancement for given loading condition.

Keywords:- FACTS Devices; loadability**; MLP; Voltage Stability; PSAT**

I. INTRODUCTION

Power system operates heavily stressed condition due to heavy load demands.. Now a day the voltage stability highly interconnected and complex power system is influenced by Voltage control, Reactive power compensation and management, rotor angle or synchronous stability. Present power system associated with problem like voltage level on different buses below the limit considering the loading of that bus, voltage collapse occurs. This reason gives major blackouts. The Voltage stability assessment has become very important to avoid blackout because interconnected power system involves with small as well as large variations in reactive power demands. Voltage instability is a problem in power systems which occurs due heavily loaded contingencies or have a shortage of reactive power. The problem of voltage stability related the whole power system, although it has a large involvement in one critical area of power system.

II Causes and Prevention of voltage collapse

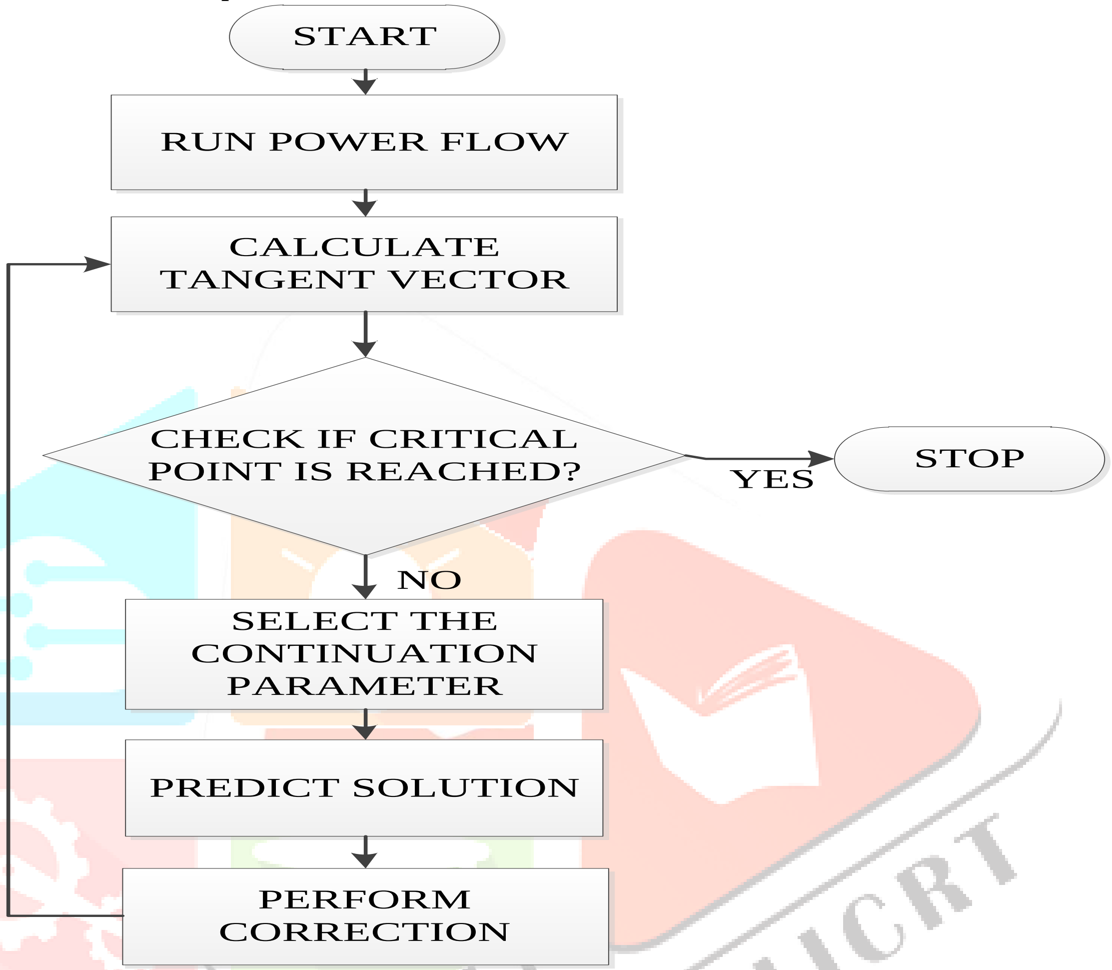
Reasons for voltage collapse are as follows:

- Load on transmission line is too high.
- Voltage source is far than the load canters.
- In sufficient load reactive power compensation.
- Large distance between generation and load.
- Under load tap changer action during low voltage conditions.

Voltage collapse is simply result of voltage instability. Load voltages try to reach equilibrium voltages. Voltage collapse occurs if the voltage below acceptable limits. Some methods applied to improvement of voltage stability and prevent the voltage collapse given as follows.

- Controllers and devices like Automatic voltage regulator on synchronous generators.
- Reactive power compensation devices. It is used to compensate reactive power demand. Ex. shunts capacitor, synchronous condenser.
- Control of tap changing transformer used to regulate the voltage
- Under voltage Load shedding at under extreme conditions.

III Flow chart Continuation power flow



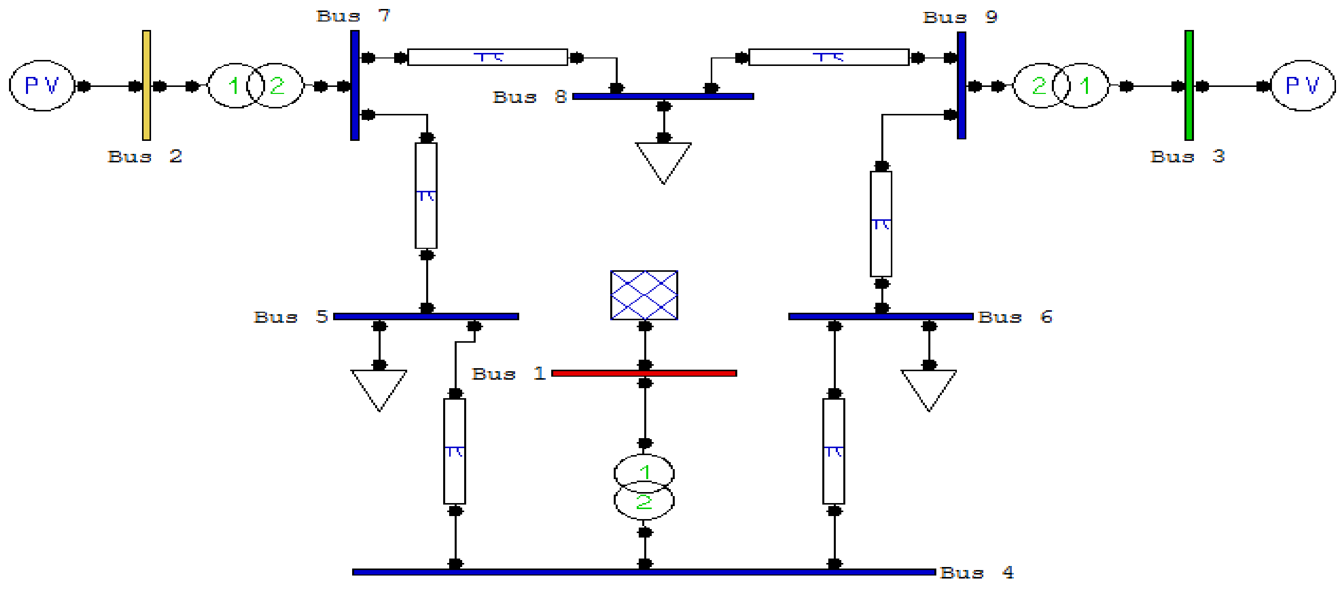
IV Modelling of System

To understand the effects of STATCOM,SVC and TCSC is increasing the voltage stability of a system under diffrernt loading condition is done using Power System Analysis Toolbox (PSAT). The weakest bus is found for the given IEEE Bus system using Continuation Power Flow method. The FACTS devices are put at the Weakest bus one by one and studing the effect of FACTS devices. As per IEEE standard desired voltage tolerance is 10% for disribution lines and 5% for the transmission lines.

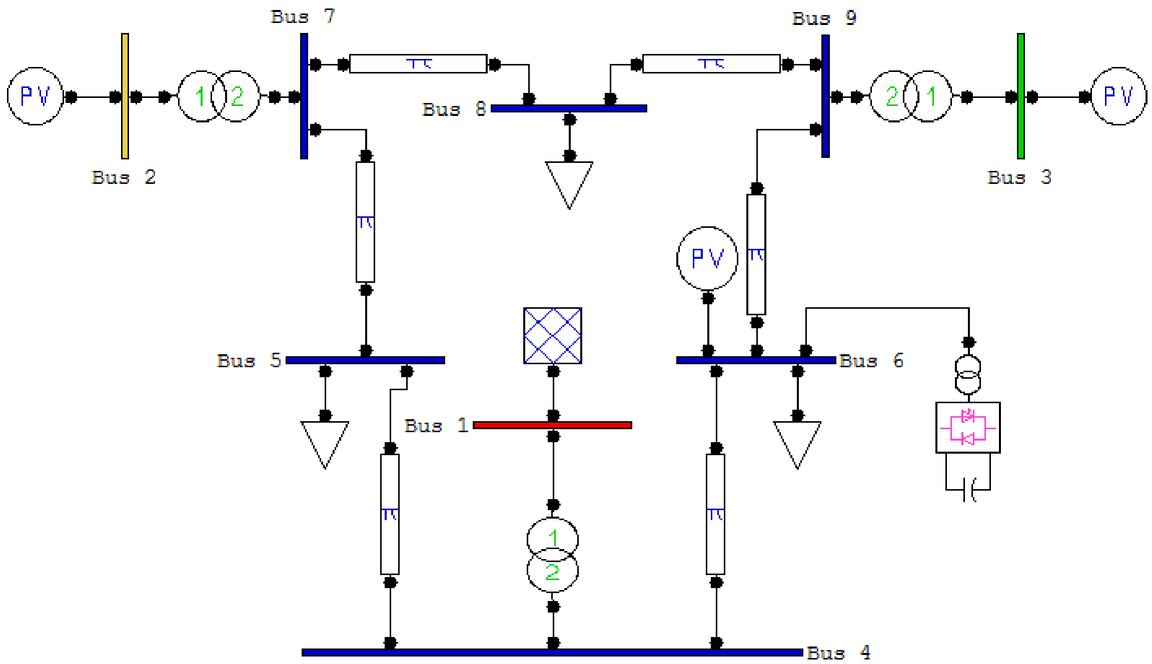
❖ Step for simulation are as follows:
  - Modelling of the system in the PSATsoftware.
  - Perfomed the power flow analysis using N-R method.
  - Perfomed the Continuation power flow analysis to finding weak bus of system.
  - From the P-V curve is used to find Best location of FACTS devices.
  - Then studying the effects of Facts devices.

V SIMULATION

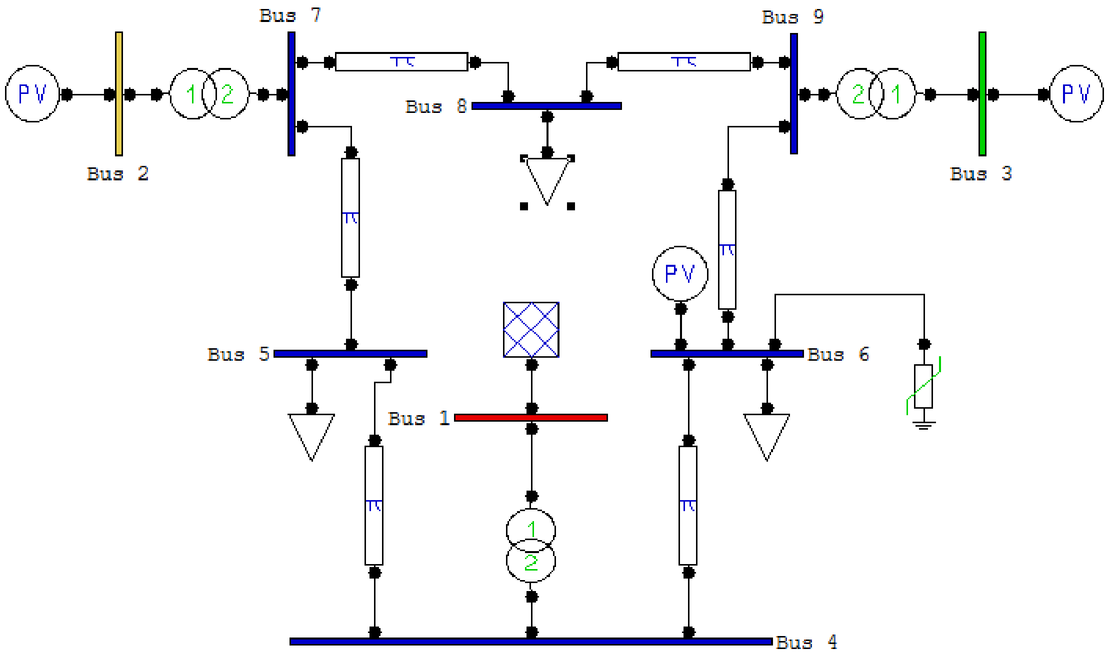
Simulation of IEEE 9 Bus system without FACTs devices:



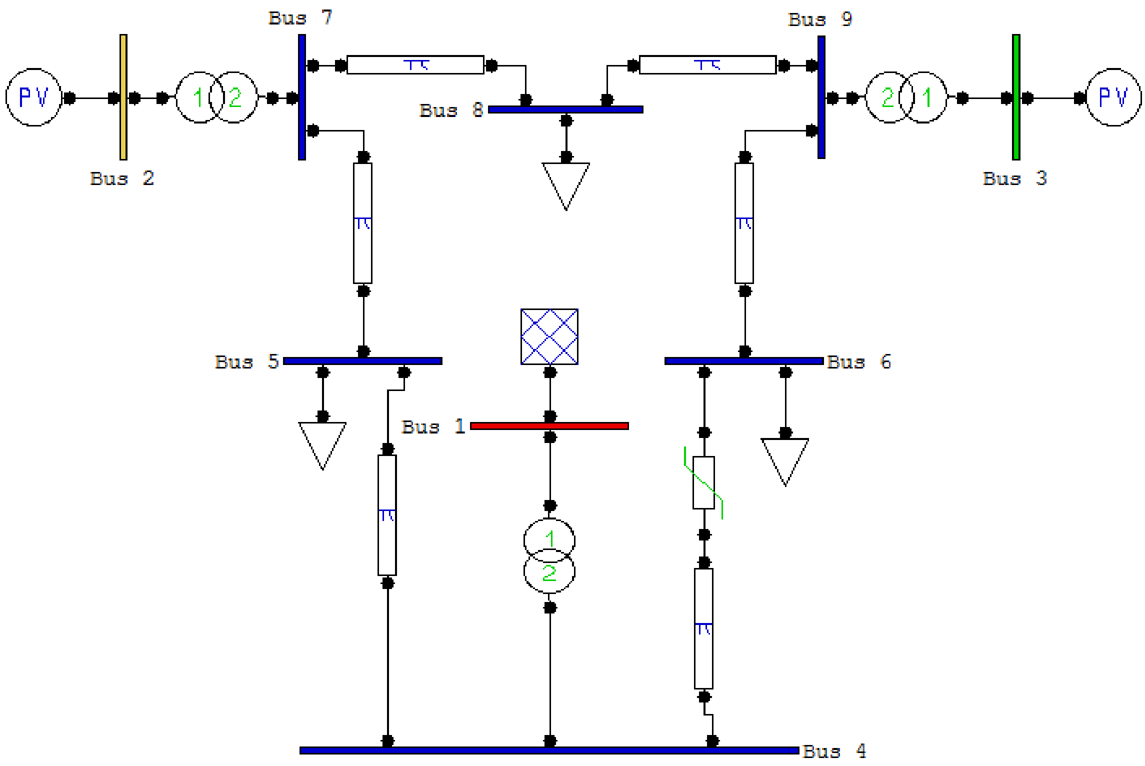
Simulation of IEEE 9 Bus system with STATCOM:

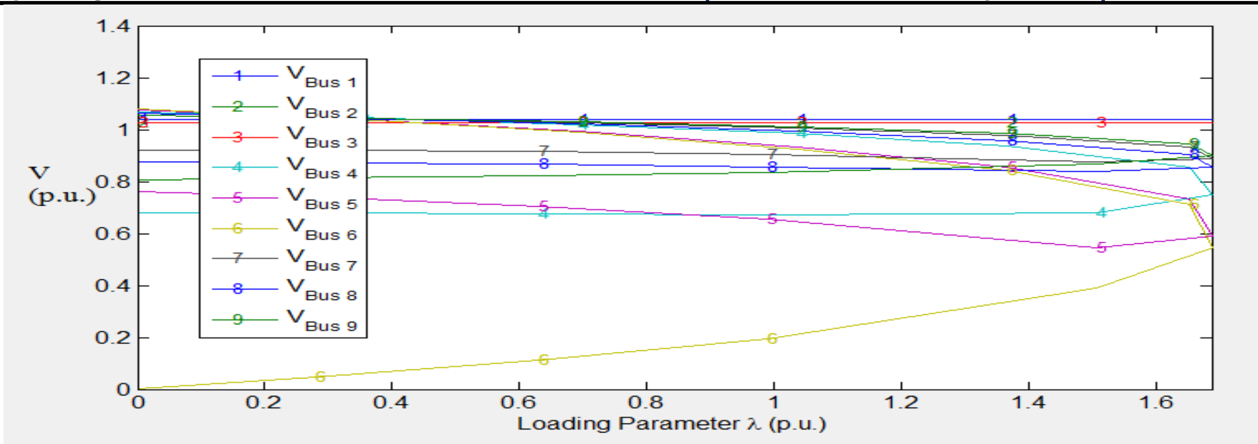


Simulation of IEEE 9 Bus system with SVC:

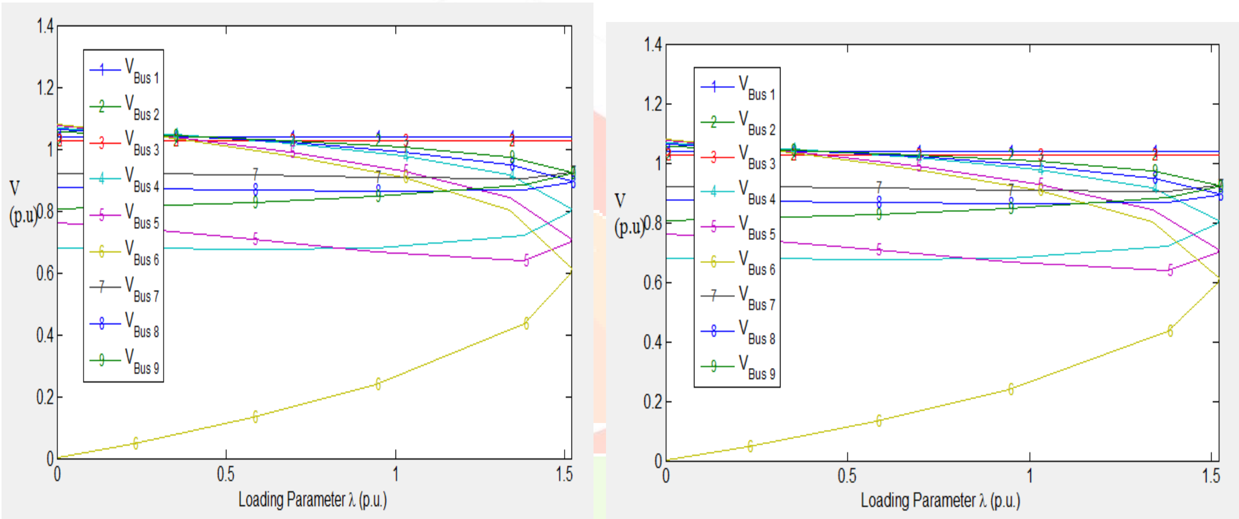


Simulation of IEEE 9 Bus system with TCSC:

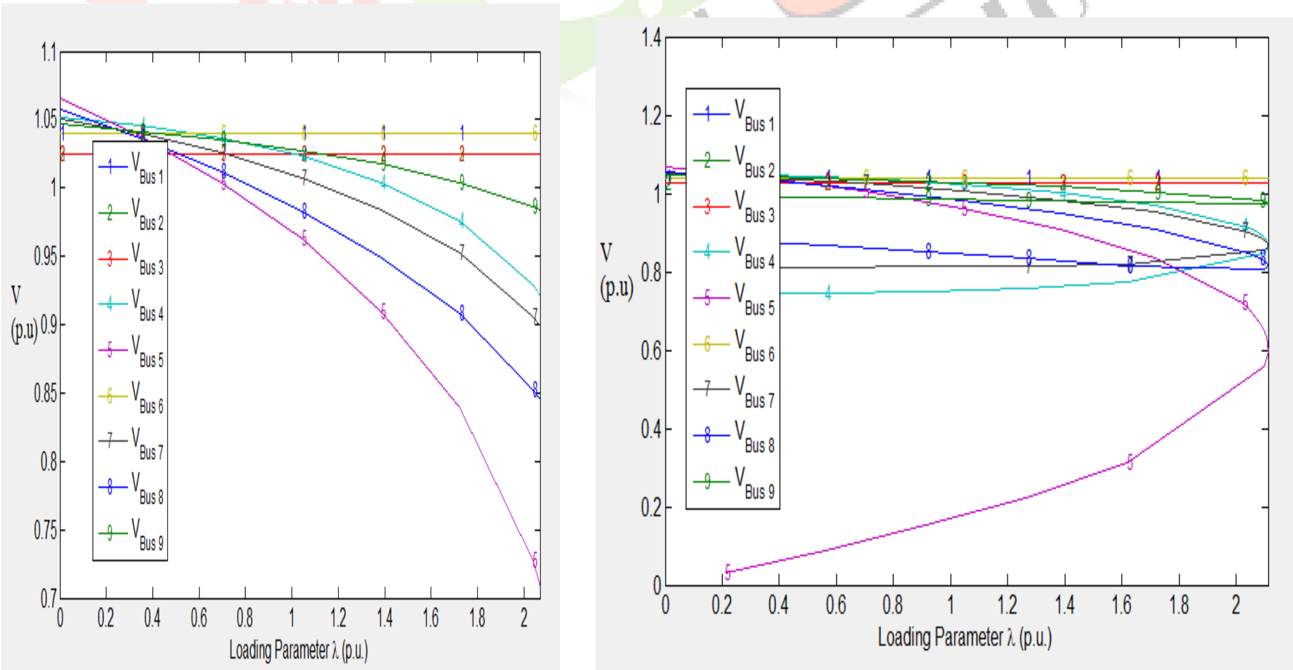




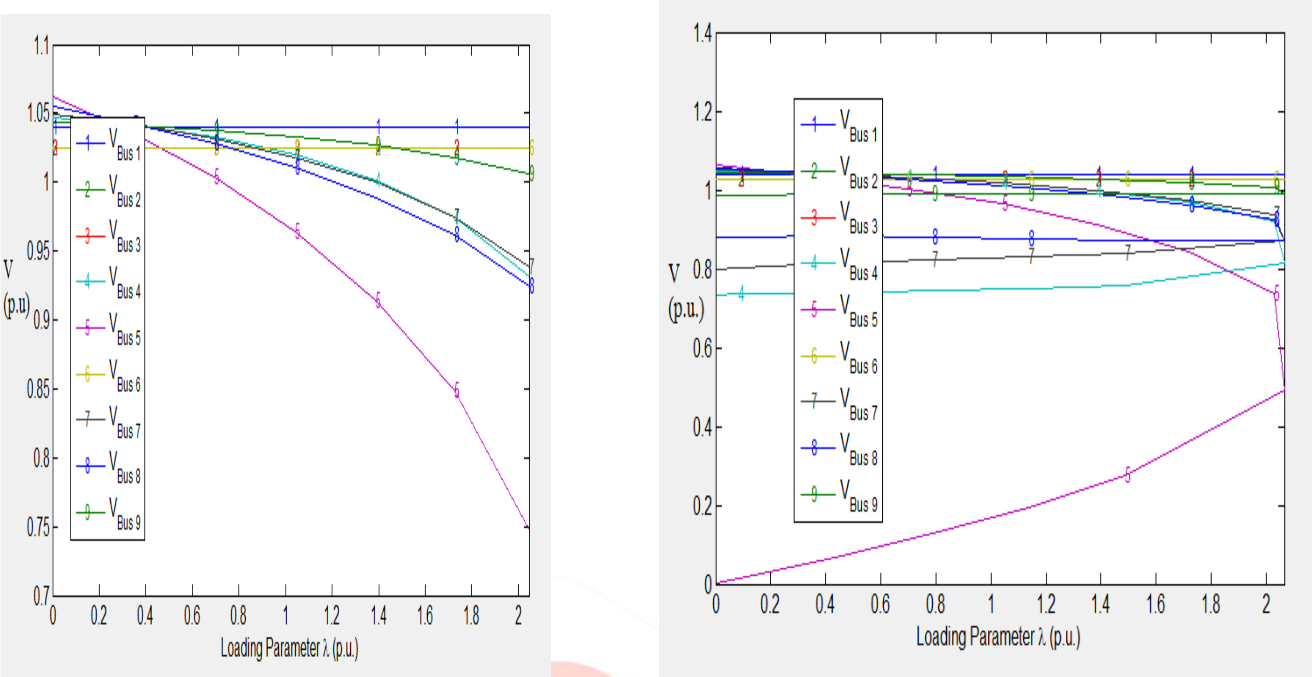
P-V curve Base Case



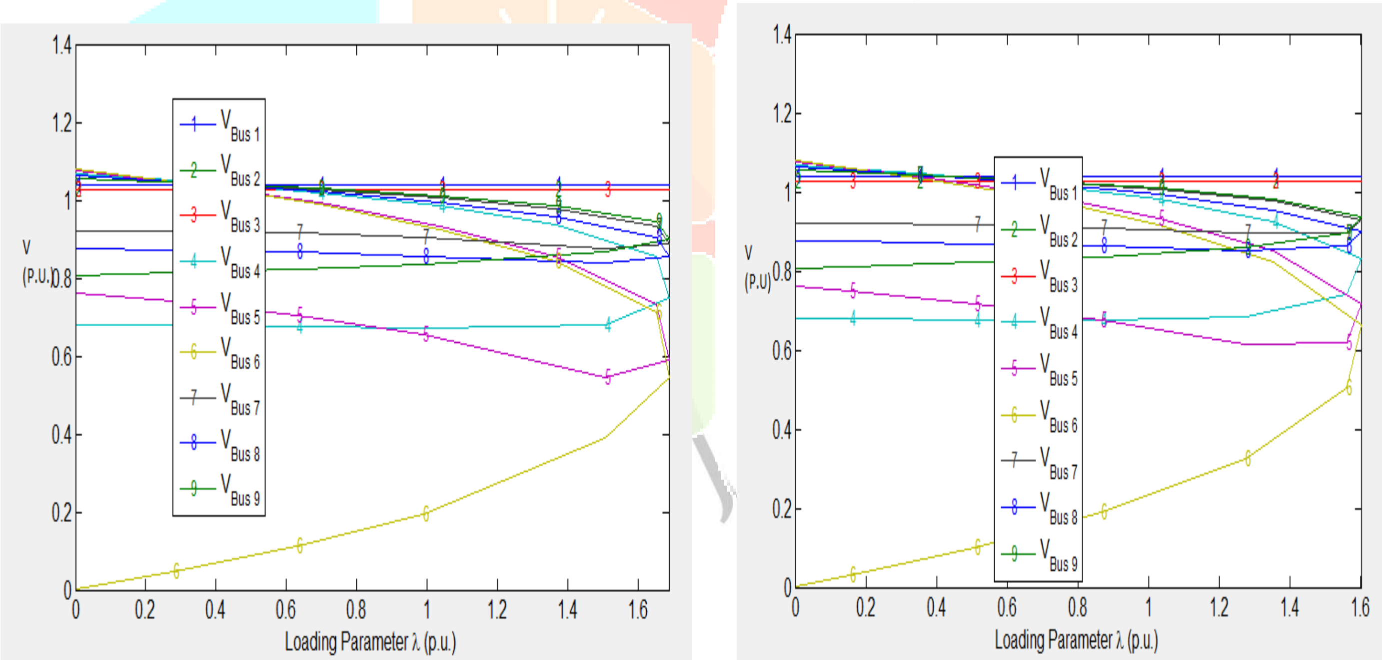
P-V curve for 15% and 30% over loading



P-V curve for15% and 30% over loading with STATCOM

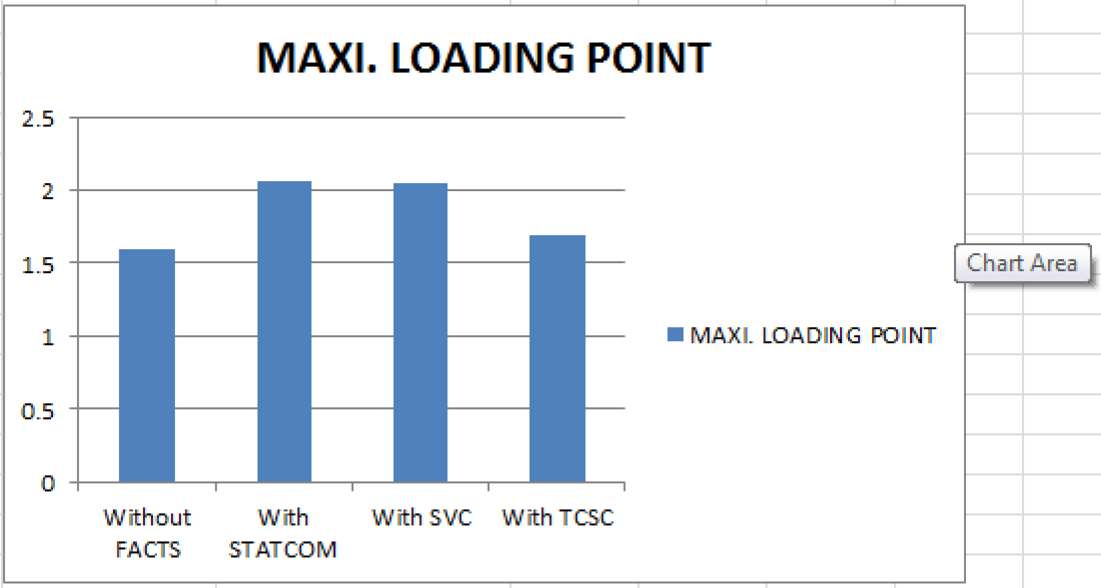


P-V curve for15% and 30% over loading with SVC

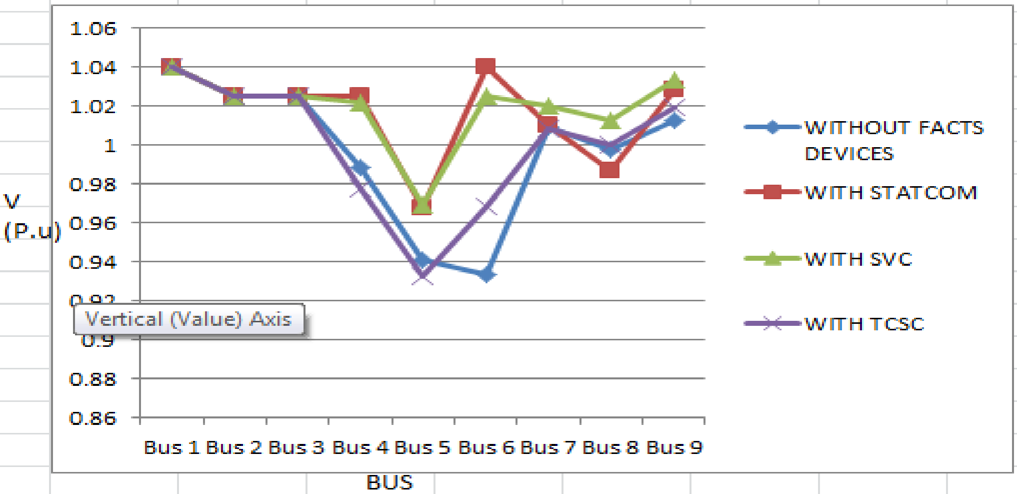


P-V curve for15% and 30% over loading with TCSC

	MAXI. LOADING POINT
Without FACTS	1.6023
With STATCOM	2.0692
With SVC	2.046
With TCSC	1.6881



	WITHOUT FACTS DEVICES	WITH STATCOM	WITH SVC	WITH TCSC
Bus 1	1.04	1.04	1.04	1.04
Bus 2	1.03	1.025	1.025	1.025
Bus 3	1.03	1.025	1.025	1.025
Bus 4	0.983	1.0253	1.0215	0.978
Bus 5	0.9413	0.9683	0.969	0.932
Bus 6	0.9333	1.04	1.025	0.968
Bus 7	1.0093	1.009	1.020	1.008
Bus 8	0.9973	0.9873	1.012	1.0003
Bus 9	1.01263	1.0283	1.033	1.019



III CONCLUSION

It is concluded from the simulations and graph that maximum loading point with STATCOM is highest while that SVC is lower than STATCOM case. It is also seen that the SVC has a relatively flat voltage profile until voltage collapse point and than decreased suddenly. In case of TCSC maximum loading point has increased than base case but lesser than STATCOM and SVC.Finally , maximum loading point for series compensation device is lesser than the shunt compensation device. FACTS device are more useful for voltage stability Enhancement.

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