Improvement of Voltage Stability and Power Flow Control in Power System Network using TCSC

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Abstract – The characteristic of a thyristor controlled series compensator (TCSC) is usually defined by the overall reactance of the device versus the firing angle of the TCR that is connected in parallel with a fixed capacitor in order to provide a smoothly variable series capacitive reactance. This is a new approach to represent IEEE 14 bus system with TCSC FACTS controller. We have been performed on IEEE 14 bus system. We represents a Simulink model of IEEE 14 bus system without TCSC and with TCSC, with three phase fault, and in presence of TCSC with three phase fault .The comparative result and simulation result waveform of TCSC FACTS Controller show that, using TCSC we can improve the voltage stability and power flow control in power system network. The Simulink model is implemented in MATLAB.

Index Terms – Firing angle, Thyristor Controlled Series Compensator (TCSC). IEEE 14 bus system, three phase fault.

1. INTRODUCTION

In modern power system load demand increases continuously due to intense industrialization and overexploitation. Due to Complex structure and operation of the system, end user faced many problems. Extant Generation and transmission facilities are not fulfill the load demand. Rapid industrialization raising the Demand of electrical power is continuously. To meet this, .FACTS Controller are used to control various power system problem. Thyristor controlled series capacitor (TCSC) can fulfill these requirements. So in this project work, performed on IEEE14 bus system with TCSC. This has motivated to study and look for an affordable solution for power system network. Hingorani & Gyugi had proposed the concept of FACTS devices in early eighties. They had shown the Improvement of power system performance by using power electronic devices called FACTS devices. Alternating current transmission system incorporating power electronics base and other static controller, it has the principle role of enhancing controllability and power transfer capability in AC system.

2. RELATED WORK

D.K. Tanti , M. K. Varma, Brijesh singh , O.N. Mehrotra, attempts to summarize ,A comparative performance of DSTATCOM, DVR and UPQC in voltage sag mitigation has been studied to select most effective controller out of three controllers for the system.[2]

Venu Yarlagadda, Dr. B.V. Sankar Ram, Dr K.R.M. Rao show the effect of TCSC on voltage stability improvement. The voltage Lmn and VCPI Indices with and without TCSC have been recorded.[3]

Manisha chadar choosed A method to reduce voltage sag and increase the voltage quality using series compensation is considered. Discrete PWM generator six pulse base TCSC series compensator and firing angle through TCSC controller system is used to reduce the voltage sag produce by non linear load. Result in simulink output waveform show that firing angle TCSC control system is more effective compare to PWM generator six pulse controlled system.[4]

Dr. S. Titus, B. J. Vinothbabu, I. Maria Anton Nishanth, the power system stability enhancement of test network with FACTS devices TCSC, STATCOM and UPFC is presented and discussed under three phase short circuit fault. It is clear that the system regains its stability under any one of the FACTS device is involved. [6]

D. Jovcic member IEEE and G.N.Pillai they are simplified fundamental frequency model of TCSC is proposed and the model result are verified. Using frequency response of the non linear load TCSC segment a simplified non linear state space model is derived. Where the frequency of the dominant TCSC complex poles show linear dependant on the firing angle.[7]

3. PORPOSED MODELLING

- Project we were performed on IEEE 14 bus system without TCSC observe the voltage, active power and reactive power waveform.
- Connect the TCSC with IEEE 14 bus system and observe the voltage, active, and reactive waveform.
- Create the Three phase fault on IEEE 14 bus system and observe the effect of fault on 14 bus voltage waveform.
- IEEE 14 bus system with three phase fault and TCSC connected, it is observed that simulation result output

TCSC improve the voltage stability and power flow control in power system network.

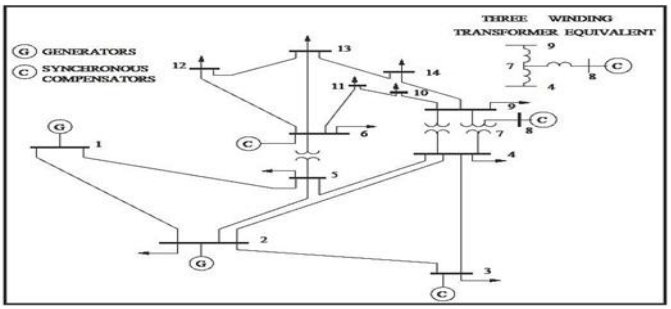
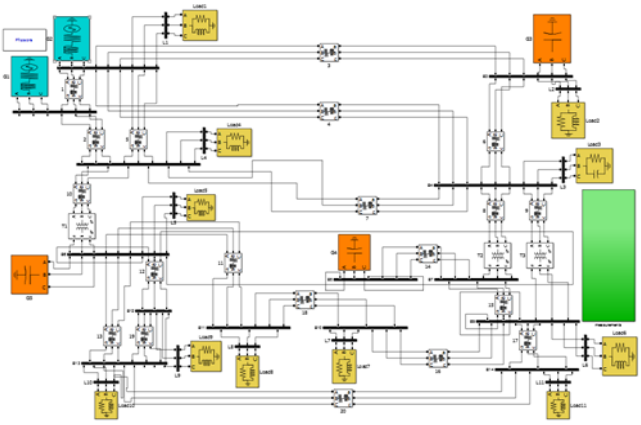


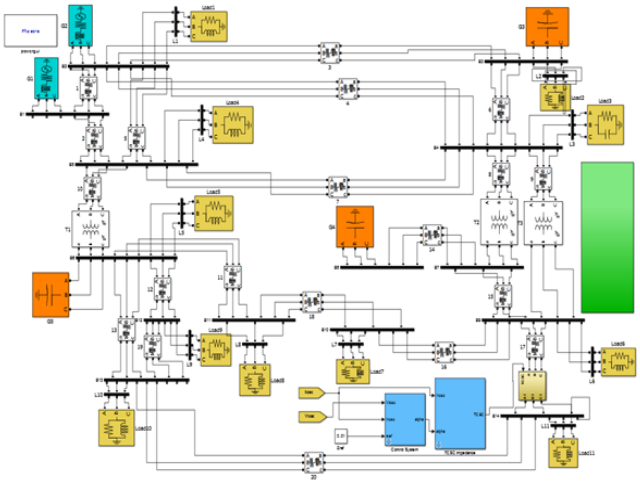
Figure 1: Single line diagram of IEEE 14 bus system

3.1 IEEE 14 bus system without TCSC



Project were perform on IEEE 14 bus system Having 14 buses and 20 line .the system consist of synchronous machine three of which are synchronous condensers. There are 11 loads in the system having net real and reactive power demand of 259 MW and 81.3 MVAR. Respectively.

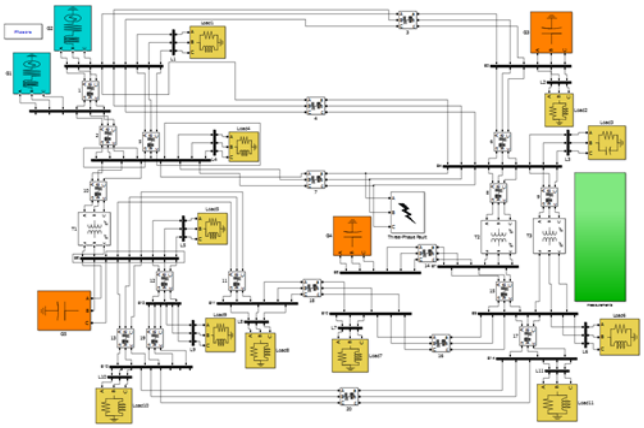
3.2 IEEE 14 bus system with TCSC



Modeling 4.2 show the simulink model of IEEE 14 bus system with TCSC. TCSC connected to bus 14. When TCSC operates in the constant impedance mode it uses voltage and current feedback for calculating the TCSC impedance. The reference impedance indirectly determines the power level, although an automatic power control mode could also be introduced.

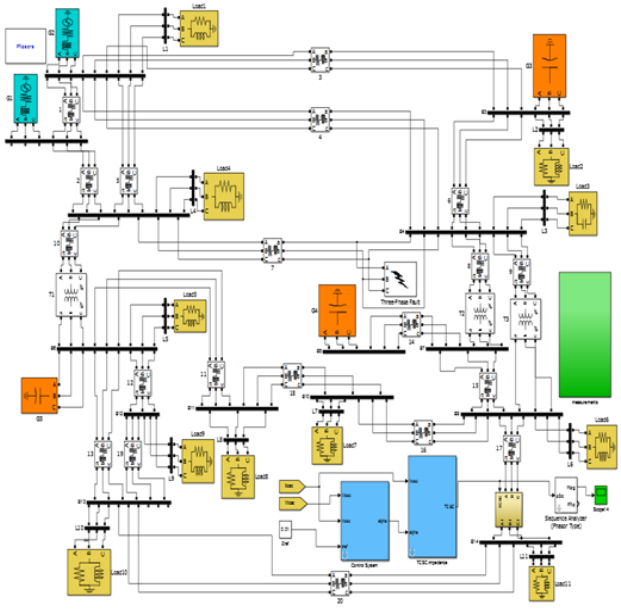
3.3 IEEE 14 bus system with three phase fault

Modeling 4.3 shows the simulink model of IEEE 14 bus system with Three phase fault .three phase fault created in between bus 4 and bus 5 for time duration of 10.00 to 10.05 sec.



3.4 IEEE 14 BUS SYSTEM WITH THREE PHASE FAULT AND WITH TCSC

Modeling 4.4 shows the simulink model of IEEE 14 bus system with three phase fault with TCSC .whenever fault occur in power system then TCSC improve the voltage stability and control the power flow in power system network.



4. RESULTS AND DISCUSSIONS

4.1 Simulation Result for IEEE 14 bus system without TCSC

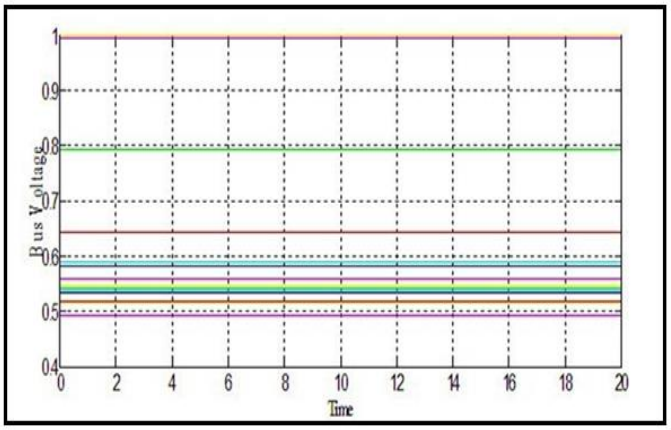


Figure 1: Simulation Result of IEEE 14 bus voltage

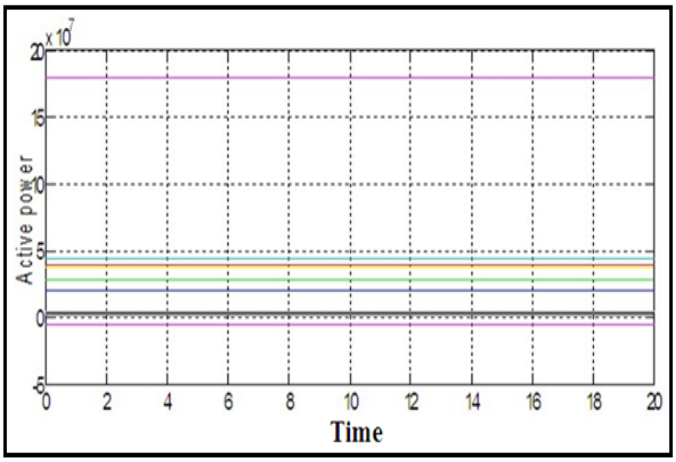


Figure 2: Simulation Result of Active power

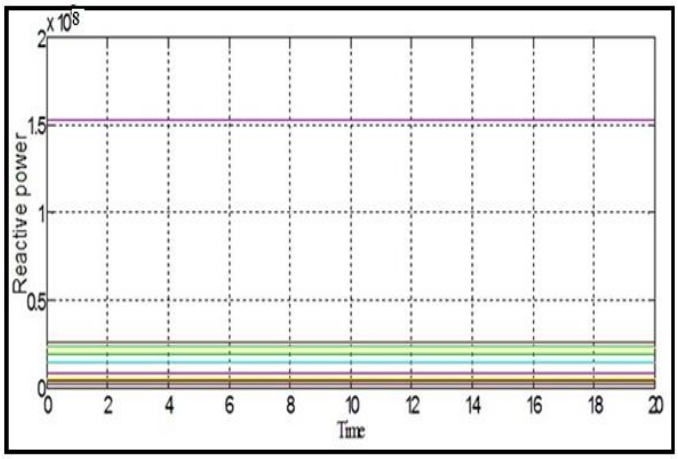


Figure 3: Simulation Result of Reactive power

4.2 Simulation Result for IEEE 14 bus system with TCSC

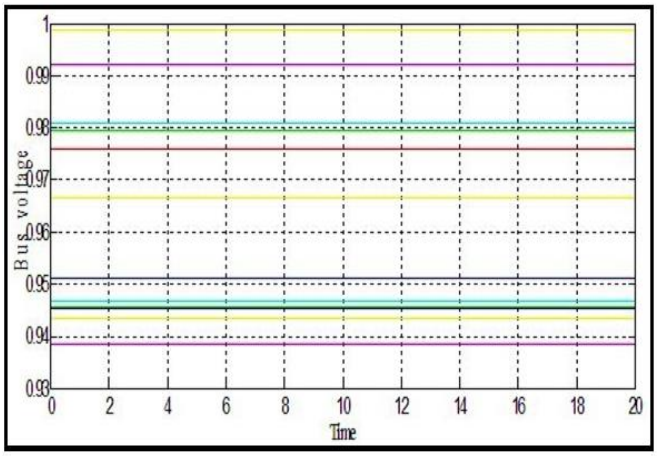


Figure 4: Simulation Result of IEEE 14 bus voltage

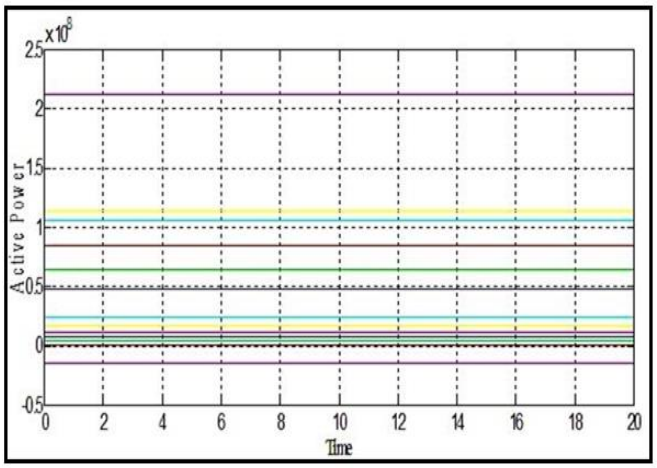


Figure 5: Simulation Result of Active power

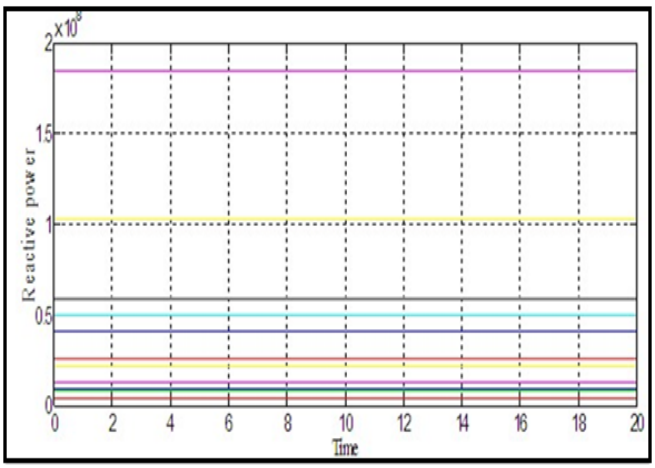


Figure 6: Simulation Result of Reactive power

4.3 SIMULATION RESULT FOR IEEE 14 BUS SYSTEMS WITH THREE PHASE FAULT

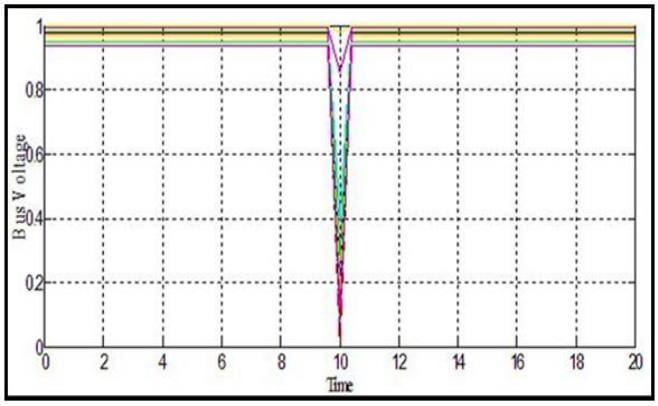


Figure 7: Simulation Result of IEEE 14 bus voltage with three phase fault

4.4 SIMULATION RESULT FOR IEEE 14 BUS SYSTEM WITH THREE PHASE FAULT AND TCSC

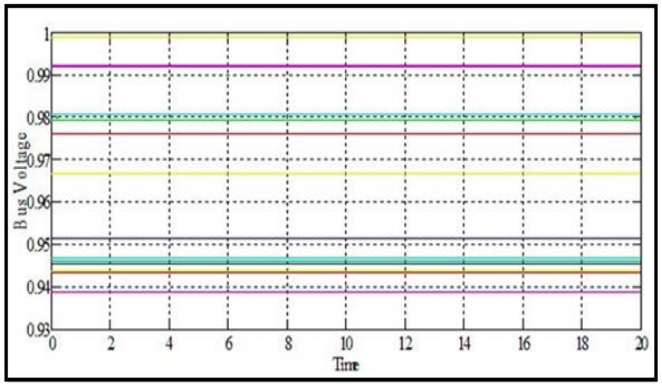


Figure 8: Simulation Result of IEEE 14 bus voltage with three phase fault with TCSC

4.5 COMPARATIVE ANALYSIS

Table No.1: Comparative Analysis of Bus voltage without and with TCSC

S.N.	BUS Voltage	Bus voltage without TCSC in P.U.	Bus voltage with TCSC in P.U.
1.	V1	0.9999	0.9989
2.	V2	0.9937	0.9922
3.	V3	0.5895	0.9809
4.	V4	0.6437	0.9761
5.	V5	0.7932	0.9795
6.	V6	0.5833	0.9513
7.	V7	0.5466	0.9865
8.	V8	0.561	0.992
9.	V9	0.5361	0.9468
10.	V10	0.5183	0.9434
11.	V11	0.5421	0.9458
12.	V12	0.5354	0.9453
13.	V13	0.5168	0.9434
14	V14	0.4933	0.9387

Table show the bus voltage of IEEE 14 bus system with and without TCSC.

Bar chart of voltage Magnitude Vs Bus Number

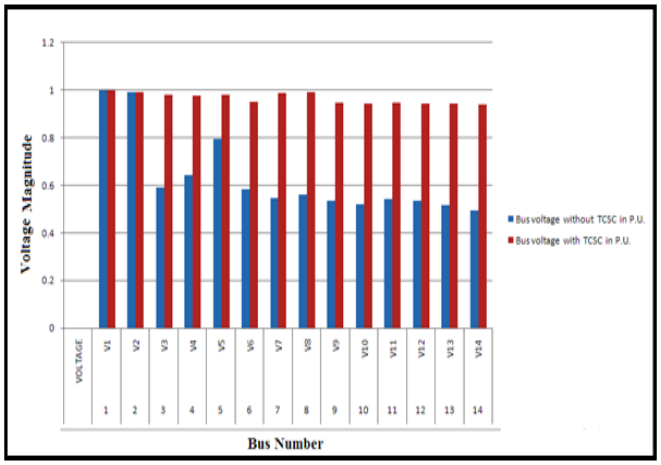


Figure 9: Bar chart representation of the difference in voltage profile of IEEE 14 bus System

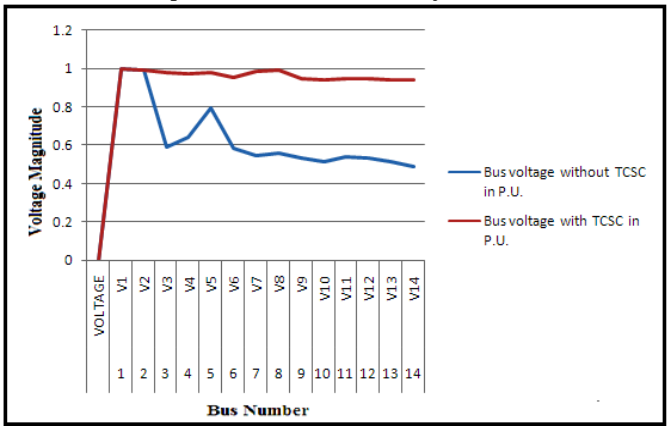


Figure 10: Graphical Representation of the difference in Voltage Profile of IEEE 14 bus System

5. CONCLUSION

In this dissertation, IEEE 14 bus system with TCSC FACTS controller is use to improve the voltage stability and power flow control in power system network .We reach at the conclusion that TCSC is one of the fast acting power electronic controller which can provide a smoothly variable series capacitive reactance. This is a new approach is different from conventional method and provide effective solution. We have been performed on IEEE 14 bus system with TCSC with the help of MATLAB/SIMULINK software to improve the voltage stability and power flow control in power system network. IEEE 14 bus system with and without TCSC, comparative result Analysis and simulation result waveform show that, TCSC improve the voltage stability and power flow control in power system network.

FUTURE SCOPE

In this dissertation work, 14 bus systems is use with TCSC. This work can further be extended to:

- Number of buses is use with TCSC.
- All L-G .LL-G, LLL-G Fault use with TCSC.
- Other FACTS controller is use rather than TCSC.
- Neuro-Fuzzy technique well becoming for voltage stability improvement.
- DE and PSO Optimisation techniques adopted for voltage stability enhancement and their expediency can be compared.

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