Transient Stability Study in IEEE9 Bus System and Compensating using TSCS

Ms. S. B. Kamble
PG Student, Electrical Engineering
Abha Gaikwad Patil College of Engineering
Mohgaon,Wardha Road, Nagpur, India.

Mr. R.R Shah
Head of Department, Electrical Engineering
Abha Gaikwad Patil College of Engineering
Mohgaon,Wardha Road, Nagpur, India.

***Abstract*—Stability is a fundamental concept which is responsible for the stable operation of power system. The concept of transient stability which is a function of operation condition disturbances deal with the ability of the system to remain intact after being subject to abnormal deviation. To improve transient stability their exists some general method like fast acting exciters ,circuit breakers and reduction in system transfer reactance ,but the recent trend is to employ FACTS device for effective utilization of existing transmission resources. The experiments conducted the facts devices contribute to power flow improvement besides they extend their services in stability improvement as well. In this paper ,the studies has been carried out in order to improve the transient stability improve the transient stability of IEEE9 bus system with fixed compensation on various line and optimal location has been investigated using trajectory sensitivity analysis for better result. In this paper in order to improve the transient stability margin further series FACTS devices has been implemented. Series compensation (TCSC) device has been used here and the result highlighted the effectiveness of the application of TCSC in improving the transient stability of power system. In this are by using IEEE9 bus system. Fixed compensation is adopted on various lines and optimal location is investigated using trajectory sensitivity analysis for better result. Their are exists many FACTS controllers' to control firing angle of TCSC and transient stability margin. The TCSC is modified by a variable capacitor, the value of which changes with the firing angle.**

Keywords— Transient stability,FACTS ,9bus system devices, Matlab/ Simpower system.

I. INTRODUCTION

Static VAR compensated FACTS device are the most important device and have been used for a number of years to improve voltage and power flow through the transmission line by resolving dynamic voltage problems. SVC is shunt connected static generator/absorber. Utilities of SVC controller in transmission line are many:

a) Provides high performance in steady-state and v transient voltage stability control.
b) Dampen power swing.
c) Reduce system loss.
d) Control real and reactive power flow.

In such an environment, application of the Flexible AC Transmission System (known as FACTS) in power systems has become an issue of great concern. FACTS technology is becoming more and more popular due to improvement in Power Electronics technology and reduction in costs. The term FACTS covers number of devices which may be working in isolation or in coordination with a few other devices. Several FACTS controllers for shunt, series or both shunt and series compensation are now operating in power systems around the world. By controlling impedance or phase angle or series injection of appropriate voltage a FACTS Controller can control the power flow as required.

The FACTS facilitates power flow control, increased power transfer capability, and enhances the security and stability of power systems without expanding transmission and generation utilities. Excellent applications of FACTS controllers, such as the unified power flow controller (UPFC), and the Static Synchronous Compensator (STATCOM), have yielded successful results. It has been shown in recent case studies that FACTS can provide a more flexible stability margin to power systems and also improve power transfer limit in either shunt or series compensation oltage. The common DC link voltage will be connected with the DC to AC converter and the output of the inverter is synchronizing with grid. This inverter changes DC power from PV array and the wind turbine into AC power and it maintain the voltage and frequency is equal to the grid voltage and frequency.

II. LITERATURE SURVEY

1 Sivamnala,R Girdhar balakrishana"comparative study of controller in TSCS for transient stability improvement using malty machine power system" IJERT,ISSN 2278-0181,VOL.2,11NOVEMBER 2013
Transient stability is the ability of the power system in to maintain synchronism of the subjected to sever Disturbance. The synchronism is assessed with relative rotor angle violation among the different machine. Accurate analysis of the transient stability requires the detail modeling of generating unit & other equipment. The transient stability assessment of multi machine 9 bus system is carried out for three
phase. Fault of self clearing type FACTS controller like TCSC help in controlling the power through a line.

2 "Gundala srinivasa rao,Dr A.Srujana"Transient stability improvement of multy-machine power system using fuzzy controlled TCSC"INTERNATIONAL JOURNAL OF ADVANCEMENT IN RESEARCH & TECHNOLOGY,VOL.1 ISSUE2 JULY 2012. This paper introduces the WSCC-9 bus system at optimal location of tcsc for different fault location is obtain by performing

different trajectory sensitivity analysis with respect to clearing time. Accurate analysis of transient stability requires the detailed modeling of generating unit and other equipments in this paper transient stability analysis by time-domain simulation in which the non linear differential equation are solve by R.K fourth order method.

3. amr G.Bahbah, and Adly A. Girgis"An investigation on the effect of line reclosing on transient stability assessment for multy machine power system" CLEMSON UNIVERSITY ELECTRIC POWER RESEARCH ASSOCIATION CLEMSON'S 29634-0995,USA

In this paper investigate the effect of line reclosing on transient stability assessment for multi machine system in term of critical time a three machine 9 bus system was used as test study the classical model of generator was used in this study in some disturbance case ,the cct decrease as the line reclosing time increase, and the cct without reclosing is less than any of those with line reclosing time in certain range may not increase cct or improve stability of the system .also in some case leaving the cleared line without reclosing may better than reclosing it at specific time .explanation of the result are introduce using conceptual stability region and transient energy function method.

4. LIQ Qing IEEE,Wang zengping and zheng zhenhua, "Study and simulation of SSSC and TCSC Transient control"IEEE SYSTEMS JOURNAL,978-1-4244-1762 - 9/08/2008IEEE. This paper has analysis that the transient characteristics of SSSC and TCSC and then summarized the switch strategy of external and internal fault based on the SMIB .the simulation result show. SSSC considered in transmission line can damp power oscillation efficiently and different switch modes result different effect especially when internal fault And also avoids the impulse voltage and current. The simulation show that 0.1s delay time reaches the satisfied effect. The effects on power compensation and damping low frequency oscillation of SSSC and TCSC for the three phase short circuit of the same line were studied and compared based on the simulation. The capacity SSSC need was less than TCSC when meets the same compensation capacity. The effects on damping low frequency oscillation and the responses speed of SSSC were superior to that of TCSC.

5. J.v kadiya and J.G Jamnani at"Modelling and analysis of TCSC controller for enhancement of transmission network "Intrenational journal of engineering technology and advance engineering . ISSN 2250-2459,VOL 2 ,ISSUE 3 MARCH 2012.

This paper introduces the simulation of EHV transmission line using facts controller TCSC is carried out to increase real power of transmission line. if real power increase , the capacity of EHV line increase as well. also receiving end voltage approximately equal to sending end voltage and the stability of the system or EHV ehv line will also increase. in this paper series compensation is used i. e controller device TCSC. TCSC controller has been used for fault on long transmission line and sub synchronous resonance and the result are calculated by different power system parameter s using software PS-CAD 4.

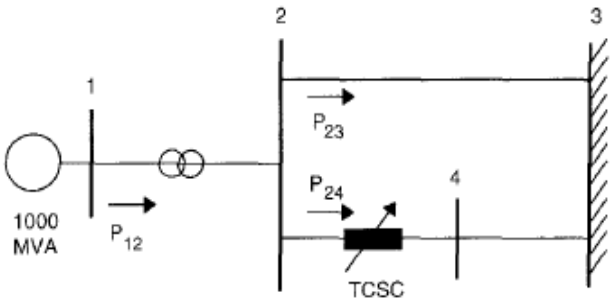
.

6. Nicklas Johansson,lennart angquist,and hans-peter nee. An adaptive controller for power system stability improvement and power flow control by means of a thyristor switch series capacitor (TCSC) "IEEE TRANSACTION ON POWER SYSTEMS, VOL. 25 NO. 1 FEBRUARY ". This paper proposes the TCSC controller is presented. The controllers aim to to stabilize the system as well improvement performance, controllers reduces the damping inertia power oscillation and improve transient stability of system in this paper controller is design for reduce power oscillation by non linear control law,in this paper 23 machine test system is used – nordic32.here the main advantage of controller is based on generic and simple model. Here the controller is used by simply implemented and reduce the amount of power system data, here the controller does'nt take into account voltage variation in grid area and ultimately it shows to decrease the performance of the damping controllers.

7. nelson martins, harminio J.C.P. pinto, john j. paserba "Using a TCSC for line power line power scheduling and system oscillation damping- small signal and transient stabillity studies" 0-7803-5938-0/00/s10.00(c) 2000IEEE This paper gives information about the application of TCSC for power scheduling using constant power and constant anglethe tcsc controller are design for protection for small as well as large disturbancestcsc controllars controls the line power and damp oscillations.here time and frequency responce techniques are used for transient stability in this paper POD controllars is used to increase the effectiveness of active power lowing through TCSCthe result of this paper are shows examples of benefits gainedfrom model analysis and frequency response.

8. V.A prabhakar reddy and C.H. rambabu at "Enhancement of transient stability limit using fuzzy controlled TCSC" IJSETR, VOL. 4 , 1 JAN 2015,ISSN-2278-7798. This paper investigates an improved transient stability improved by maintaining a synchronism of the system after subjected to sever disturbances. disturbances causes by fault on the system.

III BLOCK DIAGRAM-SMALL POWER SYSTEM WITH TCSC

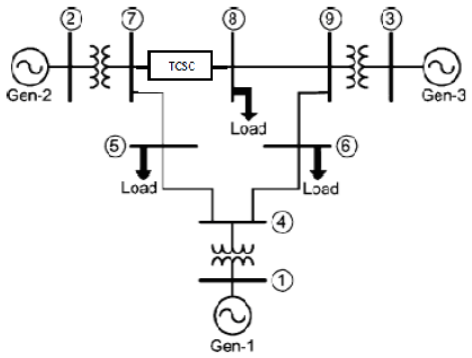


The example system model in Fig.1 comprises a 5-unit hydro power plant connected to an infinite bus through a step-up transformer followed by two transmission circuits. A TCSC device is implemented in on the two transmission line. (as per reference Paper) .The performance of the above system has been considered in case of the line outage with & without TCSC. It has been observed that the system with TCSC has better transient stability as compared with the uncompensated system. In the proposed work it has been planned that the behavior of the TCSC in the standard IEEE 9 bus system has to be evaluated for the large signal disturbance for the transient stability. SERIES DEVICES (1) Thyristor Controlled Series Compensator (TCSC) (2) Static Synchronous Series Compensator (SSSC) Important applications in power transmission and distribution involve devices such as SVC (Static Var Compensators), Fixed Series Capacitors (SC) as well as Thyristor-Controlled Series Capacitors (TCSC) and STATCOM. TSCS TCSC is one of the most important and best known FACTS devices, which has been in use for many years to increase line power transfer as well as to enhance system stability. TheTCSC consists of three main components: capacitor bank C, bypass inductor L and bidirectional thyristors SCR1 and SCR2. The firing angles of the thyristors are controlled to adjust the TCSC reactance in accordance with a system control algorithm, normally in response to some system parameter variations. In this paper, we present the criteria of FACTS technology, through the series compensators by the TCSC device to achieve the transient stability of fault occurring conditions.For approaching the fault analysis, stability criteria of the system is calculated

by several controllers to controlling the TCSC.Controller is a technique to Command the firing angle of the Thyristor Controlled Series Capacitor (TCSC) to maintain the terminal voltage of the device at faulty conditions. Thus the Controllers technique plays a vital role in the FACTS device. Several controllers like P, PI, fuzzy controllers are exists in the literature. The present work deals with a comparative study on the performance of above said controllers with Multi Machine Nine Bus System as case.Objectives of this paper are summarized below To improve the power flow in the line With compensation. o To improve the transient stability of a multi machine power system with Facts devices (TCSC) using fuzzy controller and study the effect Of fuzzy controller. of Finding the optimal location using trajectory sensitivity analysis. Comparative study among performance of the controllers.

9. *MULTY-MACHINE NINE BUS SYSTEM WITH TCSC*

Figure shows the following nine bus system with using TCSC controllars. Here three same hybrid generating system shows the nine bus system by using TCSC controllars transient stability of the nine bus system is improved although sevier fault takes place.



IV THE PROPOSED METHODOGY

1. Our proposed technique involves implementing the POD (Power oscillation Damping) controller to increase the Transient stability of the system. There are the various FACTs devices available in this work TCSC one of the impedance control FACTs device is considered for the evaluation

METHODOLOGIES

a. Develop a system based on the IEEE 9 Bus.

b. Adjust the power flow of the power system in such a way that system moves into a first swing transient stability for the large signal disturbance.

c. Observe the impedance of the complete system & draw the value of the compensation required for the system.

d. Make the Power circuit of the TCSC device. Test the system in the open loop state by manual control of the firing angle of the Thyristors. Check the performance of the system for different value of compensation & firing angle alpha.

e. Implement the TCSC controller in close loop to move the complete system from the first swing transient state to the stable state.

f. Voltage control strategy is used for implementing the TCSC controller

V. CONCLUSION

Transient stability is the ability of the power system to maintain the synchronism is assessed with relative rotor angle variation among the different machine accurate analysis of the transient stability requires the detailed modelling of the generating unit and other equipment. In the present work the transient stability assessment of multimachins 9 bus system is carried out for three face (LLL-G) of self clearing type at different fault location by applying TCSC controller are has been model and implemented in multimachin 9 bus system at optimal location. The effective location of TCSC for different fault location is obtained by performing the compensating controller. FACTS controller like TCSC help in controlling power flow through a line. Since the power system are non linear conventional controllers PI can not perform well in maintaining power system stability. Hence we use FACTS controllers are used to stabilised of system.

A) After doing the literature survey it has been concluded that,

1) FACTS technology is becoming more and more popular due to improvement in Power Electronics technology and reduction in costs.

2) The large dynamic loads reactive power compensation in industry power systems (i.e. arc furnaces), is very often a mandatory action in order to minimize voltage fluctuation and flicker, as well as for power factor improving and load balancing. All the above are different aspects of the same type of action basically called "compensation.

3) If the reactive power of the load is changing rapidly, fast response compensators are required. This is typically the case of TCSC

B) After Modeling of the TCSC in simulink (MatLab) & implementing it in the a system with inductive load following study is target

1) It is planned to make a LLL-G fault in the 9 bus system. and S.Sankara Prasad et al"transient stability enhancement of multi machine power system using
Fuzzy controlled TCSC" international journal of engineering research and technology
performance of the system in transient condition.

2) Based on the results the conclusion shall be drawn on the superiority of TCSC for the large dynamic loads reactive power compensation

REFERENCES

[1] K Srinivas "application of fuzzy controlled TCSC in multimachine power system for transient stability improvement ,vol 48,no. 19 pp.888-975, international journal of computer application 2012.

[2] S.Sankara Prasad et al"transient stability enhancement of multi machine power system using Fuzzy controlled TCSC" international journal of engineering research and technology (IJERT) VOL.1 ISSUE 6 AUGUST 2012.

[3] J.V Kadiya and J.G. Jammani "Modelling and analysis of TCSC controller for enhancement to transmission network "international journal of engineering research and technology volume 2 issue 3 march 2012.

[4] Kundur ,power system stability and control, mc graw hill, new York, 1994

[5] N.G.Hingorani, and Laszlo gyugyi " understanding FACTS" IEEE press 2000

[6] Dheeman Chatterjee , Arindam Ghosh*, "Application of Trajectory Sensitivity for the Evaluation of the Effect of TCSC Placement on Transient Stability" International Journal of Emerging Electric Power Systems volume 8, issue 1 2007 article 4

[7] WU Yanjuan key laboratory of smart grid of ministry of education ,Tianjin universityTianjin 300072,china.LI Linchuan school of automation ,Tianjin university of technology, Tianjin 3000384,china, 978-1-4244-9690-7 2011 IEEE.

[8] Krihnan, V . McCallery, JD. H enry, S.Issad ,S . " efficient database generation for decision three base power system security assessment" IEEE transient on power system , vol 26, no 4 pp 2319-2327,2011.

[9] P. Vuorenpää, T. Rauhala and P. Järventausta, "Applying TCSC Frequency Response Data Derived Using Electromagnetic Transient Analysis in SSR Frequency Scanning Studies", PowerTech, IEEE Bucharest, (2009) June 28-July 2.

[10] A. D. D. Rosso, C. A. Canizares and V. M. Dona, "A study of TCSC controller design for power system stability improvement", IEEE Trans. Power Syst., vol. 18, no. 4, (2003) November, pp. 1487-1496.