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Modelling & Simulation of Power Oscillation Damping Controller

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***Abstract*—**The main aim of this paper is to regulate power oscillation that is major concern associated with facility operation. During this analysis work is on SSSC-based power oscillation damping controller, which may damp the ability oscillations occurring because of the any modification within the line like unforeseen modification in load of line, prevalence of fault, transmission line switch and short circuit. During this work Simulation model of the 2 machine infinite bus system exploitation SSSC & power oscillation damping controller has been drained MATLAB/SIMULIINK and facility tool chest is employed for simulation purpose. These simulation models are setup into MATLAB primarily based power grid tool cabinet (PST) for his or her transient stability analysis. it's determined that with the correct modification of section of the injection of voltages through SSSC, electrical phenomenon & inductive compensation is provided by that enlarged and cut within the active power severally of line is done consistent with the mentioned power demand, however once solely the SSSC is employed within the line the subsiding time and amplitude of power oscillations area unit a lot of as compared once SSSC is employed with power oscillation damping controller. Once in 2 machine infinite bus systems 3-phase fault analysis is finished then it's determined that that the clearance time is a smaller amount once the system is supplied with SSSC and power oscillation damping controller along or together

Keywords- *PSS, PST, SSSC, SMIB, Power Oscillation Damping Controller (PODC), FACTS.*

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I. INTRODUCTION

Now a days the foremost necessary demand of facility is to enhance the parameters like irresponsibleness, transmission capability, security with utilization of power. Power transfer capability of transmission lines is reduced by stability thought. Oscillation of generator angle or line angle area unit typically related to the gear mechanism disturbances and may occur owing to step changes in load, sharp amendment of generator output, conductor shift and tangency. The low frequency is very important think about power station as a result of it causes power quality issues. The mechanical device oscillations area unit causes of total system outage. Therefore these area unit removed by totally different techniques of oscillation management like SSSC based mostly damping controller.

In early age this signal instability drawback was solved by amortisseurs enforced in generator rotors, later with the appliance of quick excitation system this was solved by development & utilization of facility Stabilizer (PSS) and but in fashionable facility owing to the affiliation of power grids in immense space, for inhume space oscillation damping owing to the flexibility of dominant line resistance, power flow and bus voltage, versatile AC transmission Systems (FACTS) devices implementation offers an alternateanswer.

II. RELATEDREVIEW

Oscillation of generator angle or line angle area unit typically related to the transmission disturbances and may occur because of step changes in load, fulminant amendment of generator output, cable switching and short circuit. Totally different modes of rotor oscillation are native mode, intra-area mode and inter-area mode. Instability issues in power systems that may cause partial or full blackout will be broadly speaking classified into 3 main classes, particularly voltage, phaseangleandfrequencyconnectedissues.antecedently these instability downside were resolved by amortisseurs enforced in generator rotors, later with the applying of quick excitation system by utilization of power grid Stabilizer (PSS) and currently with the affiliation of facility in massive space, inter-area oscillation arises which might be resolved utterly by versatile AC transmission devices. [2, 3, 18, 19].

Flexible AC transmission Systems (FACTS) area unit recognized as a transmission transfer capability improvement resolution, minimizing the gap between system (transient, voltage and little signal) stability and thermal limits. STATCOM will management or control or control voltage magnitude and to a-tiny low extent, the phase angle in an exceedingly very short time and thus has the power to boost the system damping further as voltage profile of the system. Power electronic shift capabilities in terms of management or control or control and high speed prove FACTS devices additional helpful in power flow improvement, management or control or control of voltage magnitude and transient stability throughout faults leading to improvement in installation stability. [4, 6,13].

III. PROBLUMIDENTIFICATION

Following are the problems of style of damping controller.

Choice of management or control signal – The management or control signal ought to be used from native measurement rather than telemetering. It ought to contain the modal element that's to be damped not the noise which will be amplified. The management or control law principally associated with the selection ofsignal.

Control law or formula – principally linear management or control theory is employed but some tries are created to use non-linear techniques (fuzzy logic or neural network primarily based controller).

Robustness of controller underneath varied system conditions – its best condition that matters in sensible cases. A point of adaptation would be needed during a controller that should operate underneath varied conditions.

Co-ordination among controllers – one controller at a given location isn't capable damp all the essential modes. Multiple controllers at totally different locations ought to be used. Therein case, the isolated standardization of individual controller isn't possible or feasible.

IV. METHODOLOGY

Symmetrical 3-Phase Fault at Bus-2 Simulation Model of Two Machine System with 3-Phase Fault at Bus-2.

On the two machine system model a 3-phase fault happened at bus B-2 as shown in figure 1.

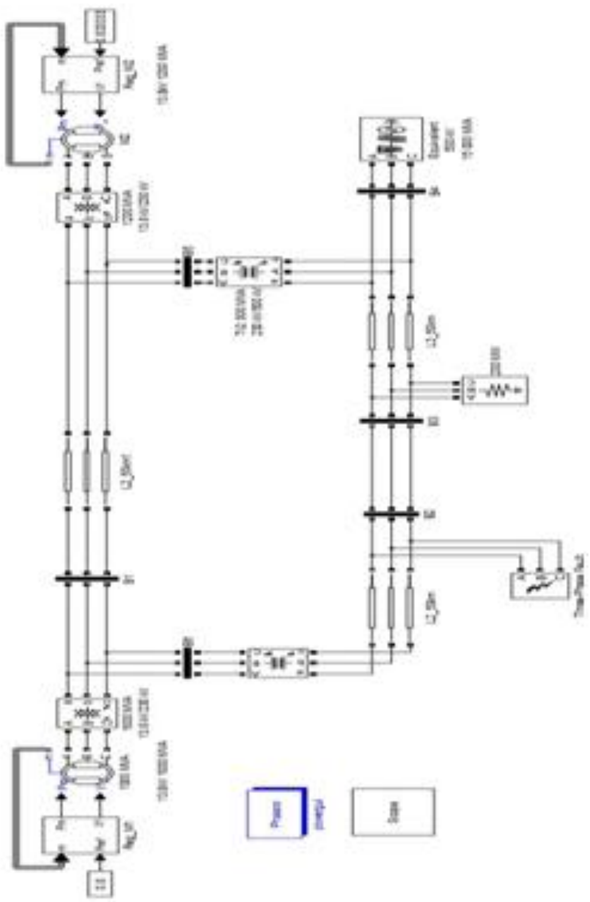

Figure 1. Simulation model of two machine infinite bus system with 3-phase fault at bus 2

In two machine infinite bus system with 3-phase fault, results of the variation of magnitude of active & reactive power at bus-2, magnitude of voltages, active & reactive power at bus1- 4 versus time are shown in figure 2 to 6 respectively.

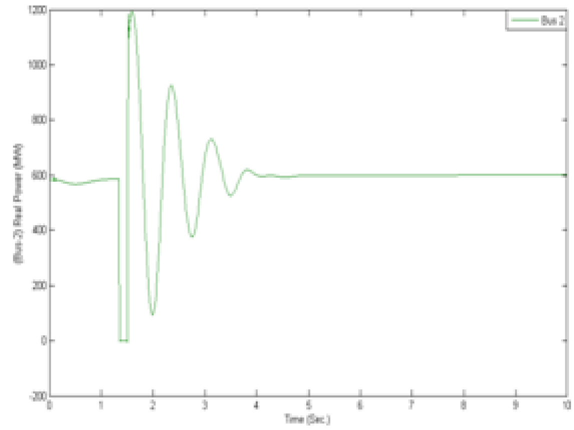

Figure 2. Active power (at bus 2) with 3-ϕ fault at bus 2

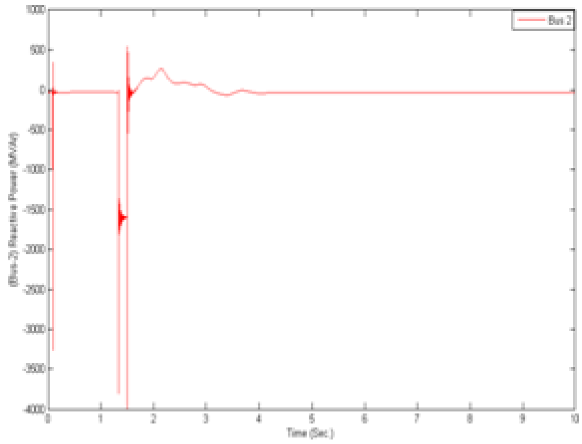

Figure 3. Reactive power (at bus 2) with 3-ϕ fault at bus 2

After clearance of fault at 1.5 sec., from figure 2 it is seen that active power at bus 2 changes abruptly for about 4 sec. and from figure 3, reactive power for about 3 sec. Theeffect of 3- phase fault on voltages, active & reactive powerremaining buses are shown in figure 4 to 6 respectively.

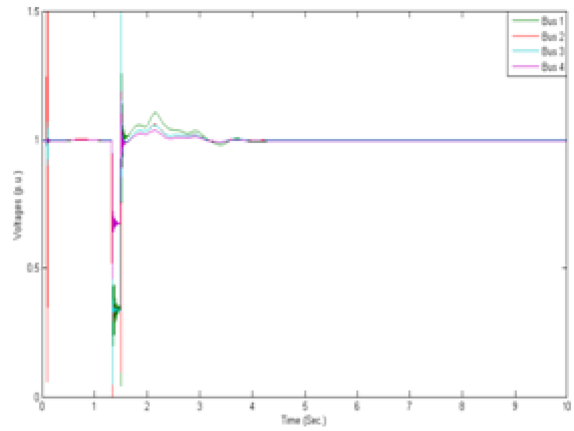

Figure 4. Voltages (at bus 1-4) with 3-ϕ fault at bus 2

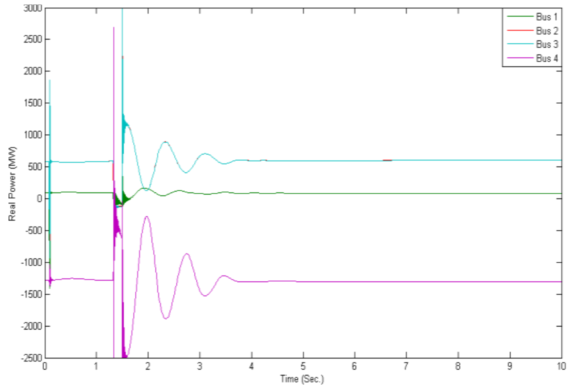

Figure 5. Voltages (at bus 1-4) with 3-ϕ fault at bus 2

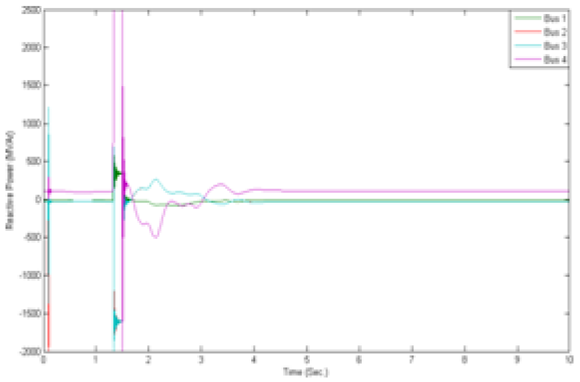

Figure 6: Reactive power (at bus 1-4) with 3-ϕ fault at bus 2

Simulation Model of Two Machine System with 3-Phase Fault& SSSC-based Damping Controller. In this case a SSSC- based power oscillation damping controller is connected between bus B1 and bus B2 of the two machine infinite bus system model with 3-phase fault of figure 7

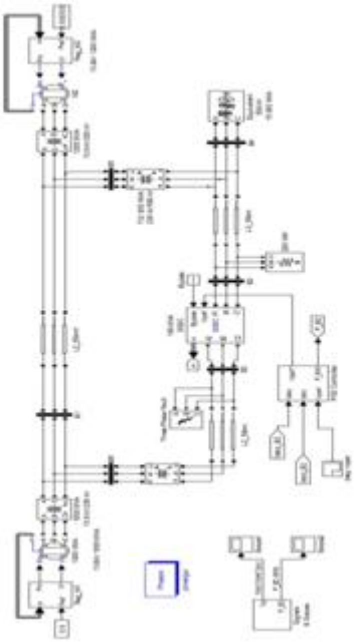

Figure 7: Simulation model of two machine infinite bus with 3-phase fault & SSSC-based damping controller

With the control of effect of 3-phase fault on two machine system by SSSC-based power oscillation damping controller, results of the variation of magnitude of injected voltage, magnitude of active & reactive power at bus-2, magnitude of voltages, active &reactive power across bus1-4 versus time are shown in figure 8 to12.

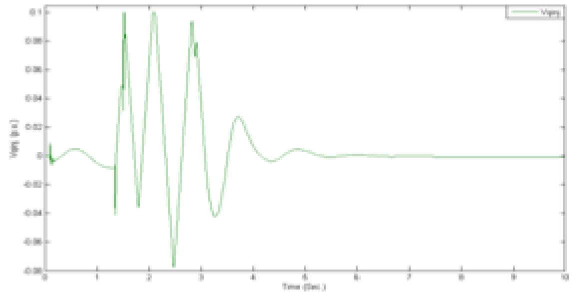

Figure 8: SSSC-based POD with 3-ϕ fault at bus 2

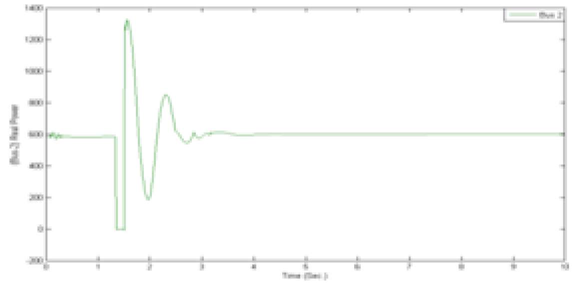

Figure 9: Active power (at bus 2) using SSSC-based POD with 3-ϕ fault at bus 2

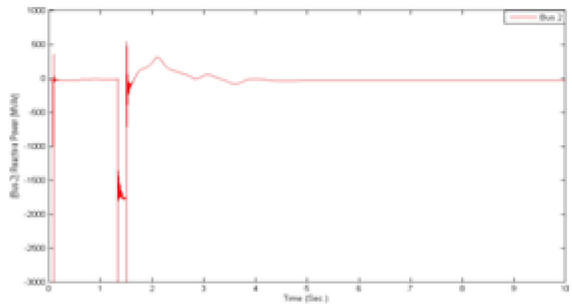

Figure 10: Reactive power (at bus 2) using SSSC-based POD with 3-ϕ fault at bus 2

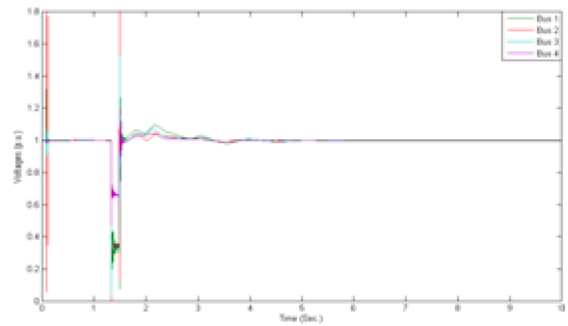

Figure 11: Voltages (at bus 1-4) using SSSC-based POD with 3-ϕ fault at bus 2

From figure 8, it is seen that by the use of SSSC-based damping controller, there is a injection of voltage which varies abruptly across zero value so as to compensate the effect of power oscillations which genarates due to the occurance of 3- phase fault at bus 2. This compensation of oscillations of active power at bus 2 is shown in figure 9, where period of oscillation remains for about 1.5 sec. and that of reactive power at bus 2 is shown in figure 10 with period of oscillation of about 2.5 sec.. The effect of 3-phase fault and SSSC-based damping controller simultaneously on voltages, active & reactive power of remaining buses are shown in figure 11 to 13 respectively

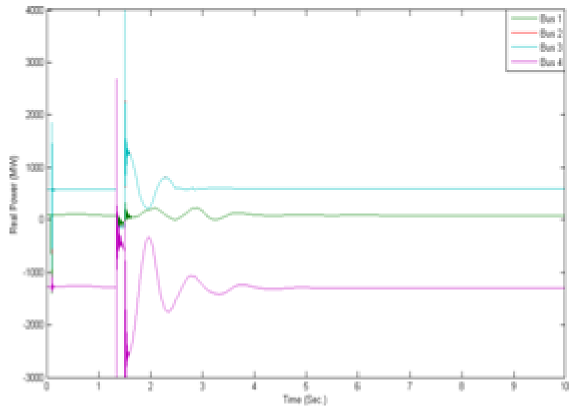

Figure 12: Active power (at bus 1-4) using SSSC-based POD with 3-ϕ fault at bus 2

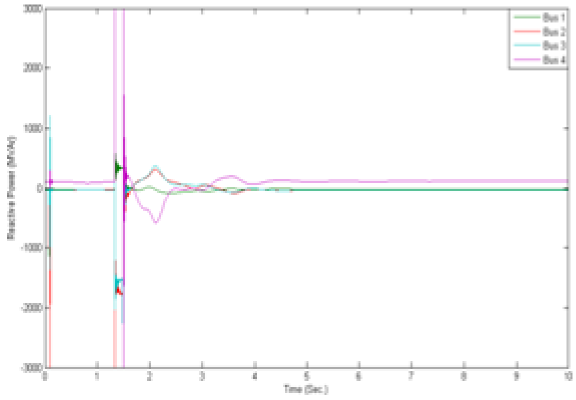

Figure 13: Reactive power (at bus 1-4) using SSSC-based POD with 3-ϕ fault at bus 2

V. RESULT &DISCUSSION

Comparison of Two Machine System with 3-Phase Fault and SSSC-based Damping Controller.

Figure 14 and 15 shows the comparison of results of variation of injected voltage , magnitude of bus-2 active power versus time with 3-phase fault & SSSC-based damping controller.

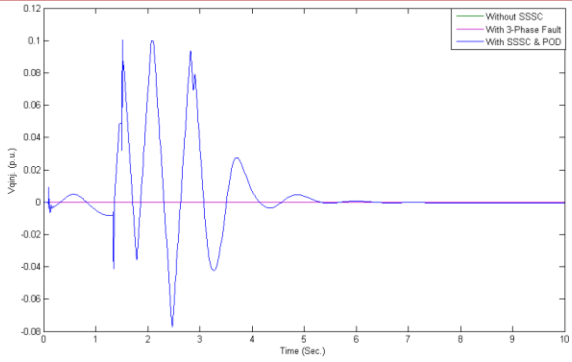

Figure 14: SSSC-based POD with 3-ϕ fault at bus 2

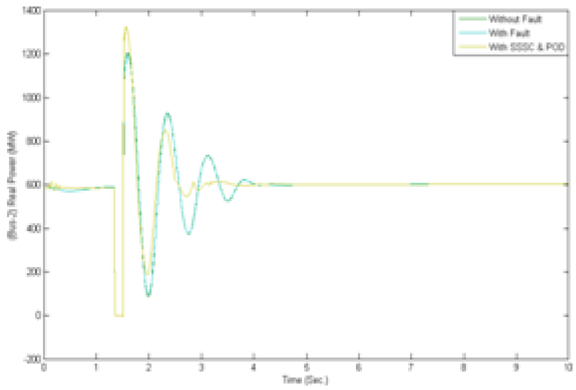

Figure 15: Active power (at bus 2) using SSSC-based POD with 3-ϕ fault at bus

Figure 14 shows the injected voltage by SSSC-based damping controller to compensate active power oscillations at bus 2. As shown in figure 15, without the use of SSSC-based damping controller, after clearance of 3-phase fault active power at bus 2 changes abruptly from 1.5 sec. to 5 sec. But with the use of SSSC-based damping controller, after clearance of fault at 1.5 sec.oscillationsinactivepoweratbus2remainupto3sec. i.e. for a time of about 1.5 sec.

VI. CONCLUSION

Simulation model of the two machine infinite bus system using SSSC & power oscillation damping controller has been done in MATLAB/SIMULIINK and power system toolbox is used for simulation purpose. In this two machine infinite bus system increase and decrease in active power demand has been shown in one step of each. It is observed that with the proper change of phase of the injection of voltages through SSSC, capacitive & inductive compensation can be provided by which increased and decreased in the active power respectively of transmission line can be done according to the mentioned power demand, but when only the SSSC is used in the line the settling time and amplitude of power oscillations are more as compared when SSSC is used with power oscillation damping controller. It also enhances the power carrying capability of other buses connected to the system. The active & reactive power in all the buses is given in the present paper. In this two machine infinite bus system 3-phase faultanalysisatbus2isalsodone.Itisobservedthatthe clearance time is less when the system is provided with SSSC and power oscillation damping controller together.

REFERENCES

[1]. N. G. Hingorani, L. Gyugyi, "Understanding FACTS: concepts and technology of flexible AC transmission systems", New York: IEEE Press, 2000.

[2]. K.R.Padiyar, "FACTS Controllers in Power Transmission and Distribution".

[3]. H. Saadat, "Power Stability Analysis", TMH Publication Edition, 2002, pp. 460-526.

[4]. A. Kazemi et al.,"Optimal Selection of SSSC-Based Damping Controller Parameters for Improving Power System Dynamic Stability Using Genetic Algorithm", Iranian Journal of Science & Technology, Transaction B, Engineering, Vol. 29, No.B1, Feb. 2005 pp1-5.

[5]. B. Geethalakshmi, T. Hajmunnisa and P. Dananjayan,"A Fuzzy Logic Controller for Enhancing the Transient Stability of 48-Pulse Inverter Based SSSC", VOL. 10, NO. 2, 2008, pp. 53-58

[6]. H. Taheri , S. Shahabi, Sh. Taheri , A. Gholami "Application of Synchronous Static Series Compensator (SSSC) on Enhancement of Voltage Stability and Power OscillationDamping", 978-1-4244-3861 2009 IEEE, pp. 533-539.

[7]. Abdul Haleem, RavireddyMalgireddy "Power Flow Control with Static Synchronous Series Compensator (SSSC)", Proc. of the International Conference on Science and Engineering (ICSE 2011) ISBN: 978-981-08-7931-0 pp. 1-5.

[8]. L. Gyugyi, C.D.Schauder, & K.K. Sen," Static synchronous series compensator: Asolid-state Approach to the series compensation of transmission lines".1997 Power Delivery, IEEE Transactions on 12(1), pp.406-417.

[9]. M. Faridiet al.,"Power System Stability Enhancement Using Static Synchronous Series Compensator (SSSC)", 978-1-61284-840- 2011 IEEE, pp.387-391.

[10]. L.J.Cai,I.Erlich, "Simultaneous Coordinated Tunning of PSS and FACTS Controller for Damping Power System Oscillations in Multi-Machine Systems", 0-7803-7967 2003 IEEE, pp. 1-6.

[11]. Li Juan, et al. "A Non-linear Control Approach to Increase Power Oscillation Damping", 2008 International Conference on Computer and Electrical Engineering.pp.734-738.

[12]. Majid Poshtan, ParvizRastgoufard, "A Nonlinear Control Method for SSSC to Improve Power System Stability", 0-7803-9772- X/06/$20.00 ©2006 IEEE.

[13]. V.K.Chandrakar, A.G. Kothari, "MFFN based Static Synchronous Series Compensator (SSSC) for Transient Stability improvement", world Academy of Science Engineering and Technology 05 2009, pp.1066-1070.

[14]. K.K.Sen, "SSSC-static synchronous series compensator: theory, modeling and publications." IEEE Trans. Power Delivery. Vol. 13, No.1, January 1998, PP. 241-246.

[15]. H.F.Wang, "Static synchronous series compensator to damp power system oscillations", Electric Power System Research 54 (2000) pp.113-119.

[16]. Sidartha Panda, "Modelling, simulation and optimal tuning of SSSC-based controller in a multi machine power system", World journal of Modelling and simulation vol. 6(2010) no. 2, pp. 110-12.

[17]. A.Ghosh, G.Ledwich, "Modelling and Control of thyristor- controlled series compensator", IEE Proc.-Trans. Dist. vol-142, No. 3, 1995 pp 297-307.

[18]. D.Murali, M. Rajaram,"Transient Energy Analysis for STATCOM and SSSC Applications", International journal of Electrical and Power Engineering 3(4): 2009, pp. 191-197.

[19]. Chi Su, Zhe Chen, "Damping Inter-Area Oscillations Using Static Synchronous Compensator (SSSC)", UPEC-46th International Universities Power Engineering Conference, September 2011.

[20]. K.M.Sze. et al, "Application of PWM based Static Synchronous Series Compensator (SSSC) to enhance Transient Stability of Power System", 6th international conference of APSCOM Nov.2003 pp. 409-41

[21]. P. Srivastava, R Pardhi "A Review on Power System Stability and Applications of FACT", International Journal of Engineering Research and Applications, Vol. 3, Issue 3, May-Jun 2013, pp.879- 883.

[22]. P. Kumar, K. Namrat"Voltage Control and Power Oscillation Damping of Multi-Area Power System Using static synchronous Series", Journal of Electrical and Electronics Engineering, Issue 5 (July-Aug. 2012), PP 26-33.