ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

Control and Optimization of Power Flow in Transmission Line Using UPFC

A.Ashwini
M.Tech,
Jawaharlal Nehru Institute of Technology (JNIT).

G.Sirisha
Associate Professor,
Jawaharlal Nehru Institute of Technology (JNIT).

Ch Satyanarayana
Associate Professor,
Jawaharlal Nehru Institute of Technology (JNIT).

Abstract:

This paper is based on practical contingency condition of a transmission line, over which a study using UPFC is done without sacrificing the available generation capacity. The Unified Power Flow Controller (UPFC) is the most versatile and complex power electronic equipment that has emerged for the control and optimization of power flow in electrical power transmission system. Installing the UPFC makes it possible to control an amount of real power flow through the line. This paper presents control of power flow through overloaded/under loaded line under study. Simulation were carried out using MATLAB software to overcome the contingency condition by using UPFC.

Index Terms:

FACTS, unified power flowcontroller (UPFC), coordinationcontroller.

I.INTRODUCTION:

Today's power system is highly complex and requires careful design of new devices taking into consideration the already existing equipments. Now a day, numbers of private generating units are getting commissioned due to power generation policy and open access to transfer power. But, due to variety of environmental and regulatory concern, the expansion of electric power transmission facilities is restricted. Power Transmission and Generation utility would be benefited if they could increase line power capability while being able to delay the construction of new transmission lines. So as to meet, additional power transfer capability, beyond the present limit, will be needed to meet the requirement and to provide adequate margin.

Power transfer capability is constrained by facility overloads and reactive power deficiencies. For optimum utilization of available transmission facilities, FACTS (UPFC) can be used to mitigate the problems [1][2]. It is well known that the power flow through transmission line is a function of line impedance, magnitude and phase angle of bus voltage. If these parameters can be controlled, the power flow through the transmission line can be controlled in a predetermined manner.

Flexible AC Transmission System (FACTS) uses advanced power electronics to control the parameters in the power system in order to fully utilize the existing transmission facilities. Modern power systems are becoming increasingly stressed because of growing demand and variety of factors. In recent years, energy, environment, right-of-way, and cost problems have delayed the construction of new transmission lines, while the demand for electric power has continued to grow. This situation has necessitated a review of the traditional power system concepts and practices to achieve greater operating flexibility and better utilization of existing power systems.

Representative of the FACTS devices are SVC (Static Var Compensators), TCSC (Thyristor Controlled Series Capacitor), STATCOM, the Unified Power Flow Controller (UPFC), a phase shifters, etc. These devices may be connected in shunt/series or a combination of shunt and series. Variety of advantages like improvement in steady state power flow, transient stability, voltage stability etc. can be derived. Performance of an existing transmission system can be improved. The UPFC is the most versatile and complex of the FACTS devices, combining the features of STATCOM and the SSSC. The UPFC can provide simultaneous control of all basic power system parameters viz., line voltage, impedance and phase angle [1].

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

II.PROPOSED SYSTEM:

Basic Concepts:

Submit your The UPFC consists of two series and shunt converters with AC transmission systems. It is a combination of STATCOM and SSSC. These parts are coupled together with common DC link (capacitor) to allow the real power flow between the series and shunt converter output terminals bi-directionally, and to provide real and reactive line compensation without an external energy source. UPFC is able to control the series voltage injection by the means of unconstrained angle. The transmission line with UPFC, which is extended in AC transmission network.

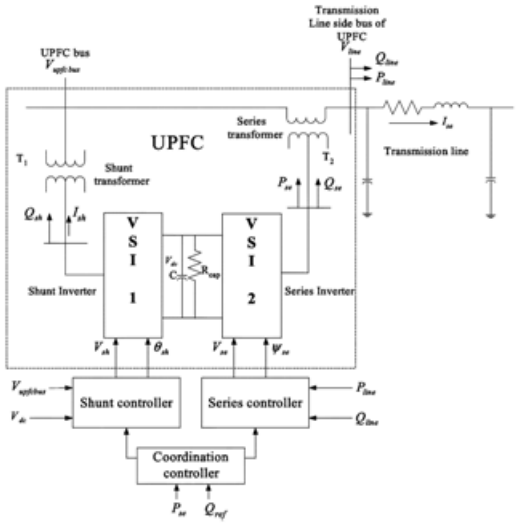

Fig.1. UPFC connected to a transmission line.

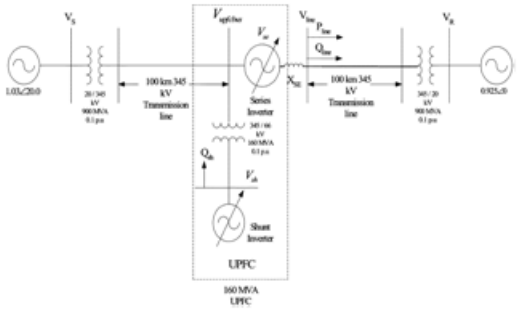

Fig. 2 Power system with UPFC.

The washout circuit represents the reactive power coordination controller. The gain of the washout circuit has been chosen to be 1.0. This is because, any increase/decrease in the transmission line reactive power flow due to change in its reference is supplied by the shunt converter. The washout time constant is designed based on the response of the power system to step changes in transmission

III CONTROL STRATEGY:

A.Shunt Converter Control Strategy:

The shunt converter of the UPFC controls the UPFC bus voltage/shunt reactive power and the dc link capacitor voltage.In this case, the shunt converter voltage is decomposed intotwo components. One component is in-phase and the other inquadrature with the UPFC bus voltage. De-coupled controlsystem has been employed to achieve simultaneous control ofthe UPFC bus voltage and the dc link capacitor voltage.

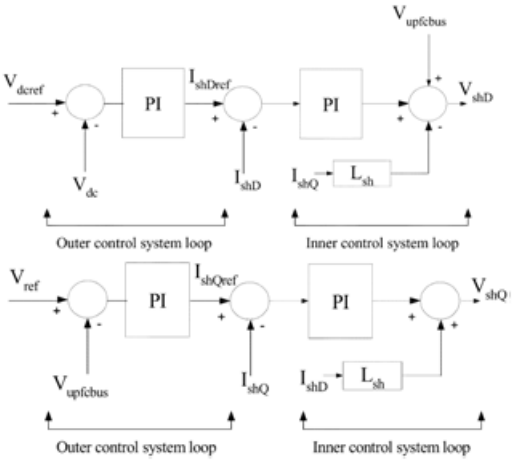

Fig. 3 . De-coupled D-Q axis shunt converter control system.

B.Series Converter Control Strategy:

The series converter of the UPFC provides simultaneouscontrol of real and reactive power flow in the transmission line.To do so, the series converter injected voltage is decomposedinto two components. One component of the series injectedvoltage is in quadrature and the other in-phase with the UPFCbus voltage. The quadrature injected component controls thetransmission line real power flow. This strategy is similar tothat of a phase shifter. The in-phase component controls thetransmission line reactive power flow. This strategy is similarto that of a tap changer.

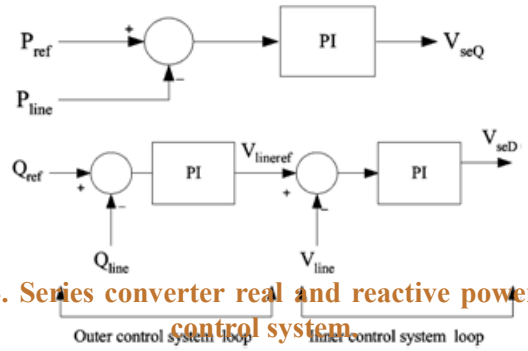

Fig. 4. Series converter real and reactive power flow control system.

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

IV.SIMULATION RESULTS:

RESPONSE OF THE POWER SYSTEM TO STEP CHANGES IN REACTIVE AND REAL POWER FLOW REFERENCE

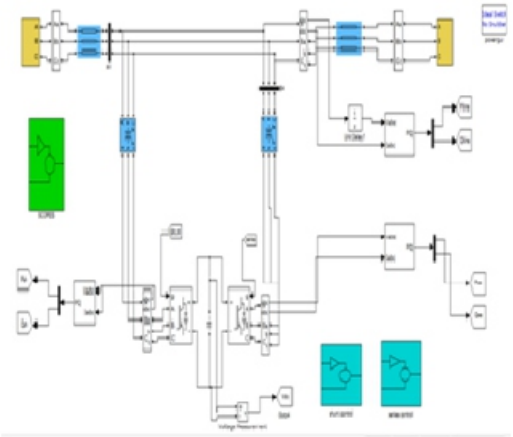

Fig.5 Single line diagram in MATLAB

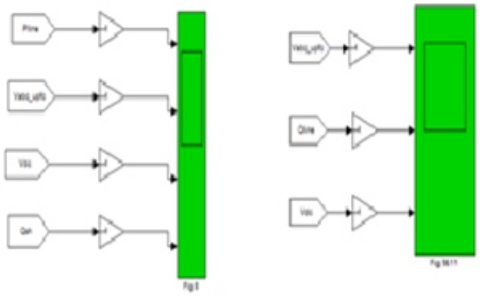

Fig6UPFC scope in MATLAB

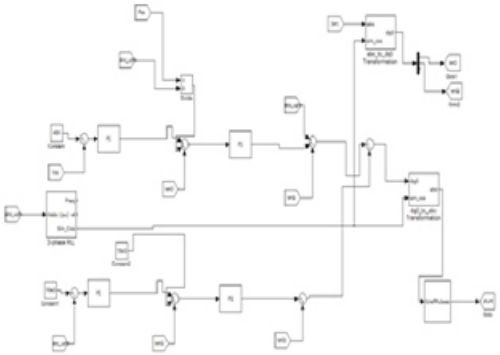

Fig.7 shunt controller in MATLAB

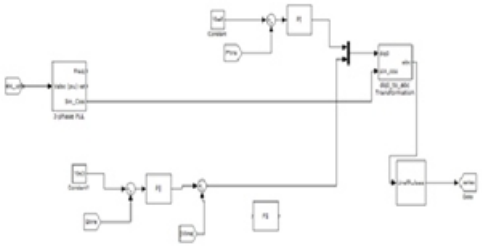

Fig.8 series controller in MATLAB

POWER OSCILLATION DAMPING:

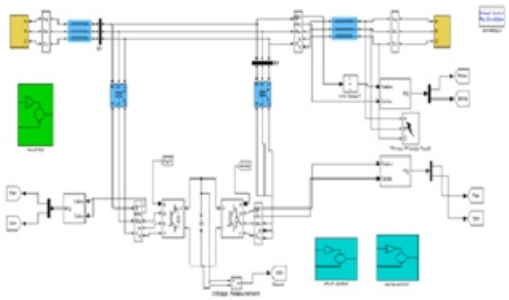

Fig.9single line diagram for fault UPFC in MATLAB

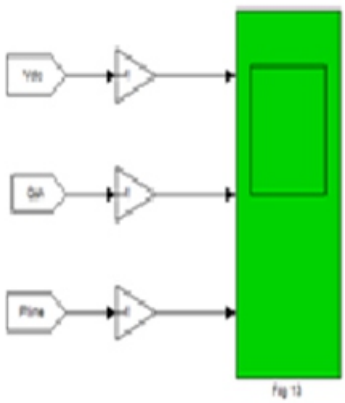

Fig.10 Fault UPFC scope

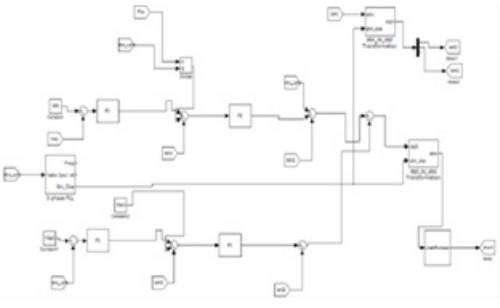

Fig.11 Fault shunt control in MATLAB

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

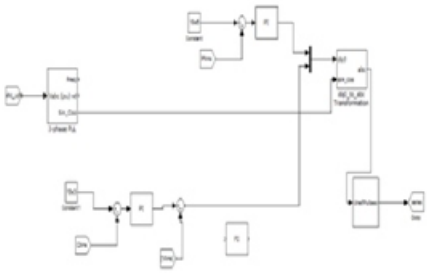

Fig.12 Fault series control in MATLAB

Response Of The Power System To Step Changes In Reactive And Real Power Flow Reference

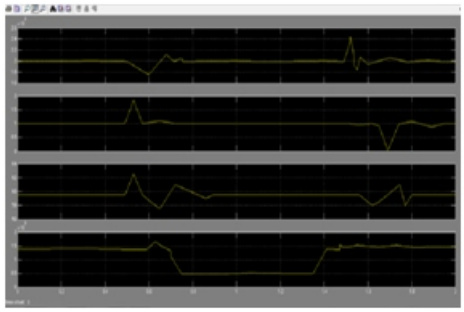

Fig.13 Response to step change in reactive power reference P line (MW), V upfc bus (p.u), V dc(KV),Q line(MVAR)

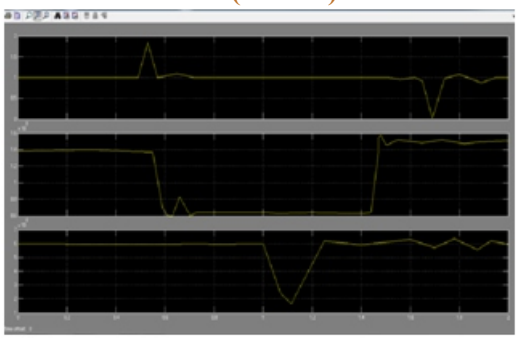

Fig14 Impact of reactive and real power coordination control V upfcbus(p.u), Q line (MVAR),V dc (KV)

POWER OSCILLATION DAMPING:

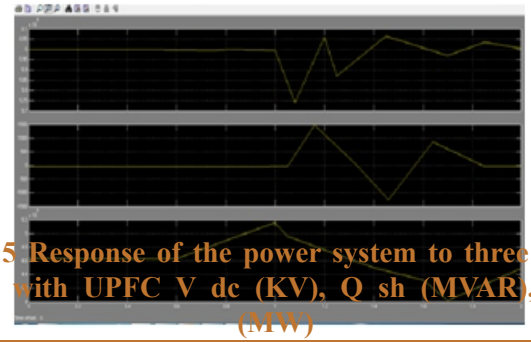

Fig.15 Response of the power system to three phase fault with UPFC V dc (KV), Q sh (MVAR),P line (MW)

V CONCLUSION:

In this study, the MATLAB environment using model of UPFC connected to a three phase-three wire transmission system. This paper presents control and performance of UPFC intended for installation on a transmission line. Simulation results show the effectiveness of UPFC in controlling real and reactive power through the line.

REFERENCES:

[1] N.G. Hingorani and L. Gyugyi, "Understanding FACTS: concepts and technology of flexible ac transmission systems", IEEE Press, NY, 1999.

[2] Y.H. Song and A.T. Johns, "Flexible ac transmission systems (FACTS)", The Institute of Electrical Engineers, London, 1999.

[3] M. Noroozian, L. Angquist, M. Ghandhari, and G. Andersson, "Use of UPFC for optimal power flow control", IEEE Trans. on Power Delivery, Vol. 12, No. 4, pp. 1629-1634, 1997.

[4] L. Gyugyi, "Dynamic compensation of ac transmission line by solid-state synchronous voltage sources", IEEE Trans. Power Delivery, Vol. 9, pp. 904-911, Apr.1994.

[5] R. MihaliEet.al, "Improvement of Transient Stability Using Unified Power Flow Controller", IEEE Transactions on Power Delivery. Vol.11,No1. January 1996.

[6] A. Edris, A.S. Mehraban, L. Gyugyi, S. Arabi, T. Reitman, "Controlling the Flow of Real and Reactive Power ", IEEE Computer Applications in Power, pp. 20-25, January 1998.

[7] L.Gyugyi, C.D. Schauder, S.L. Williams, T.R. Reitman, D. R. Torgerson, A. Edris, "The Unified Power Flow Controller: A New Approach to Power Transmission Control," IEEE Trans. on Power Delivery, Volume 10, No. 2, pp. 1085-1097, April 1995.

[8] Ying Xiao; Song, Y.H.; Chen-Ching Liu; Sun, Y.Z.; "Available transfer capability enhancement using FACTS devices", Power Systems, IEEE Transactions on Volume: 18, Issue: 1, 2003 , Page(s): 305 – 312.

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

[9] Farhangfar, A.; Sajjadi, S.J.; Afsharnia, S.; "Power flow control and loss minimization with Unified Power Flow Controller (UPFC)", IEEE Conference on Electrical and Computer Engineering, 2004, Page(s): 385 - 388 Vol.1.

AUTHOR DETAILS:

A.ASHWINI, received B.Tech degree from Madhira college of engineering , Palennaram,chilukuru(M), Kodad, Telangana in 2013. And currently pursuing M.Tech in Electrical power system at Jawaharlal Nehru Institute of Technology, Mangalpalli(V), Ibrahimpatnam(M), Telangana

G.SIRISHA,obtained his B.Tech (EEE) degree from DVR&Hs MIC college of Technology in 2006, kanchikacharla,M.Tech.(Power electronics) from Ellanki college,patancheru,JNTU Hyderabad in 2012, pursuing Ph.D in JNTU Hyderabad .She worked as Asst. Prof. in Jawaharlal Nehru Institute of Technology ,Hyderabad. She also has been working as a Associate Professor in Jawaharlal Nehru Institute of Technology. Her areas of interest include power system operation & control, distribution studies and optimization techniques in power system operation. she is also LMISTE. She is having 8 years teaching experience.

CH.SATYANARAYANA, obtained his B.Tech (EEE) from Sindhura College of Engineering & Technology in 2006, M.Tech.(Power Engineer) from SCIENT INSTITUTE OF TECHNOLOGYin 2012.He worked as Asst. Prof. Tudi Ram Reddy Institute of Technology & Sciences .He has been working as a Associate Professor in dept. of EEE at Jawaharlal Nehru Institute of Technology. He Stood First at Mandal level in S.S.C. His areas of interestPowerSystems-1,Electrical Circuits,NetworkTheory,Control Systems,Electrical Measurements,Electrical Distribution Systems.He is having 8 years teaching experience