A novel Real and reactive power coordination controller for a unified power flow controller (UPFC)

[14]Dammanagari Harish Reddy & [2]S R K Reddy

1. M.Tech, Kbr Engineering College, Bhovanagiri, Near Bibi Nagar, Pagidipalli, Telangana
2. Assosciate.Professor, Kbr Engineering College, Bhovanagiri, Near Bibi Nagar, Pagidipalli, Telangana

ABSTRACT

Nowadays the measurement of reliability indices for proper evaluation of reliability in a power system has become a great challenge to power engineers. The HV lines are now installed in different countries as well as in India also. But the amount as well as quality of power transfer is very much responsible towards congestion in power system. FACTS technologies have been introduced to overcome the various operational difficulties during control of power flow as well as power compensation. By properly locating these FACTS devices the phase angle, impedance and voltage profile of the selected bus can be controlled. The UPFC is the most versatile, multifunction controller which uses the complex power electronic devices for the efficient control as well as optimization of power flowin transmission line. In this paper firstly, the basic operating principle of UPFC has been discussed. Additionally the power transmission capacity has also been improved by implementing the UPFC in a modeled power system which has been implemented in MATLAB.

Keywords: FACTS; UPFC; Power flow Control; MATLAB; SIMULINK; VSC; HYSTERESIS CURRENT CONTROL

INTRODUCTION In modern power system to increase operating flexibility, controllability, transmission capacity, enhancing transient stability, enhancement of ATC, mitigation of subsynchronous resonance and for precise control of power flow, new types of FACTS devices are extensively used especially for transmission systems in newly deregulated electricity markets. The UPFC [1, 3, 5] is a part of a family of power electronic equipment capable of producing acontrolled synchronous voltage source (SVS) for use in modern electric power transmission system. It may be either connected in series or in parallel to power transmission lines for the purpose of better utilization of electric power system and optimization of power flow. The development of first commercial UPFC is carried out under the joint sponsorshipof the EPRI, AEP and Westing House of USA [2]. In order to realize the mechanism as well as the control strategy of UPFC, Analog and Digital Simulators are normally used. In digital simulation, the electromagnetic transient programs are widely used for UPFC analysis [4]. A power frequency model of UPFC has been developed in MATLAB to interface it into the ac power transmission network for analyzing its various effects on large- scale power systems. Simulation results show that the proposed UPFC control strategy can improve the overall system dynamic performance effectively in addition to independently control the real and reactive power in the transmission line.

Characteristics and Operating Principle of UPFC

UPFC is the representative of the most versatile and last generation of FACTS devices. This new FACTS device represents both the features of STATCOM and SSSC and thus having the capacity of controlling the all transmission line parameters (voltage, phase angle and line impedance).The UPFC uses one VSI (act as an SVS) connected in series to the transmission line through a series transformer while another VSI is connected in shunt with the local bus through a shunt

International Journal of Research

Available at https://edupediapublications.org/journals

p-ISSN: 2348-6848
e-ISSN: 2348-795X
Volume 02 Issue 11
November 2015

transformer. These two VSI are connected back to back through a common dc link including a storage capacitor Figure 1: Model Block Diagram of an UPFC connected
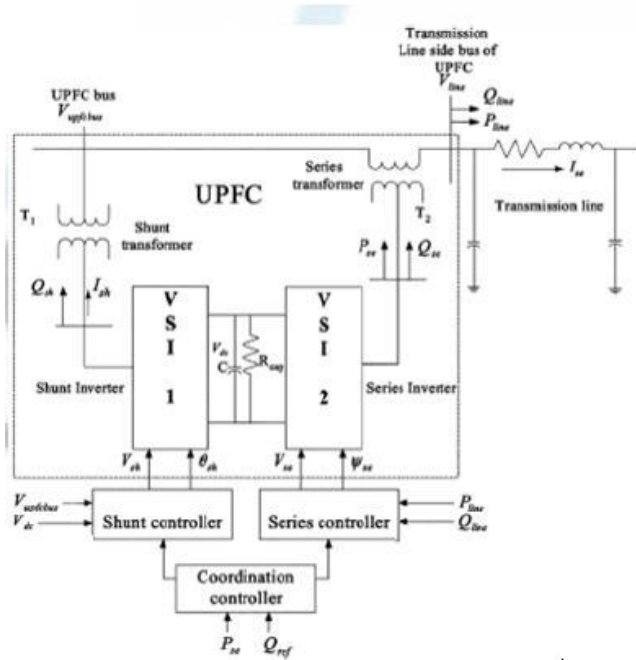
with transmission line necessary reactive power by electronic way at its acterminals and thus better voltage regulation is obtained at the connection point. But the drawback of the VSI is unless there is a suitable power source at its dc side terminals, exchange of real power would be improper. Three phase controllable voltage source is connected in series with the line to control both the active & reactive power flow in the transmission line as well as to the load. Here the net real power absorbed from the line by the UPFC equal to the losses of both the VSI as well as the transformers and the exchange of reactive power with the line is provided by the remaining capacity of the shunt connected VSI. However the two VSI can work independently by separating the dc side. UPFC Control Block Diagram Nowadays the FACTS technology provides greater flexibility than the SSSC for controlling the both active and reactive power of transmission line. Here in UPFC mode, the active power is transferred from the shunt connected VSIto the series converter through the DC bus. Contrary to theSSSC where the injected AC voltage (Vs) is constrained to be in quadrature with line current, this injected voltage now may have any angle with respect to line current.

CONTROL STRATEGY

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 into two components. One component is inphase and the other in quadrature with the UPFC bus voltage. Decoupled control system has been employed to achieve simultaneous control of the UPFC bus voltage and the dc link capacitor voltage. Series Converter Control Strategy The series converter of the UPFC provides simultaneous control of real and reactive power flow in the transmission line. To do so, the series converter injected voltage is decomposed into two components. One component of the series injected voltage is in quadrature and the other in-phase with the UPFCbus voltage. The quadrature injected component controls the transmission line real power flow. This strategy is similar to that of a phase shifter. The in-phase component controls the transmission line reactive power flow. This strategy is similar to that of a tap changer.

HYSTERESIS CURRENT CONTROL

Basic self oscillating controllers based on hysteresis are well described in the literature [1,2]. The hysteresis controller can be made with either a current- or a voltage loop. The benefits of hysteresis controllers are primarily the linear modulation caused by the sawtooth-shaped carrier with ideally straight slopes, and by the infinite power supply rejection ratio,PSRR, if the supply variation can be considered very slow compared to the switching frequency. Power supply variations at higher frequencies are not suppressed totally, and will result in sum and difference products of the reference signal and the power supply variation, but these still meets high suppression. For use in audio amplifier applications, the hysteresis controller is very desirable due to the high linearity and simple design. However, hysteresis controllers suffers from a switching frequency dependent on the modulation index, M, of

the amplifier. All other basic types of self oscillating modulators suffer from this phenomena too.

CONCULSION

The following conclusion is obtained from the above outputgraphs:Congestion is eliminated and better power flow control is obtained Transient stability is improved. Voltage profile across different types of load is enhanced.

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 Page 1119 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.

[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