www.ijecs.in
International Journal Of Engineering And Computer Science ISSN:2319-7242
Volume 4 Issue 6 June 2015, Page No. 12357-12360

Power Flow Control in Transmission Line Using IPFC Equipped with Fuzzy Logic Controller

Yogesh Kumar[1] Bipul Kunj[2] Navita[3]
LOVELY PROFESSIONAL UNIVERSITY
M.TECH POWER SYSTEM
Discipline of Electronics and Electrical Engineering,
Phagwara, 144402, Punjab, India
[1]yogesh.sharma1404@gmail.com [2]bipulkunj@rocketmail.com [3] navi_ee@hotmail.com

***Abstract* — The interline power flow controller (IPFC) is a Flexible ac transmission based device comprises voltage source converter for the series compensation in multiline transmission systems. The IPFC is capable to manage power between two or more interconnected lines. The voltage source converter injects reactive power which is used to flow the active power in the transmission lines. Flow of electrical energy in the transmission line can be controlled adequately by utilizing IPFC. This paper proposed the compensation in the transmission line using IPFC for managing power flow and comprehensive analysis of active power is presented with and without IPFC using projected circuit models. The matlab/simulink tools equipped with fuzzy logic controller is using for simulation.**

Keywords— FACTS, IPFC, voltage source converters, fuzzy logic controller.

I. INTRODUCTION

Nowadays the FACTS technologies are used for getting more service and enhance the reliability of the transmission facilities. There is necessary to utilize FACTS devices to improve the instability. The IPFC is capable to balance the power flow between multiple transmission lines. It has consisting no. of voltage source converter connected with the same DC terminals. Each voltage source converter provides series compensation to the individual line. In this way, the power optimization of the overall system can be realized through power transmit from overloaded lines to under loaded lines with dc link.

II. INTERLINE POWER FLOW CONTROLLER

The Interline Power Flow Controller is used for compensation in transmission line to control power flow. The static synchronous Series controller is employed to boost the transmittable active power over

a specified line and also to provide stability in the multiline transmission system.

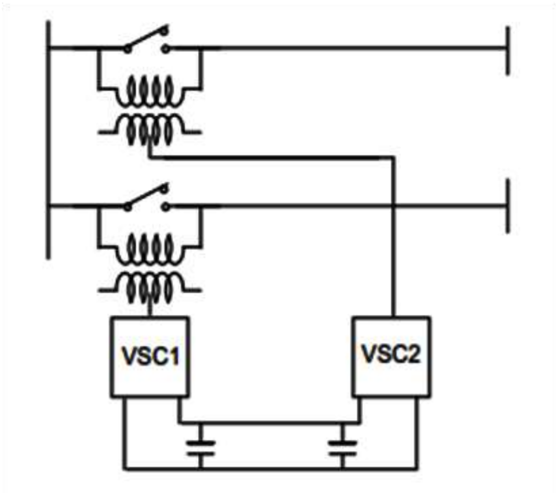

Fig.1 Interline Power Flow Controller

In the shown figure 1 the IPFC consisting of two voltage sourced converters, connected back-to-back and are operated from a common dc link provided by a storage capacitor. The arrangement shows functions as an ideal ac-to-ac power converter in which the real power can freely flow in either direction between the ac terminals of the two converters, and each converter can independently generate or absorb reactive power at its own ac output terminal.

III. NECESSITY OF INTERLINE POWER FLOW CONTROLLER

Many type of instability problem occurs during the transmission of power so that we should require inter line power flow controller for,

i. Power flow management between multiline transmission systems.
ii. Enhancing the controllability and increase the power transfer capability.
iii. Reducing the power losses.
iv. Protect the system from damage.

IV. SYSTEM MODEL

The four bus system is proposed for enhancing the voltage stability and maximizes the power flow capability in the system.

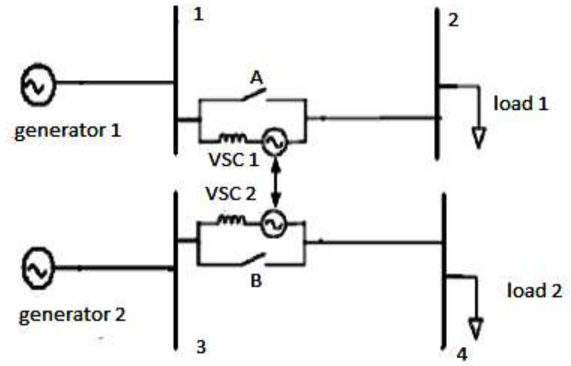

Fig.2 Four Bus System

The shown diagram of four bus system has consisting two generators and two loads. There are two transmission lines, where line 1-2 is stronger than line 3-4. The interline power flow controller is located at bus 1 and each voltage source converters are connected in parallel with each other. The IPFC is bypassed when closing the switches A and B, which is taking as uncompensated system. The IPFC is providing service when switch A and B is opened. By rising of load at bus 2 and bus 4 with sufficient amount of power generation at bus 1 and 3, we can determine the variation of voltage at bus 2 and bus 4 without and with interline power flow controller.

V. FUZZY LOGIC CONTROLLER

The initial phase for designing IPFC based fuzzy is to pick the state variables, illustrative of system element execution, must be taken as the input signals to the controller. Decision of proper variables in the fuzzy control rule is additionally a vital calculates the execution of the fuzzy control system. These variables change the numerical estimations of the information of the fuzzy input, to fuzzy quantities the second step is to pick the linguistic variables, remembering that the quantity of linguistic variables indicates nature of the control. As the number of the linguistic variables expands, the computational time and memory likewise increment. Along these lines a balance between the nature of control and computational time is expected to pick the quantity of linguistic variables. For the test systems, taking seven linguistic variables for Input and Output. The Membership Functions of Input and Output Variables are following:

(i) LP (Large Positive), (ii) MP (Medium Positive), (iii)SP (Small Positive), (iv) ZE (Zero), (v) SN (Small Negative), (vi) MN (Medium Negative) and (vii) LN (Large Negative).

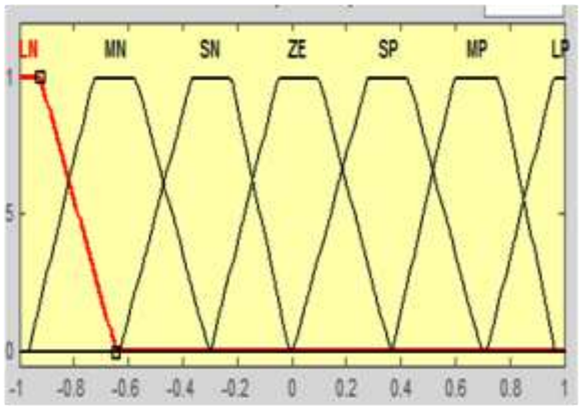

Fig.3 Trapezoidal Membership Functions of Input and Output Variables

VI. SIMULATION OF IPFC

(a) Uncompensated transmission line

For simulation, a single phase system is considered. Two lines are taking; one is the primary line and another is secondary line. The load of the line is considered such a way that one line is overloaded as comparison to primary line. Both lines are connected with 120 KV. Primary line is connected with 15^0 phase angle and secondary line is connected with 30^0 phase angle.

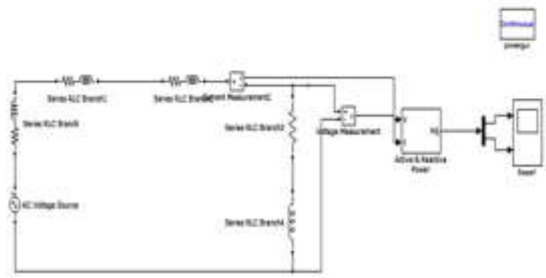

Fig.4 Uncompensated Transmission Line [2]

(b) Open loop IPFC system

The two line four bus transmission system connected with interline power flow controller is shown. Both primary and secondary lines are connected in the open loop.

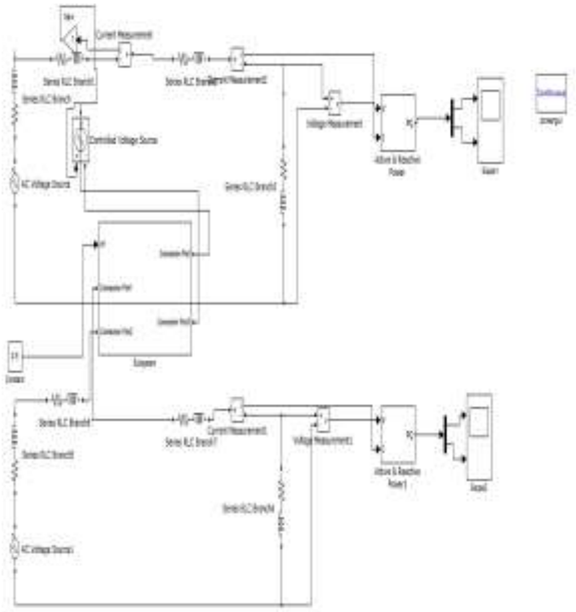

Fig.5 Open Loop IPFC system

(c) Closed loop IPFC system

The circuit diagram below is shown for the closed loop transmission system with IPFC. The scopes are measured power at the output. Across the primary load and secondary load the measured voltages are sensed with the help of voltage sensor. The sensed voltages are given to the fuzzy logic controller which controls the voltage signals and used for driving switches. The primary and secondary lines are connected with 120 KV voltage source and their phase angles are 15^0 and 30^0 respectively.

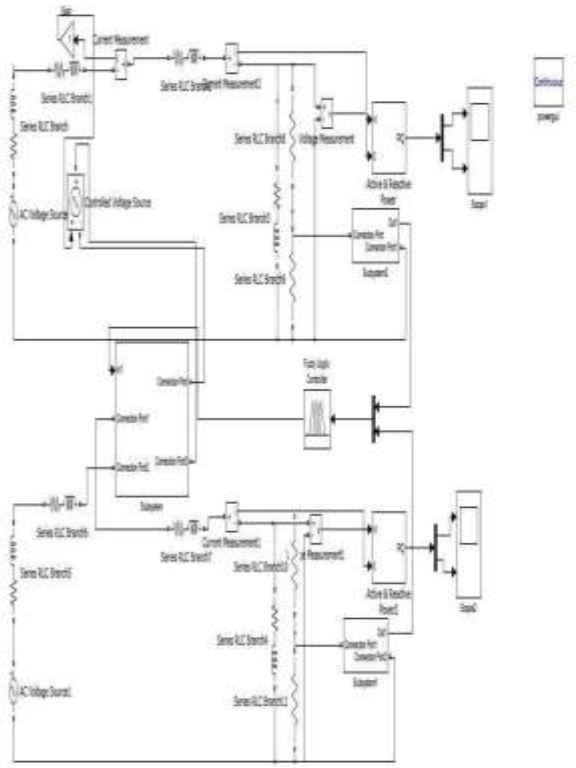

Fig.6 Closed Loop IPFC System

VII. COMPARISON OF OUTPUTS

The transmission systems model has been developed and the respected active power outcomes of compensated lines are plotted with respect to uncompensated lines. The output shows increase in active power and power flow in transmission line is properly balanced.

(a) Primary transmission line for open loop IPFC

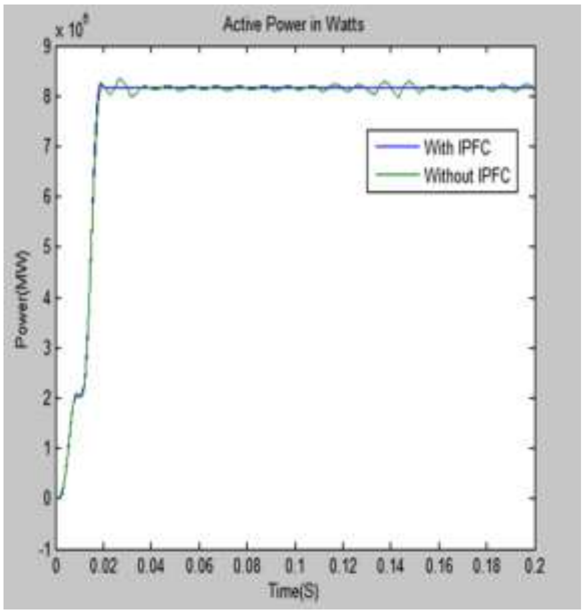

Fig.7 Primary Transmission Line for Open Loop ipfc

In the shown figure, without IPFC the active power is oscillated and with IPFC the active power is increases.

(b) secondary transmission line for open loop IPFC

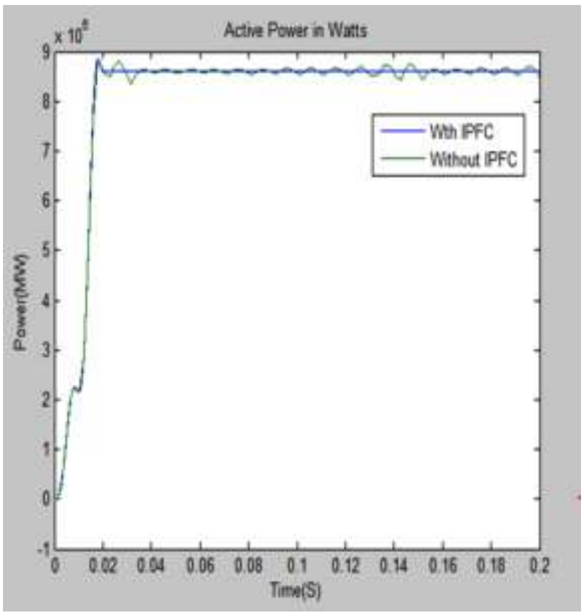

Fig.8 Secondary Transmission Line for Open Loop IPFC

In the shown figure, active power in transmission line with IPFC is increases and without IPFC the active power is oscillated.

(c) Primary transmission line for closed loop IPFC

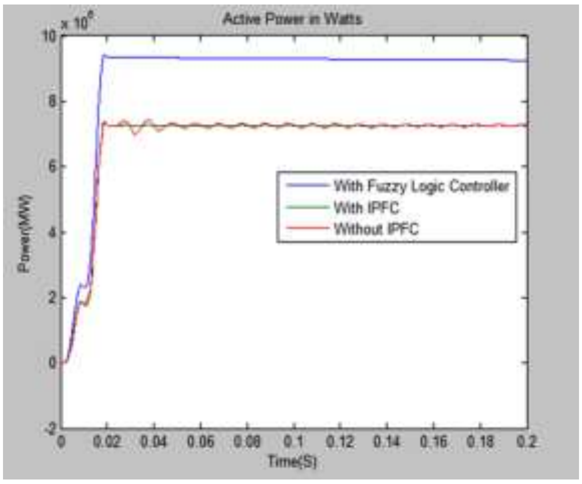

Fig.9 Primary Transmission Line for Closed Loop IPFC

The above figure shows comparison of active power in primary transmission line with IPFC, without IPFC and closed loop IPFC with fuzzy logic controller. The active power increases with IPFC.

(d) Secondary transmission line for closed loop IPFC

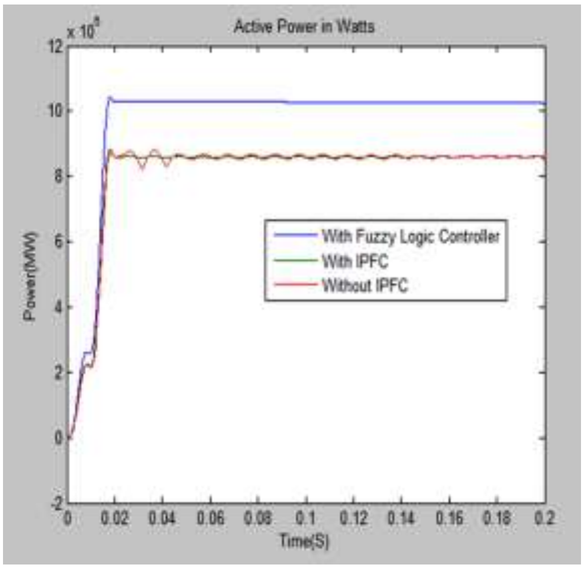

Fig.10 Secondary Transmission Line for Closed Loop IPFC

The above figure shows comparison of active power in secondary transmission line with IPFC, without IPFC and closed loop IPFC with fuzzy logic controller. The active power maximized with IPFC.

VIII. CONCLUSION

Interline power flow controller have ability to make balance between multiple transmission line. In this paper transmission system with two line four bus system is simulated in matlab/simulink using fuzzy logic controller. The IPFC improve the power quality and managed power flow in the transmission line. The active power of open loop and closed loop IPFC system is compared with the distorted active power of uncompensated transmission systems. In the proposed model of interline power flow controller increases active power and improved voltage profile.

IX. REFERENCES

[1] N.G. Hingorani, L. Gyugyi "UNDERSTANDING FACTS, Concepts and Technology of FACTS, IEEE Press book, 2000.

[2] Indra Prakash Mishra, Sanjiv Kumar "Control of Active and Reactive Power Flow in Multiple Lines Through Interline Power Flow Controller (IPFC)",

[3] International Journal of Emerging Technology and Advanced Engineering Volume 2, Issue 11, November 2012.

[4] A. P. Usha Rani and B. S. Rama Reddy Modeling and Digital Simulation of Interline Power Flow Controller System, International Journal of Computer and Electrical Engineering, Vol. 2, No. 3, June, 2010 1793-8163.

[5] Samima Akter ,Priyanath Das "Comparison of the Performance of IPFC (series-series) and UPFC (series-shunt) FACTS Controller in Power System", International Journal of Computer Applications ,Volume 67– No.2, April 2013.

[6] Devesh Raj Saxena "Multi-Line power Flow Control Using Int

[7] erline Power Flow Controller (IPFC) in Power Transmission system" International Journal of Engineering and Computer Science Volume 2 Issue 11 November, 2013.

[8] T.Sreekanth Reddy "Simulation and Design of an Interline Power Flow Controller" IJTES,Val 1 (4), July 2013.

[9] S. Sankar and S. Ramareddy "Simulation and design of IPFC system for voltage sag compensation" ISST Journal of Electrical & Electronics Engineering Vol. 1 No.1, (January June 2010.

[10] Darly. S. S, Vanaja Ranjan "Modeling, Simulation and Fault Diagnosis of IPFC using PEMFC for High Power Applications" JEET Vol. 8, 2013.

[11] VSN. Narasimha Raj, B.N.CH.V. Chakravarthi "Improvement of Power System Stability Using IPFC and UPFC Controllers" IJEIT, Volume 3, Issue 2, August 2013.

[12] Akhilesh A. Nimje, Chinmoy Kumar Panigrahi "Interline Power Flow Controller: Review Paper" IEEJ, Vol. 2 (2011).

[13] G.Radhakrishnan, M.Rathika "Application of IPFC Scheme in Power System Transients and Analyzed using Fuzzy Technology" International Journal of Computer Applications Volume25, July 2011.