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ICIREST-19 Power Transfer Enhancement of Transmission Line by Combining AC-DC Transmission and Analysis of UPFC

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Abstract: *The basic concept in designing of any power lines in transmission of ac-dc power with power upgrading using UPFC is proposed through a single circuit ac transmission line. In this proposal certain limitation are their due to the use of ground as return path. More ever the instantaneous value of each conductor voltage with respect to ground becomes higher than the Line-Line voltage. By using UPFC that is unified power flow controller we can make it possible to handle practically all power flow control and transmission line compensation problem which provide functional flexibility in power which is not possible by the use of conventional thyristor control system. In this paper we have design UPFC to improve stability of power oscillation that are caused due to non-linearity of the load. MATLAB -Simulink model has been develop for this concept.*

Keywords: *Control system, MATLAB, UPFC, power devices.*

I. Introduction

With the need of increase power transfer transient and dynamic stability is an important factor for secure operation of power system. The system (UPFC) is suitable control strategy that has the potential to significantly improve the transient stability margin. UPFC is the most versatile and can be used to enhance the system stability and is capable of both supplying and absorbing real and reactive power with respect to AC-DC-AC transmission line. The UPFC is in phase with dc bus voltage and inject voltage of variable magnitude and phase angle and can exchange real power with transmission line and thus improve power flow capability of the line. The UPFC is robust and system specially design for most technically in the flexible ac transmission.

The UPFC consist of series branches of R-L-C to balance the power between power between shunt and series converter and to maintain constant voltage across transmission line. The optimal design of UPFC has many positive influence on validating of the power system running. These UPFC belongs to the family of the family of FACT controllers. There are in general five types of controller used worldwide in transmission line. They are Load tap changer (LTP), Phase angle regulator(PAR), Static VAR compensator (SVC), Static compensation (STATCOM),UPFC. Among all of these the Unified Power Flow Controller (UPFC), finds an important place by offering real time and dynamic compensation of AC transfer system in order to create required multi-functionality of the system. UPFC is able to control all the parameters influencing the power flow in the transfer line (i.e voltage of impedance and phase angle) and that's why its unique name is unified is given. In addition it can independently control the flow of real and reactive power.

II. Objectives

In power system transmission, it is desirable to maintain the voltage magnitude, phase angle and line impedance.

Therefore, to control the power from one end to another end, this concept of power flow control and voltage injection is applied.

Modeling the system and studying the results have given an indication that UPFC are very useful when it comes to organize and maintain power system.

In this study the effects of UPFC locations are investigated on voltage profile and transmission lines power flow as active and reactive power are analyzed.

Following Objectives are made:

1. Power flow control to be achieved and congestion Should be less
2. Transient stability Should be improved
3. Faster Steady State achievement
4. Improved Voltage Profile

III. Operating Principal Of Upfc

The basic conception of the UPFC was proposed by Nabavi-Niaki and Iravani in 1996[4].The Unified Power Flow Controller(UPFC) was devised for the real-time control and dynamic compensation of ac transmission systtem, providing multi-functional exibility required to solve many of the problems facing the power delivery industry.

The UPFC is made up of two voltage source controllers sharing the same capacitor at their dc voltage controlled side. One voltage source controller is in parallel with one side of a transmission line and the other voltage source controller in the UPFC is in series connect to the other side of the same transmission line. The basic structure of the UPFC is shown in the Figure 1. The UPFC can simultaneously control the active and reactive power flow and voltage magnitude. However it has little effect on voltage angle.

AC transmission lines form the backbone of the electricity grid in most countries and continents. The power flow will follow the path of least impedance and is uncontrollable, unless active grid elements are used. To enhance the functionality of the ac transmission grid, flexible ac transmission systems (FACTS) support the transmission grid with power electronics. These devices offer a level of control to the transmission system operator. A unified power-flow controller (UPFC) is the most versatile of these FACTS devices. A transmission line equipped with a UPFC can control the balance of the transmitted power between parallel lines and, as such, can optimize the use of the transmission grid for all parallel power flows. A one-wire schematic of a transmission-line system equipped with a UPFC is given in Fig.1

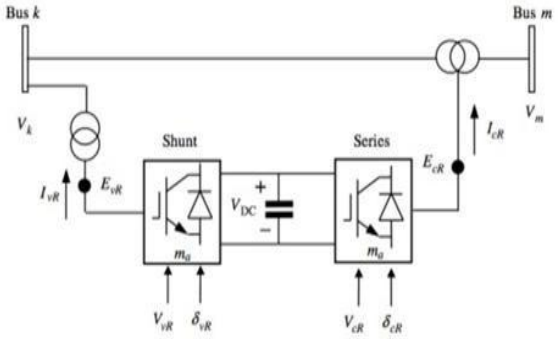

Fig1. Basic Structure of UPFC

A UPFC is connected to the transmission line by coupling transformers, both with a shunt and with a series connection. The UPFC consists of two ac/dc converters, the ac sides connected to the shunt and series connection with the transmission line, and the dc sides connected back to back. UPFCs are typically built with voltage-sourced converters, having a capacitor as (limited) dc energy storage.

The control scheme and comprehensive analysis for a unified power flow controller (UPFC) on the basis of theory, computer simulation, and experiment. This developed theoretical analysis reveals that a conventional power feedback control scheme makes the UPFC induce power fluctuation in transient states. The conventional control scheme cannot attenuate the power fluctuation, and so the time constant of damping is independent of active and reactive-power feedback gains integrated in its control circuit. An advanced control scheme which has the function of successfully damping out the power fluctuation. A UPFC rated at 10 kVA is designed and constructed, which is a combination of a series device consisting of three single-phase pulse width modulation (PWM) converters and a shunt device consisting of a three phase diode rectifier.

IV. Designing Of Upfc

The UPFC consist of a series R-L-C network in bus line. The UPFC is designed consist of three important methods.

1) It can control the terminal voltage of the line.
2) It can perform series compensation.
3) Phase-shift control- Phase shift by UPFC is in the state which find phase change but its amplitude doesn't change.

Multipurpose control of UPFC; it may control the power at the same time and compensation is carried out with respect to terminal voltage and line series compensation change or alteration in phase-shift angle. The power circuit of UPFC is shown below

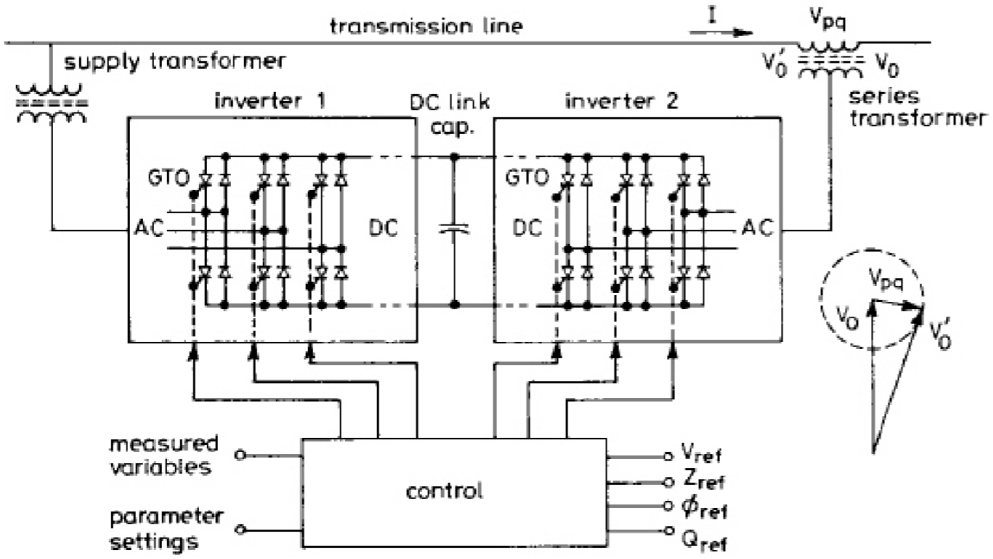

Fig2.Implementation of UPFC

V. Simulation Model Of System

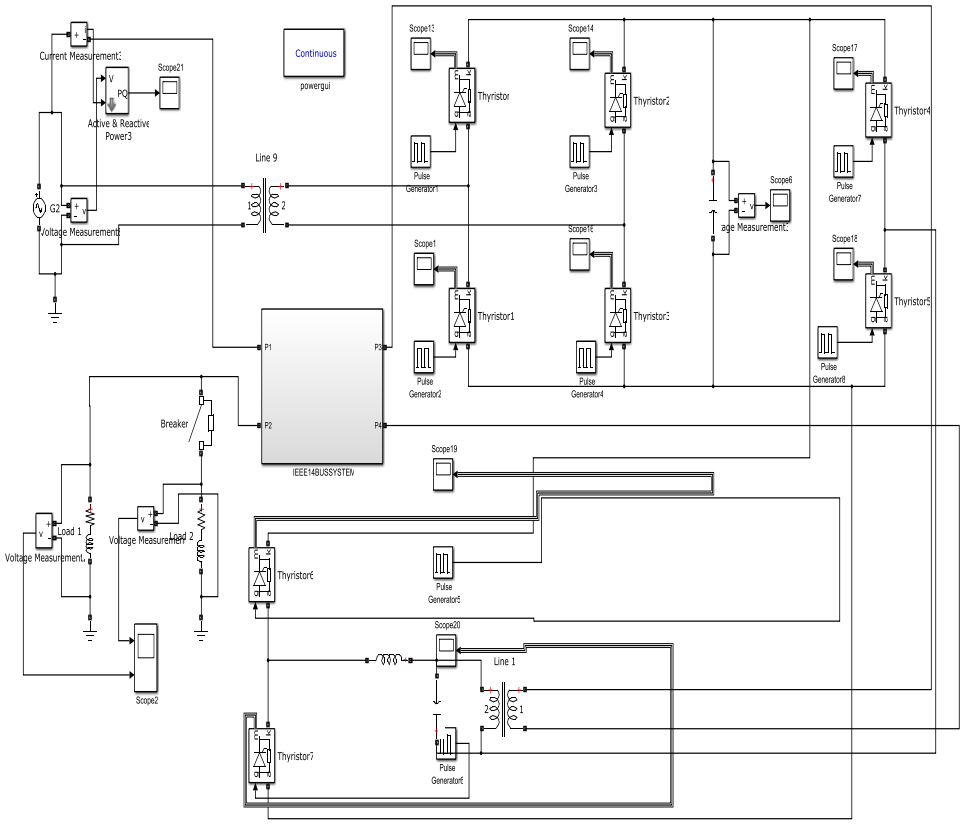

Fig3. Simulation model of system

VI. Simulation Model Of Upfc

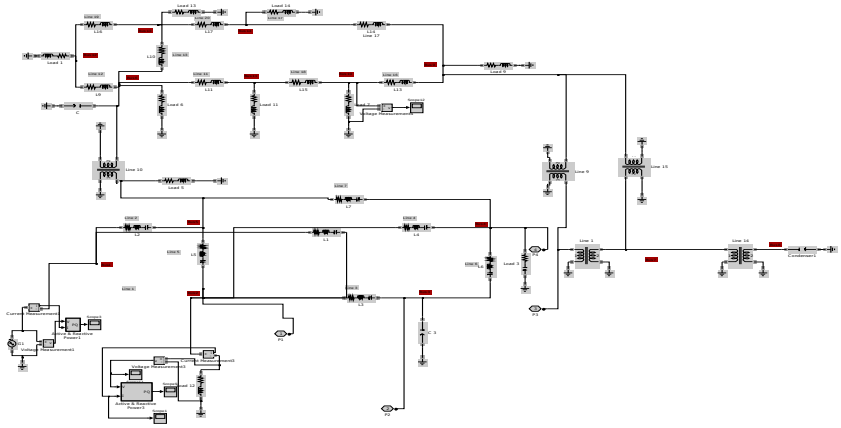

Fig4. Simulation model of UPFC

VII. Results

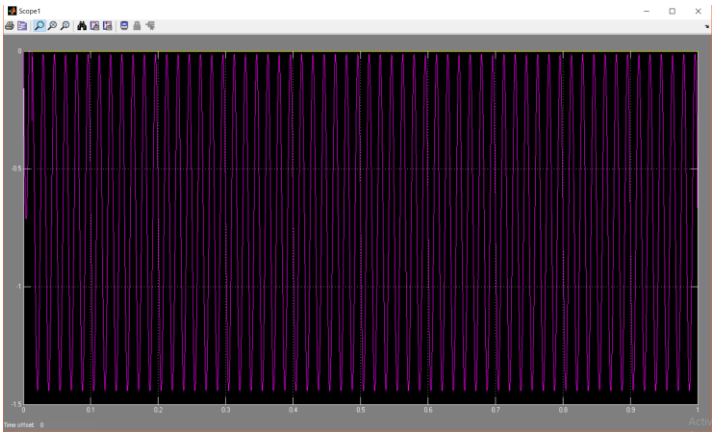

Fig5.Result of converter 1

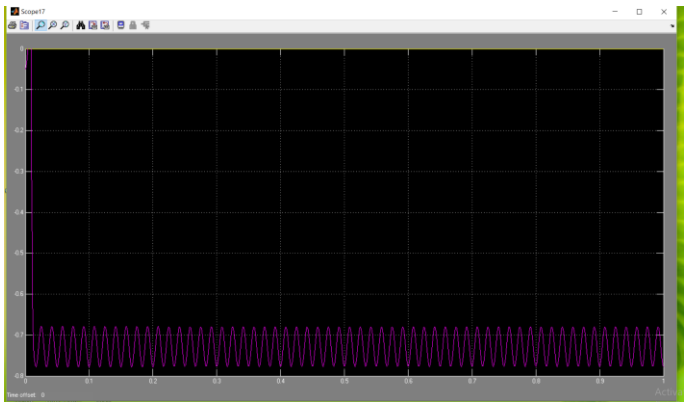

Fig6. Result of converter 2

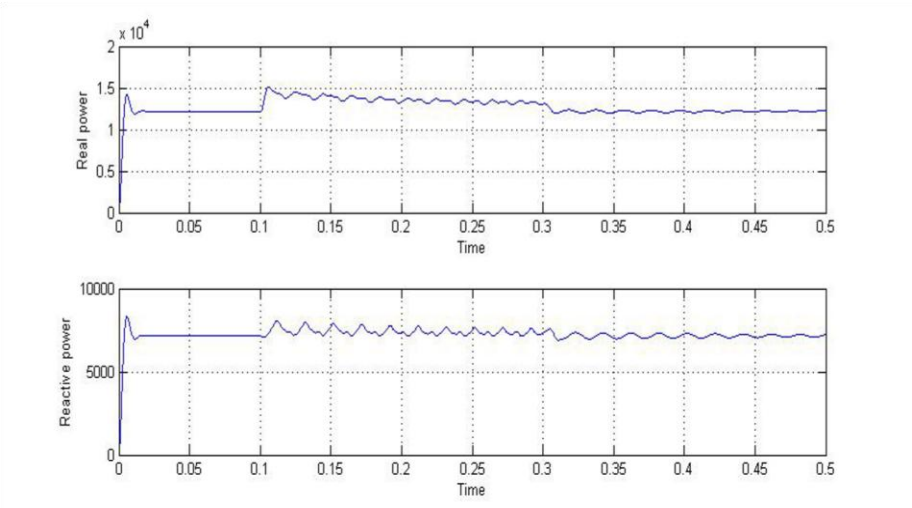

Fig7. Real and reactive power at sending end.

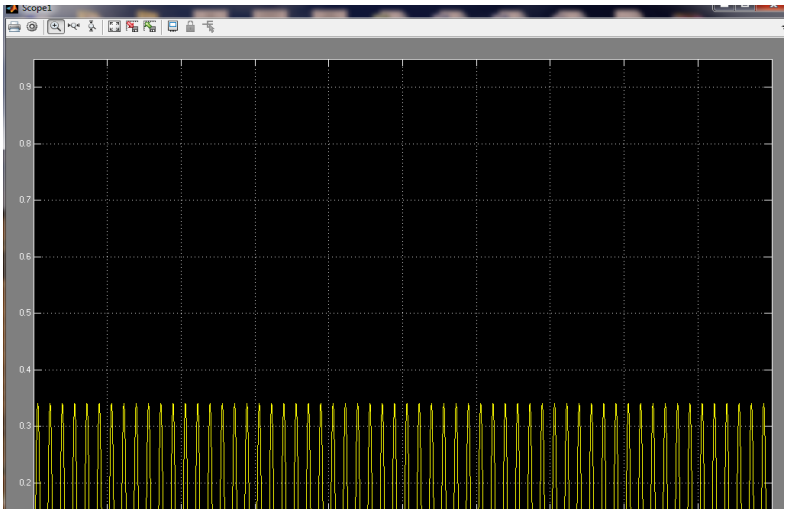

Fig8. Output of system.

VIII. Conclusion

The purpose of applying FACTs tools is to removes the oscillation of the power angle and increase stability of the system by upgrading the power more-ever the UPFC helps in providing the quality power without damping and controlling the voltage effectively at the non-linear load side.

UPFC is one of the index tools of AC transfer system having promising capabilities for controlling the parameters of utilizing the transfer system in the steady state and the transient state of system.

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