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Control of Active and Reactive Power Through Multi-Level Inverter Based UPFC System

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Abstract--**This paper presents Unified Power Flow Controller that's depends on Multi-Level Inverter system for controlling of power flow in the transmission line. This UPFC system maintains the transient stability of power system through the improvement of active and reactive power. The main scope of this paper is to involve the improvement of transient stability by using the pulse width modulation based multi level inverter system on MATLAB and simulation software. The active and reactive powers can be control by UPFC system at the receiving end of the transmission line these are shows by the comparison of without and with UPFC system through the simulink model .**

Key Words: Facts, PWM, Active Power, Reactive Power , VSI.

I. INTRODUCTION

In the contemporary power networks the deregulation and competitive environment will imply a new scenario in terms of load and power flow in the field of electricity and a lot off problem occur due to transmission factor and losses. But nowadays many problems remove by the use of electronics based equipment and latest technology. In the filed of electrical FACTS are many places are used mainly transmission line. The UPFC devices offer an alternative mean to mitigate power system oscillations. Thus, an important question is the selection of the input signals and the adopted control strategy for these devices in order to damp power oscillations in an effective and robust manner. Much research in this domain has been realized [14]. This research shows that UPFC is an effective device for this purpose. It is totally based on electronics and also control by electronics switches. The main is objective of FACTS to increase the transmission capacity and to control power flow in the transmission line. The UPFC is also a part of FACTS devices and it is a combination of STATCOM and SSSC. STATCOM is a basically shunt connected converter and SSSC is a series connected inverter to the transmission line. UPFC is the combination of both the devices and it is controllable through a number of techniques such like PWM, FUZZY Logic, GA, etc. In this paper for controlling of Inverter PWM technique are used. PWM technique is most versatile usable technique because its switches depends on logical gates and operate in micro seconds. For the designing of multilevel inverter can be use different switches such like IGBT, MOSFET, GTO and many switches. But I use MOSFET devices because it is a better to other devices.

II. UPFC SYSTEM

The UPFC, which was proposed by L. Gyugyi in 1991 [1], is one of the most economically and accurate FACTS devices in a power system. It is primarily used for control of active and reactive power compensation in transmission lines for a flexibility, reliability and economically operation of power system. Until recently all three parameters that affect power flow on the line, i.e. the line impedance, voltage at the terminals of the line or load angle, were controlled separately using either manually or other FACTS devices such as a Static Var compensator, a Thyristor Controlled Series Capacitor ,a phase shifter, etc. However, in real time the UPFC allows simultaneous or independent control of these parameters with transfer from one control scheme to another. Also, the UPFC can be used for voltage support, stability improvement and damping out of low frequency power system oscillations. Because of its valuable features, modeling and controlling an UPFC have come into intensive investigation in the recent years. UPFC dynamic model known as a fundamental frequency model can be found in [6], and [12]. This model consists of two voltage sources one connected in series and the other one in shunt with the power network to represent the series and the shunt voltage source inverters. Both voltage sources are modeled to inject voltages of fundamental power system frequency only. Model in [6] neglects the DC link capacitor dynamics which might make results obtained using this model inaccurate, models in [6], [8] and [12] include DC link capacitor dynamics and can be used for study of UPFC effect on the real power system behavior.

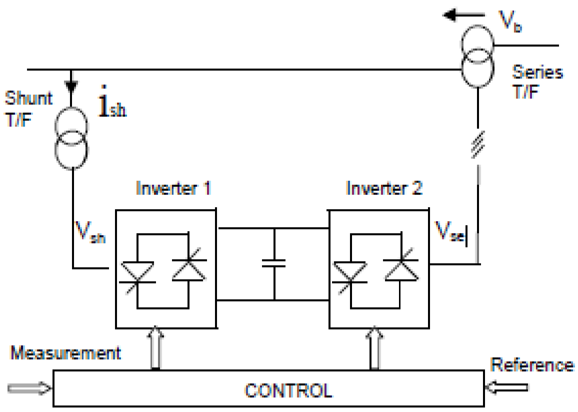

Figure 1: Schematic diagram of UPFC system

A. *Basic Operation Of UPFC :*

A simplified schematic of a UPFC is shown in Fig 1 The main features are two inverters, one connected in series with the transmission line through a series connected transformer, and one connected in shunt with the line through a second transformer. The DC terminals of the inverter are connected together and their

common dc voltage is supported by a capacitor bank. The inverter is controlled to inject a set of synchronous voltages in series with the line. In the process of doing this, the series inverter will exchange real and reactive power with
the line [4].

B. Basics of Voltage Source Converters :

As we know that inverter is a converter device which is convert the DC to AC and also the real power flows from the DC side to AC side (inverter operation) if the converted output voltage is controlled to increases the AC system voltage. If the converted output voltage is made to decreases the AC system voltage the real power will flow from the AC side to DC side (rectifier operation). Inverter action is carried out by the MOSFETs while the rectifier action is carried out by the diodes. Two switches on the same leg cannot be on at the same time. The magnitude of the inverter output voltage controls the reactive power exchange between the converter and the AC system. If the magnitude of the converter output voltage is greater than the magnitude of the AC system voltage. If the magnitude of the converter output voltage is less than that of the AC system the converter will absorb reactive power[5].

C. Bacic of Pulse Width Modulation Technique :

Due to PWM simplicity many authors, i.e. [6], [7], [8], [12], have used PWM control techniques in their UPFC studies The output voltage can be controlled by using various control techniques. Pulse Width Modulation (PWM) techniques can be designed for the lowest harmonic content. It should be mentioned that these techniques require large number of switching per cycle leading to higher converter losses. Therefore, PWM techniques are currently considered unpractical for high voltage applications. However, it is expected that recent developments on power electronic switches will allow practical use of PWM controls.

III. BENEFIT OF UPFC

The aim of paper to present the model of a UPFC connected to a transmission line of a power network, active and reactive power control design and detailed digital simulation of the UPFC in the MATLAB/SIMULINK environment**.**
By the use of UPFC system –

Series compensation: For increasing transmission capability, improve system stability, control voltage regulation, and proper load division among parallel feeders. Increase power transfer capability.

Improvement in system stability: Power transfer and for the same values of Vs (sending end voltage) and Vr (receiving end voltage), the phase angle δ in case of series compensate line is less than that for the compensated line.

Its neither requirement of any manual operation nor any extra equipment required.

IV. SIMULATION RESULTS

Without UPFC system transmission line model shown in figure 2 and with UPFC system shown in figure 3 and the results of these are two models shown in figure 4 and Figure 5 respectively. The improved active and reactive power clearly shows by comparison of figure4 and figure-5.
In this model

Sending voltage(Vs) = 6 KV
Series Resistance(Rs)=.001*10 Ohm
Series inductance = $.3*10^{-6}$ H

Without UPFC obtained data:
Active power = $7*10^5$
Reactive Power = $3.55*10^5$

With UPFC obtained data:
Active power = $12*10^5$
Reactive Power = $7.55*10^5$

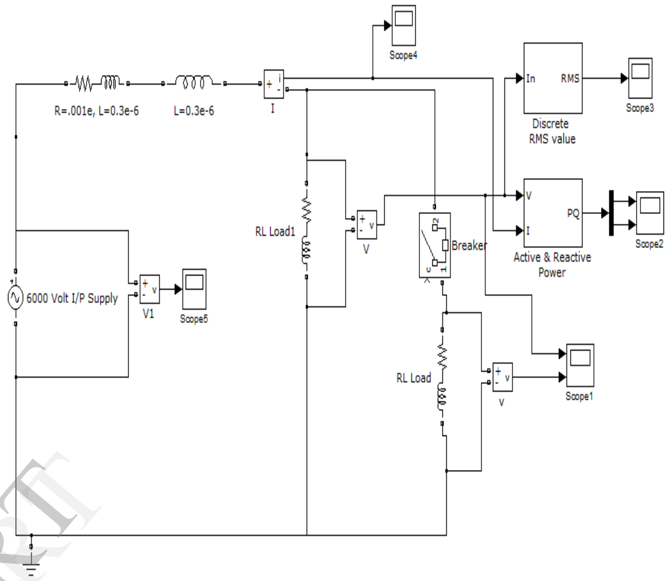

Figure2: Simulink model of transmission line without UPFC

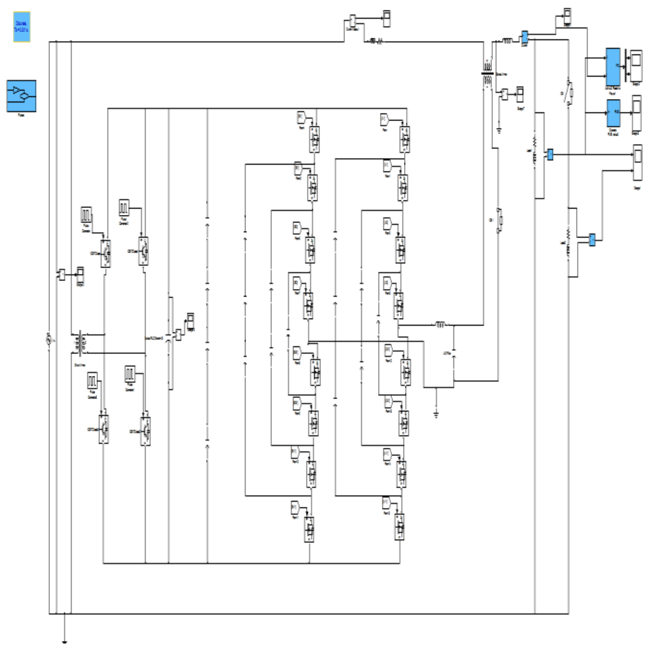

Figure3: Simulink model of transmission line with UPFC

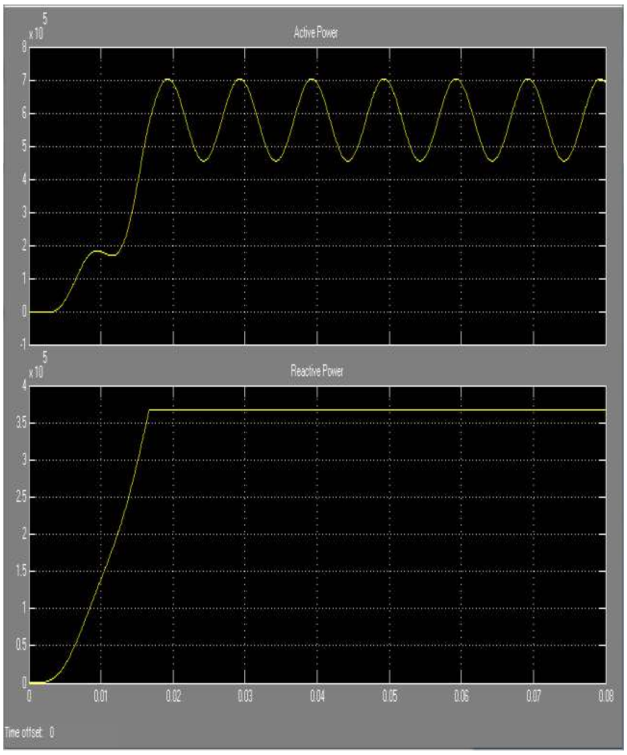

Figure4: The active and reactive power without UPFC

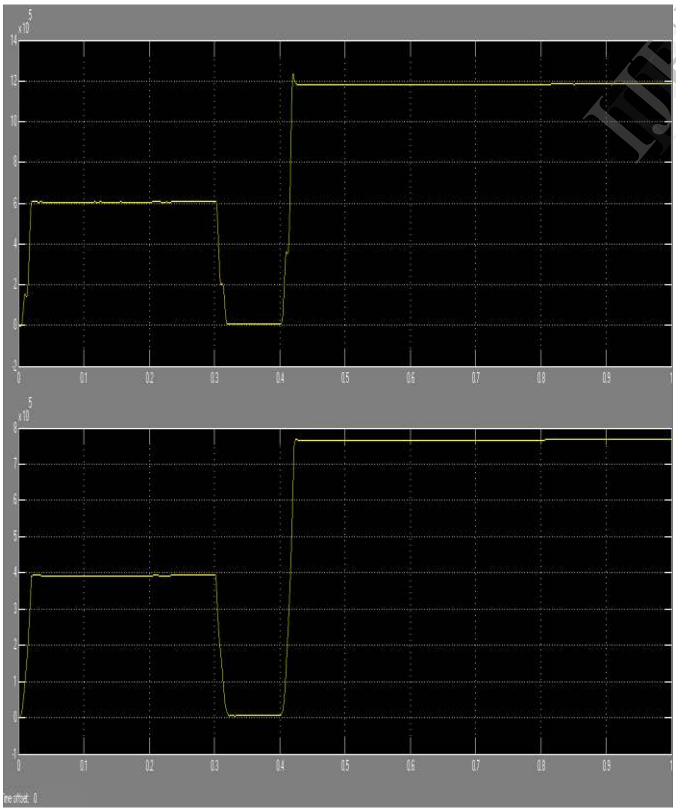

Figure5: The active and reactive power with UPFC

V. CONCLUSION

By the study of simulation results, UPFC systems is most important for the transmission line because that improves the active And reactive power and also improve the system stability so its very neccesary for our transmission network matlab simulink environment is used to simulate the model of multi level inverter based UPFC system . The UPFC system also reduces harmonics and ability to control real and reactive powers. So for better result and better efficiency we can use UPFC system in medium and long transmission line.

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