Paper on Transmission Line Loss Reduction by UPFC (Unified Power Flow Controller)

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Abstract---The power transfer capability of electric transmission lines are usually limited by large signals ability. Economic factors such as the high cost of long lines and revenue from the delivery of additional power gives strong intensive to explore all economically and technically feasible means of raising the stability limit. On the other hand, the development of effective ways to use transmission systems at their maximum thermal capability. Fast progression in the field of power electronics has already started to influence the power industry. This is one direct outcome of the concept of FACTS aspects, which has become feasible due to the improvement realized in power electronic devices in principle the FACTS devices should provide fast control of active and reactive power through a transmission line. The UPFC is a member of the FACTS family with very attractive features. This device can independently control many parameters. This device offers an alternative mean to mitigate transmission system oscillations. It is an important question is the selection of the input signals and the adopted control strategy for this device in order to damp power oscillations in an effective and robust manner. The UPFC parameters can be controlled in order to achieve the maximal desire effect in solving first swing stability problem. This problem appears for bulky power transmission systems with long transmission lines. In this paper a MATLAB Simulink Model is considered with UPFC device to evaluate the performance of Electrical Transmission System. The main aim of this review paper is to study various researches done in past to reduce transmission line losses by UPFC.

Keywords: MATLAB , simulink , UPFC

I. INTRODUCTION

In competitive electricity markets the most important component is Transmission system/ network and it serves as the key mechanism for generators to compete in the supply to reach large users. With the restructuring in power supply industry and open access the importance of controllers for achieving Flexible AC Transmission systems (FACTS) is increasing. Comprehensive FACTS Controller referred to as the Unified Power Flow Controller (UPFC). It utilizes the synchronous voltage sources to provide comprehensive control of power flow in transmission systems. Installing the UPFC can improve power transfer capability. The

UPFC is an advanced power system device capable of providing simultaneous control of Instantaneous speed of response voltage magnitude, active and reactive power flows in an adaptive fashion. It has

1. Extended functionality
2. Capability to control voltage, line impedance and phase angle in the power system network
3. Enhanced power transfer capability
4. Ability to decrease generation cost
5. Ability to improve security and stability
6. Applicability for power flow control, loop flow control, load sharing among parallel corridors.

II. WORKING OF UPFC (UNIFIED POWER FLOW CONTROLLER)

The UPFC is made out of two voltage-source converters (VSCs) with semiconductor devices having turn-off capability, sharing a common dc capacitor and connected to a power system through coupling transformers. The basic structure of UPFC is shown in Fig.1. The shunt converter is primarily used to provide the real power demand of the series converter at the common dc link terminal from the ac power system. It can also generate or absorb reactive power at its ac terminal, which is independent of the active power transfer to (or from) the dc terminal. Therefore, with proper control, it can also fulfil the function of an independent advanced static VAR compensator providing reactive power compensation for the transmission line and thus executing indirect voltage regulation at the input terminal of the UPFC.

The series converter is used to generate a voltage at the fundamental frequency with variable amplitude and phase angle, which is added to the ac transmission line by the series connected boosting transformer. The inverter output voltage injected in series with the line can be used for direct voltage control, series compensation, phase shifting, and their combinations. This voltage source can internally generate or absorb all the reactive power required by the different type of controls applied and transfers active power at its dc terminal.The reactive power is generated/absorbed independently by each converter and does not flow through the dc link. The dc link provides a path to exchange active power between the converters. The series converter injects a voltage in series with the system voltage through a series transformer. The power flow through the line can be regulated by controlling the magnitude and angle of the series-injected voltage. The injected voltage and line current determine the active and reactive power injected by the series converter. The converter has a capability of electronically generating or absorbing the reactive power. However, both the series and shunt converters can independently exchange reactive power with the ac system. However, the injected active power must be supplied by the dc link, in turn taken from the ac system through the shunt converter. When the losses of the converters and the associated transformers are neglected, the overall active power exchange between the UPFC and the ac system becomes zero.

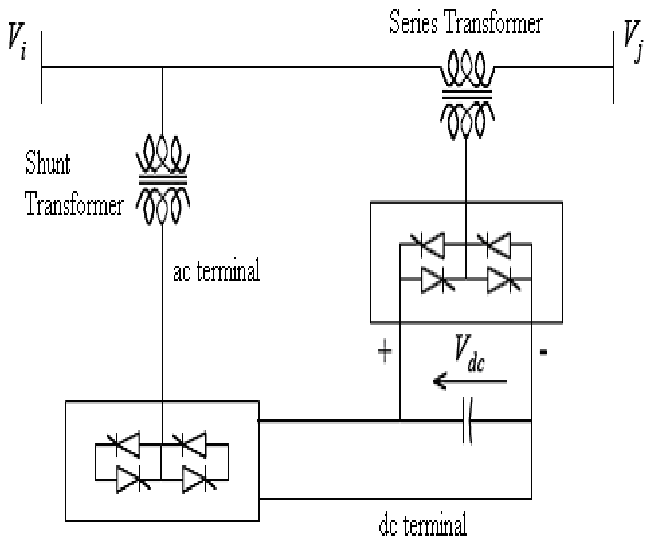

Fig. 1:

III. Simulation And Results

Simulation of 5 bus test system is done on MATLAB software and the results are obtained

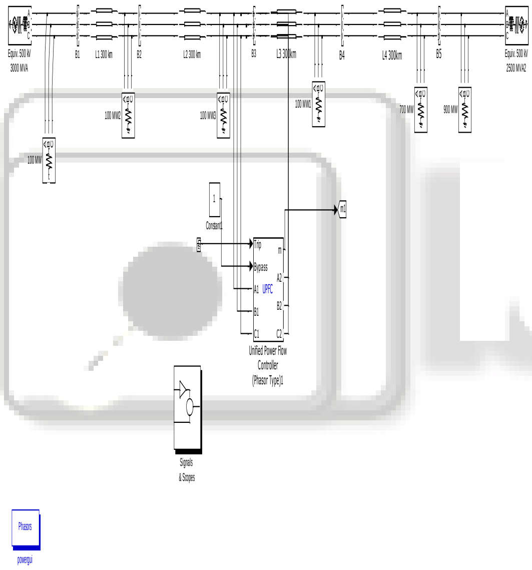

Fig. 2:

Circuit shown above is the standard 5 bus test system with UPFC is connected in the middle of the circuit.

IV. Waveform Of Active And Reactive Power

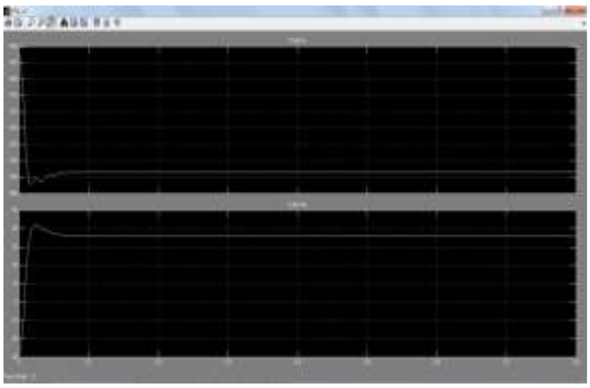

Fig. 3:

V. WAVEFORM OF VOLTAGE AND CURRENT

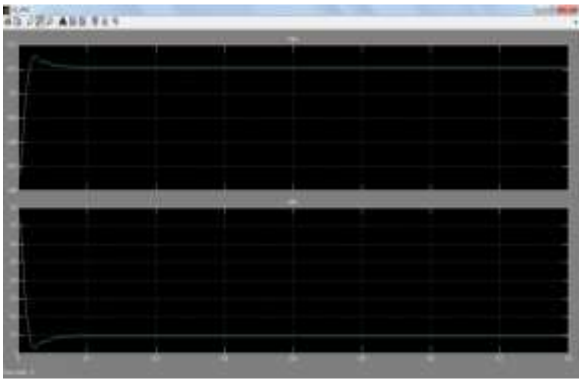

Fig. 4:

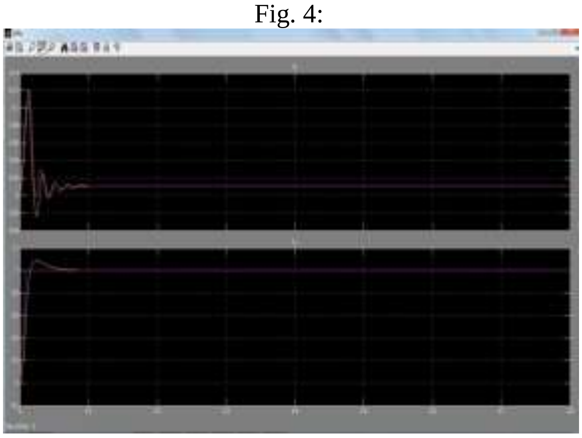

Fig. 5:

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