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ENHANCEMENT OF POWER TRANSMISSION STABILITY BY IMPROVEMENT OF POWER FACTOR & REDUCING T.H.D IN A LONG TRANSMISSION LINE MODEL USING UPFC WITH FUZZY LOGIC CONTROLLER

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Abstract- In this paper research is carried on a long transmission line model compiled in the MATLAB for the enhancement of power with improved power factor and reduced harmonic distortion. UPFC (unified power flow controller) which is a FACT device is used in between the transmission line at the center of T model for compensation. UPFC is a mix venture of SSSC and STATCOM and is controlled using the implementation of fuzzy logic controller and the results shows that power factor and other parameters were improved with less distortion.

Key words: UPFC, FLC, FACT devices, MATLAB

I. INTRODUCTION

Transient stability is the ability of power system to maintain synchronism when subjected to a severe disturbance, such as a fault on transmission facilities, sudden loss of generation, or loss of a large load. The system response to such disturbances involves large excursions of generator rotor angles, power flows, bus voltages, and other system variables.

With the invent of Flexible Alternating Current Transmission(FACTS) devices based on power electronics, excellent operating experiences available world-wide, these devices are becoming more mature and more reliable to improve the performance of long distance AC transmission. FACTS controllers can be classified as (i) Variable impedance type controllers and (ii) Voltage source converter based controllers. This paper considered one of the FACTS devices UPFC. UPFC is the most versatile one that can be used to enhance steady state stability, dynamic stability and transient stability.

The UPFC is capable of both supplying and absorbing real and reactive power. Analysis of transient stability from with UPFC in

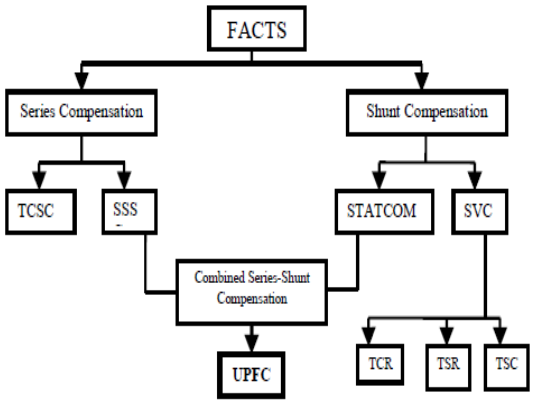

Fig 1.1 Understanding FACT devices from histogram

MATLAB/SIMULINK WSCC model has been done. This paper considered three different conditions i.e. pre fault, with fault, and with UPFC (steady state, LLG fault, and after fault with UPFC).

II. CONTROL STRATEGY- UPFC

The Unified Power Flow Controller (UPFC) is the most versatile one that can be used to enhance steady state stability, dynamic stability and transient stability. The UPFC is capable of both supplying and absorbing real and reactive power and it consists of two ac/dc converters. One of the two converters is connected in series with the transmission line through a series transformer and the other in parallel with the line through a shunt transformer. The dc side of the two converters is connected through a common capacitor, which provides dc voltage for the converter operation. The power balance between the series and shunt converters is a prerequisite to maintain a constant voltage across the dc capacitor. As the series branch of the UPFC injects a voltage of variable magnitude and phase angle, it can exchange real power with the transmission line and thus improves the power flow

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capability of the line as well as its transient stability limit. The shunt converter exchanges a current of controllable magnitude and power factor angle with the power system. It is normally controlled to balance the real power absorbed from or injected into the power system by the series converter plus the losses by value [13]

III. UNIFIED POWER FLOW CONTROLLER

The Unified Power Flow Controller (UPFC) devised for the real-time control and dynamic compensation of ac transmission systems, providing multifunctional flexibility required to solve many of the problems facing the power delivery industry.

The Unified Power Flow Controller (UPFC) consists of two voltage sourced converters, using gate turn-of (GTO) thyristor valves. These converters, labelled "Converter 1" and "Converter 2" in the figure 3.1, are operated from a common dc link provided by a dc storage capacitor. This arrangement 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 [13].

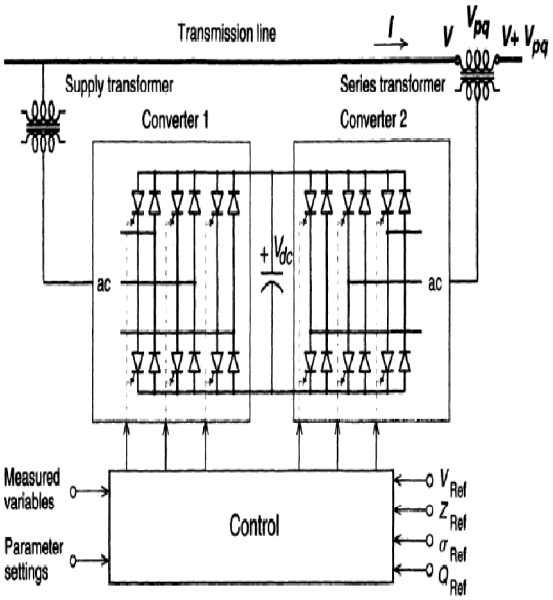

Fig 3.1 Unified power flow controller

IV. BASIC OPERATING PRINCIPLE OF UPFC

The Unified Power Flow Controller (UPFC) was devised for the real-time control and dynamic compensation of ac transmission systems, providing multi-functional flexibility required to solve many of the problems facing the power delivery industry.

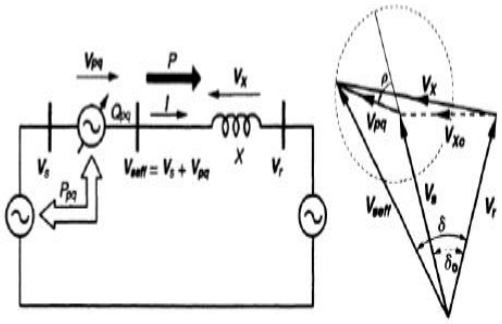

Fig 3.2 - Conceptual representation of Unified Power flow Controller

V. MATLAB SIMULATION MODEL

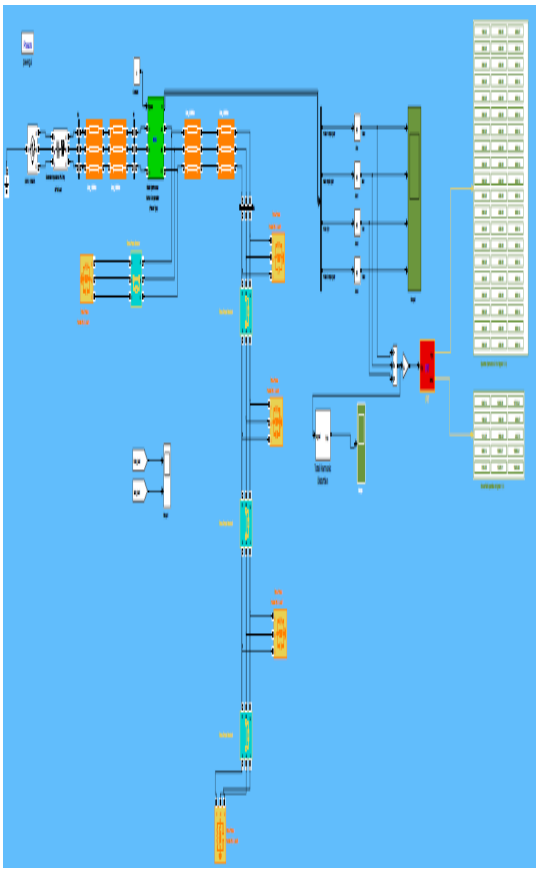

Fig 4.1 - Simulation model used for analysis

A 230 kV ,100 MVA source is taken for a long transmission line of 800 km. the line resistance per unit length is considered as [0.01273 0.3864] ohms/km [N*N matrix] or [R1 R0 R0m] in per unit, the line inductance per unit length is [0.9337e-3 4.1264e-3] H/km [N*N matrix] or [L1 L0 L0m] and the line capacitance per unit length is [12.74e-9 7.751e-9] F/km [N*N matrix] or [C1 C0 C0m] for each 200 km length. In this long transmission line parallel R-L-C load is connected which is introduced in different steps as no load, half load and full load. UPFC is introduced in the middle of the line as the most nominal place in the T model of installation strategy.

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VI. RESULT ANALYSIS:

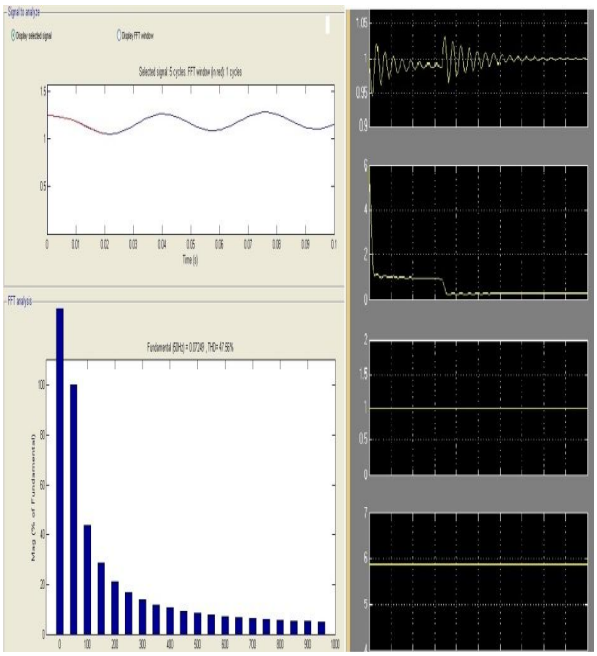

Fig 5.1 Results showing with UPFC PI controller

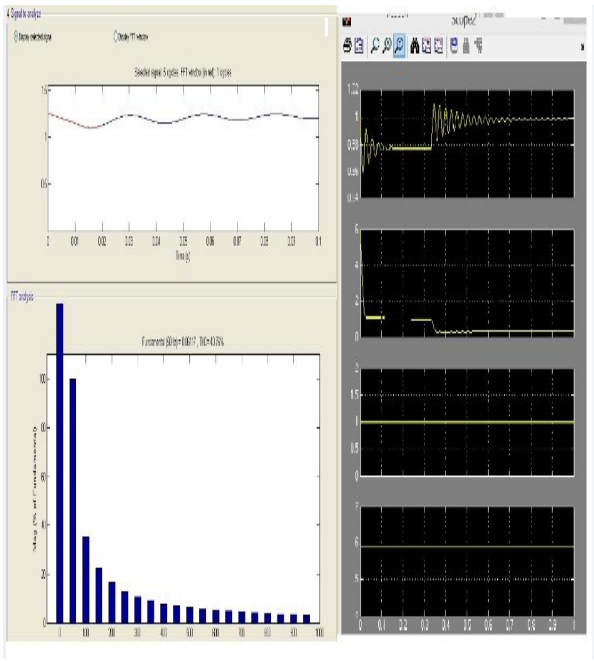

Fig 5.2 - Results showing with UPFC fuzzy logic controller

VII. ANALYSIS

1. It can be clearly seen in fig 5.1 and 5.2 that the fast settlement of system is in fig 5.2 which is controlled by the approaches of fuzzy logic control. it shows the improvement of settling time parameter of time response as it increases damping ratio also.
2. In the total harmonic distortion window showing FFT analysis it is seen that previously the THD is reduced from 47.9 % to 43.67 %.THD is inversely propotional to power factor hence power factor is improved improving the transmission capacity of power with reduced losses/
3. steady state error is improved
4. Overshoots are reduced.
5. Fast response of the system.

VIII. CONCLUSION

For the transmission of power through long distance over the line it is transmitted in high ratings and due to which due to sudden load or generator side disturbances compensation is required for maintaining the complete system in synchronism. While compensation now it is required to have fast responses and immediate controlled actions which can be done by using intelligent system of controlling .in this paper the same is done as the implementation of fuzzy logics are used in controlling the UPFC and it is seen that harmonic distortions are improved with fast settlement of the system.

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