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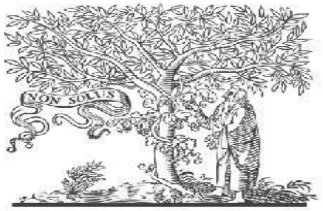

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IMPROVED POWER QUALITY AND REACTIVE POWER COMPENSATION IN A GRID CONNECTED SYSTEM FOR NON-LINEAR LOADS USING FUZZY CONTROLLED DISTRIBUTE STATIC COMPENSATOR

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Abstract

The power quality problem occurred due to a non-linear load in the distribution network and its severe impact on sensitive loads. To overcome this problem, the new series, parallel FACTS device use. The Interline Power Flow Controller (IPFC) is a VSC based Flexible AC Transmission System FACTS controller for series compensation with the unique capability of power flow management among the multiple transmission lines in the transmission system. The performance of the considered IEEE 14 bus system is analyzed in terms of oscillations using IPFC. In this work, An IEEE 14 bus system is modelled in MATLAB/SIMULINK software. The most essential controller in FACTS controllers is the Unified Power Flow Controller(UPFC).UPFC is the most versatile FACTS device for real and reactive power flow control and voltage regulation. By incorporating UPFC in our modern power system it is possible to control the power flow thereby decreasing the energy crisis to a greater extent. UPFC can provide simultaneous control of real power and reactive power flow by modeling the power system in MATLAB-SIMULINK, thereby improving the performance, power quality, and voltage profile in the power system Initially, the basic transmission line system model is simulated. After that connect IPFC as well as UPFC controller one by one is simulated in MATLAB and check the performance of output waveform. This analysis is carried out using MATLAB/Simulink.

Keywords: Flexible AC Transmission System (FACTS), Interline Power Flow Controller (IPFC), Unified Power Flow Controller (UPFC) , MATLAB/SIMULINK.

1. INTRODUCTION

In the modern power systems are highly complex & designed as such to fulfill the growing demands of power with better power quality. High technology nowadays is being used for controlling power flow. Due to this, power quality is improved. Modern technology and new constructions of transmission lines are also needed for improving power system security, profitability, and reliability. When power systems are heavily loaded, faulted, or have reactive power shortages then voltage collapse occurs. System instability and it occurs due to many power system components due to voltage collapse. Reactive power imbalance occurs when the system is faulted, heavily loaded and voltage fluctuation is there. The investigates the performance of series-series.(Interline Power Flow Controller) and series-shunt (Unified Power Flow Controller) FACTS controllers by compensating real and reactive power flow. For analysis, the IEEE14 Bus system is used.Shunt compensation is used in all high voltage transmission line, EHV

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systems to supply reactive power and improve voltage profile. Series compensation is used to increase transmission line capacity, system stability.

2. EXISTING METHDOLOGY

The Unified Power Flow Controller representative of the 3rd generation of FACTS devices, in power system steady- state it can implement power flow regulation, reasonably controlling line active power & reactive power, improving the transmission capacity of the power system, and in the system transient state can realize fast-acting reactive of power compensation as well as supporting the voltage at the access point dynamically and improving system voltage stability, moreover, it can improve the damping of the system and power angle stability. Unified Power Flow Controller is a combination of a static synchronous compensator (STATCOM) and a static synchronous series compensator (SSSC) coupled via a common DC voltage link. The merits of the UPFC are to control the active and reactive power flows in the transmission line. All the process of automatic control with good performance over a wide operating range with simple design and implementation. After replacing the IPFC with UPFC the overall block diagram of the project is given below with the help of this diagram it's clearly understood that how to improve the power quality of the power system using UPFC FACTS devices.

Sending End

Receiving End

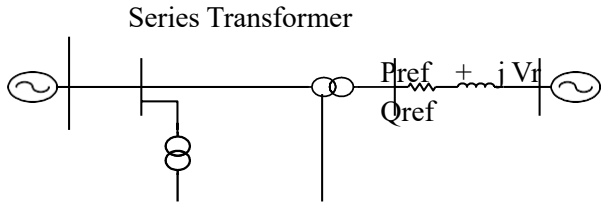

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Figure. 1: Therotical Output Of The Transmission System.

Figure 1 shows the theoretical output of the transmission system without applying UPFC as well as applying UPFC. In that, it clearly shows when we apply UPFC on the transmission line the output of power has increased with comparing with the transmission line without UPFC.

It is a combination of series controllers. The objective of introducing this controller is to address the problem of compensating several transmission lines connected at a substation The Interline Power Flow Controller (IPFC) provides, in addition to the facility for independently controllable reactive (series) compensation of each line, a capability to directly transfer or exchange real power between the compensated lines. Simplified Schematic of Two- Converter IPFC Mode shown in fig.1.

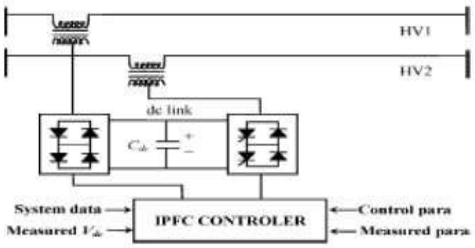

Figure 2: Simplified schematic of two-converter IPFC mode.

3. PROPOSED METHDOLOGY

Unified Power Flow Controller (UPFC) is the most versatile device designed based on the concept of a combined series-shunt FACTS Controller. It can simultaneously control all the transmission parameters affecting the power flow of a transmission line i.e. voltage, line impedance, and phase angle. The simplified schematic unified power flow controller is shown in fig.3

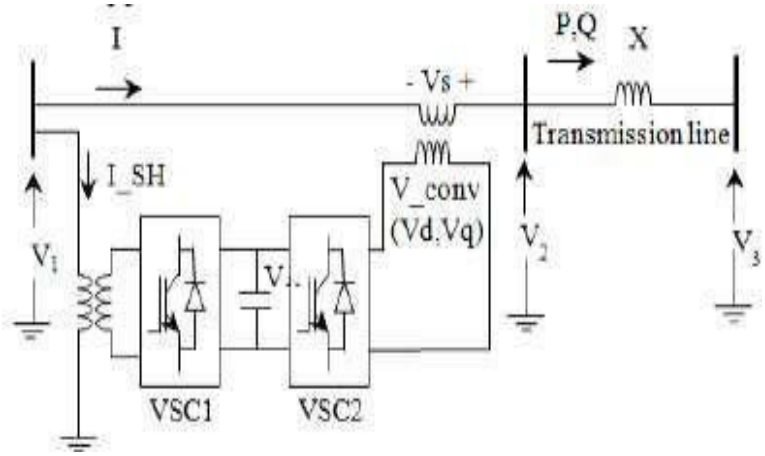

Figure 3: Simplified schematic Unified Power Flow Controller.

4. RESULTS AND DISCUSSION

DIFFERENT STAGES OF OPERATION

By analyzing the whole system in different stages which are as follows:

Stage-I

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IEEE 14 bus system without IPFC and UPFC considered for analysis is shown in Fig.5. MATLAB simulation model of IEEE 14 Bus Power Network without IPFC and UPFC is shown in fig.6.This system includes five T-G units with IEEE type-1 exciters14 buses, three transformers, and twenty AC transmission lines. This system has 11 loads totaling. Bus 1 is selected as a slack bus. The generator G1 is considered as reference. The three synchronous compensators are considered as generators to meet the demand of real

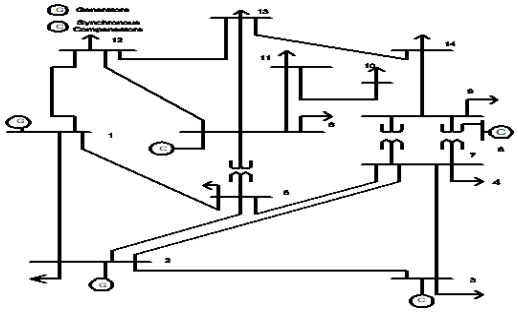

Figure. 4: 14 bus Power Network

power by loads. The output waveform of the IEEE 14 bus power network without IPFC and UPFC is shown in fig.4.

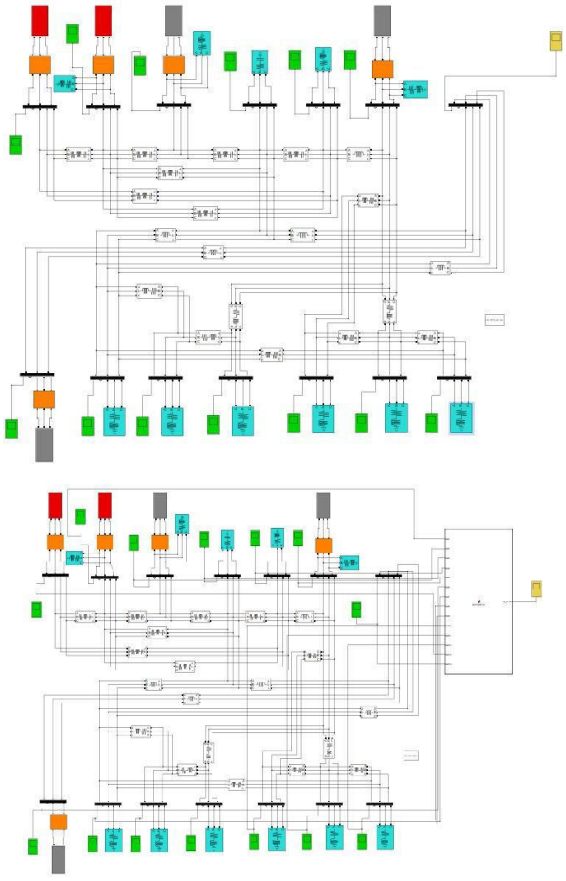

Figure 5: MATLAB simulation model of UPFC

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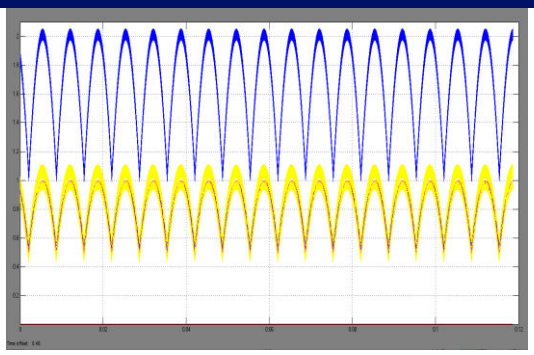

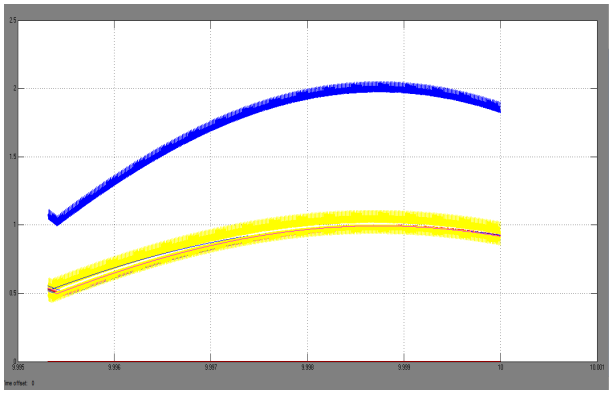

Figure 5: The output waveform of UPFC in a continuous working model

Figure 6: The output waveform of UPFC

A comparison between the study of the unified power flow controller and the interline power flow controller in optimal power flow (OPF) control. The performance of the UPFC and the IPFC is compared from the viewpoint of the total active power losses. UPFC and the IPFC are powerful tools for power flow regulation, with the help of UPFC and IPFC transfer capability of the transmission line can be increased. Combined with the generating bus voltage adjustment, the OPF incorporating either The capacity of the UPFC is usually significantly larger than that of the IPFC to achieve a similar.

5. CONCLUSION

From the analysis of all 3 stages, it is concluded from the first stage represent the response of the IEEE 14 bus power network output without applying the IPFC and UPFC. After that 2 and 3 stages, it is clear that both IPFC and UPFC are balanced the real and reactive powers respectively as well as the converters' losses are neglected. There is a considerable improvement in real and reactive power with a change in capacitance value. But increased capacitor rating means an increase in the cost of the equipment. So, we can conclude that UPFC gives better performance as a profile of power when compared with the IPFC for a for the same IEEE 14bus transmission system

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