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Design and Testing of PWM controlled Four Switch Three Phase Inverter based UPFC

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Abstract:
Design and testing of Micro Grid with Unified Power Flow Compensator (UPFC) using Four Switch Three Phase Inverter (FSTPI) is the main objective of this paper. PWM control strategies are implemented for analyzing this power configuration. In this proposed paper deals with the PWM controller based UPFC for micro grid application. The PWM controller was selected due to smooth Power control. Four Switch Three Phase Inverter (FSTPI) was implemented in UPFC to reduce the size, switching losses, no of power switches, noise to signal ratio, power losses. The UPFC power configuration is designed and tested with Four Switch Three Phase Inverter using PWM controller for loads using MATLAB/SIMULINK software. The simulation result narrates that the FSTPI based UPFC which give better performance in improvement of smooth control of real, reactive power in transmission lines. The design of FSTPI based UPFC will reduce the overall cost and maintenance.

Keywords: *FSTP Inverter, PWM Technique, MATLAB/SIMULINK*

I. INTRODUCTION

Micro grid is a number of loads are connected together with different energy resources with clear electrical boundaries which permit it to act as a single entity with respect to the grid [1,3,4]. It also can able to join or cut the energy source or load from the grid which enables to operate both in standalone operation or connected to each other.

Operation of to micro grids were discussed with Control and protection challenges [2,5,7,8-17] because of the distributed energy source. The higher controllability in power systems by means of power electronic devices such as FACTS-devices to get efficient power, stability, and total harmonics distortion (THD).Its main goal is to improve controllability and real and reactive power improvement throughout the network. The various system configuration of UPFC with its controllers are discussed in the recent papers [18-23]. A Novel Configuration of Unified Power Flow Controller and new controllers are analyzed [24-30]

II. CONFIGURATION OF UPFC

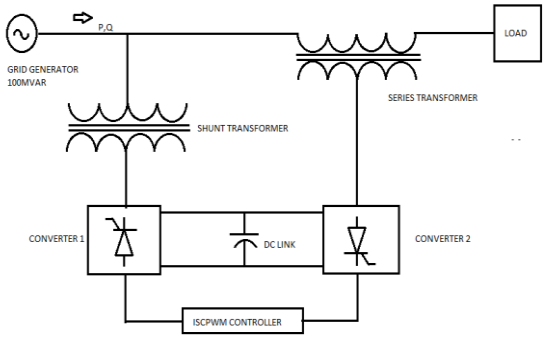

Fig 1: Structural Diagram of PWM Inverter Based UPFC

In previous literatures, the UPFC for three phase inverter with six switches were analyzed. In this proposed paper four switch three phase inverter (FSTPI) with PWM controller were analyzed. PWM controller is implemented and analyzed the real power, reactive power flow in the microgrid. Fig 1 shows that basic Structural Diagram of PWM Inverter Based UPFC with Micro grid.

The basic principle of UPFC is that it combination of shunt STATCOM and Series SSSC which consist of voltage source converter each which is connected

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by dc coupling link which is provided by a capacitor. It supports the real power exchange resulting from the SSSC and reduction of reactive current by STATCOM. This DC link helps to transfer converted power to through converter 1 and linked via a shunt connected transformer. In addition converter from SSSC delivers the real power and the converter from STATCOM helps to reduce or maintain required reactive power to the transmission line. SSSC converter also helps to inject a controllable voltage magnitude and angle to the transmission line via series connected transmission thereby provides the control of real and reactive power flow on the line. Thus, the transmission line is operated in unified power factor by STATCOM converter or exchanging controlled reactive power with the transmission line. So, UPFC DC link which has no reactive power flow.

III. ANALYSIS OF SIMULATION RESULT

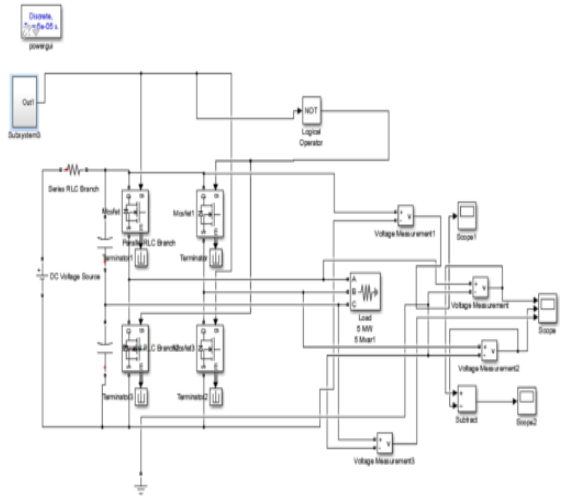

Fig 2: FSTPI Using PWM Technique

Fig 2 narrates that shows the simulation of FSTPI using PWM technique with input voltage of 440V and load as resistance with 1 ohm. The pulse is generated by square wave gating signal T1 and T3 at the output frequency (i.e.) 50 Hz. The other generation of two square wave gating signal T2 and T4 should be an invert signal corresponding to square wave gating signal T1 and T3. The third voltage is produced with the help of split capacitor C1 and C2.

The fig 3 shows the comparison of real power flow of UPFC with FSTPI. It narrates that the improvement of real power in transmission line while connecting UPFC with PWM controller for three leg and two leg inverter.

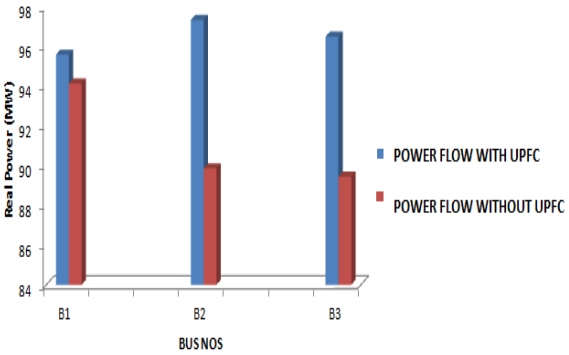

Fig 3: Real Power Comparison of UPFC with FSTPI

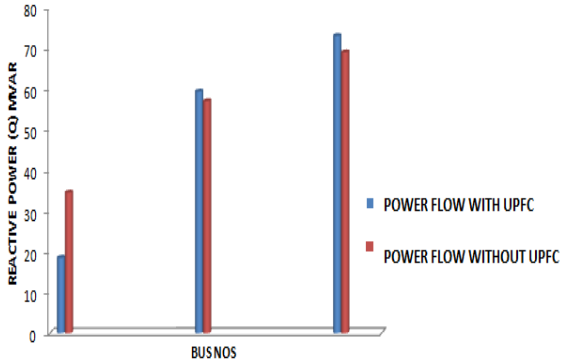

Fig 4: Reactive Power Comparison UPFC with FSTPI

In Fig 4 shows the comparison of reactive power UPFC with FSTPI. It tells the improvement of reactive power in transmission line while connecting UPFC with PWM controller for two leg inverter. It shows that the two leg inverter which gives better results in power flow and reduced transmission losses than three leg inverter.

IV.CONCLUSION

The result shows the better improvement in real and reactive power while using two leg PWM inverter based UPFC in the transmission line. PWM controller based UPFC will boost both the real and reactive power in the transmission line was tested in the simulation using MATLAB/SIMULINK software. While implementing the two leg inverter with the UPFC, it has reduced switching loss,

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reduced space and cost, low maintenances and improved real and reactive power.

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