MITIGATION OF POWER QUALITY ISSUES IN RENEWABLE RESOURCES USING UPQC

S.SINDHUJA[1],V.ABINAYA [2], M.ABIRAMY[3], S.AKILA[4], S.ANANTHI[5]
Assistant Professor[1], UG Students[2, 3,4, 5]
Department of Electrical and Electronics Engineering
Bharathiyar Institute of Engineering For Women-Deviyakurichi

Abstract – Power quality issues are becoming more significant now days because of the increasing number of power electronic device.. This paper deals with the Unified Power Quality Conditioner (UPQC) aims at integrating both shunt and series active power filters through a common DC link capacitor. The shunt active power filters are used to compensate current related problem. The series active power filters are used to compensate voltage related problems.The proposed control method has been modeled using MATLAB/SIMULINK and simulation results are presented to validate the proposed control method.

Key Words: Power, Synchronous Reference *Frame Theory(SRF)*

1. INTRODUCTION

In recent years, with the increasing application of power electronic device which behave as a nonlinear load, power quality problems such as harmonic, voltage sag/swell and imbalance have become serious issues. With the help of FACTS device and custom power device we are capable to reduce the power quality problems. The shunt APFs are used to compensate current related problems, such as reactive power compensation, current harmonic filtering, load unbalance compensation, etc. The series APFs are used to compensate voltage related problems, such as voltage harmonics, voltage sag voltage swell, voltage flicker, etc. The unified power quality conditioner(UPQC) aims at integrating both shunt and series APFs through a common DC link capacitor. The UPQC is similar in construction to a unified power flow controller. The UPFC is employed in power transmission system, whereas the UPQC is employed in power distribution system. The primary objective of UPFC is to control the flow of power at, fundamental frequency. On the other hand the UPQC controls distortion due to harmonics and unbalance in voltage in addition to control of flow of power at the fundamental frequency. It consists of two voltage source inverters (VSI) connected back-to-back, sharing a common DC link in between. One of the VSIs acts as a shunt APF, whereas the other as a series APF. The performance of UPQC mainly depends upon how quickly and accurately compensation signals are derived. Control schemes of UPQC based on PI controller has been widely reported. In this paper the proposed synchronous reference frame control is tested under unbalanced load condition using MATLAB/Simulink software.

1.1 UPQC

UPQC is the most attractive solution for solving voltage and current related problems. It is capable of mitigating the effect of voltage sag /swell at the point of common coupling. It also prevents the harmonics present in the system.Fig.1 shows

the basic configuration of UPQC.

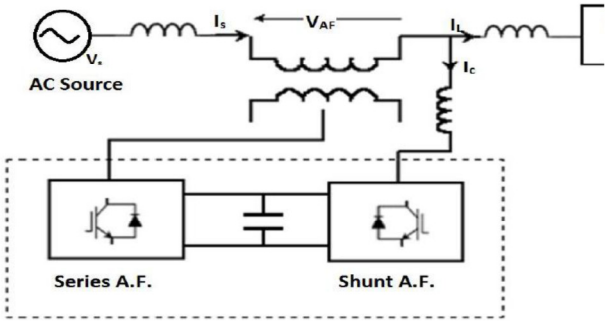

Fig1.1 Basic configuration of UPQC

It contain two voltage source inverter (VSIs), connected back-to-back sharing a common DC capacitor. The series active filter is responsible for the mitigation of voltage sag and shunt active filter is responsible for the compensation of harmonics.

2. SRF-BASED CONTROL ALGORITHM

SRF method can be used for the mitigation of power quality problems from the supply voltage and current. In the case of UPQC the voltage and current signals are transformed from a-b-c quantities to d-q frame. In the case of SRF theory d-q coordinates rotates with supply voltage.

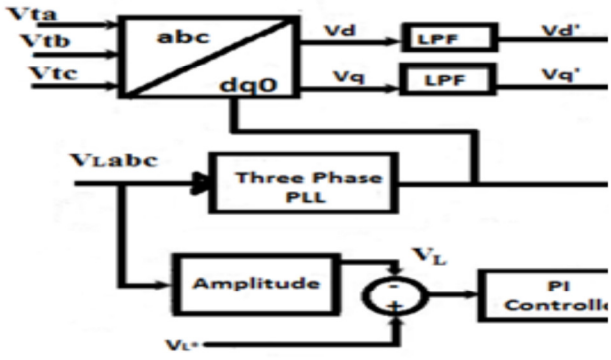

Fig. 2.Synchronous Reference Frame Theory

A. *Simulation without UPQC*

The Simulink model of the single bus system with a nonlinear load is shown in the figure 5. The total harmonic distortion present in this system is 10.23%. The supply current is shown in the figure 6.

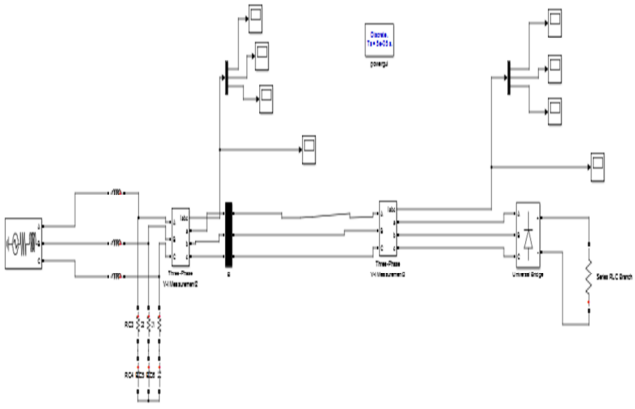

Fig. 5. Simulink diagram

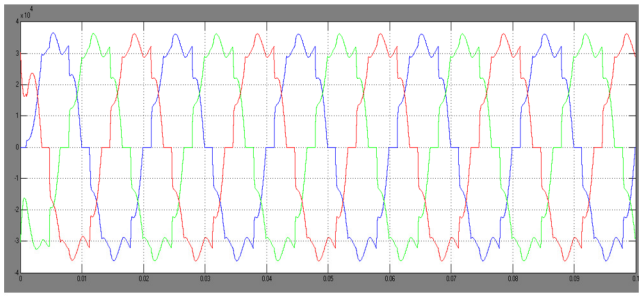

Fig. 6.Analysis of current.

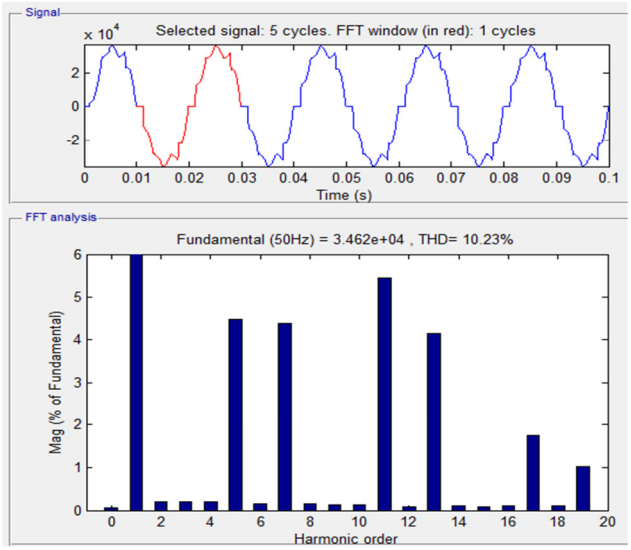

Fig. 7. THD analysis.

B. *Simulation with UPQC*

The Simulink model of the single bus system with shunt active filter is shown in the figure 8. The total harmonic distortion of this system is 6.08%. The supply current is shown in the figure 9.

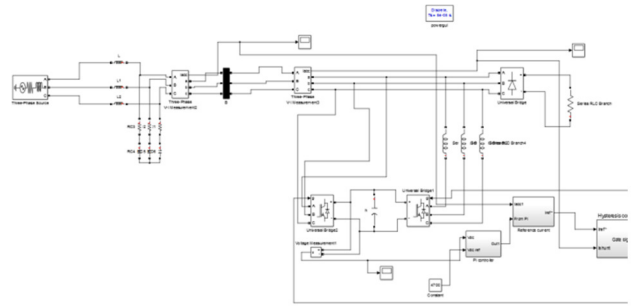

Fig. 8. Simulink diagram

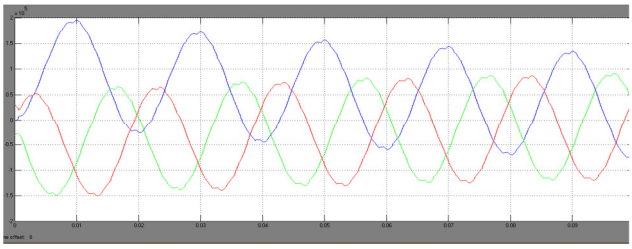

Fig.9. Analysis of current.

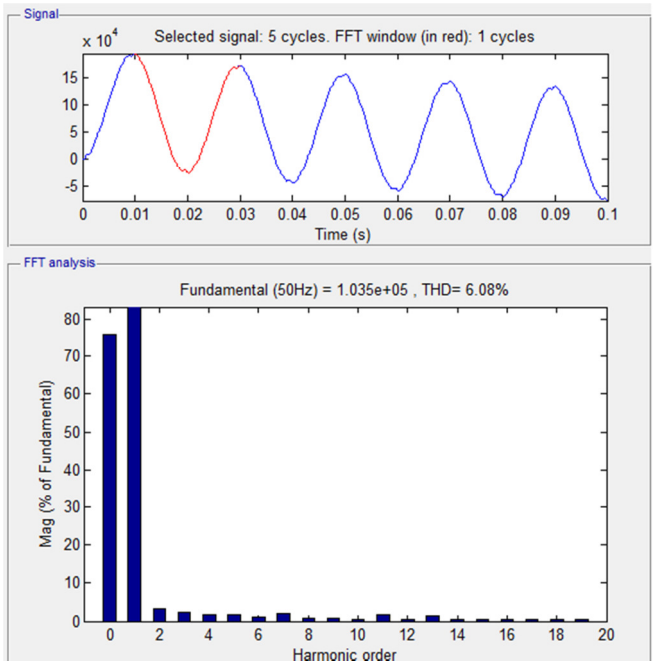

Fig. 10. THD analysis.

C. *Performance Comparison*

NON LINEAR LOADS	WITHOUT UPQC (THD)	WITH UPQC(THD)
	10.23%	6.08%

CONCLUSION

UPQC using Synchronous Reference Frame (SRF) has been investigated for compensating reactive power and harmonics .Then the total harmonic distortion without UPQC and with UPQC was compared. From the analysis, SRF theory is efficient method to correct the abnormality in the voltage and current and also help to maintain the load voltage balanced and constant.

REFERENCE

[1] P. Kundur, J. Paserba, V. Ajjarapu, G. Andersson, A. Bose, C. Canizares, N. Hatziargyriou, D. Hill, A. Stankovic, C. Taylor, T.V. Cutsem, and V. Vittal, "Definition and classification of power system stability: IEEE/CIGRE joint task force on stability terms and definitions," IEEE Trans. Power Syst., vol. 19, no. 3, pp. 1387–1401, Aug. 2004.

[2] P. Kundur, Power System Stability and Control. New York, NY, USA: McGraw-Hill, 1994.

[3] V. Mahajan, "Power System Stability Improvement with Flexible A .C. Transmission System (FACTs) Controller," Power System Technology an IEEE Power India Conference, POWERCON 2008.

[4] J. Miret, M. Castilla, J. Matas, J. M. Guerrero, and J. C. Vasquez, "Selective harmonic-compensation control for single-phase active power filter with high harmonic rejection," IEEE Trans. Ind. Electron., Vol. 56, No. 8, pp. 3117-3127, Aug. 2009.

[5] V. Khadkikar, A. Chandra, and B. N. Singh, "Generalised single phase p-q theory for active power filtering: Simulation and DSP based experimental investigation," IET Power Electron., Vol. 2, No. 1, pp. 67-78, Jan. 2009.

[6] M. Cirrincione, M. Pucci, and G. Vitale, "A single-phase DG generation unit with shunt active power filter capability by adaptive neural filtering," IEEE Trans. Ind.Electron., Vol. 55, No. 5, pp. 2093-2110, May 2008.

[7] M. Saitou, N. Matsui, and T. Shimizu, "A control strategy of single phase active filter using a novel d-q transformation," *in Proc. IEEE IAS '03*, pp. 1222-1227, 2003.