HARMONIC REDUCTION IN FOURTEEN BUS SYSTEM BY USING UNIFIED POWER QUALITY CONDITIONER

G.V. Prasanna Anjaneyulu[1], Dr. P. Sangameswara Raju[2]

[1] Research Scholar, [2] Professor, EEE Department,

S.V.U.C.E., S.V. University, Tirupathi, A.P., (India)

ABSTRACT

This paper deals THD reduction in Fourteen Bus system employing Unified Power Quality Conditioner (UPQC). The UPQC system combines the abilities of the Dynamic Voltage Regulator (DVR) and the Active Filter (AF). The Fourteen Bus systems with and without UPQC are modeled and simulated using the blocks of MATLAB/SIMULINKand the THD are presented. It is noted that the introduction of UPQC improves the transmission efficiency. The UPQC is proposed in the present work to improve qualityof fourteen bus system.

Keywords: Active Filter, Dynamic Voltage Regulator, Power Quality, Total Harmonic Distortion .

I. INTRODUCTION

The quality power supply is essential for proper operation of industrial processes which contain critical and sensitive loads. Nonlinear loads and electronically switched loads will distort steady state AC voltage and current waveforms. Periodically distorted waveforms can be studied by examining the harmonic components of the wave-forms. The nonlinear load injects the harmonic current into the networks and consequently distorts the voltage waveform. This distorted voltage waveform affects other loads connected. To avoid this problem and to protect the loads from distortion, the harmonic components of the voltage and current must be compensated.By use of Passive filters, the problem reduces, but these have many disadvantages such as fixed compensation, large size, and resonance problems. To overcome the above problem, the shunt active filters were used with passive filters [1]-[2], but this method does not reduce the voltage harmonics. In order to deal voltage and current harmonic problems simultaneously, the most sophisticated device i.e., unified power quality conditioner has been developed [2]-[3]. In section 2, structure of UPQC is presented. In section 3, Fourteen bus system without UPQC, with UPQC and their comparative analysis are presented. Finally, section 4 concludes the results.

II. STRUCTURE OF UPQC

UPQC is a series combination of series and shunt active power filters sharing a common DC link. The two active power filters have different functions. Series filters is operated as a controlled voltage source to suppress and isolate voltage harmonics, same time shunt filters acts as a controlled current source to compensate the current harmonics. This paper presents complete simulation of UPQC system. The basic configuration of the UPQC is presented in Fig.1.

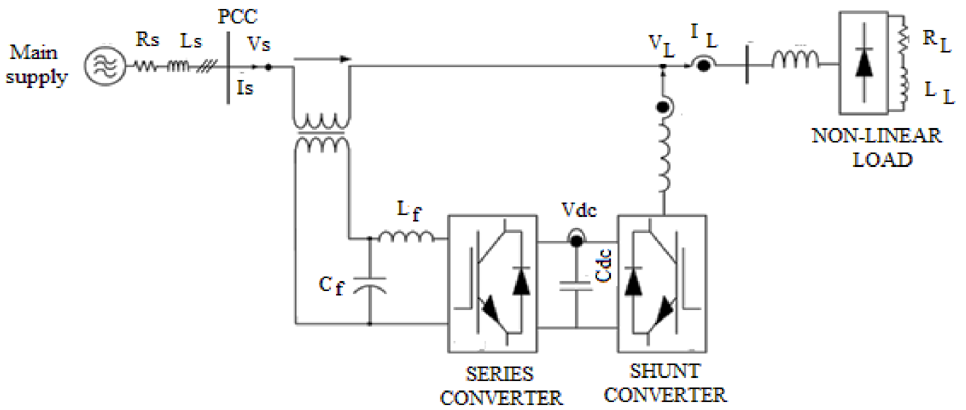

Fig.1: Basic Configuration of UPQC

Fig.1 shows a basic configuration of general UPQC consisting of two voltage source inverters: one act as a series APF and the other as shunt APF, which are connected back to back through dc link capacitor. The series APF which is connected between the source and PCC using three single phase series transformers has the capability of compensating the voltage harmonics, voltage flicker and improving voltage regulation [4]. The shunt APF is connected through a small rated capacity inductive filter in order to eliminate the high switching ripple content in the shunt APF injected current.

The above literature does not deal with the Power Quality Improvement in fourteen bus system using UPQC. This work proposes UPQC in fourteen bus systems for improving Power Quality. A new Simulink model for fourteen bus system with UPQC is presented in this paper.

III. SIMULATION RESULTS

The model for fourteen bus system is developed using the elements of MATLAB and SIMULINK. The results of simulation with and without UPQC are presented in this section. The Simulink model for fourteen bus system with linear and nonlinear loads is shown in Fig.3.1. PQ power measurement blocks are connected to measure real power and reactive power. The output voltage of wind generator is shown in Fig.3.2. Voltage across load-1 and load-2 are shown in Fig.3.3. The voltage decreases at time equal to 0.2 sec due to the addition of second load. The FFT analysis is done for the current and the T.H.D is 9.3%.

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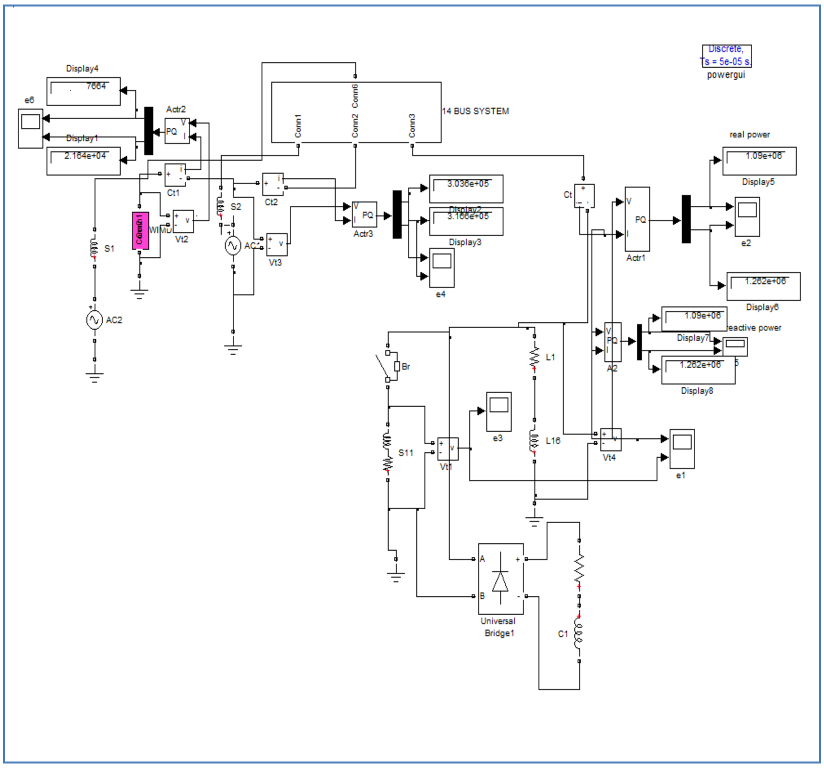

Fig.3.1: 14 Bus system without UPQC

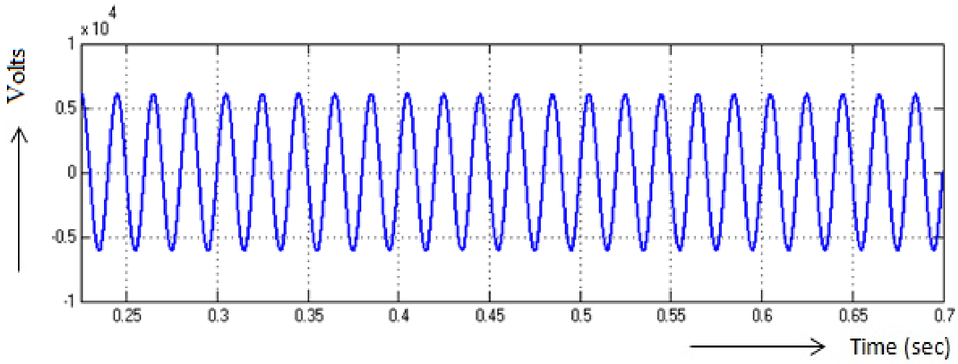

Fig.3.2: Output Voltage of Wind Generator

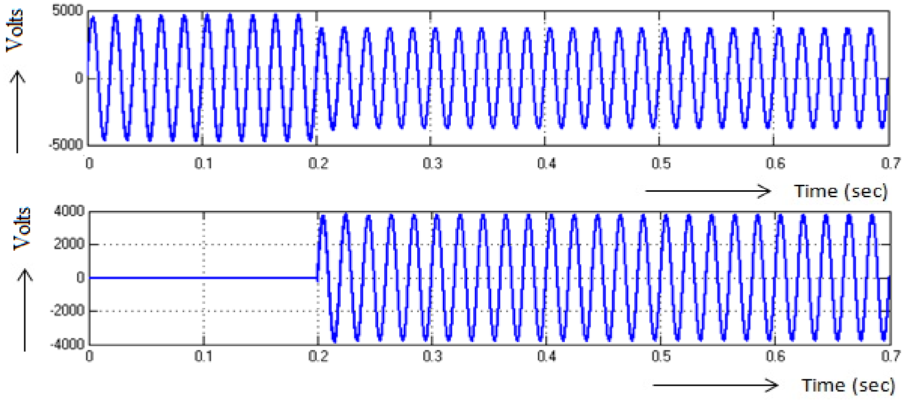

Fig.3.3: Voltage across load-1 and load-2

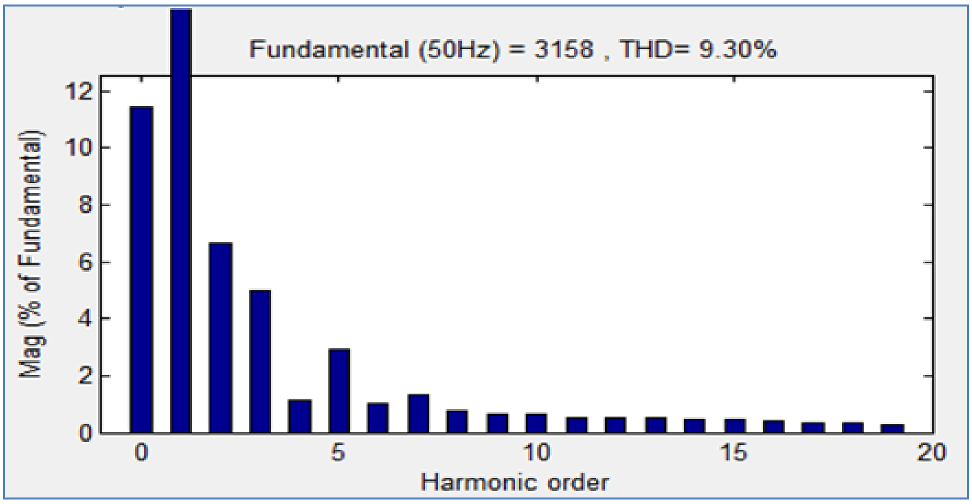

Fig.3.4: FFT Analysis for current

IV. FOURTEEN BUS SYSTEM WITH UPQC IMPLEMENTATION

The SIMULINK model of fourteen bus system with UPQC is shown in Fig. 4.1. The UPQC is introduced to improve the voltage profile and reduce the T.H.D. The subsystem containing 14-bus network is shown in Fig.4.2. Line impedances are represented as series combination of resistance and reactance. Load impedances are represented as series resistance and reactance between bus and neutral. The output voltage of wind generator is shown in Fig.4.3. The voltage across load-1 & load-2 are shown in Fig.4.4. The voltage profile is improved by the addition of UPQC at time equal to 0.4 sec. FFT analysis for the current is shown in Figure 4.5 and T.H.D is 5.8%. The comparison of THD are summarized in Table -1.

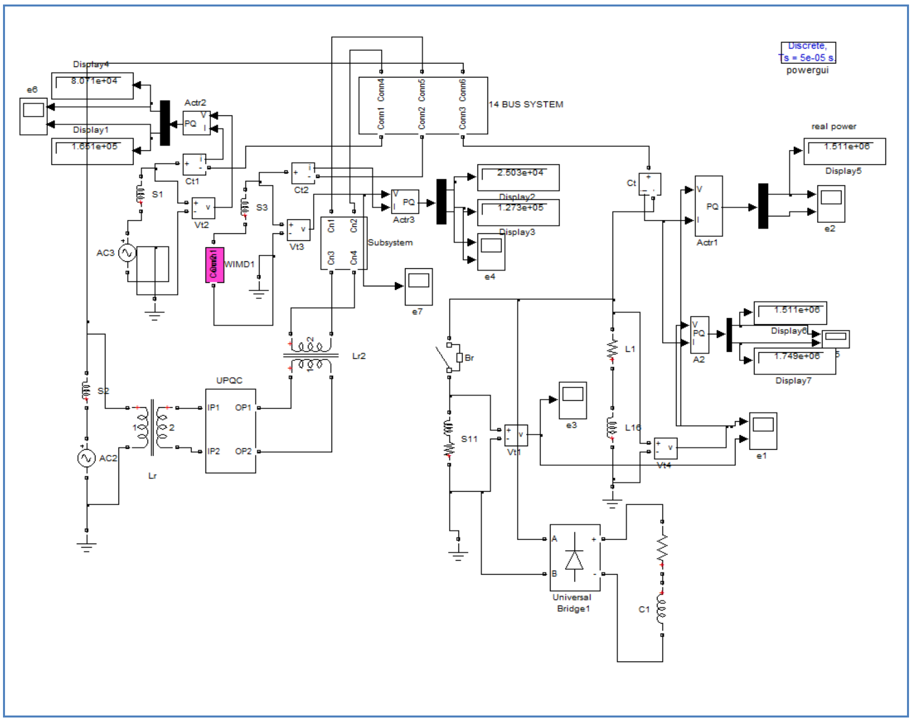

Fig.4.1: 14 Bus system with UPQC

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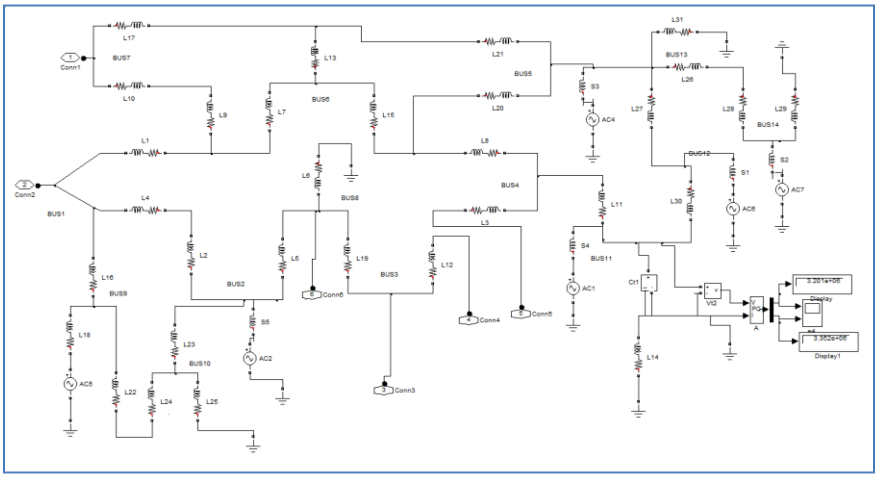

Fig.4.2: 14 Bus Network

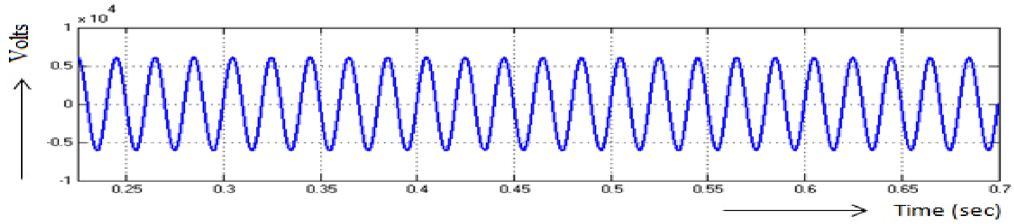

Fig.4.3: Output Voltage of Wind Generator

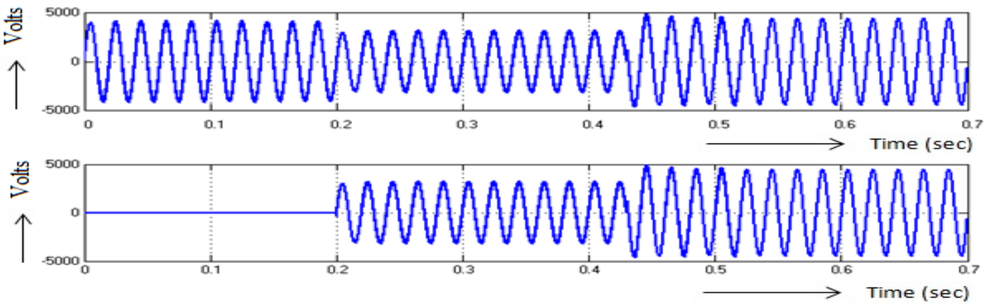

Fig.4.4: Voltage across Load-1 and Load-2

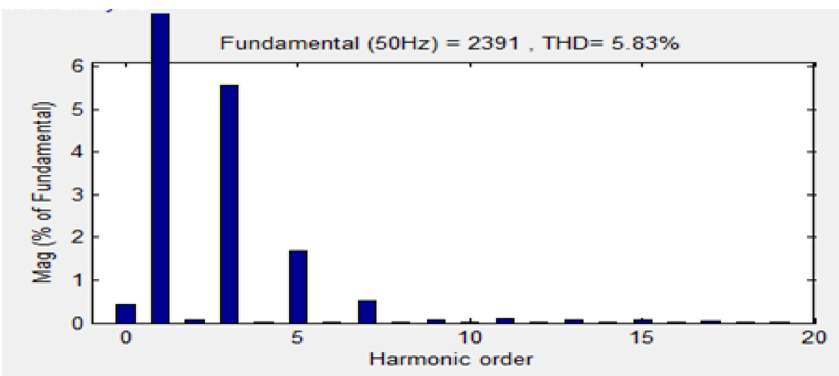

Fig.4.5: FFT Analysis

Table.1: Summary of THD

Description	Without UPQC	With UPQC
T.H.D	9.3%	5.8%

V. CONCLUSIONS

The UPQC based fourteen bus system was successfully designed, modeled and simulated using MATLAB. The comparison of results of fourteen bus system with and without UPQC is presented. The THD is reduced from 9.3% to 5.8% by adding UPQC to 14-Bus system. The benefits of UPQC are voltage injection ability and harmonic reduction. The disadvantage of three phase UPQC system is that it requires twelve IGBT's.
The Scope of the present work is to estimate the reduction in losses Fourteen bus system employing UPQC.

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