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DESIGN OF FIFTY BUS SYSTEM WITH MULTIPLE UPQCs

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ABSTRACT

In multi bus system, Unified Power Flow Converter (UPQC) ispreferred because of the harmonic reduction ability and voltage injection property. The UPQC is used to reduce voltage sag and line losses. In this work, the auto theory proposed, the idea of multiple UPQC's to improve the voltage profile. Simulation studies are performed using MATLAB simulation tool. Case studies of fifty bus system with and without UPQC's are presented.

Key Words: Active Filter, Dynamic Voltage Regulator, Total Harmonic Distortion, Line Losses, Power Quality

I. INTRODUCTION

It is the target of the electric utility to supply its clients with a sinusoidal voltage of genuinely consistent greatness and recurrence. The generators that deliver the electric force produce a nearby estimate to a sinusoidal sign. The arranging, configuration, and operation of mechanical and business power frameworks require a few studies to help with the assessment of the underlying and future framework execution, framework dependability, wellbeing and the capacity to develop with creation and working prerequisites. The routine air conditioning electric force frameworks are intended to work with sinusoidal voltages and streams.

The quality force supply is vital for legitimate operation of mechanical procedures which contain basic and delicate burdens. However nonlinear burdens and electronically exchanged burdens will mutilate relentless state air conditioning voltage and current waveforms.However there are loads and devices on the system which have nonlinear characteristics and result in harmonic distortion of both the voltage and current signals. As more nonlinear loads are introduced within a facility, these waveforms get more distorted. In a modern power system due to wide use of nonlinear loads such as adjustable speed drives, electric arc welders, and furnaces it has become necessary to establish criteria for limiting power quality problems. These problems cause reduction in system efficiency, poor power factor, maloperation of electronic equipment's and reduction in equipment mean life time.

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 Figure -1.

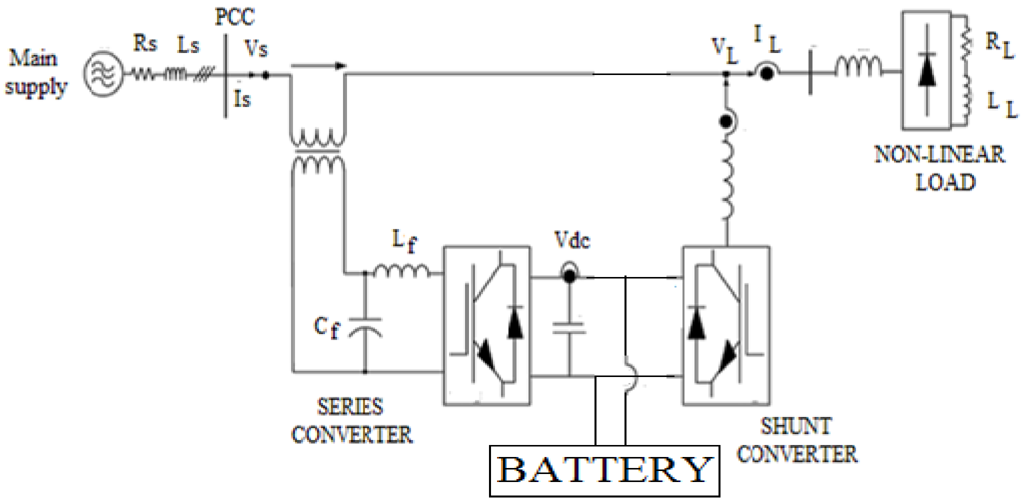

Fig. 1: Basic Configuration of UPQC

Figure 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.

III. SIMULATION RESULTS

Fifty bus system without UPQC are shown in Figure 3.1. Each line is shown as series impedance. Each load is shown as shunt impedance. Each alternator is shown as a AC source. The voltage at bus 4 is shown in Figure 3.2. The peak value of voltage is $0.9*10^4$ real and reactive power are $2.8*10^5$ w and $8*10^4$ VAR respectively.

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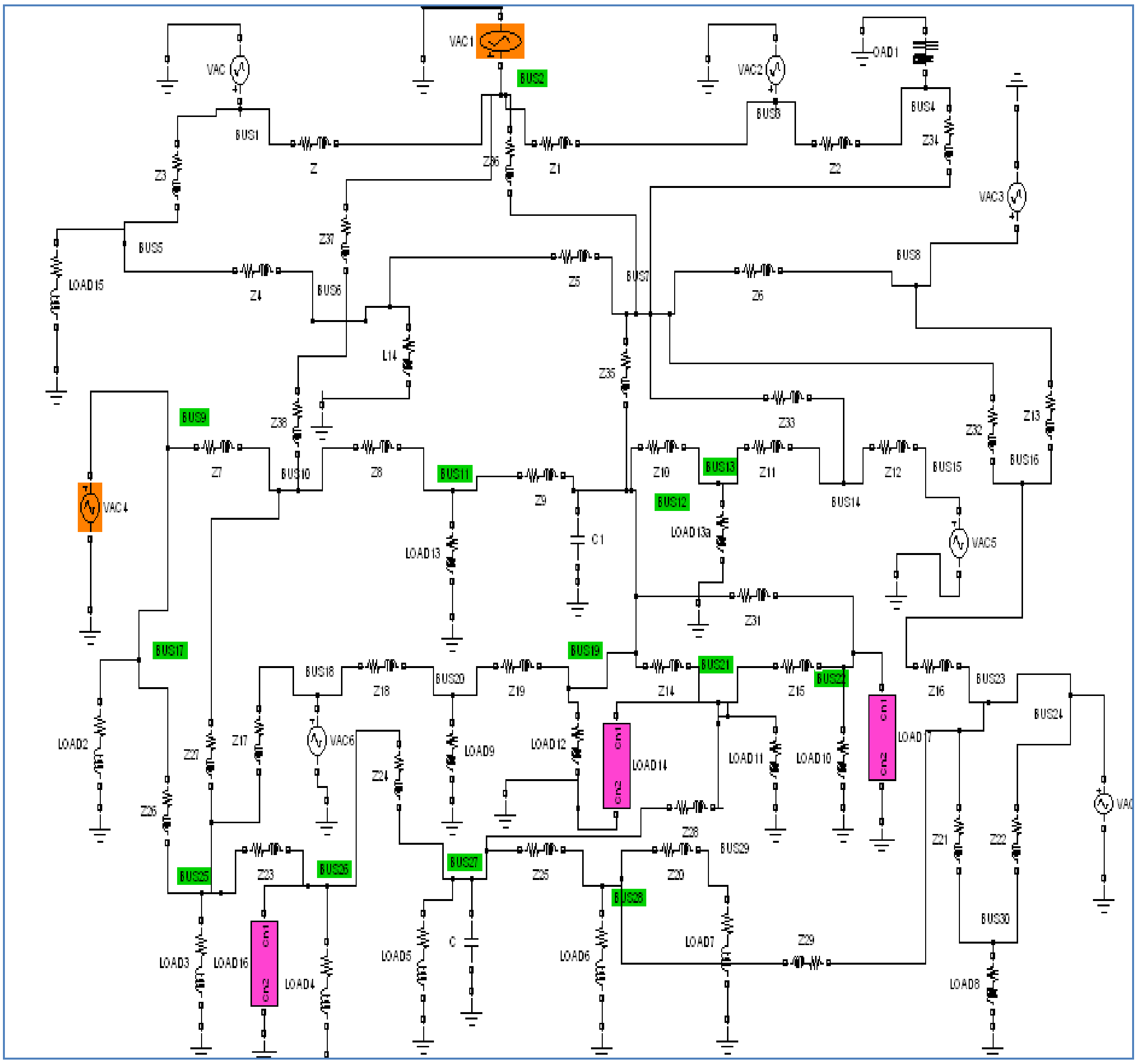

Fig.3.1: Fifty Bus Systems without UPQC

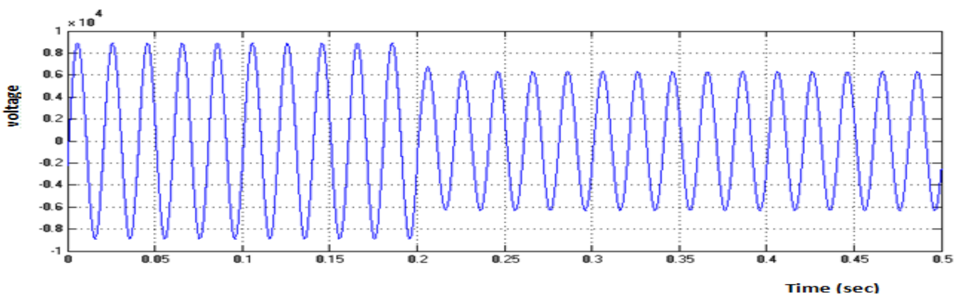

Fig.3.2: Bus – 4 Voltage

The Real power at Bus four is shown in Figure 3.3. The Reactive power at Bus four is shown in Figure 3.4. Real and Reactive power decreases to $1.4*10^5$ W and $4*10^4$ VAR respectively.

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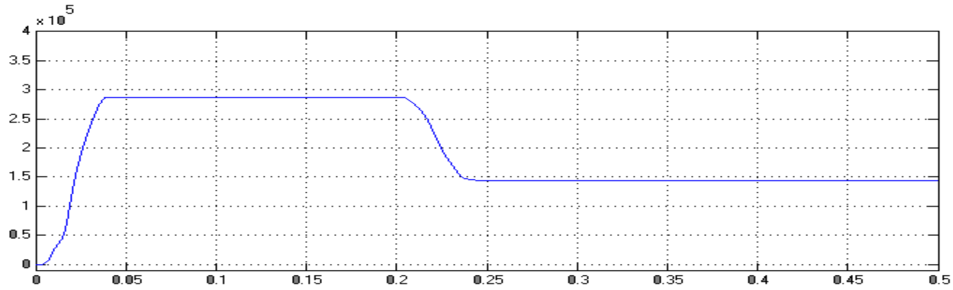

Fig.3.3: Real Power at Bus – 4

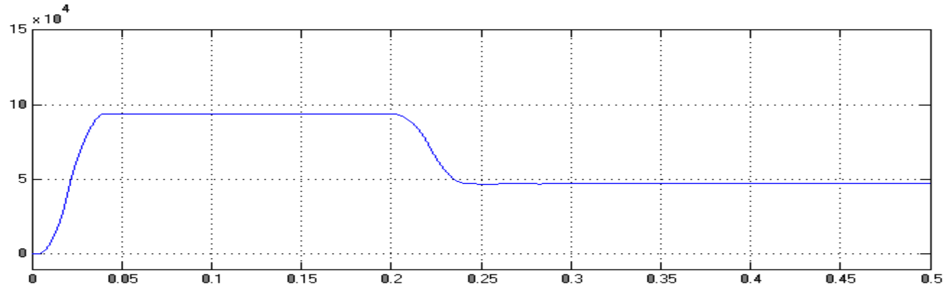

Fig.3.4: Reactive Power at Bus – 4

The voltage at Bus 26 is shown in Figure 3.5. The real power at bus twenty six is shown in Figure 3.6. The reactive power at bus twenty six is shown in Figure 3.7. The Peak value of voltage is 8000V. The real and reactive power is $2.8*10^5$ W and $8.9*10^5$ VAR respectively. Real and Reactive power decreases to $2.3*10^5$ W and $6.9*10^5$ VAR respectively.

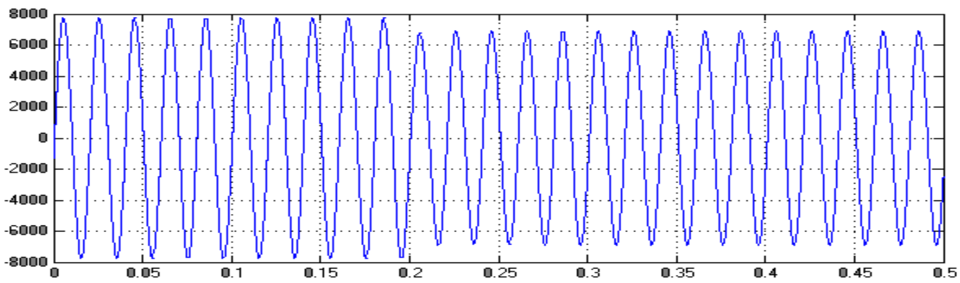

Fig.3.5: Voltage at Bus - 26

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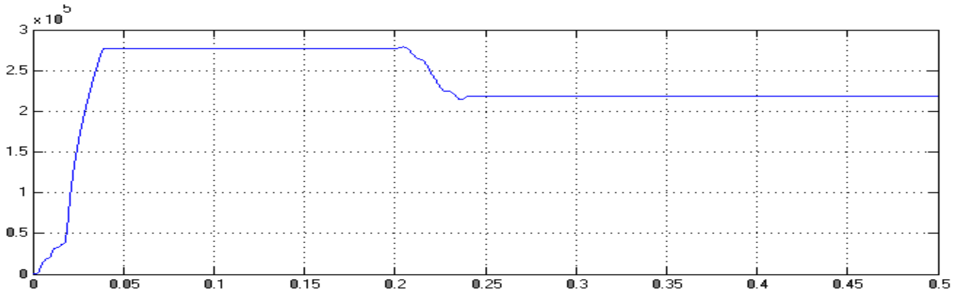

Fig.3.6: Real Power at Bus – 26

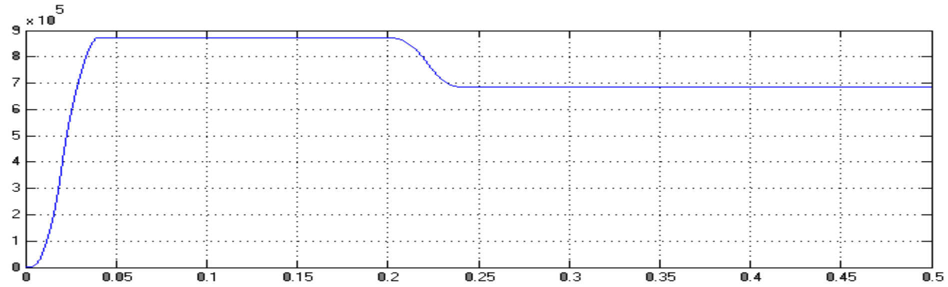

Fig.3.7: Reactive Power at Bus – 26

The fifty bus system with UPQC is shown in Figure 3.8. Three UPQCs are introduced. The UPQC model is shown in Figure 3.9. The peak value of voltage is 7000 V, real and reactive powers are $2.4*10^5$ W and $7.5*10^4$ VAR respectively.

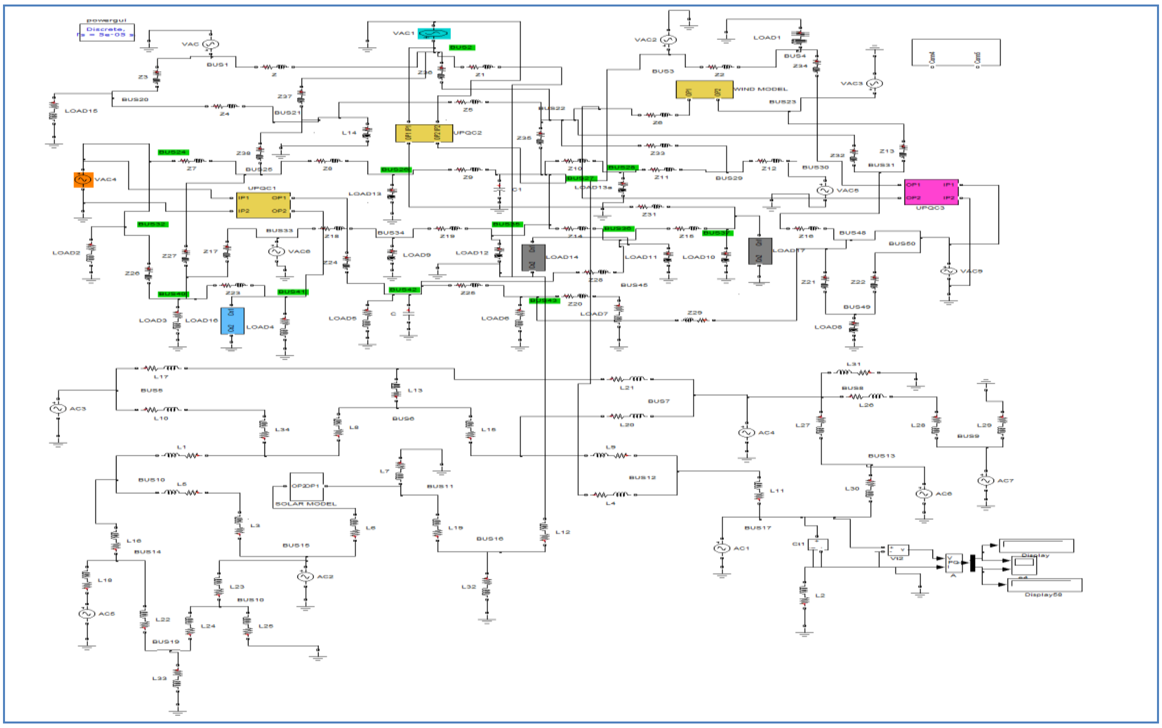

Fig.3.8: Fifty Bus System with UPQC

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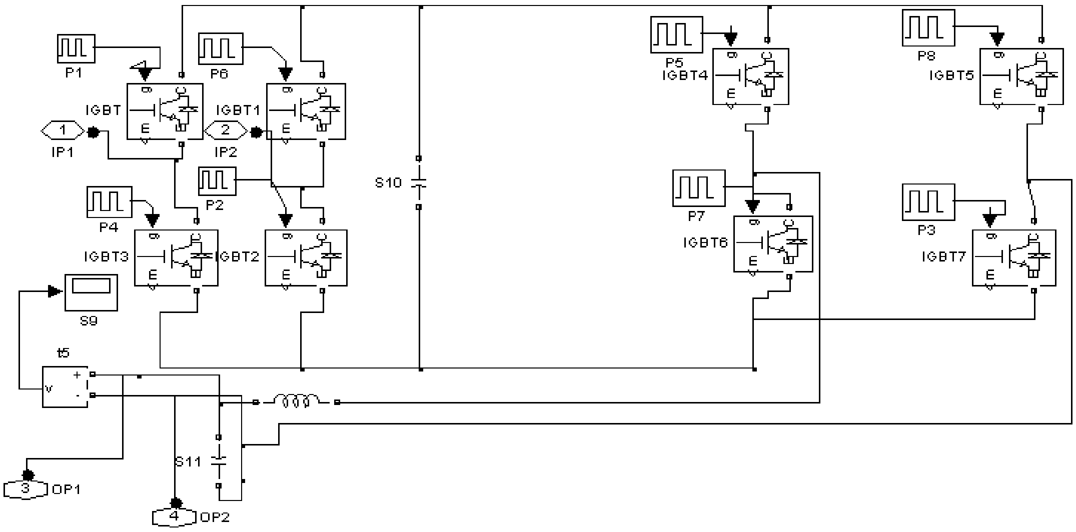

Fig.3.9: Model for UPQC

The Voltage of bus four is shown in Figure 3.10. The Real power at bus four is shown in Figure 3.11. The Reactive power at bus four is shown in Figure 3.12. Real and reactive power decreases to $1.8*10^5$ W and $5.8*10^4$ VAR.

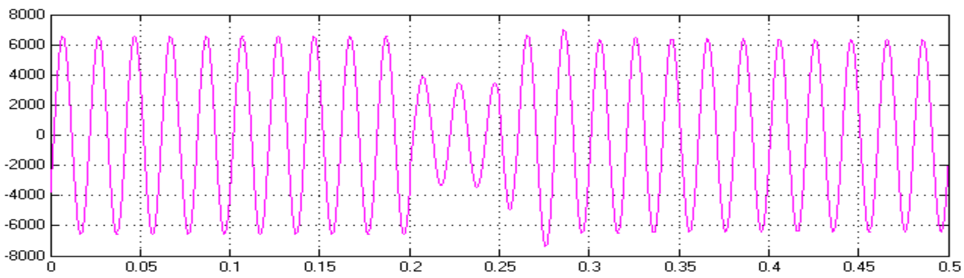

Fig.3.10: Voltage at Bus - 4

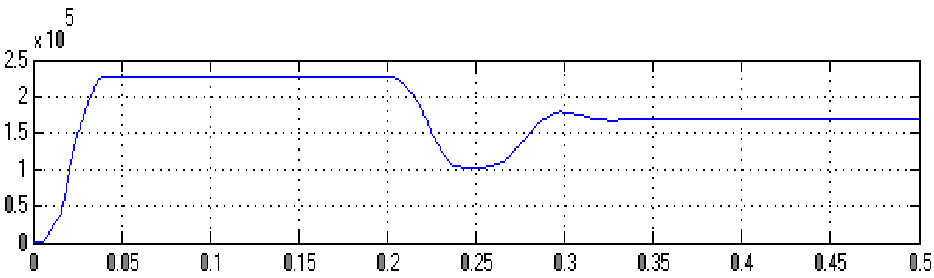

Fig.3.11: Real Power at Bus – 4

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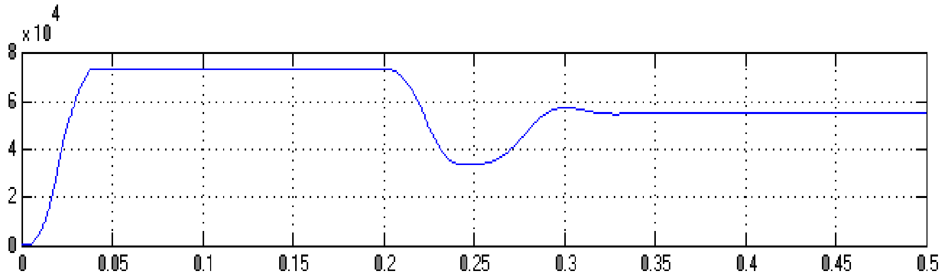

Fig.3.12: Reactive Power at Bus – 4

The voltage at Bus 26 is shown in Figure 3.13. The real power at bus twenty six is shown in Figure 3.14. The reactive power at bus twenty six is shown in Figure 3.15. The peak value of voltage is 5900 V, real and reactive powers are $2.5*10^5$ W and $7*10^5$ VAR respectively. Real and reactive power increases into $2.4*10^5$ W and $8*10^5$ VAR respectively.

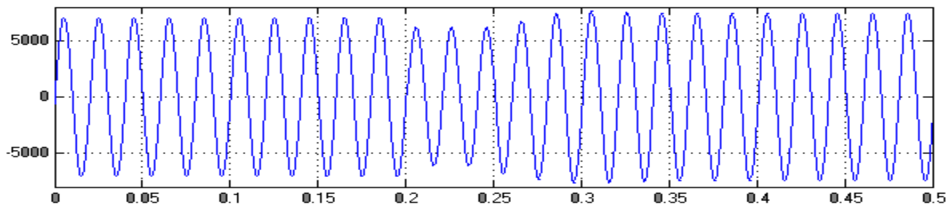

Fig.3.13: Voltage at Bus- 26

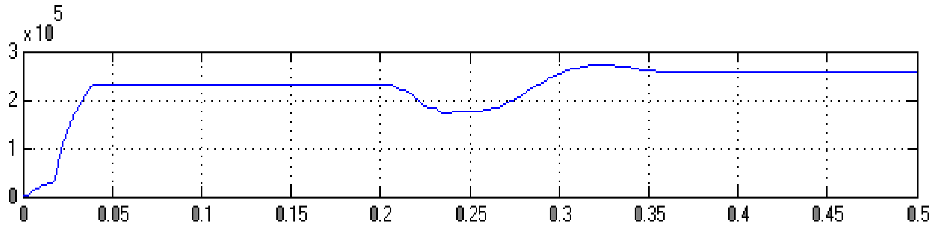

Fig.3.14: Real Power at Bus – 26

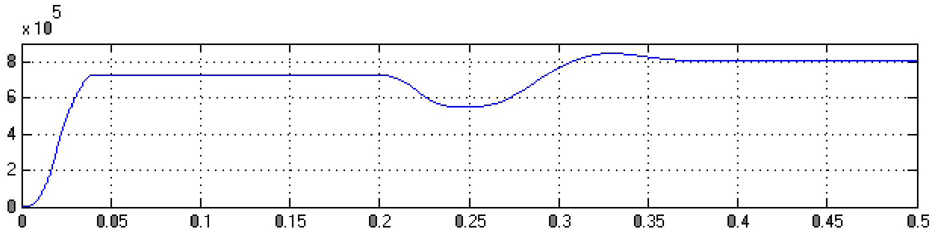

Fig.3.15: Reactive Power at Bus – 26

The voltage at Bus 45 is shown in Figure 3.16. The real power at bus fourty five is shown in Figure 3.17. The reactive power at bus fourty five is shown in Figure 3.18. The peak value of voltage is $1.3*10^4$ V, real and reactive powers are $2.4*10^5$ W and $1*10^6$ VAR respectively. Real and reactive power increases to $6.5*10^5$ W and $2*10^6$ VAR respectively.

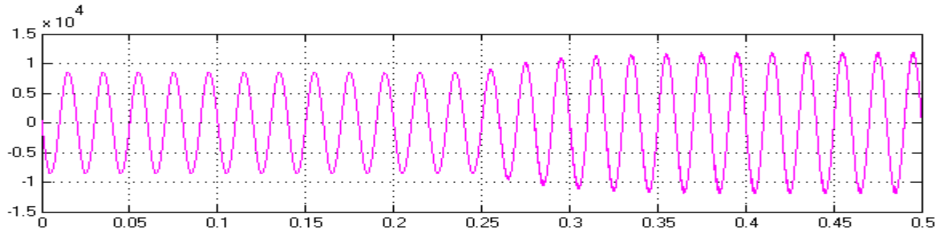

Fig.3.16: Voltage at Bus - 45

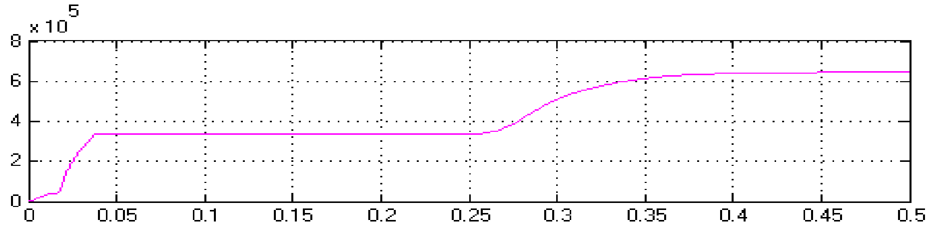

Fig.3.17: Real Power at Bus – 45

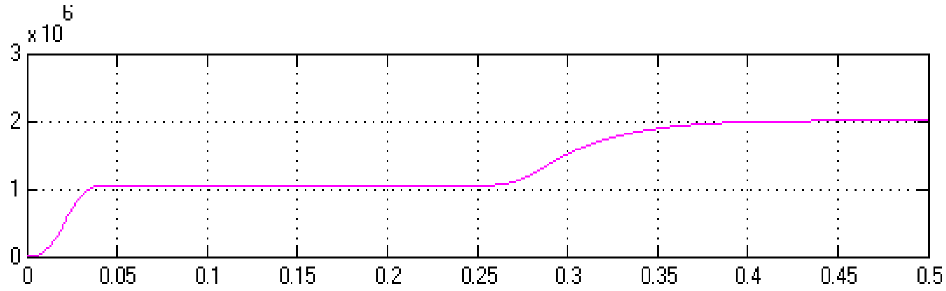

Fig.3.18: Reactive Power at Bus – 45

IV. CONCLUSIONS

In this paper, the proposed PV boost converter based UPQC system was presented. Simulation results with and without UPQC was performed using MATLAB. The results indicated that performance of 50 bus system with UPQC is superior that of the system without UPQC.By considering the performance of UPQC, it is more suitable for multibus systems.

The investigations of fifty bus system with single boost converter based PV system were carried out.

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