"CONTROL OF VSC AND CSC BASED UPQC TO IMPROVE POWER QUALITY"

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Abstract: *Power quality issues are gaining more attention these days because an increasing the equipment that are sensitive to distortions in supply voltage. Due the use of nonlinear load current are distorted at the supply side. Unified power quality conditioner find the application to provide solution related to power quality problem. There are many types of UPQC but according the construction they are divided as voltage source converter and current source converter based UPQC. Both types of UPQC used for provide solution related to voltage and current distortion. Series filter are eliminated the voltage imperfection and shunt filter are eliminated the current imperfection.in this paper simple PI controller and PWM is used for the derivation of reference signal and switching signal. Simulation of VSC and CSC based UPQC are done in MATLAB/Simulink. Results of the VSC and CSC based UPQC show that the voltage and current harmonic are effectively eliminated.*

Key Words: *UPQC, Power quality, VSC, CSC, series filter, shunt filter.*

1. INTRODUCTION:

Power quality issues are gaining more attention these days as an increasing equipment that are sensitive to distortions or dips in supply voltages are used. At the same time an increasing number of power electronic devices such as adjustable speed drives, uninterruptible power supplies etc. are being used causing harmonic pollution in distribution networks. To eliminate this, regulations apply in many places that limit the distortion and unbalance that a customer can produce in a distribution system. These regulations may require the installation of custom power device on customer premises. At the same time, it is the duty of any utility to supply a distortion-free balanced voltage to its customers, mainly those sensitive ones. In this paper we utilize the UPQC to perform both these tasks simultaneously. The UPQC is a relatively new device and it has been viewed as combination series and shunt active filters. In that paper it has been shown that VSC and CSC based can be used to attenuate current harmonics on the supply side. In this paper we introduce the operation of a UPQC that combines the operations of a distribution static compensator (DSTATCOM) and dynamic voltage restorer (DVR) together. The series component of the UPQC inject voltage so as to maintain the voltage at the load terminals balanced and free of distortion. Simultaneously, the shunt component of the UPQC injects current in the ac system such that the currents entering the bus to which the UPQC is connected are balanced sinusoids.

Since development of VSC based UPQC was in use due to its compact size, easy to extend multilevel. With the availability of IGBT the use of current source converter based UPQC is increasing due to its inbuilt short circuit protection capability, higher efficiency at low power rating, simple open loop current control and effective filtering of harmonics.

This paper present a control of VSC and CSC based UPQC under the nonlinear load. A simple PI controller and PWM technique is used for reference and switching pulse generation. In this paper simulation results of both configuration is shown.

2. UPQC CONFIGURATION:

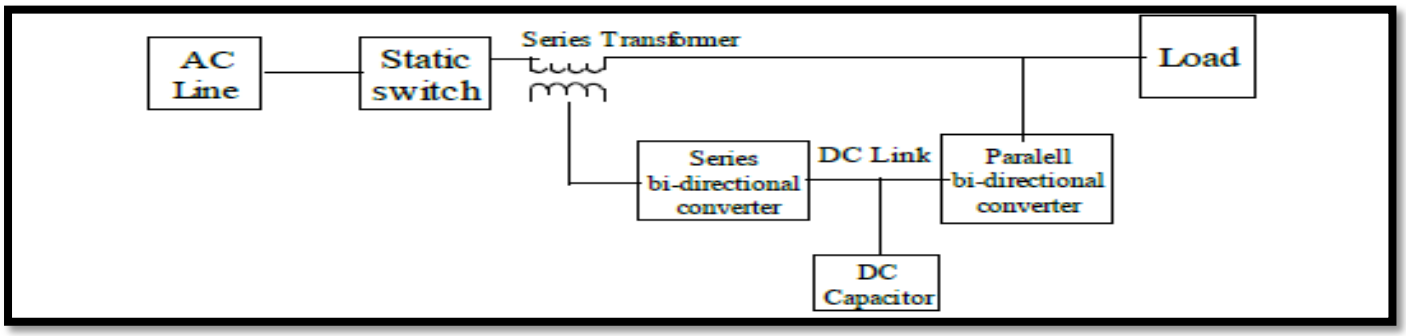

Figure 2.1 Conceptual diagram of UPQC

Figure 2.1 shows the conceptual diagram of the UPQC. Unified power quality conditioner (UPQC) comprises of two bidirectional converters connected back to back through an energy storage device. Figure 2.2 shows the VSC based UPQC in which capacitor is used as common DC link. Figure 2.3 shows the CSC based UPQC in which inductor is used as common DC link. This paper present a control of VSC and CSC based UPQC under the nonlinear load. A simple PI controller and PWM technique is used for reference and switching pulse generation. In this paper simulation results of both configuration is shown.

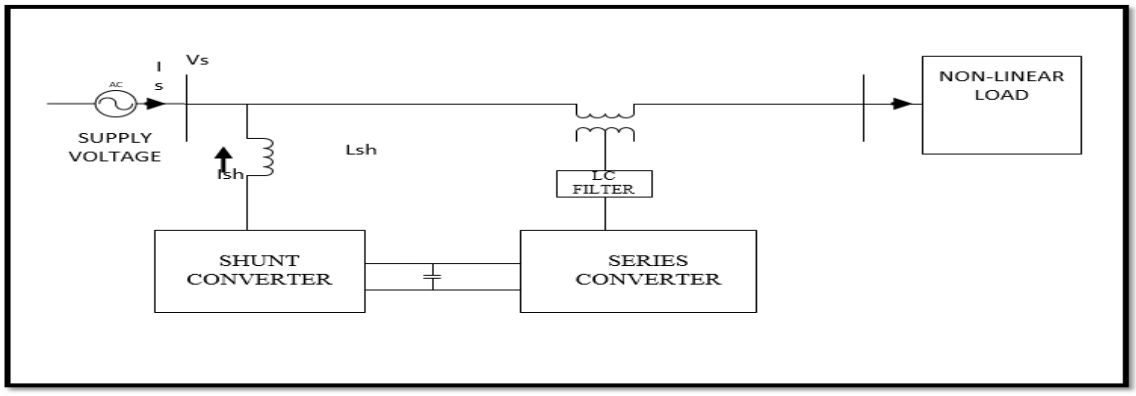

Figure 2.2 VSC based UPQC

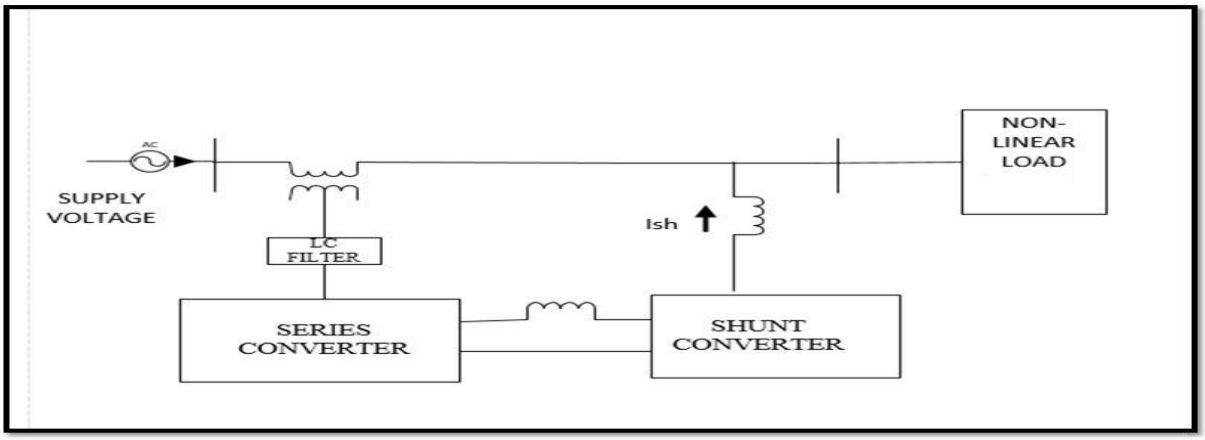

Figure 2.3 CSC based UPQC

3. SERIES CONTROL STRATEGY:

In the series filter pulse is generated by PWM technique in both VSC and CSC based UPQC. A series active filter acts as controlled voltage source by imposing high impedance for the harmonic currents, blocking their flow from both loads to source and source to load directions. The source voltage may contain zero, negative sequence as well as harmonic component, which need to be eliminated by series compensator. In order for the load voltage to perfectly sinusoidal and balanced, the series filter should produce a voltage that makes the load voltage sinusoidal. The reference load voltages are obtained by multiplying a PLL based unit vector templates with a constant equal to peak amplitude of fundamental input voltage. Now reference voltage are compared with the measured value and output is given to the PWM for series controller pulse generation.

4. SHUNT CONTROL STRATEGY:

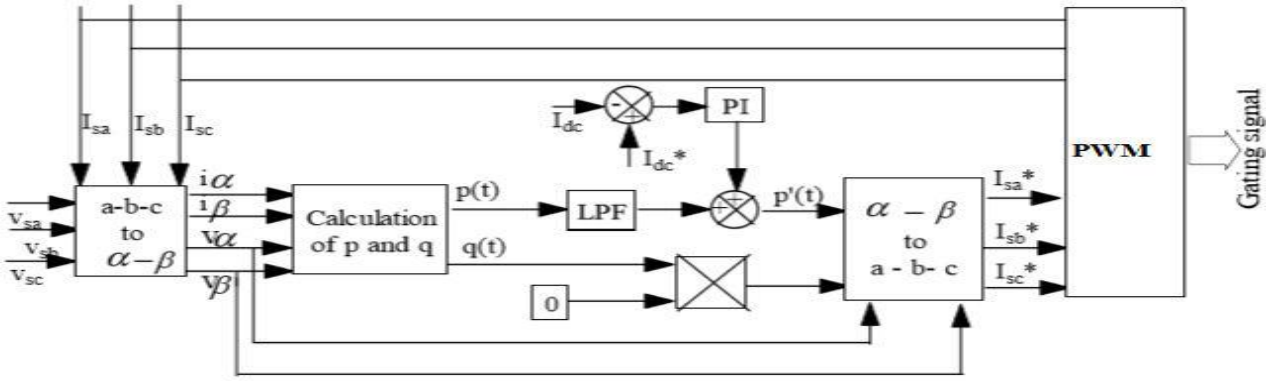

Figure 4.1 shunt controller

The main aim of the shunt active filter is to absorb current harmonics, compensate for reactive power and negative sequence current injected by the load. In addition, it control current/voltage of the DC link to desired value. In VSC based UPQC reference are multiply with the PI output to generate the signal for shunt active filter which compensate current harmonic and maintain the DC link voltage to desired value.

In case of CSC based UPQC, the dc link current is sensed and compared with reference dc link current. A PI controller then processes the error. The output signal from PI controller is regarded as switching power losses of shunt active filter, and is added to real power loss component to derive reference source current. These reference currents are then compared with actual source current and error given to PWM controller to derive the switching signals of shunt inverter. The schematic block diagram of shunt filter controller is shown in figure 4.1

5. SIMULATION AND RESULTS:

Supply	3 Phase 50Hz 415V
Nonlinear load	10+j7.85
Line resistance	.01
Line inductance	50µH

Table 5.1 System parameter

VSC		CSC	
DC link voltage	300V	DC link Current	100 amp
DC link capacitance	450µF	DC link inductance	450mH

Table 5.2 DC link parameter

5.1 VSC based UPQC Results

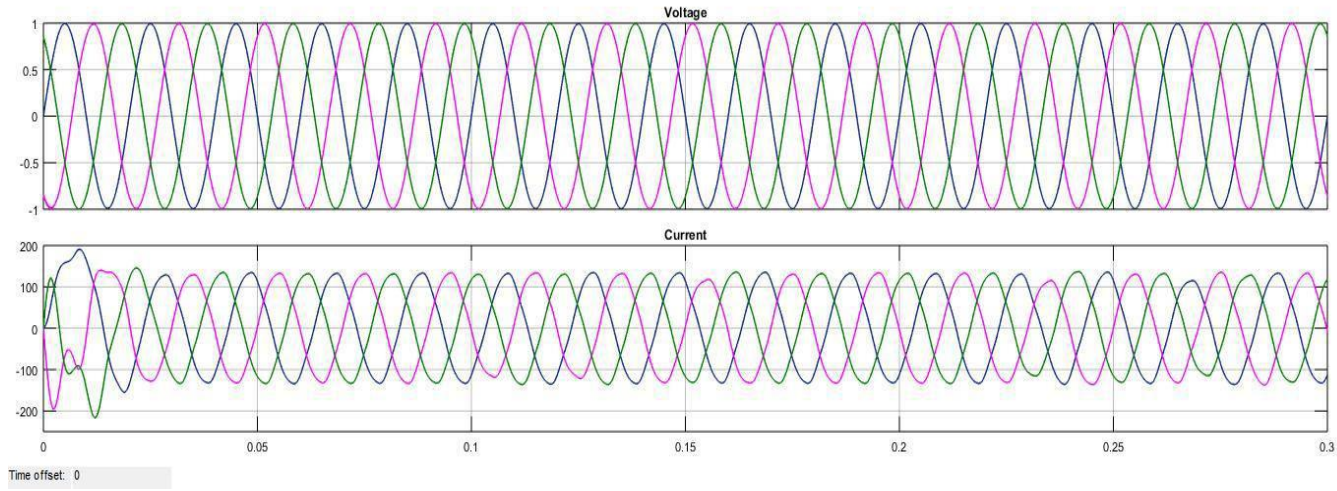

Figure 5.1 Supply side voltage and current

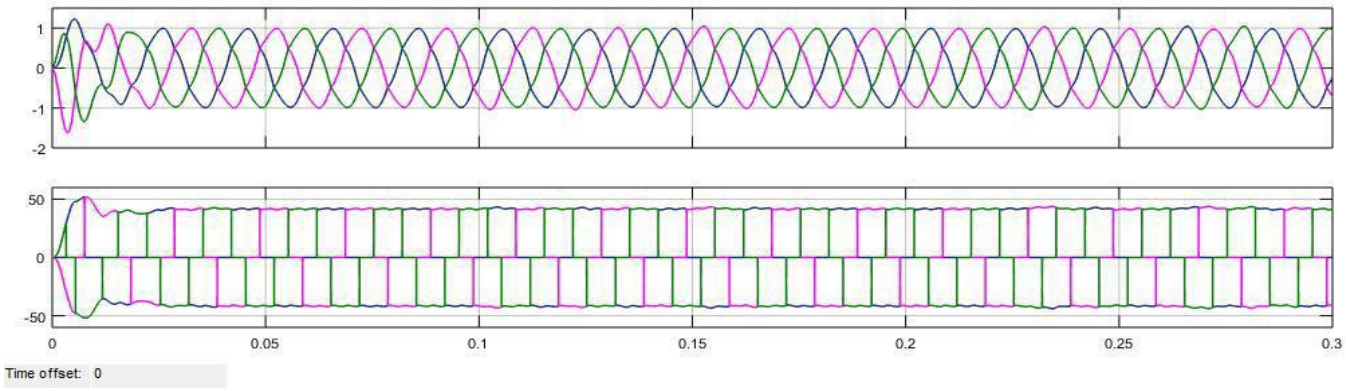

Figure 5.2 Load side voltage and current

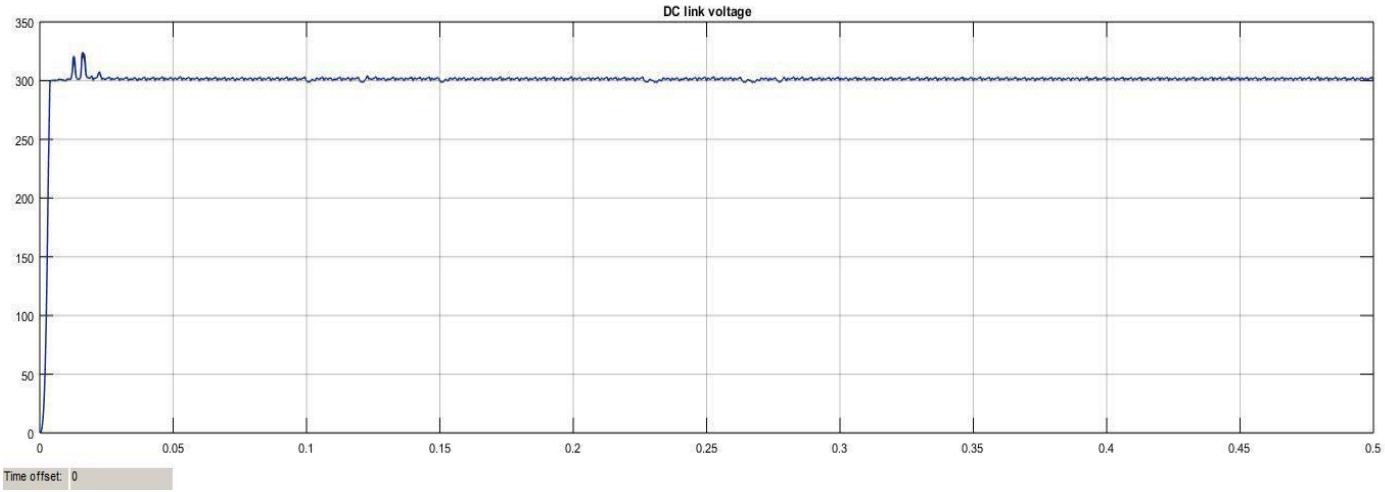

Figure 5.3 DC link voltage

Figure 5.1 shows the supply voltage and current waveform. At 0.02 sec supply current became sinusoidal and contain some harmonics. Figure 5.3 Shows the DC link voltage that are maintain to the rated value. THD analysis of the source current is done in VSC based UPQC. THD of the supply current reduced from the 28.78% to 2.64%. Figure 5.4 Show the THD of the supply current. VSC based UPQC effectively reduced harmonic from the source current under the nonlinear load condition.

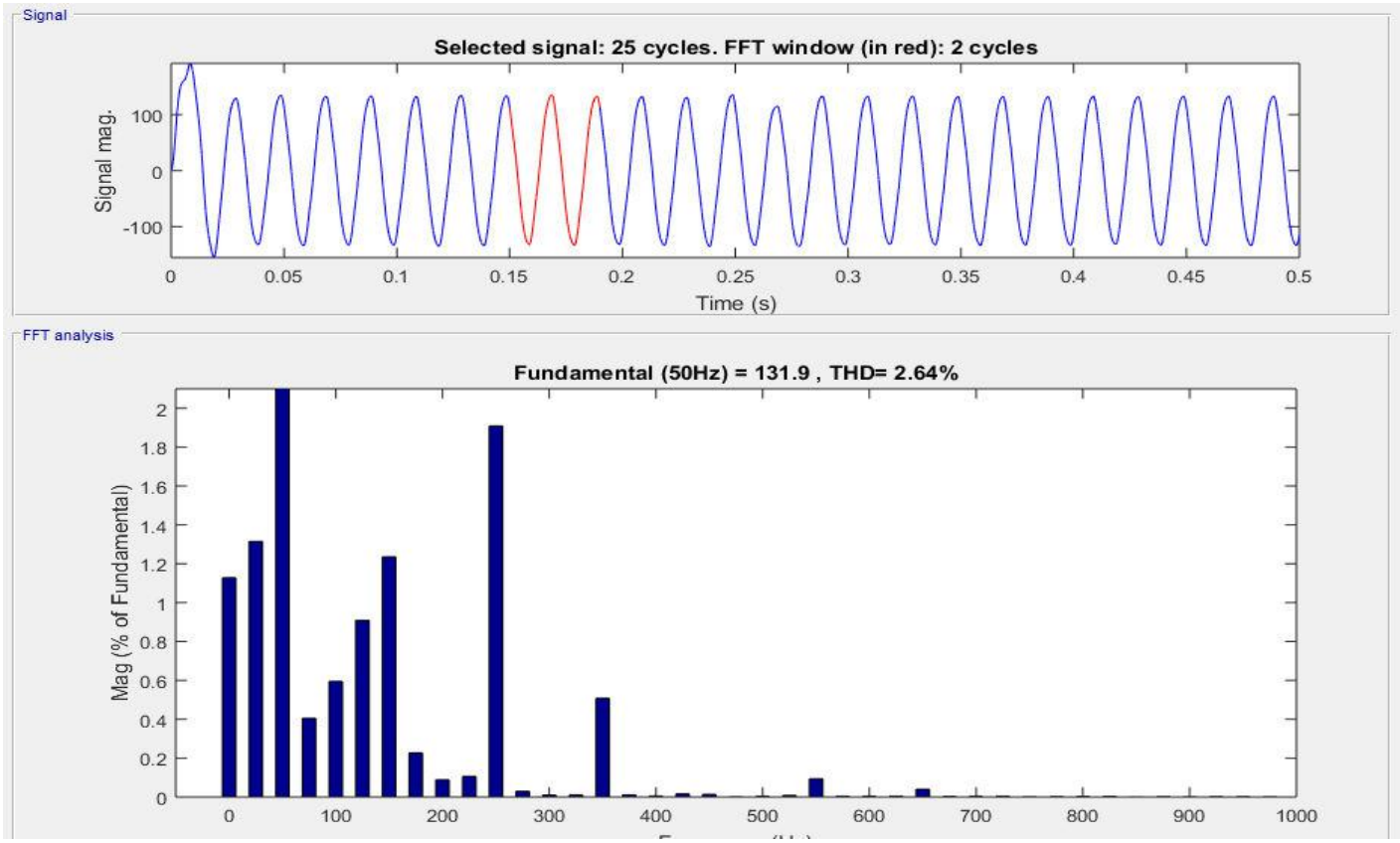

Figure 5.4 THD of Supply Current

5.2 CSC based UPQC Results

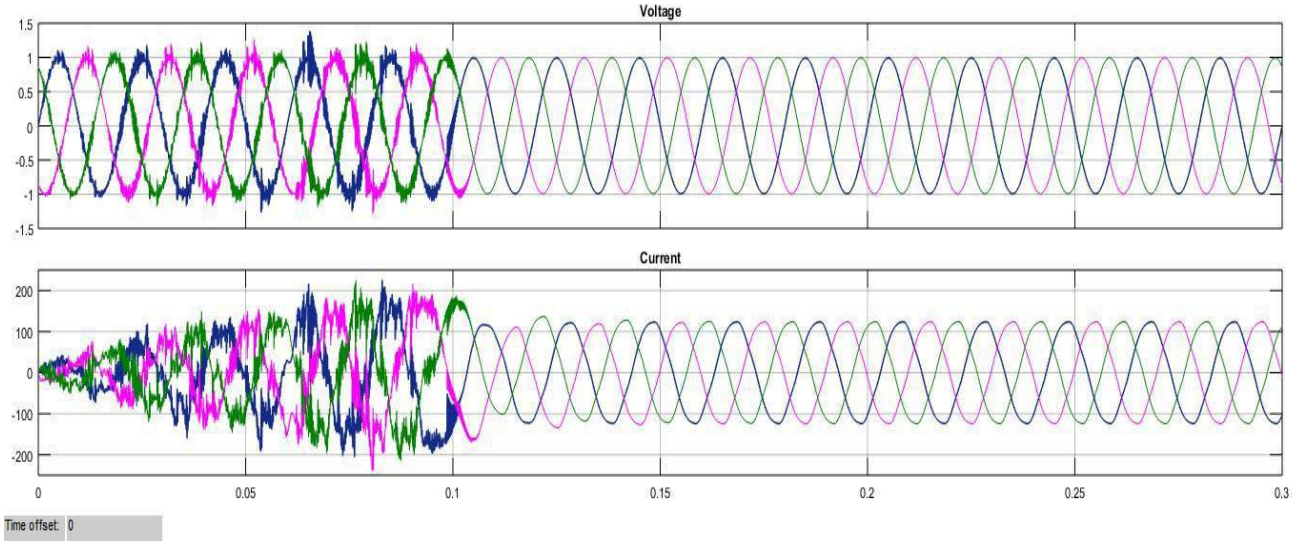

Figure 5.5 Supply voltage and current

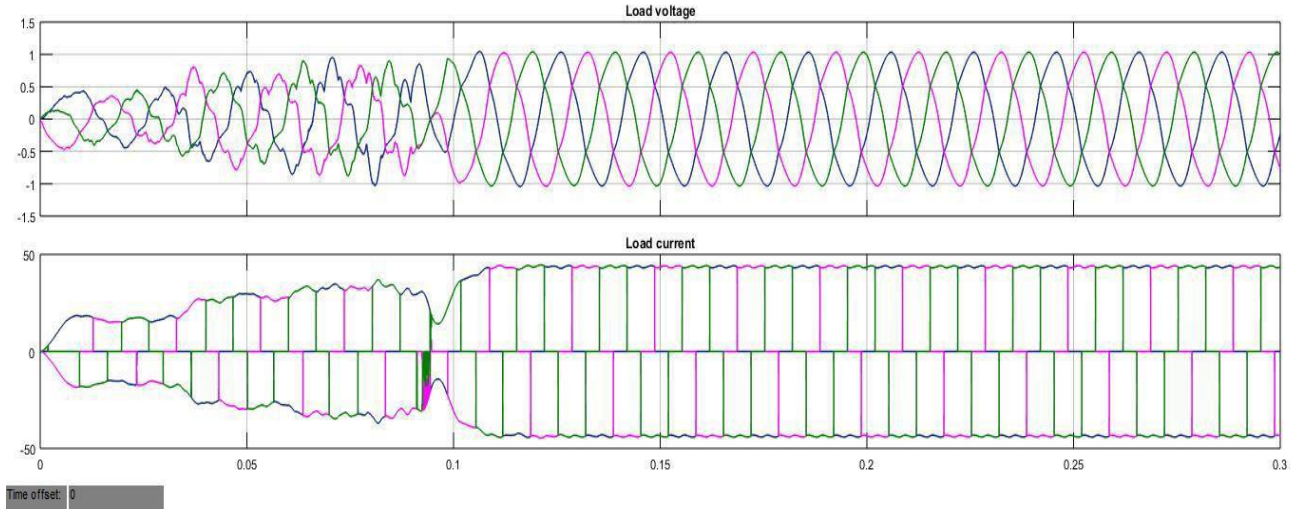

Figure 5.6 Load voltage and current

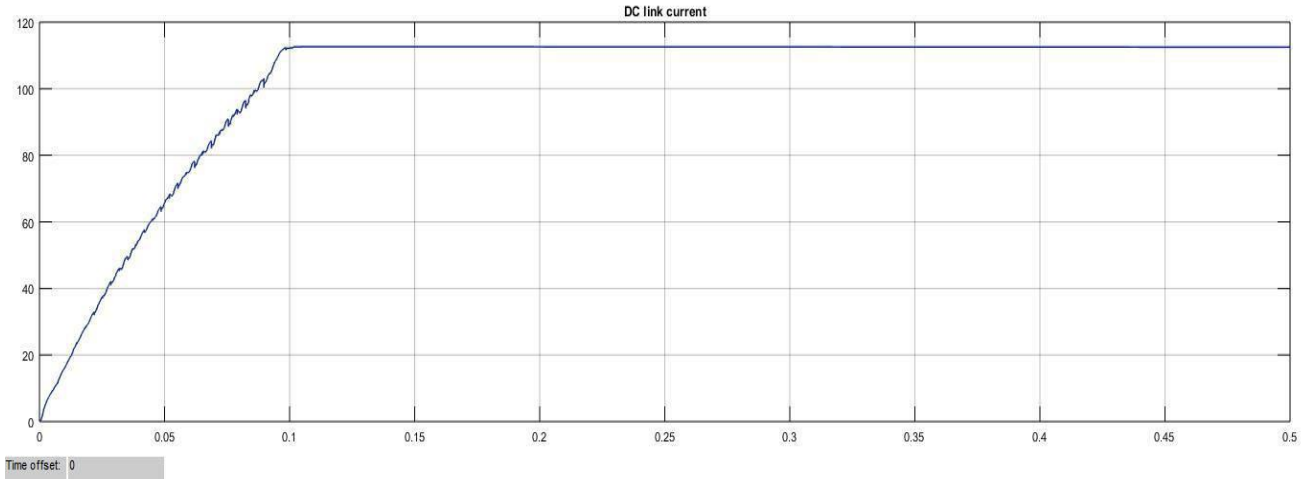

Figure 5.7 DC link current

Figure 5.5 shows the supply voltage and current waveform. At 0.1 sec supply current became sinusoidal and contain some harmonics. Figure 5.7 Shows the DC link current that are maintain to the rated value. THD analysis of the source current is done in CSC based UPQC. THD of the supply current reduced from the 28.78% to 2.37%. Figure 5.8 Show the THD of the supply current. CSC based UPQC effectively reduced harmonic from the source current under the nonlinear load condition.

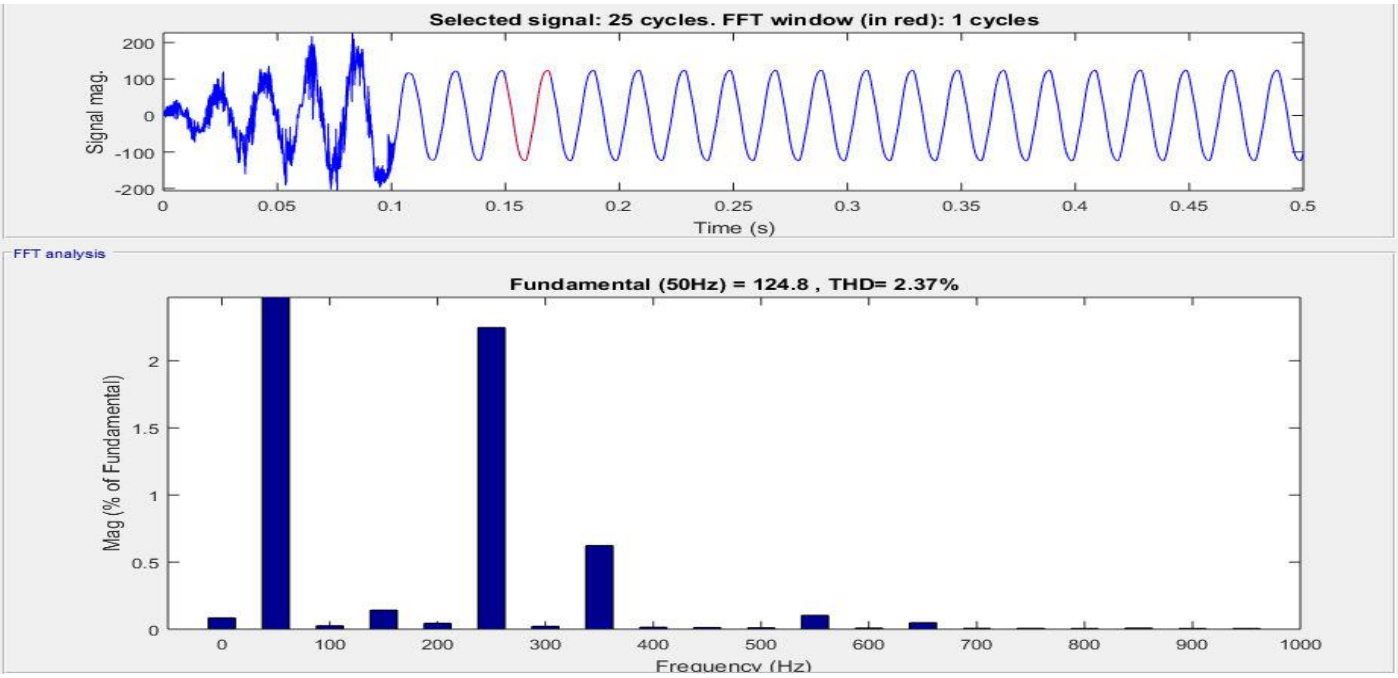

Figure 5.8 THD of supply current

6. CONCLUSION:

In recent days, the quality of power has become more important to the most of the customer load. The VSC and CSC based UPQC is the solution for the power quality related problem.in this paper simulation is done under the nonlinear load condition. VSC and CSC based UPQC effectively reduced the harmonic on the supply side current. CSC based UPQC has advantage of inbuilt short capability due to use of IGBT. But CSC based UPQC is not extended to multilevel. VSC based UPQC reduced the THD of supply side current from 28.78% to 2.64%. Hence, CSC based UPQC effectively enhance the power quality of the system. CSC based UPQC reduced the THD of supply side current from 28.78% to 2.37%. Hence, CSC based UPQC effectively enhance the power quality of the system. Hence CSC based UPQC more effectively reduced the harmonic then the VSC based UPQC.

7. REFERENCES:

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