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POWER QUALITY IMPROVEMENT BASED ON UNINTERRUPTIBL POWER SUPPLY (UPS) IN DISTRIBUTION SYSTEM

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ABSTRACT

This paper presents the reactive power compensation with novel idea in UPS. The most effective power quality improvement solution is analyzed an uninterruptible power supply systems. The conventional UPS has three stages i.e. rectifier converts AC to DC, Battery to store DC and Inverter to convert DC to AC. A novel technique has implemented in off-line UPS. The power is delivered to load via by-pass switch when main supply is available. Inverter does not operate during this period. So inverter function is same as conventional inverter. To overcome this problem, static change over switches has proposed. Hence it will get better voltage regulation and loss less in distribution system. The performance simulation result is analyzed using MATLAB/SIMULINK

Keywords - Inverter, Battery, Capacitor, Gate signal, Real power, Reactive power, Bypass switch.

I. INTRODUCTION

The significant challenge is in choosing the most effective power quality solution for a particular application. It is critically important to understand the characteristics of power disturbances. One of the most effective power quality improvement solutions to data center which has been Uninterruptible power supply systems. There are two main designs of UPSs: on-line and off-line. The on-line uninterruptible power supplies are more demand because it operates continuously to rectify the ac source voltage from the utility to dc and then inverter the dc voltage back to ac to serve the critical load. The off-line uninterruptible power supplies such as the pure wave UPS system operate in a standby mode. The utility source is directly connected to load Under normal conditions. There is no continuous rectification of the utility source. The off-line UPS operates only when the utility source deviates from specified values. So this case pure Wave UPS system supplies a clean sine wave to the load. The off-line UPS systems such as pure sine wave UPS system do not inherently provide transient protection to the critical load. Therefore it is required to install a transient voltage suppression system to protect the critical load from transients. The on-line and off-line UPSs are required transient voltage suppression system protection. Therefore there is little difference between the two technologies.

II. UNINTERRUPTIBLE POWER SUPPY

An uninterruptible power supply is an electrical device that provides emergency power to a load. When main power fails, the UPS will act as an auxiliary or emergency power system or standby generator. It will provide instantaneous protection from input power interruptions. The on-battery run time is an uninterruptible power source relatively short but sufficient to start a standby power source or properly shut down by the protective equipment. The primary role of any UPS is provided short-term power, when input source fails. The most UPS units are also capable in varying to correct common utility power problems [3] [4].

(a) Voltage spike

(b) Sustained overvoltage

(c) Sustained reduction in input voltage

(d) Noise

(e) Instability of the main frequency

(f) Harmonic distortion

The general categories of modern UPS systems are on-line. An on-line UPS is used a double conversion method of accepting AC input, rectifying to DC for passing through the rechargeable battery, then it is inverting back to AC forpowering the protected equipment. In the off-line system, the load is powered directly by the input power and the backup power is only used when the utility power fails.

III. OFF-LINE UNINTERRUPTIBLE POWER SUPPY

The off-line UPS is providing surge protection and battery backup. The protected equipment is normally connecteddirectly to incoming utility power. When the incoming voltage falls below or rises above a predetermined level, the standby UPS turns on its internal DC to AC inverter circuit. The standby UPS is the mechanical switches which is connected equipment on to its DC to AC inverter output. The switch over time can be as long as 25msec. it depends on the amount of time. It takes the standby UPS to detect the lost utility voltage[5] [6]. The general off-line is shown in figure 1

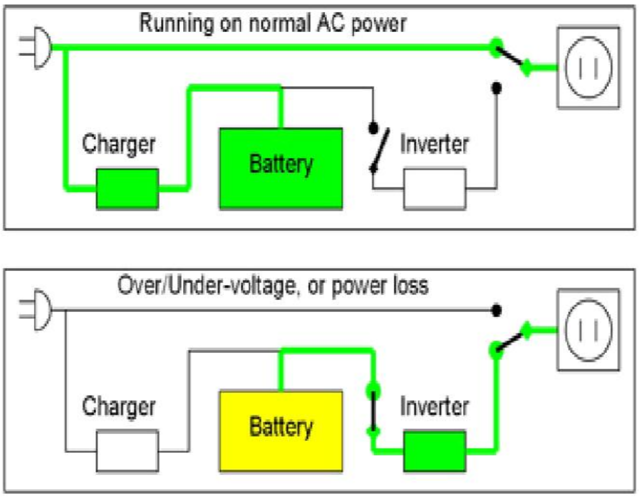

Figure 1. General off-line UPS system

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IV. ANALYSIS OF OFF-LINE UNINTERRUPTIBLE POWER SUPPY

The off-line UPS is classified following blocks i.e (a) rectifier(b) battery (c) inverter (d) bypass switch. In the rectifier is depending on the number of phases. It is either single or three phase rectifier. The battery is stored the DC power from rectifier. The power stored in the battery serves as energy source during power failure to feed load. The DC voltage of battery is converted to AC by the inverter. It comprises six switches which are switched with PWM firing pulses to produce close to sinusoidal output [7] [8]. The off-line UPS, the power is fed to the load from mains through the bypass switch. The switch may either be electromagnetic relay or static switch. The switch is in closed position during mains availability and opens during mains failure.

A. Existing off-line UPS system

The existing off-line UPS system is employed the bypass switch. It is fed power during mains availability. The inverter is idle in this condition. So inverter feeds load during power failure as shown in figure2.

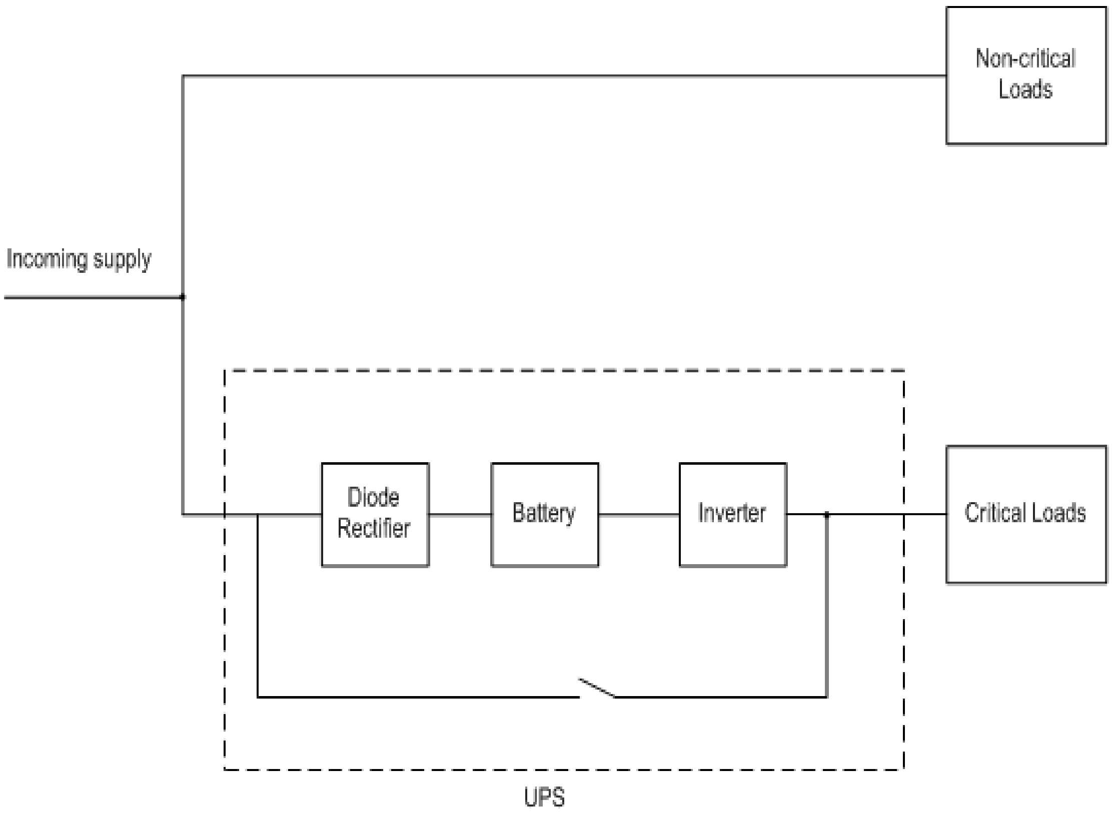

Figure 2. Existing model of off-line UPS system

V. PROPOSED OF OFF-LENE UNINTERRUPTIBLE POWER SUPPY

The proposed off-line UPS system is the inverter functions as power factor corrections unit during mains availability. The conventional inverter is used during power failure as shown in figure 3.

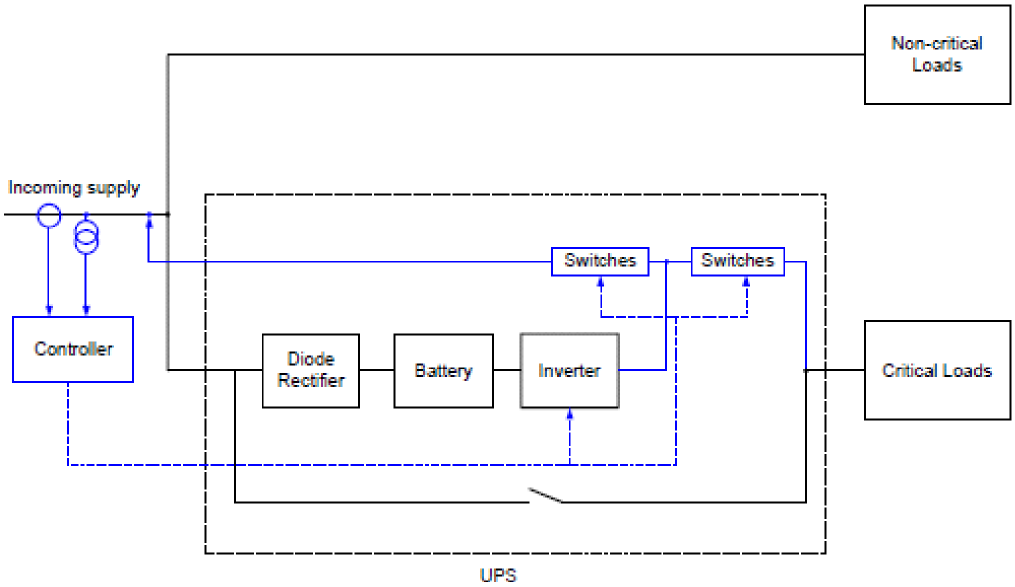

Figure 3. Proposed model off-line UPS system

A. Operation during mains availability in the system

When the bypass switch is feeding power to load, the inverter is correcting line power factor with current and voltage inputs of the line as shown in figure4

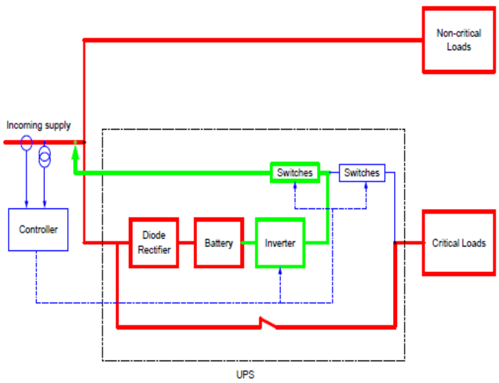

Figure 4. Operation during mains availability in the sysem

B. Operation during mains failure in the system

When the bypass switch is opened, the inverter will be restored and to feed power to critical loads. The change over function is achieved by switches as shown in figure5.

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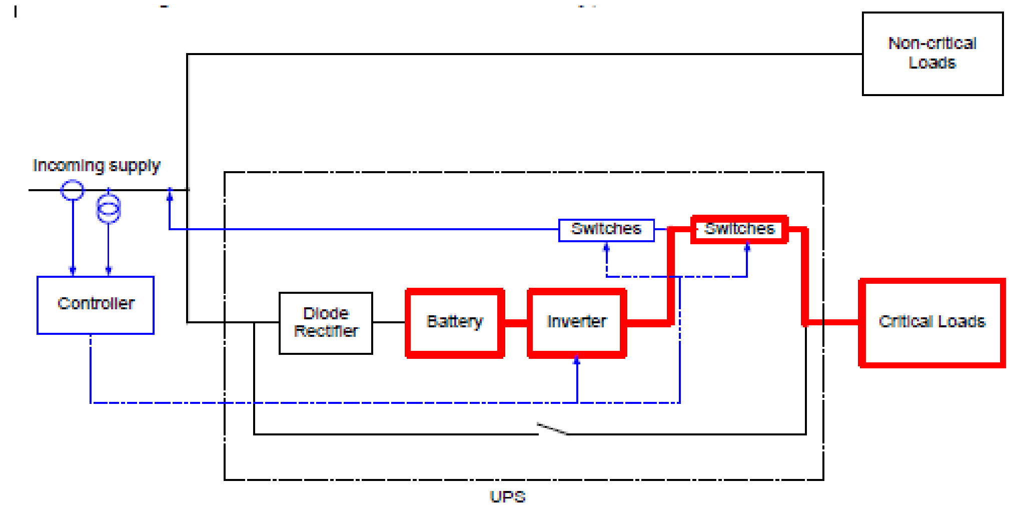

Figure 5. Operation during mains failure in the system

VI. SIMULATION RESULTS

The objective of the simulation is modeled a system with lagging power factor load (asynchronous motor) and fixed compensation system (capacitor bank). The results are used to proceed the next milestone i.e VAR measurement and harmonic elimination.

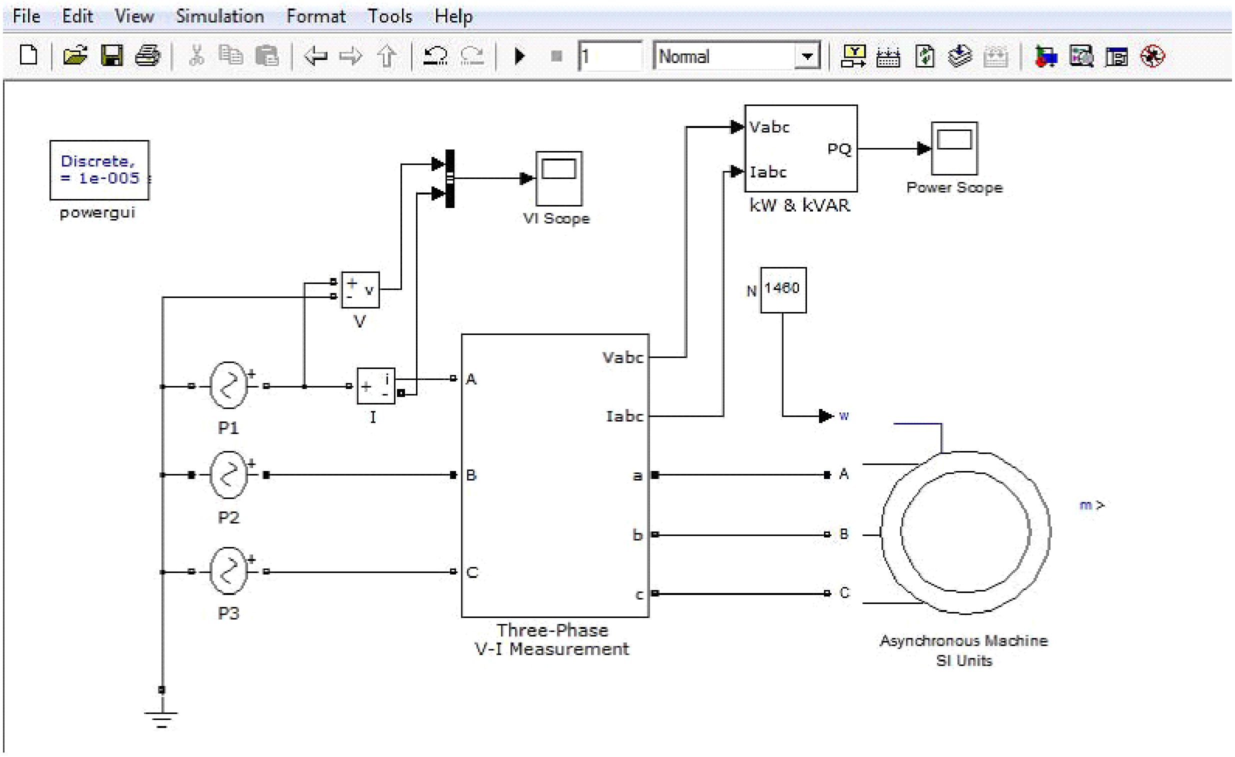

Figure 6. model for lagging power factor load without compensation

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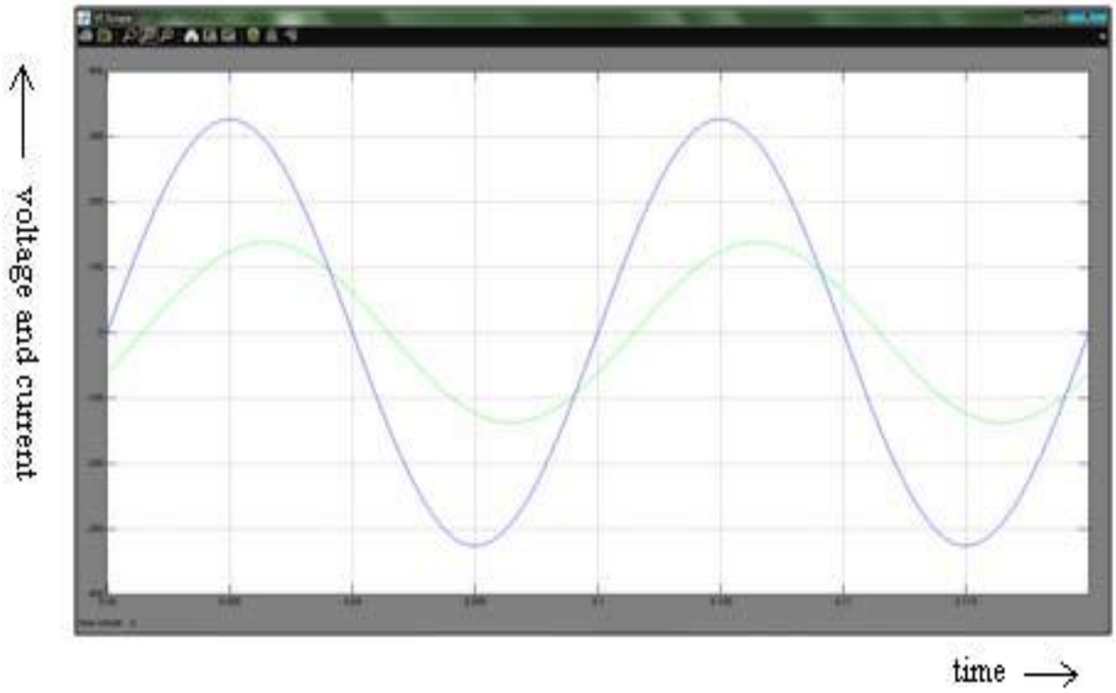

Figure 7. voltage and current wave form without compensation

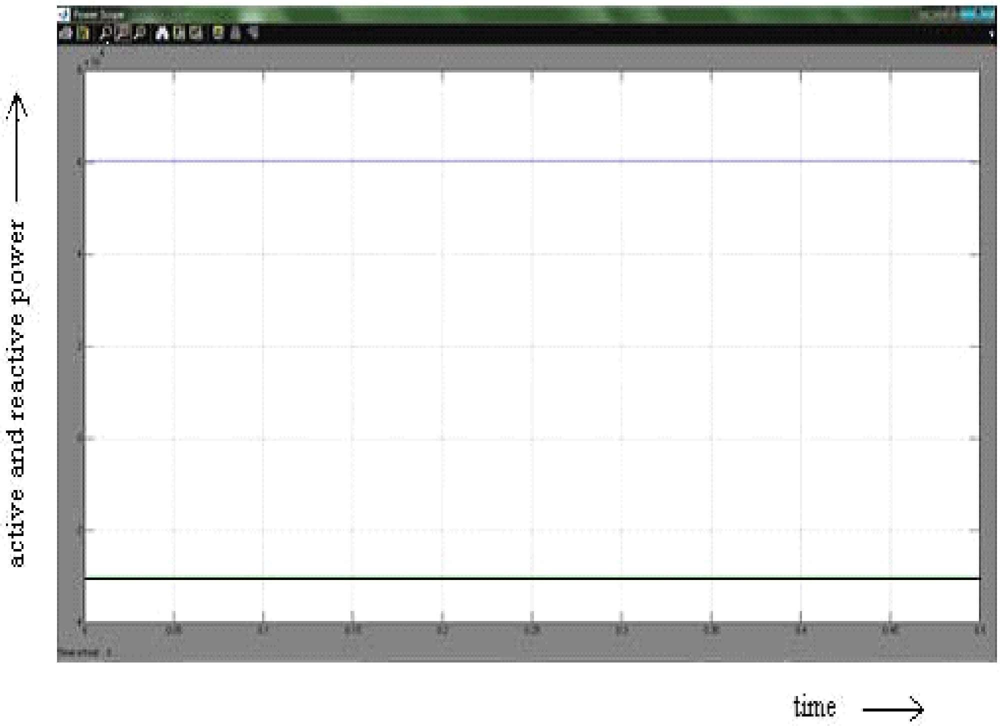

Figure 8. active and reactive power wave forms without compensation

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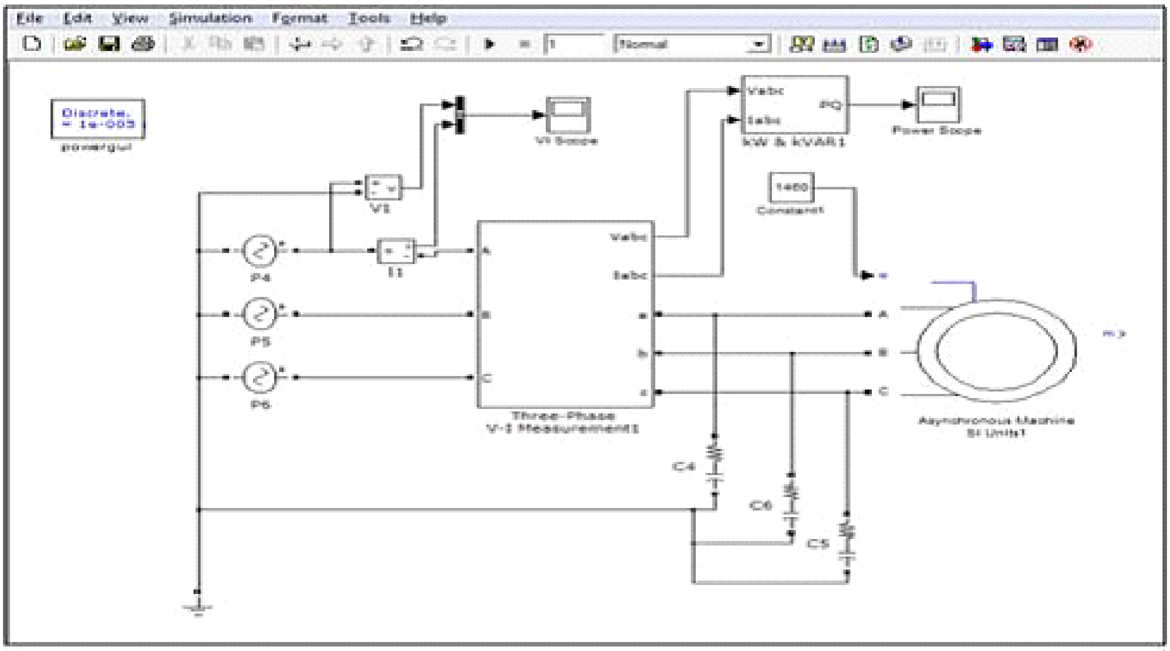

Figure 9. model for lagging power factor with fixed compensation

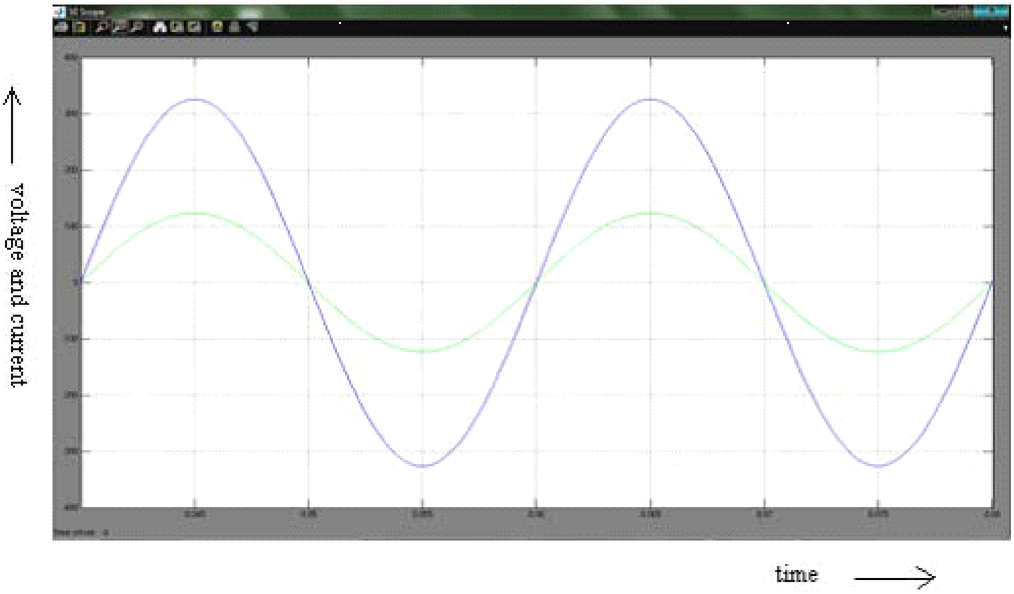

Figure 10. voltage and current wave form with fixed compensation

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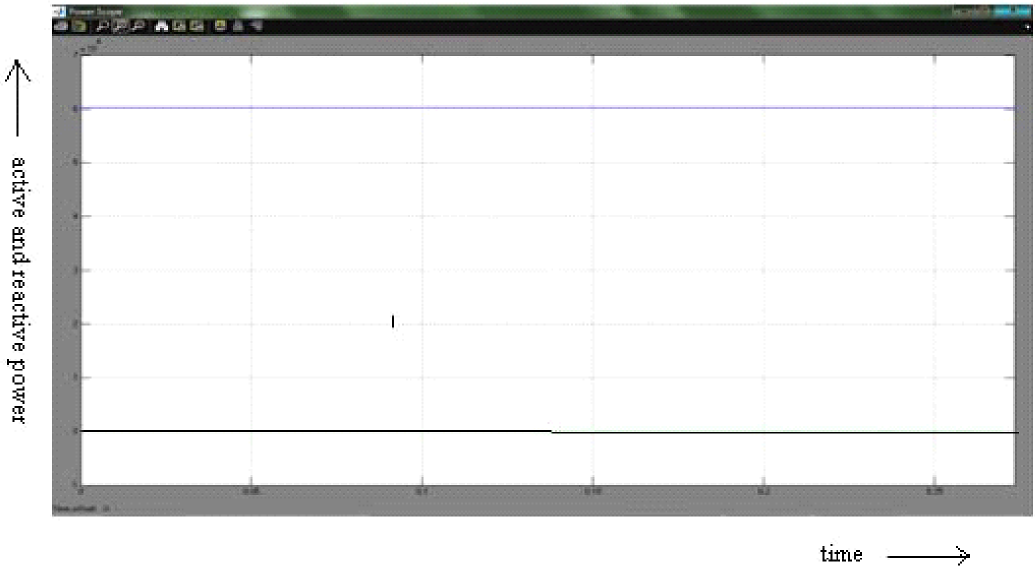

Figure 11. active and reactive power with fixed compensation

Generally 60 hertz or 50 hertz, the voltage waveform can be disturbed by the presence of higher frequencies. The power electronics equipment operates best when the total harmonic distortion (THD) of the source voltage is less than 5% and no single harmonics exceeds 3% of the total voltage. The on-line UPSs create voltage harmonics in the output due to the characteristics of the inverter. But in the linear load, the online UPS systems have THD of 5% of the output voltage. The THD is higher for non-linear loads. The on-line UPSs have typically generated more harmonics. But the off-line UPS systems generate fewer harmonic in majority times. The critical load is served by the utility source with low harmonic content as shown in figures below.

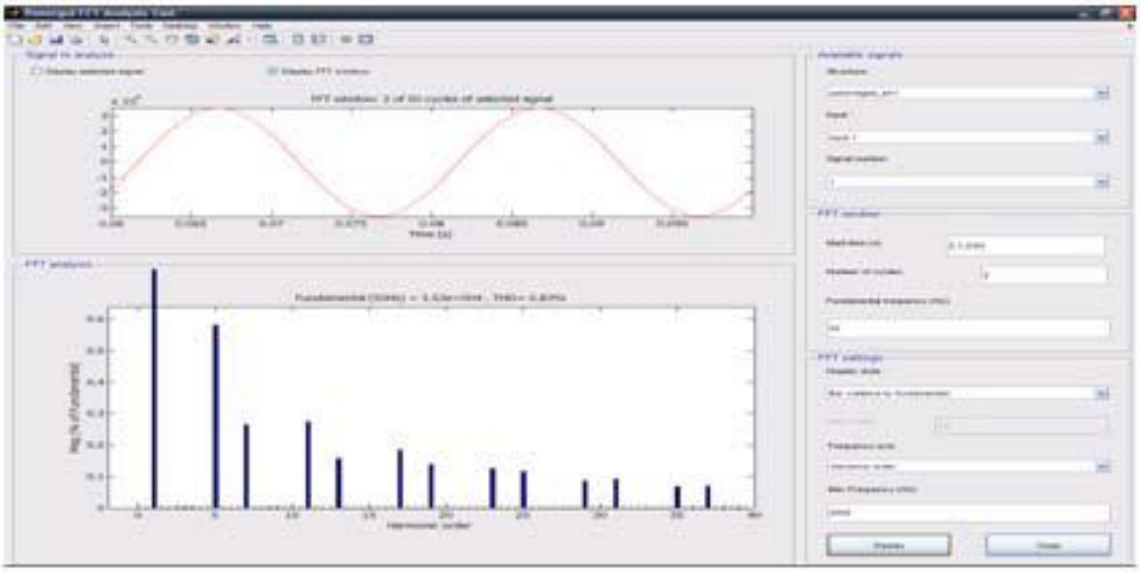

Figure 12. Generation of harmonic in input voltage

Figure 13. Generation of harmonic in inverter output

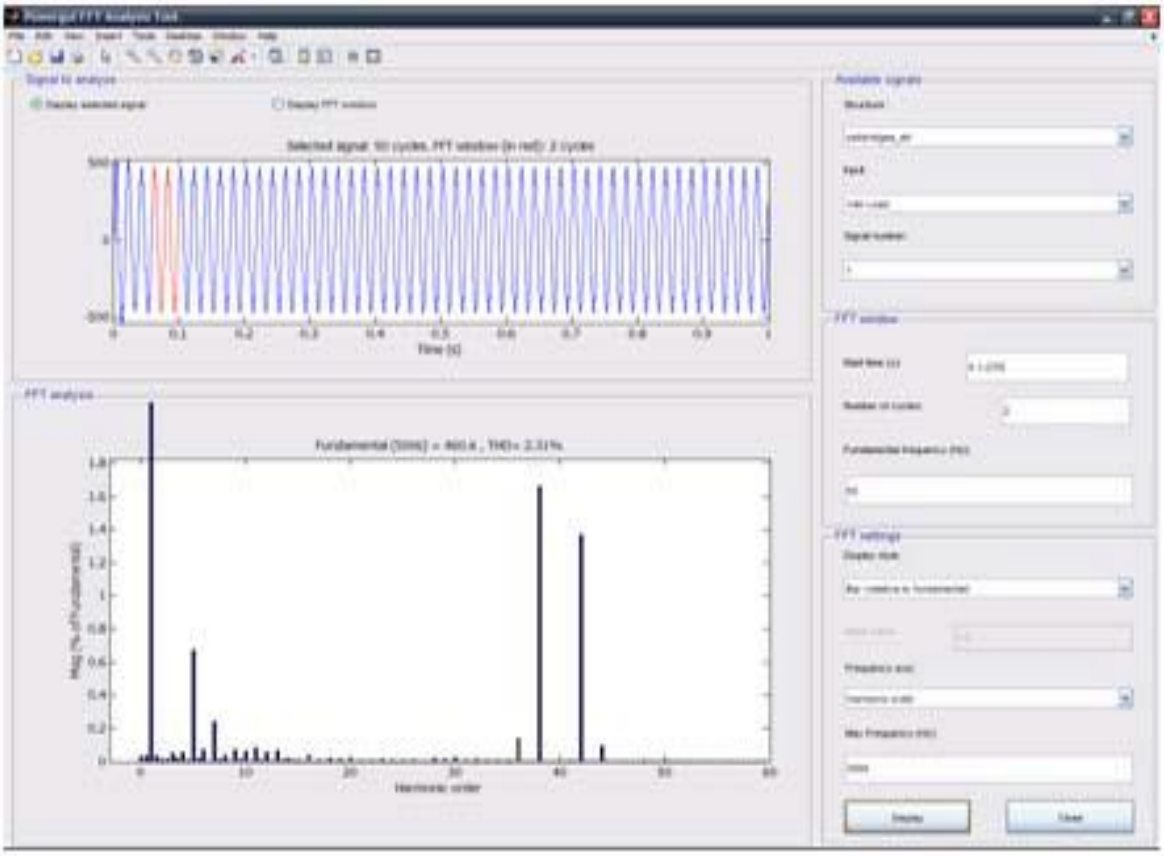

Figure 14. generation of harmonic in load side

TABLE I. COMPARISON OF PERCENTAGE HARMONICS

Harmonic in input voltage	Harmonic in inverter output voltage	Harmonic in load voltage
0.83%	66.62%	2.31%

VII. CONCLUSION

In this paper, a proposed off-line UPS is presented using computer loads. It is analyzed harmonic mitigation input voltage, output voltage in inverter and load side voltage. There active power compensation and battery charging are achieved in different mode of operation using PQ theory. So an uninterrupted and reliable power supply system has provided in the off-line UPS mode using feedback system to regulate the output voltage and provided a pure sinusoidal line current and lower loss in distribution system. The further work can be carried out variable compensation with based VAR compensation in the system.

APPENNDIX

Simulation	values
Lagging power factor load with fixed compensation	Power supply: 200V, 50Hz Load: Induction motor, 200V, 40kW
Gate pulse generation	Power supply: 250V, 50Hz V_{ref1} = 0.9; V_{out}=230V V_{ref2}=0.7 ; V_{out}=200V
Reactive power compensation with inverter and capacitor bank	Power supply: 25kV, 50Hz Transformer: 25kV/400V, 50kVA Capacitor: 5000micro Farad Load: 400V,50kW, 10kVAR

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