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PERFORMANCE ANALYSIS OF SOLAR PV/WIND AND BATTERY ENERGY STORAGE SYSTEM INTEGRATED UPQC

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Abstract – *In this paper renewable energy like solar PV/ wind and battery energy storage system integrated with unified power quality conditioner is designed and its performance analysis are evaluated. The proposed system consists of a shunt and series voltage compensators connected back to back with common DC-link to improve the power quality. The power quality problems arises in the grid side such as voltage sag and swells can be reduced by Series compensator and the problem of current harmonics due to nonlinear load can be reduced by Shunt compensator. The model of unified power quality conditioner is developed and simulated using software MATLAB/ Simlink.*

Key Words: Power Quality, Shunt Compensator, Series Compensator, UPQC, Solar PV, MPPT

1. INTRODUCTION

Power systems equipments are designed to work in non-polluted environment in order to maintain voltage and frequency constant but power quality problem can be raised due to the mal function of equipments connected in the power system. In order to improve power qualities issues, the equipments must be operated with low harmonics and neutral currents. The power quality problem can be achieved by PV-array adding battery energy management system called power conditioners. The power conditioners having both shunt and series compensator connected back to back by a dc-link is called the unified power quality conditioner (UPQC). The power quality issues can be controlled by UPQC in addition with renewable energy resource solar PV/wind. Using shunt and series compensators, voltage sag, swell, current harmonics and active power injection to grid can be controlled with the help of UPQC. PV energy storage problem issues can be addressed by using distributed generating. In future of power systems distributed generating play a vital need to connected DGs to grid using power electronic converters.

2. PROPOSED UPQC CONFIGURATION

Figure 1 shows the construction of solar PV/wind-battery energy management system unified power quality conditioner system configuration. The three-phase solar PV/wind-battery energy management system unified power quality system conditioner model consists of series compensator, shunt compensator and DC link capacitor. The battery is connected to boost DC-DC converter and the PV array is connected to buck boost DC-DC converter and are connected in parallel with the DC link. The three phase non-linear load is connected in the output in order to verify the system performance.

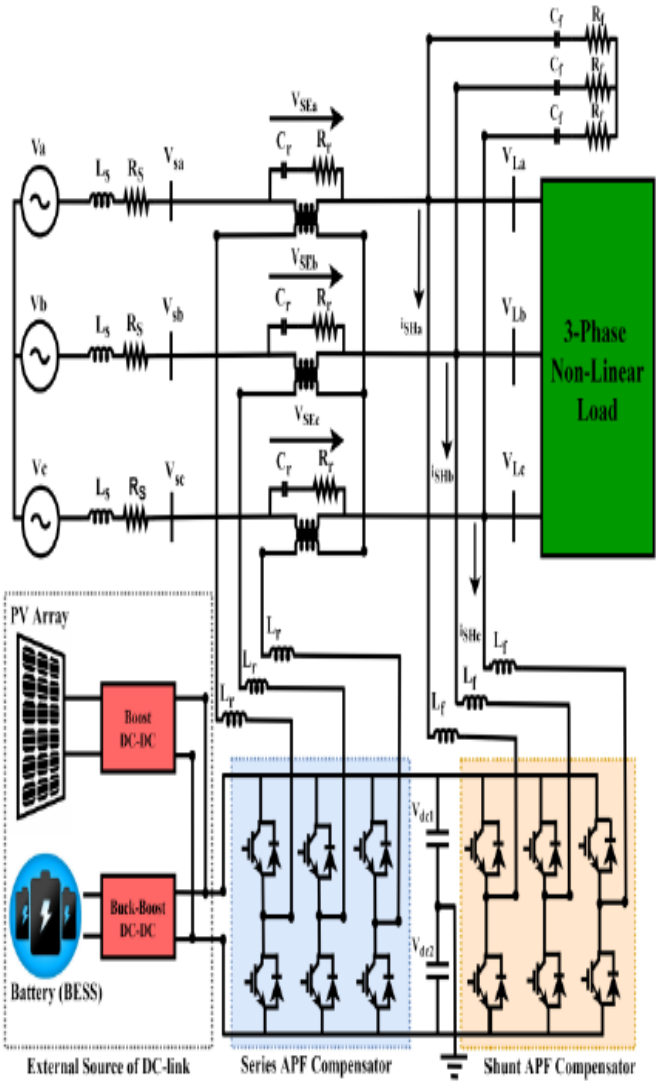

Figure 1 UPQC system configuration

Series compensator act as voltage source stands between source and coupling point whereas shunt compensator act as current source and is connected to point of common coupling (PCC). The power quality problems arises in the grid side such as voltage sag and swells can be reduced by Series compensator and the problem of current harmonics due to nonlinear load can be reduced by Shunt compensator. Harmonics generated due to switching action of converters can be eliminated by ripple filter. The maximum power extracts at its maximum power point from the solar PV array by shunt compensator. By maximum power point tracking (MPPT) algorithm the reference voltage for the DC link of UPQC is generated.

3. SIMULATION AND DISCUSSION

A solar PV/ wind and battery energy storage system integrated with unified power quality conditioner system is simulated using MATLAB/SIMULINK software as shown in figure 2.

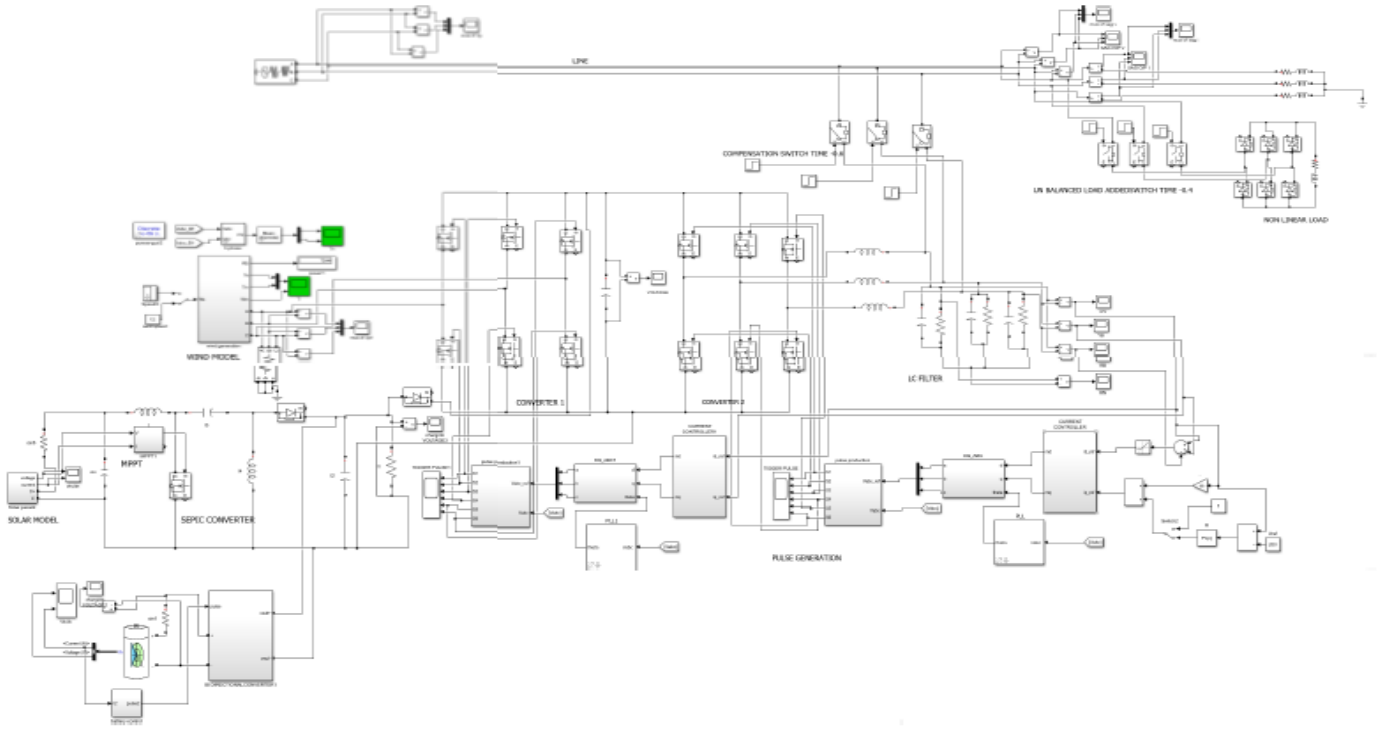

Figure 2 Simulation Diagram of UPQC with solar PV/wind and BES

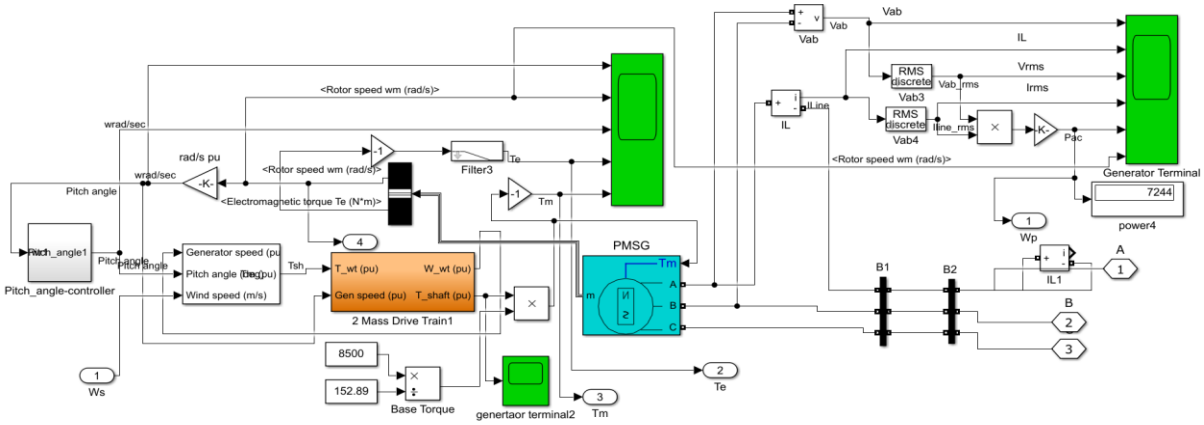

Figure 3 Wind generation system

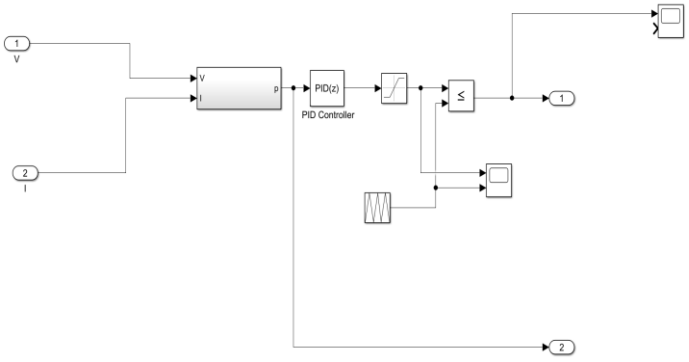

Figure 4 MPPT Controller

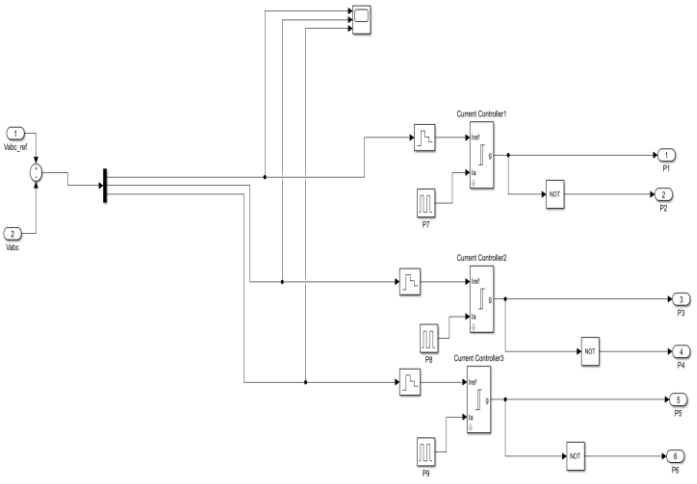

Figure 5 Pulse production circuit

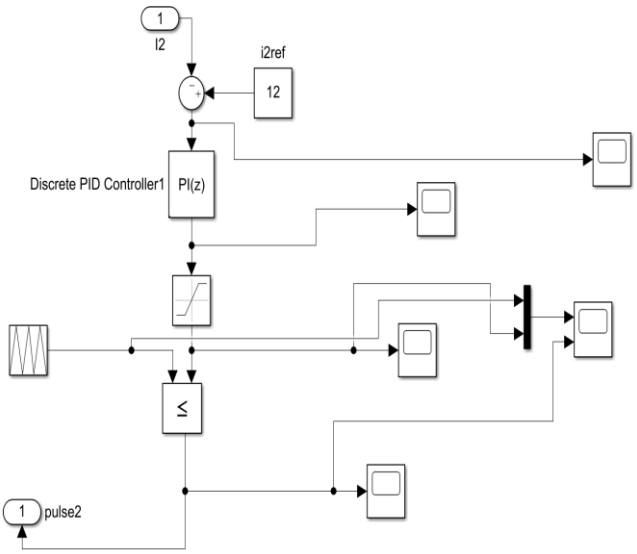

Figure 6 Battery Control

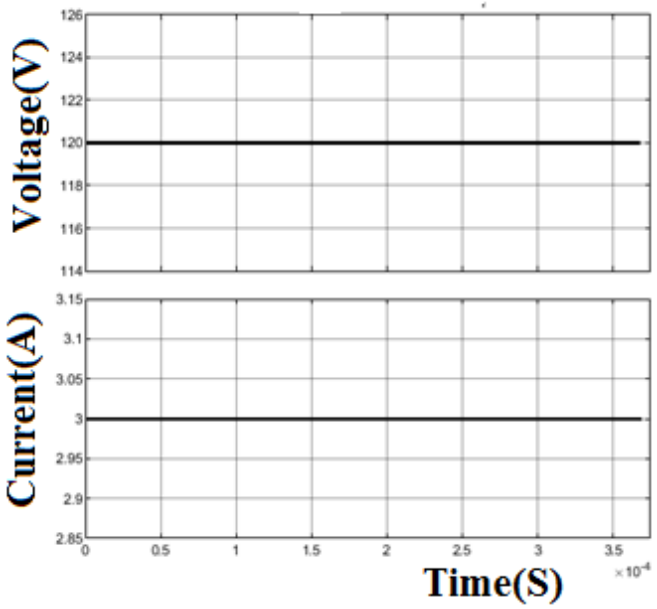

Figure 7 Solar input voltage and current

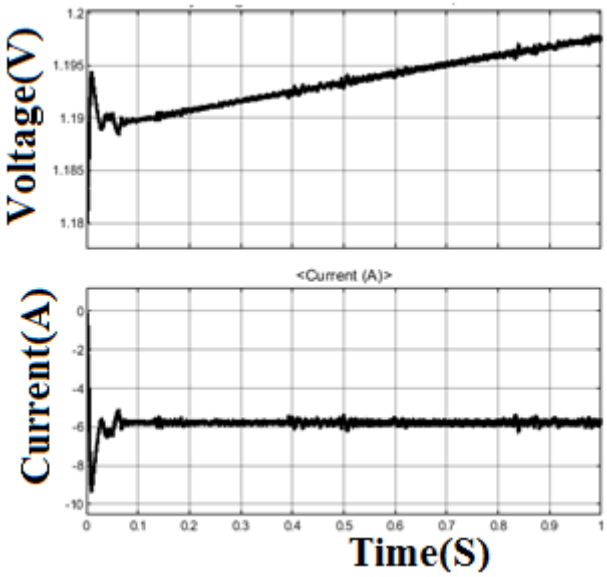

Figure 8 Battery voltage and current

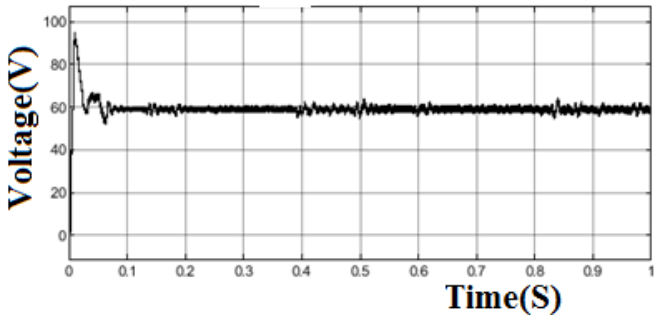

Figure 9 Battery charging voltage

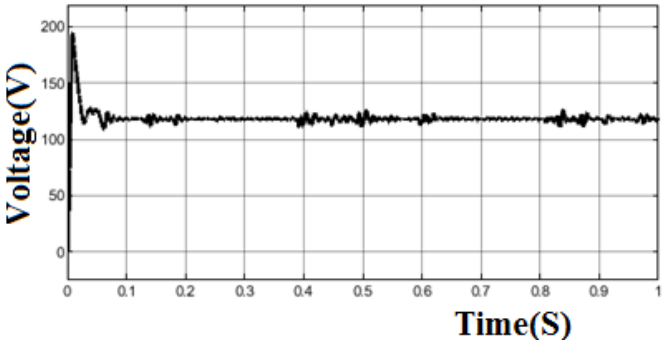

Figure 10 Converter input voltage

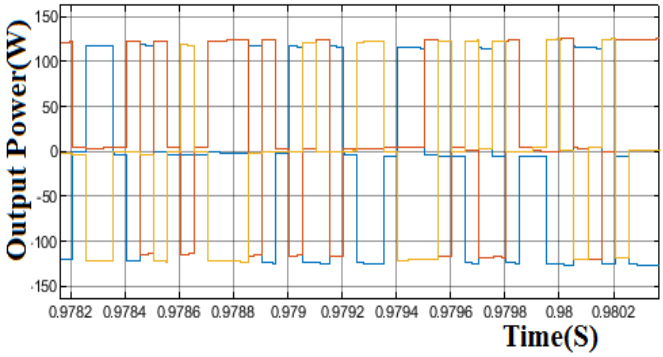

Figure 11 Wind power output

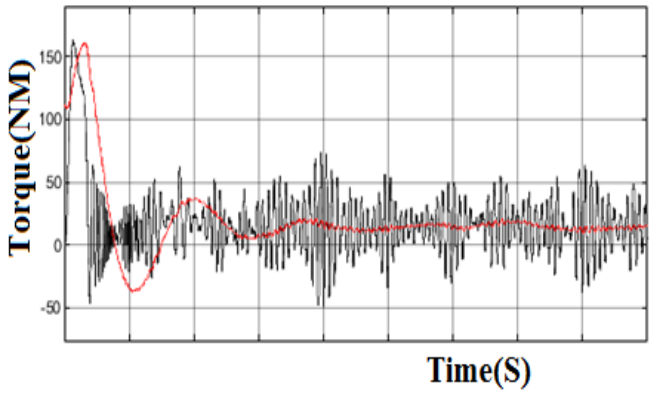

Figure 12 Wind Torque

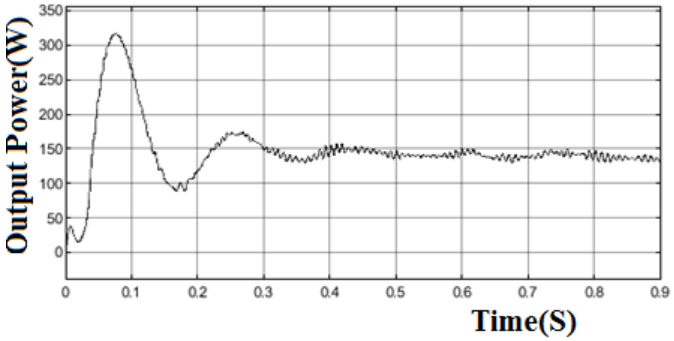

Figure 13 Wind power output (Mechnical)

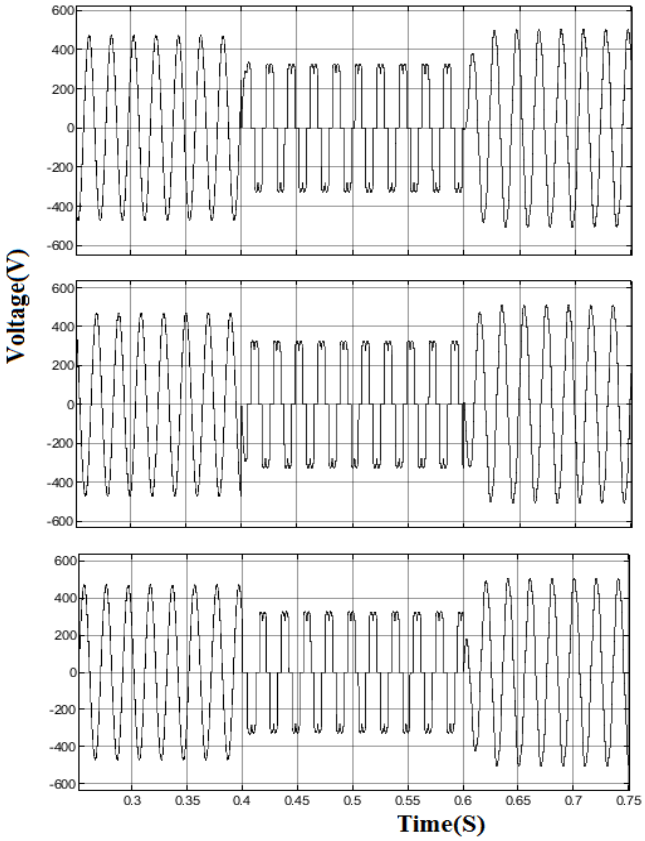

Figure 14 output Sag voltage

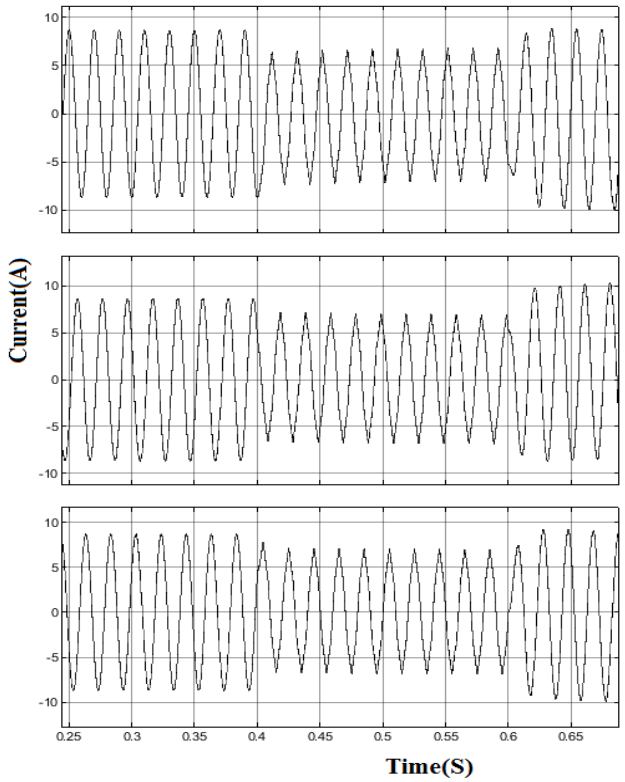

Figure 15 output Sag current

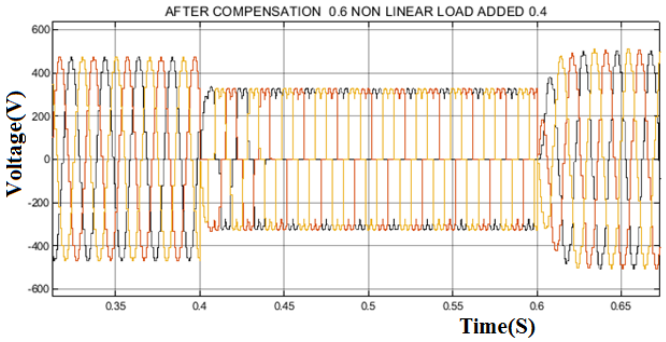

Figure 16 Three phase Sag voltage after Compensation

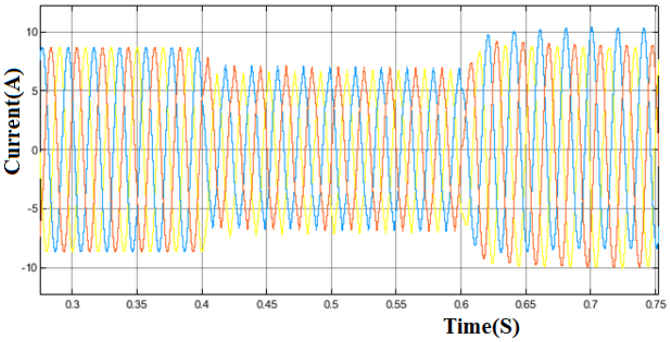

Figure 17 Three phase Sag Current after Compensation

4. CONCLUSION

In this paper renewable energy like solar PV/ wind and battery energy storage system integrated with unified power quality conditioner was designed and its performance analysis was evaluated. The model of unified power quality conditioner is developed and simulated using software MATLAB/ Simlink. The power quality problems arises in the grid side such as voltage sag and swells can be reduced by Series compensator and the problem of current harmonics due to nonlinear load can be reduced by Shunt compensator. Result of voltage, current and power is observed with UPQC is connected to the nonlinear load.

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BIOGRAPHIES

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