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A Simplified Control Technique for a Dual Unified Power Quality Conditioner

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Abstract: In this project PWM Control Technique for migration of voltage dips using Interline Unified power Quality Conditioner. In these control technique we are using two active filters, a series active filter and a shunt active filter (parallel active filter), to control the sinusoidal reference with a source of both voltage and current and also to eliminate the harmonics and unbalance. In IUPQC series active filter (SAF) works as a current source due to this high impedance occurs which is indirectly compensate the harmonics and disturbances of the grid voltage and the load voltage. In IUPQC parallel active filter (PAF) works as a voltage source due to these low impedance occurs which is indirectly compensate the harmonics of grid current and also providing a low impedance path for the harmonic load current. It presents a dual three-phase topology of unified power quality conditioner (UPQC) composed of two filters, a series active filter and a parallel active filter, aimed to compensate both, the current and voltage, harmonics and unbalance. The increasing competition in the market and the declining profits has made it pertinent for the industries to realize the significance of high-power quality. This project tends look at the solving the problems by using custom power devices by Dual Unified Power Quality Conditioner (IUPQC). In IUPQC there is no need of coordinate transformation this reduces the complex calculation. This work describes the techniques of correcting the power quality problems in the distributed system. The proposed system can able to compensate the nonlinear load condition and also ensure the sinusoidal voltage for the load in all three phases. In this project, the proposed IUPQC simulation design control, power flow analysis, and using MATLAB Simulation technique.

Keywords: Active Filters, Control Design, Power Line Conditioning, Unified Power Quality Conditioner (UPQC).

I. INTRODUCTION

The current drained by nonlinear loads has a high harmonic content, distorting the voltage at the utility grid with consequently affecting the operation of critical loads. By use a unified power quality conditioner (UPQC), it is likely to ensure a regulated voltage for the loads, reasonable as well as with low harmonic distortion also at the identical time draining undistorted currents from the utility grid, still if the grid voltages along with the load current have harmonic contents. The UPQC consists of two active filters, the series active filter (SAF) with the shunt otherwise parallel active filter (PAF). The PAF is generally controlled as a non sinusoidal current source, which is dependable for compensating the harmonic current of the load, though the SAF is controlled as a non sinusoidal voltage source, which is responsible for compensating the grid voltage. Together of them have a control reference with harmonic contents, with usually; these references might be obtained during complex methods. Some works illustrate a control technique to both shunts with SAFs which uses sinusoidal references exclusive of the need of harmonic extraction, in order to reduce the difficulty of the reference generation of the UPQC. An interesting alternative for power quality conditioners was projected in as well as was called line voltage regulator/conditioner.

This conditioner consists of two single-phase current source inverters where the SAF is controlled by a current loop with the PAF is controlled by a voltage loop. In this way, both grid current along with load voltage are sinusoidal, also therefore, their references are as well sinusoidal. Some authors have applied this concept, using voltage source inverters in uninterruptable power supplies as well as in UPQC. In this concept is called “dual topology of unified power quality conditioner” (IUPQC), with the control schemes use the p−q theory, requiring determination in real time of the positive sequence components of the voltages along with the currents. The aim of this project is to suggest a simplified control technique for a dual three-phase topology of a unified power quality conditioner (IUPQC) to be used in the utility grid connection. The proposed control scheme is developed in ABC reference frame along with allows the use of classical control theory not including the need for coordinate transformers along with digital control implementation. The references to both SAF as well as PAFs are sinusoidal, dispensing the harmonic extraction of the grid current along with load voltage.

II. POWER QUALITY

Our technological field had became totally depend upon the continual obtain ability of electrical power. In most areas economical power is made accessible via nationwide grids, number of generating stations connecting to each other to the loads.The grid should deliver basic countrywide requirements of lighting, air conditioning, heating, residential, refrigeration and shipping in addition to the considerable deliver to commercial, governmental, medicinal, fiscal, engineering, and communities of communications. Economical power authentically permits today's modern world to operate at its busy grid. Many power conundrums come in the economical power grid, which with its thousands of kilometers of transmission lines is subjected to climatic conditions such as snowfall, ice, hurricanes, lightning storms, and flooding along with apparatus failure, chief switching operations and traffic accident. Also power conundrums damaged today's technological apparatus are often bring about locally within a expertise from any number of conditions such as faulty distribution apparatus, intense start-up loads, confined construction and even typical back-ground electrical noise. Mainly the seven types of Power Quality problems are there. They are

- Transients.
- Interruptions.
- Voltage Sag.
- Voltage Swell.
- Waveform distortion.
- Voltage fluctuations.
- Frequency variations.

A. Transients

Potentially the most disturbing type of power disruptions transients fall into two subclasses:

- Impulsive.
- Oscillatory.

Impulsive: Impulsive transients are abrupt high peak contingency that increases the current and/or voltage levels in any direction of a positive or negative direction. These kinds of contingencies can be categorized further by the quick at which they happens (slow, medium and fast). Impulsive transients can be very quick contingencies. One instance of a transient of positive impulsive originated by Electrostatic discharge (ESD) experience is demonstrated in Fig.1.

Oscillatory: An oscillatory transient is a quick alteration in the condition of a steady-state of a signal's voltage, current or both at the negative and positive signal boundaries swinging at the expected frequency of system. In plain spans the transient basis the power signal to alternate swell and then dwindle very quickly. Oscillatory transients commonly atrophy to zero within a cycle (a deteriorating oscillation).

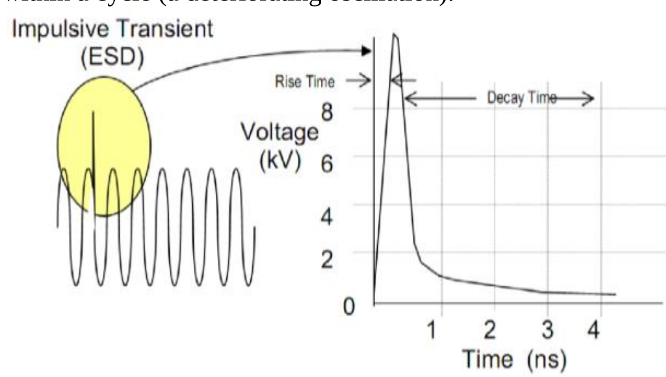


Fig.1. Positive Impulsive Transient.

For instance leading distortion of a revolving motor it operates momentarily as a generator as it powers along, thus generating electricity and delivering it in the course of the allocation of electrical.

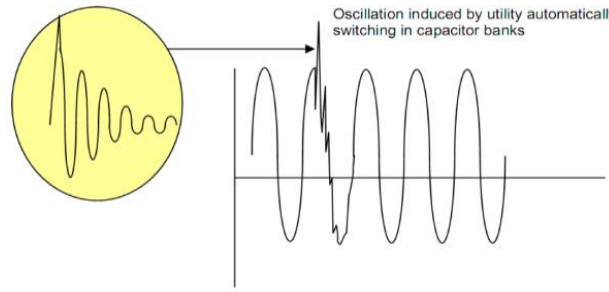


Fig.2. Oscillatory Transient.

When oscillatory transients be seen on an energized circuit, frequently because of utility switching functions (especially when capacitor banks are instinctively switched into the network), they can be quite imitative to electronic apparatus. Fig.2 shows a distinctive low frequency Oscillatory Transient treatable to capacitor banks being energized.

B. Interruptions

Interruptions (Fig.3) are explained as the total loss of load current or supply voltage. Be determining on it's during something continues, an interruption is can be classified as transitory, immediate, sustained or temporary.

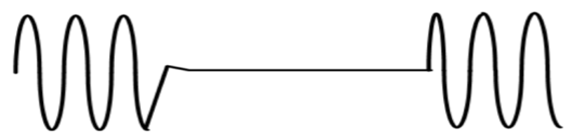


Fig.3. Momentary Interruption.

The basis of interruptions can change, but are commonly the fruits of some kinds of electrical supply grid devastation such as destructive weather (heavy ice or snow on lines, soaring winds etc.), animals, radiance strikes, vehicle accidents, trees, necessary circuit breaker tripping or a apparatus abandonment. While the utility basic structures are drafted to automatically atone for many of these conundrums, it is not dependable. One of the main usual examples of what can basis an interruption in economical power systems are utility protective appliances such as involuntary circuit re-closers.

C. Voltage Sag

A Voltage Sag is a curtailment of AC voltage next to a specified frequency for the span of 0.5 cycles to 1 minute's time as shown in Fig.4. Sags be generally effected through system faults and be as well frequently the consequence of switching on loads through heavy startup currents.

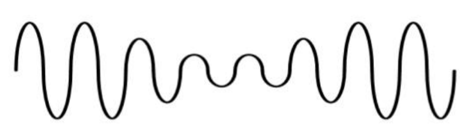


Fig.4. Voltage Sag.

Familiar causes of sags comprise starting large loads (such since one may see while they first start up a huge air conditioning unit) along with remote fault clearing achieved by utility appliance. Similarly, the starting of large motors within an industrial ability is able to effect in important voltage drop (sag). A motor could withdraw six times its convectional running current otherwise more, as starting. Creating a sudden and large electrical load such like this will probably origin a important voltage drop to the rest of the circuit it resides on.

D. Voltage Swell

A swell is a reverse form of sag, containing a increase in AC voltages for a duration of 0.5 cycles to 1 minute's interval. For swells, rapid (especially large) load declines high-impedance neutral associations and a fault of single-phase on a system with three-phase is general supply as shown in Fig.5.

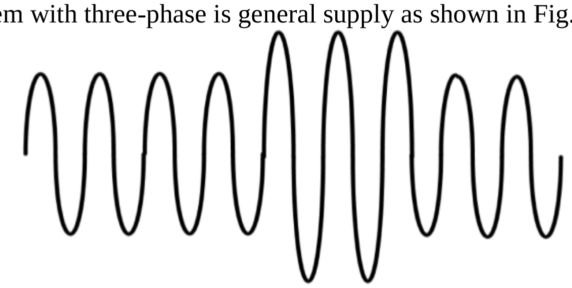


Fig.5. Voltage Swell.

The effect can be degradation of contacts of electrical, semiconductor break in electronics, errors in data, insulation degradation and flickering of lights. UPS systems, Power line conditioners and for resonant "control" transformers are familiar solutions. Much similar swells, sags may not be evident until their consequences are seen. Having power conditioning and/or UPS devices that also observe and log incoming power events will help to calculate when and how often these actions happen.

III. PROPOSED SYSTEM

The conventional UPQC structure is composed of a SAF with a PAF, as shown in Fig. 6. In this configuration, the SAF works as a voltage source in order to compensate the grid distortion, unbalances, also disturbances like sags, swells, as well as flicker.

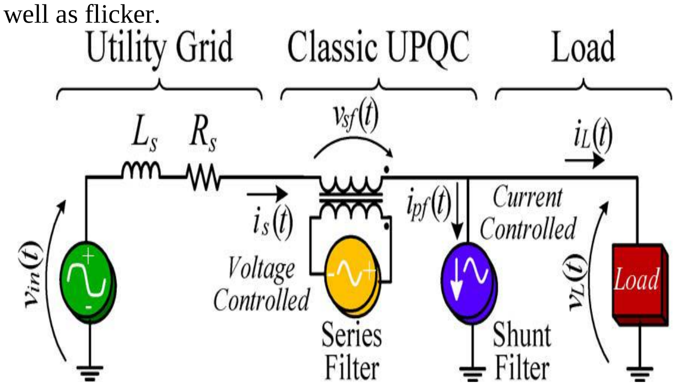


Fig.6. Conventional UPQC.

Hence, the voltage compensated by the SAF is composed of a fundamental content along with the harmonics. The PAF works as a current source with it is responsible for compensating the unbalances, displacement, also harmonics of the load current, ensuring a sinusoidal grid current. The series filter connection to the utility grid is made through a transformer, while the shunt filter is usually connected directly to the load, mainly in low-voltage grid applications.

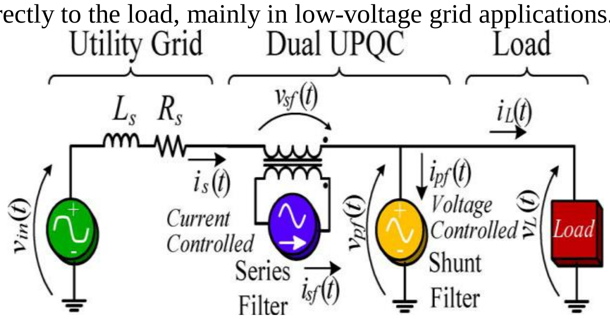
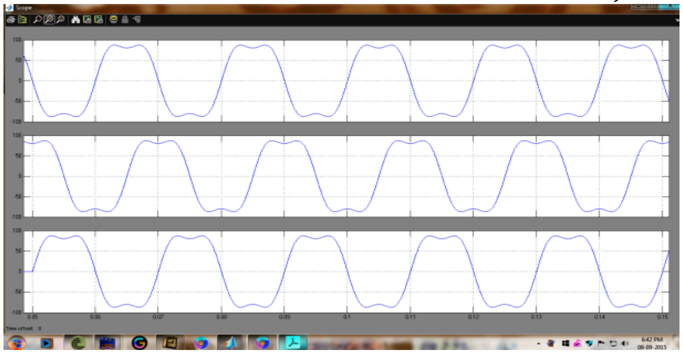


Fig.7. Dual UPQC (IUPQC).

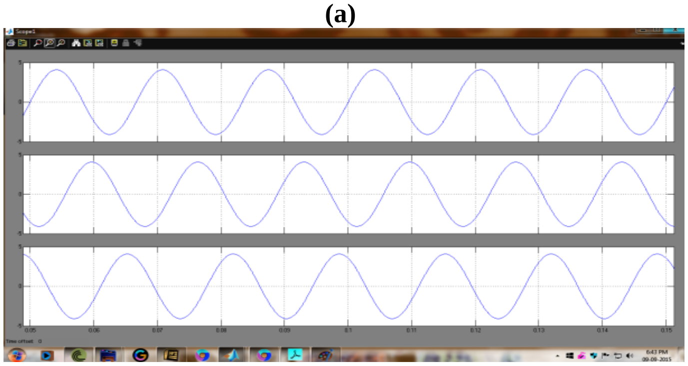
The conventional UPQC has the following drawbacks: difficult harmonic extraction of the grid voltage along with the load involving difficult calculations, voltage and current references with harmonic contents requiring a high bandwidth control, also the leakage inductance of the series connection transformer affecting the voltage compensation generated by the series filter. In order to reduce these drawbacks, the iUPQC is investigated in this project, and its scheme is shown in Fig. 7. The scheme of the iUPQC is much related to the conventional UPQC, using an involvement of the SAF as well as PAF, diverging only from the way the series with shunt filters are controlled. In the iUPQC, the SAF works as a current source, which impose a sinusoidal input current synchronized with the grid voltage. The PAF works as a voltage source imposing sinusoidal load voltage synchronized with the grid voltage. In this way, the iUPQC manage uses sinusoidal references for both active filters. This is a major point to examine related to the classic topology since the only request of sinusoidal reference generation is that it must be synchronized with the grid voltage. The SAF acts as high impedance for the current harmonics with indirectly compensates the harmonics, unbalances, also disturbances of the grid voltage since the connection transformer voltages are equal to the difference between the grid voltages with the load voltage. In the same way, the PAF indirectly compensates the unbalances, displacement, with harmonics of the grid current, providing a low-impedance path for the harmonic load current.

IV. SIMULATION RESULTS

The pre charge method and the pre charge sequence are an important and not trivial design step of the iUPQC due to the power flow characteristics of the system. During the startup, the voltage supplied to the load cannot be distorted, and the iUPQC coupling in the circuit shall not affect the load. The pre charge method developed allows the startup of the iUPQC with no need of load power disconnection. In order to emulate a harmonic distorted load current, a three phase rectifier with capacitive filter and two single-phase rectifiers with *RL* load connected to phases A and B, respectively, was used.



(a)



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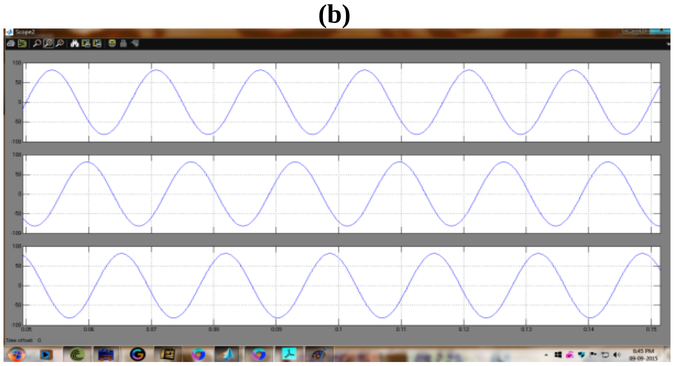

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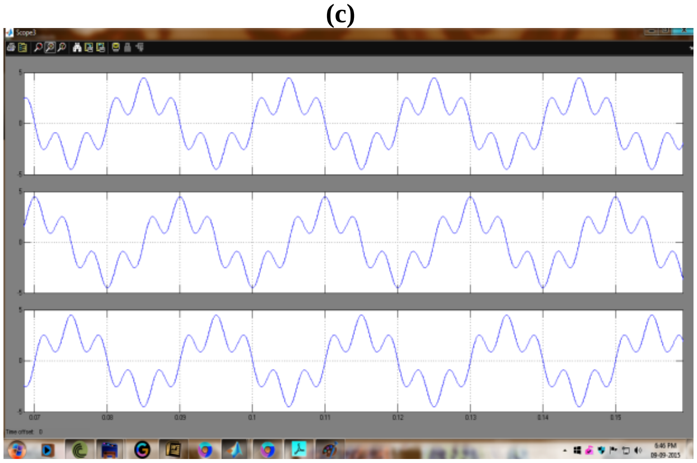
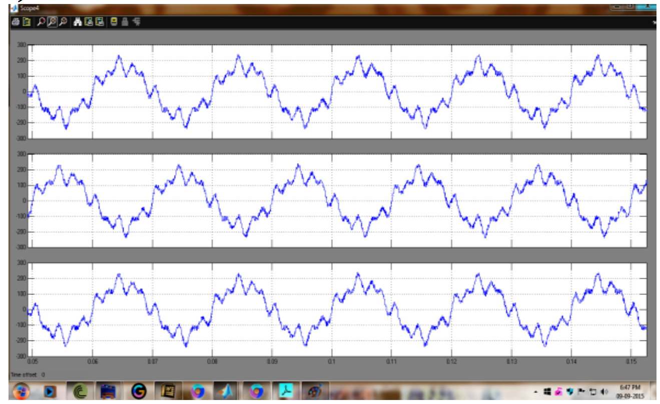


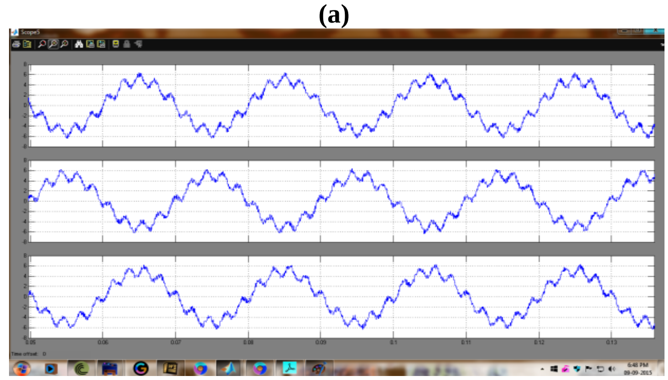
(d)

Fig.8 (a), (b), (c), (d) source and load voltages and currents.

Fig8 (a), (b), (c), (d) shows the currents and voltages in the source and load. It is possible to see that the currents drained from the source are sinusoidal, balanced, and synchronized with the source voltage, with power factors of 0.980, 0.994, and 0.994 for phases A, B, and C, respectively.



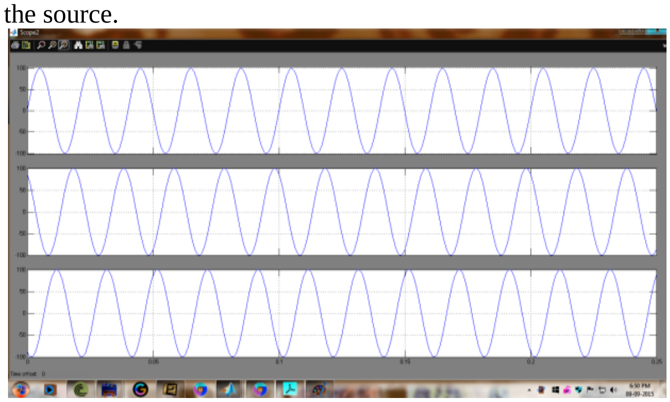
(a)



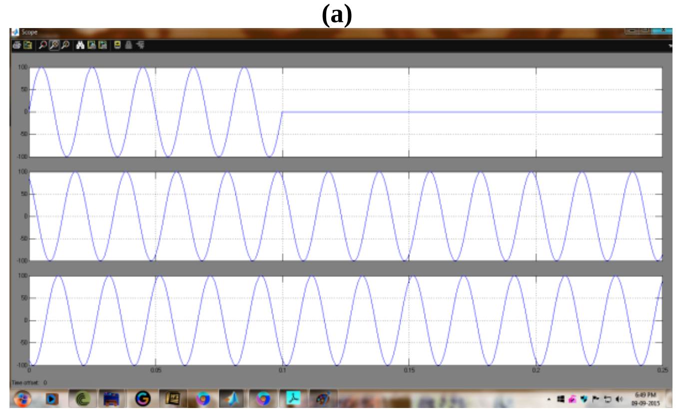
(b)

Fig.9. (a), (b) PAF currents.

Fig. 9 (a), (b) shows the currents through the PAF. The PAF indirectly supplies the load harmonic currents because the SAF only drains the fundamental current component from the source.



(a)



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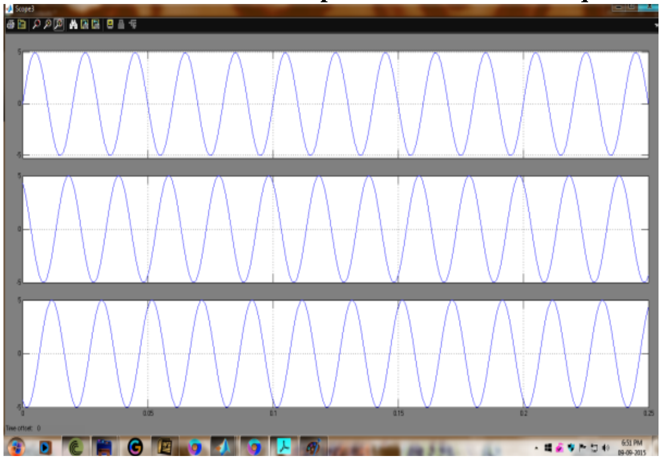

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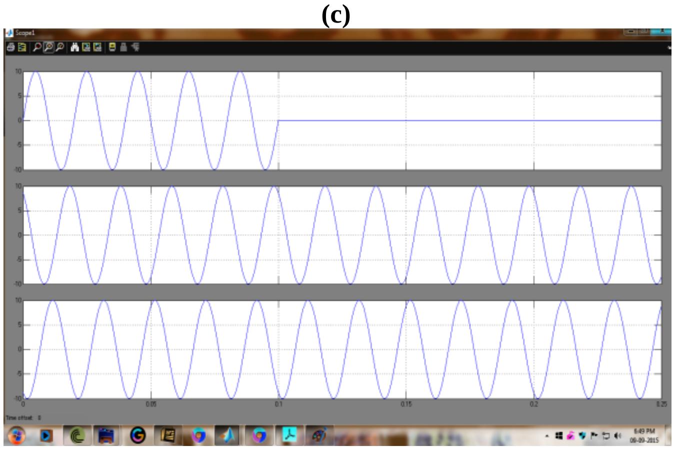
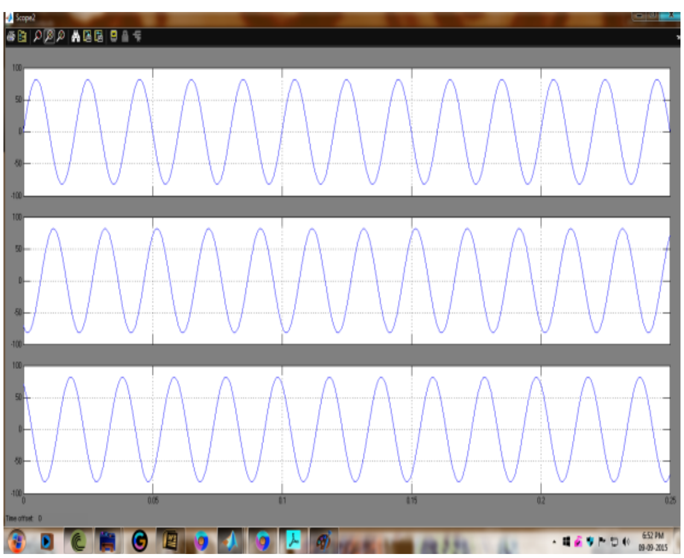


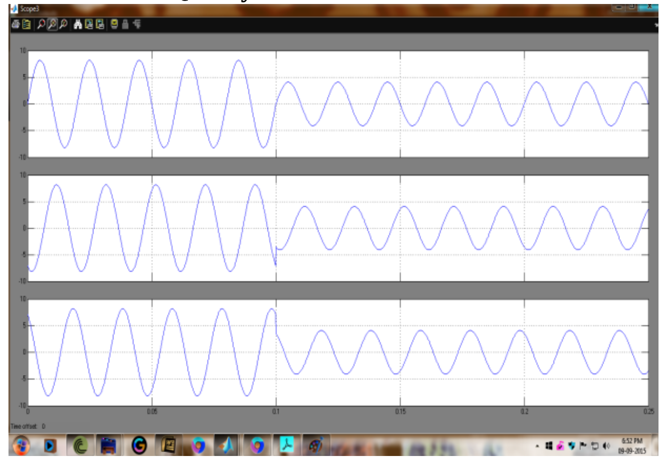
(d)

Fig.10 (a), (b), (c), (d) source voltages and currents and load voltages.

Fig10 (a), (b), (c), (d) shows the source and load voltages during a voltage interruption in phase A, it shows the source currents during a fault in phase A. It is possible to see that the source currents in the other phases have the amplitudes increased in order to keep the nominal power of the load.



(a)



(b)

Fig.11 (a), (b) load voltages and currents.

The load voltages and the load currents are shown in Fig. 11 (a), (b) during a load step from 100% to 50%.

V. CONCLUSION

The IUPQC references do not have harmonic contents, and the only requirement is the synchronism with the grid voltage. Another positive aspect of the IUPQC in low-voltage applications (distribution system network) is the non interference of the leakage impedance voltage of the SAF connection transformer in the load voltage compensation because the load voltage is directly controlled by the PAF. On the other hand, the leakage impedance interferes in the current loop bandwidth, decreasing its frequency response under distorted grid voltages. The results validate the proposed IUPQC control scheme, proving that the power quality can be meaningfully better with a simple control method which uses only synchronized sinusoidal references. The results obtained with the IUPQC confirms that the proposed ABC reference frame control works very well and that it was able to compensate the nonlinear load currents and also ensure the sinusoidal voltage for the load in all three phases. The control also had a great performance during the load steps and voltage disturbances at the source.

VI. REFERENCES

[1] J. Munoz, J. Espinoza, L. Moran, and C. Baier, "Design of a modular UPQC configuration integrating a components economical analysis," IEEE Trans. Power Del., vol. 24, no. 4, pp. 1763–1772, Oct. 2009.

[2] I. Axente, J. Ganesh, M. Basu, M. Conlon, and K. Gaughan, "A 12-Kva DSP-controlled laboratory prototype UPQC capable of mitigating unbalance in source voltage and load current," IEEE Trans. Power Electron., vol. 25, no. 6, pp. 1471–1479, Jun. 2010.

[3] I. Axente, M. Basu, M. Conlon, and K. Gaughan, "Protection of unified power quality conditioner against the load side short circuits," IET Power Electron., vol. 3, no. 4, pp. 542–551, Jul. 2010.

[4] S. Karanki, M. Mishra, and B. Kumar, "Particle swarm optimizationbased feedback controller for unified power-

quality conditioner," IEEE Trans. Power Del., vol. 25, no. 4, pp. 2814–2824, Oct. 2010.
[5] W. C. Lee, D. M. Lee, and T.-K. Lee, "New control scheme for a unified power-quality compensator-Q with minimum active power injection," IEEE Trans. Power Del., vol. 25, no. 2, pp. 1068–1076, Apr. 2010.
[6] B. Franca and M. Aredes, "Comparisons between the UPQC and its dual topology (iUPQC) in dynamic response and steady-state," in Proc. 37th IEEE IECON/IECON, Nov. 2011, pp. 1232–1237.
[7] M. Kesler and E. Ozdemir, "Synchronous-reference-frame-based control method for UPQC under unbalanced and distorted load conditions," IEEE Trans. Ind. Electron., vol. 58, no. 9, pp. 3967–3975, Sep. 2011.

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