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RESOLVEMENT OF POWER QUALITY PROBLEMS BY UNIFIED POWER QUALITY CONDITIONER (UPQC)

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ABSTRACT

In this project presents a Design of a Unified Power Quality conditioner (UPQC) connected to three phase four wire system (3P4W). The neutral of series transformer used in the fourth wire for the 3P4W system. The neutral current that may flow toward transformer neutral point is compensated by using a four-leg voltage source inverter topology for shunt part. The series transformer neutral will be at virtual zero potential during all operating conditions. In this simulation we observe the power quality problems such as unbalanced voltage and current, harmonics by connecting non linear load to 3P4W system with Unified Power Quality conditioner. A new control strategy such as unit vector template is used to design the series APF to balance the unbalanced current present in the load currents by expanding the concept of single phase P-Q theory.

KEYWORDS: Unified power quality conditioner,Series active power filter,Shunt active power filter,Power quality

INTRODUCTION

Electrical power system is design to provide high quality power for satisfactory operation of various electrical equipment. However the extensive use of non-linear loads in modem power system is becoming highly vulnerable to power quality and contributing to increased power quality issues. The main issues of a poor power quality are harmonic currents, poor power factor, supply-voltage variations; etc.It has been always a challenge to maintain The quality of electric power within the acceptable limits. The adverse effects of poor power quality may result into increased power losses, abnormal and undesirable behavior of equipments, interference with nearby communication lines, and so forth. The term active power filter (APF) is a widely used terminology in the area of electric power quality improvement. APFs have made it possible to mitigate some of the major power quality problems effectively. The UPQC is one of the APF family members where shunt and series APF functionalities are integrated together to achieve superior control over several power quality problems. The function of unified power Control strategy plays a vital role in the overall performance of the power conditioner. Rapid detection of disturbance signal with high accuracy, fast processing of the reference signal and high dynamic r e s p on s e of the controller are the prime requirements for desired compensation. Generation of appropriate swi tching Pattern or gating signal with reference to command compensating signal determines the control strategy of the UPQC.

PROPOSED SCHEME

In proposed system easy expansion of 3P3W system to 3P4W system. The neutral current, present if any, would flow through this fourth wire toward transformer neutral point. This neutral point current can be compensated by using a split capacitor. This neutral current achievement is used the method P-Q Theory in UPQC. The UPQC consisting of the combination of a series active power filter (APF) and shunt APF.

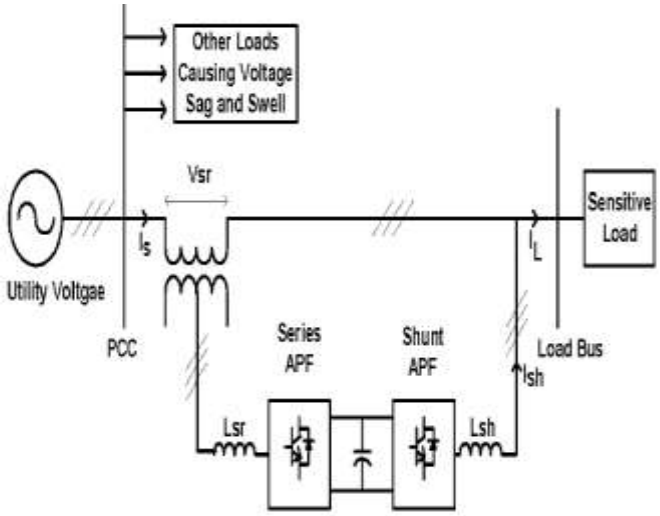

Fig1.Block diagram of UPQC

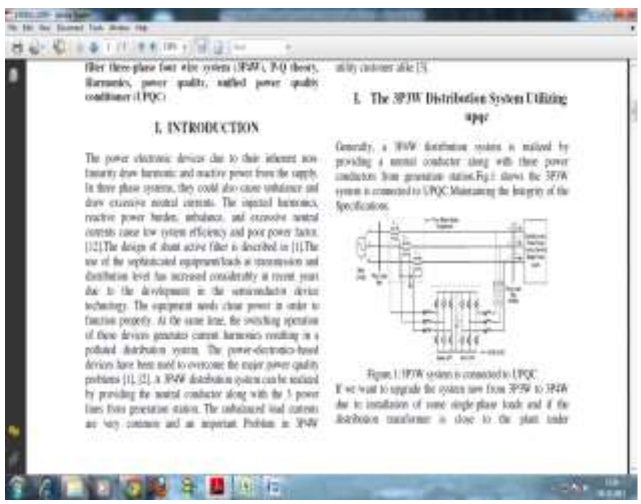

Fig2..UPQC System connection

Existing Method

In Existing to connecting series active filters the voltage harmonic compensation, high impedance path to harmonic currents these are the main functions. All these non-linear loads draw highly distorted currents from the utility system, with their third harmonics component almost as large as the fundamental. The increasing use of non-linear loads, accompanied by an increase in associated problems concerns both electrical utilities and utility customer.

Unified Power Quality Conditioner (UPQC)

The extensive use of power electronic based equipments/loads almost in all areas, the point of common coupling (PCC) could be highly distorted. Also, the switching ON/OFF of high rated load connected to PCC may result into voltage sags or swells on the PCC. There are several sensitive loads, such as computer or microprocessor based AC/DC drive controller, with good voltage profile requirement; can function improperly or sometime can lose valuable data or in certain cases get damaged due to these voltage sag and swell conditions. One of the effective approaches is to use a unified power quality conditioner (UPQC) at PCC to protect the sensitive loads. A UPQC is a combination of shunt and series APFs, sharing a common dc link. It is a versatile device that can compensate almost all power quality problems such as voltage harmonics, voltage unbalance, voltage flickers, voltage sags & swells, current harmonics, current unbalance, reactive current. This project is based on the steady state analysis of UPQC during voltage sag and swells on the system. Aim is to maintain the load bus voltage sinusoidal and at desiredconstant level in all operating conditions. The major concern is the flow of active and reactive power during these conditions, as it plays an important role in selecting the KVA ratings of both shunt and series APF.

The UPQC is installed in order to protect a sensitive load from all disturbances. It consists of two voltage source inverters connected back to back, sharing a common dc link. One inverter is connected parallel with the load. It acts as shunt APF, helps in compensating load harmonic current, reactive current and maintain the dc link voltage at constant level. The second inverter is connected in series with the line using series transformers, acts as a controlled voltage source maintaining the load voltage sinusoidal and at desired constant voltage level.

Control Stratergy
The control strategy is based on the extraction of unit vector templates from the distorted input supply. These templates will be then equivalent to pure sinusoidal signal with unity amplitude. The three phase distorted input source voltage at PCC contains fundamental component and distorted component. To get unit input voltage vectors U_S the input voltage is sensed and multiplied by equal to $(1/V_m)$ where V_m is equal to peak amplitude of fundamental input voltage. These unit input voltage vectors are taken to phase locked loop (PLL).With proper delay, the unit vector templates are generated.

$$U_a=\sin\omega t$$
$$U_b=\sin(\omega t-120^0)$$
$$U_c=\sin(\omega t+120^0)$$

Multiplying the peak amplitude of fundamental input voltage with unit vector templates gives the reference load voltage signals.

$$V^*=V_m \cdot U_{abc}$$

The measured load voltages are compared with reference load voltage signals. The error generated is then taken to a hysteresis controller to generate the required gate signals for series APF. The unit vector templates can be applied for shunt APF to compensate the harmonic current generated by non-linear load. The shunt APF is used to compensate for current harmonics as well as to maintain the dc link voltage at constant level. Reference currents and voltages are generated using Phase Locked Loop (PLL). The control strategy is based on the extraction of Unit Vector Templates from the distorted input supply. These templates will be then equivalent to pure sinusoidal signal with unity (p.u.) amplitude. The 3-ph distorted input source voltage at PCC contains fundamental component and distorted component. To get unit input voltage vectors Uabc, the input voltage is sensed and multiplied by gain equal to 1/Vm, where Vm is equal to peak amplitude of fundamental input voltage. These unit input voltage vectors are taken to phase locked loop (PLL).

Simulink Software
Simulink (Simulation and Link) is an extension of MATLAB by Math works Inc. It works with MATLAB to offer modeling, simulating, and analyzing of dynamical systems under a graphical user interface (GUI) environment. The construction of a model is simplified with click-and-drag mouse operations. Simulink includes a comprehensive block library of toolboxes for both linear and nonlinear analyses. Models are hierarchical, which allow using both top-down and bottom-up approaches. As Simulink is an integral part of MATLAB, it is easy to switch back and forth during the analysis process and thus, the user may take full advantage of features offered in both environments. This tutorial presents the basic features of Simulink and is focused on control systems as it has been written for students in my control system

APPLICATIONS
Hybrid application an and Storage applications genrally uses UPQC system to remove power quality problems genrally occurs.In hybrid applications UPQC increases active power in circuit and removes harmonic cureents which will improve power factor and ultimately power quality

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RESULTS

The simulation of the proposed system has been done using MATLAB/SIMULINK

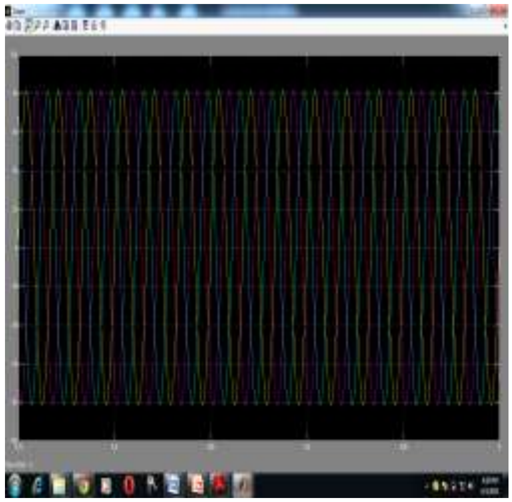

Fig 3. Input 3 phase voltage

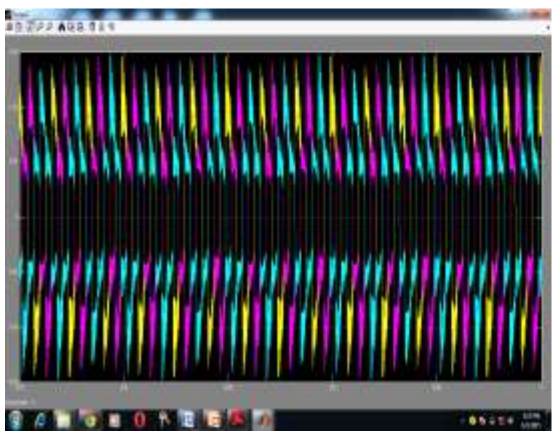

Fig 4.Distorted Output voltage due to nonlinear load

Fig 5.Output voltage with 3 phase fault

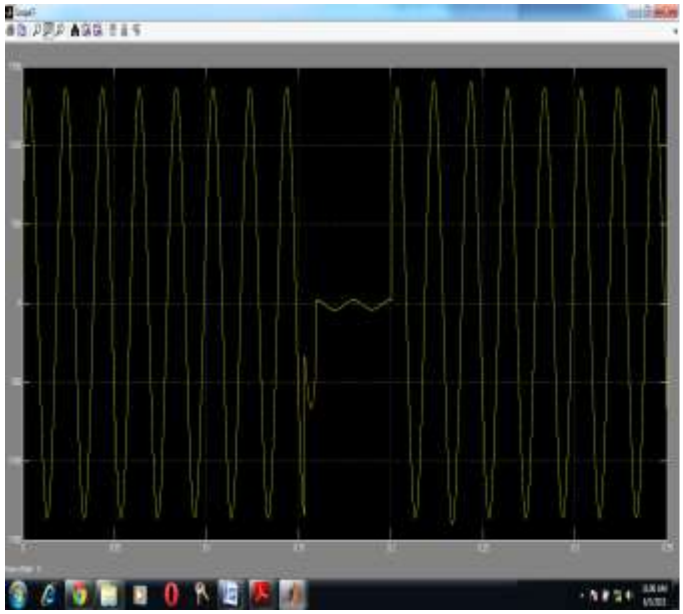

Fig 6.UPQC compensation for timer values

CONCLUSIONS

The conventional methods require the measurements of load, source, and filter currents for the shunt APF and source and injection transformer voltage for the series APF. The simulation results show that, when under unbalanced voltage conditions, the control algorithm eliminates the impact of rotor speed instability and series APF compensates the loads voltage. Recent rapid interest in renewable energy generation, especially front-end inverter-based large-scale photovoltaic and wind system, is imposing new challenges to accommodate these sources into existing

Transmission/distribution system while keeping the power quality indices within acceptable limits. Thus UPQC compensates both voltage- and current-related power quality problems simultaneously.

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