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Design and Analysis of UPQC Based Fault Mitigation for Power Quality Enhancement in Distribution System

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ABSTRACT:

Power quality problems have become more complex at all level of power system. By using power electronic devices can be effective improve the quality of power supplied to the distributed system. The topology of UPQC to have a reduced dc-link voltage without compromising its compensation capability. This proposed topology also helps to match the dc-link voltage requirement of the shunt and series active filters of the UPQC. The equipment corresponds to the back-to-back connection of a series and a shunt active filter connected to DC link which is able to reduce the voltage interruption, voltage sag, harmonics and reactive power control. The average switching frequency of the switches in the VSI also reduces; consequently the switching losses in the inverters reduce. A simulation study of the proposed topology has been study by using MATLAB/SIMULINK.

Key words: ***UPQC controller, Power quality (PQ), Series Active Filter (SEF), Shunt Active Filter (SAF), Active power filter (APF), harmonics.***

INTRODUCTION

Power quality issues have been progressively bringing on concern because of the wide utilization of nonlinear loads, for example, movable pace drives, electric bend welders, and the exchanging force supplies in conveyance frameworks.

Nonlinear burdens cause consonant streams in systems and thus contort the voltage waveform at the purpose of regular Coupling (PCC) because of framework impedances. This contorted voltage waveform destructively influences alternate burdens joined at the PCC. To keep away from this issue and to shield loads from twists, the symphonious segments of the voltage and current must be completely adjusted. LC aloof channels and shunt dynamic force channels (APFs) are frequently used to moderate consonant streams. The force quality is a crucial client centered measure and it's significantly influenced by the operation of an appropriation and transmission system. These days, era of power from renewable sources has enhanced all that much. Since most renewable vitality sources are discontinuous in nature, it is a testing undertaking to incorporate a critical part of renewable vitality assets into the force matrix framework.

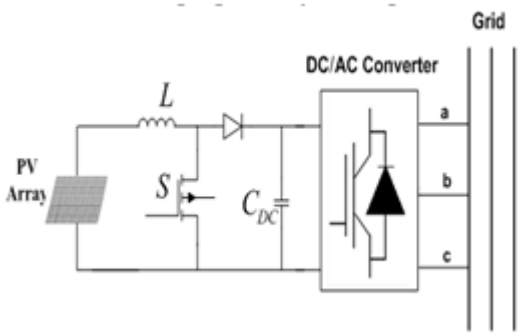

Fig. 1: General structure of grid connected PV systems

So as to at the same time manage consonant voltage and current issues, a propelled arrangement, i.e., the bound together power quality conditioner (UPQC) has been produced. The UPQC is made out of a shunt and an arrangement dynamic force channel to guarantee that both the heap voltage and the supply current get to be sinusoidal, where the shunt APF is worked as a controlled current source to repay the symphonious streams delivered by nonlinear burdens. In the interim,

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the arrangement APF goes about as a controlled voltage source to repay the music of the supply voltage. Different UPQC control plans have been created to relieve symphonious voltages and streams. UPQC has the capacity remunerate current music receptive force, voltage bends and control burden stream yet can't repay voltage interference due to not having sources. The enthusiasm for renewable vitality has been expanding quickly in light of the fact that renewable vitality may assume a vital part later on force framework. A little conveyed era (DG) ought to be interconnected with the force framework keeping in mind the end goal to keep up the recurrence and voltage.

In this paper another structure is proposed for UPQC, for lessening the Dc join voltage. For this situation, UPQC finds the capacity of infusing energy to touchy burden amid source voltage intrusion. This proposed topology additionally serves to coordinate the dc-join voltage prerequisite of the shunt and arrangement dynamic channels of the UPQC. The hardware compares to the consecutive association of an arrangement and a shunt dynamic channel, joined with DC join by help converter which has the capacity diminish the voltage hang and swell and voltage interference, sounds and receptive force control. A reproduction investigation of the proposed topology has been study by utilizing MATLAB/SIMULINK.

II. Flexible AC Transmission System (FACTS)

The goal of joining FACTS is into the force framework lines are like HVDC yet more prominent adaptability are included like enhancing genuine force move ability in the lines, counteractive action of sub-synchronous reverberation (SSR) oscillations and damping of force swings [9]. Truths gadgets have four understood sorts which are utilized as a part of numerous power frameworks on the planet. Single sort controller is the sorts of FACTS that introduced in arrangement or shunt in an AC transmission line, while brought together sort controller are the consolidated converters kind of FACTS controllers like UPFC and HVDC. The accompanying sorts of FACTS gadgets are VSC sort based controllers:

Shunt controller: Illustration gadget, STATCOM imitates like a variable inductor or can be a capacitor in shunt or parallel association in the transmission line. This kind of gadget is equipped for copying inductive or capacitive reactance in swings to manage line voltage at the purpose of coupling. Shunt controller when all is said in done controls the voltage infusion.

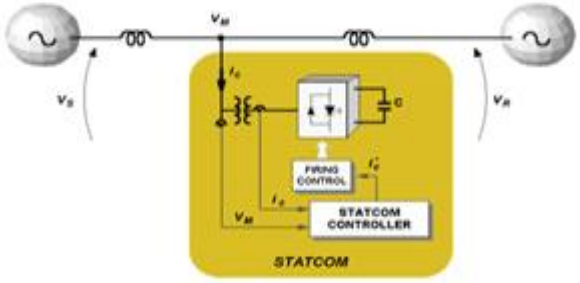

Fig 2: STATCOM circuit diagram

Series controller: Example gadget, SSSC copies like a variable inductor or a capacitor in arrangement with a transmission line and it impersonates inductive or capacitive reactance thusly to manage powerful line reactance between the two closures. Arrangement controller by and large controls current infusion.

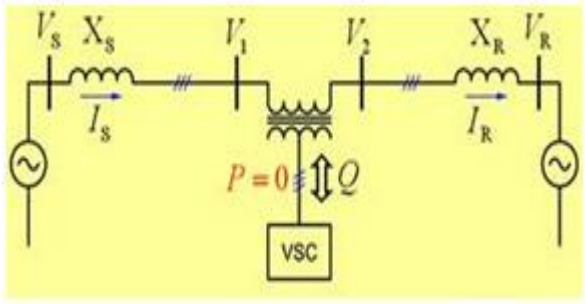

Fig 3: SSSC circuit diagram

Shunt-series controller: can be a standalone controller as STATCOM and SSSC. This kind of controller is a receptive Compensator except for creating its own misfortunes. It is likewise perceived as "brought together" controller and obliges little measure of force for DC circuit trade happening between the shunt and arrangement converters. See Fig.2 for shunt-arrangement controller.

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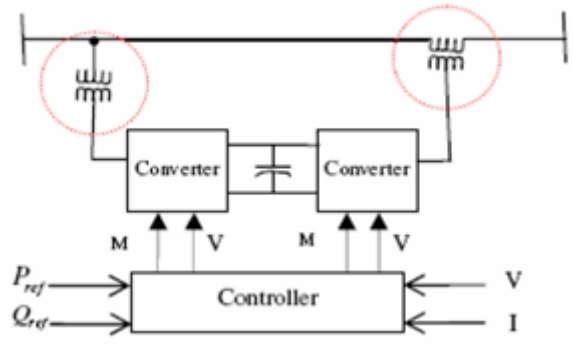


Fig.4: Block diagram of UPQC controller

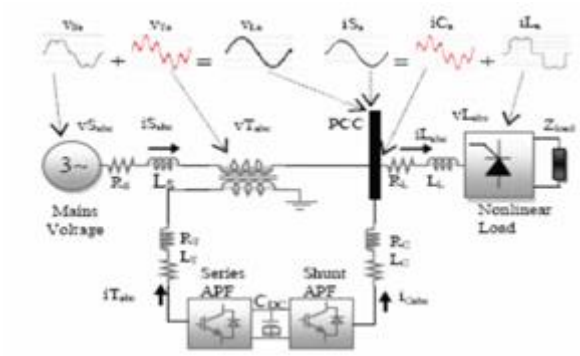


Fig 5: Generalized Diagram of UPQC system

The UPQC comprises of two voltage source inverters connected consecutive with each of them sharing a typical dc join. Fig-2 demonstrates the control chart of UPQC framework. One inverter act as a variable voltage source is called arrangement APF, and alternate as a variable current source in called shunt Active Power Factor. The fundamental point of the arrangement APF is consonant segregation in the middle of burden and Supply; it has the ability of voltage gleam/irregularity remuneration and in addition voltage regulation and symphonious pay at the utility-shopper PCC. The shunt APF is utilized to retain current music, make up for responsive power and negative-grouping current, and direct the dc join voltage between both APFs.

The proposed circuit is the mix of STATCOM AND SSSC i.e., UPQC. The topology of UPQC to have a diminished dc-join voltage without trading off its pay ability. This proposed topology likewise serves to coordinate the dc-join voltage necessity of the shunt and arrangement dynamic channels of the UPQC. The hardware compares to the consecutive association of an arrangement and a shunt dynamic channel joined with DC join which has the capacity diminish the voltage list and swell and voltage interference, music and receptive force control.

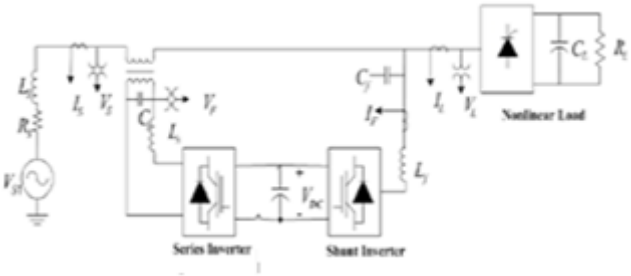
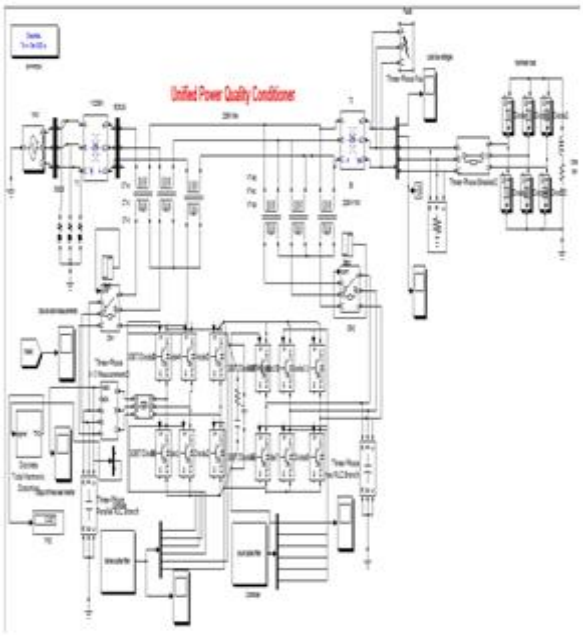


Fig 6: Proposed circuit diagram of an UPQC with DC link

IV. SIMULATION RESULTS

Simulation is performed using MATLAB/SIMULINK software. Simulink liabrary files include inbuilt models of many electrical and electronics components and devices such as diodes, MOSFETS, capacitors, inductors, motors, power supplies and so on. The circuit components are connected as per design without error, parameters of all components are configured as per requirement and simulation is performed

CIRCUIT CONNECTION:



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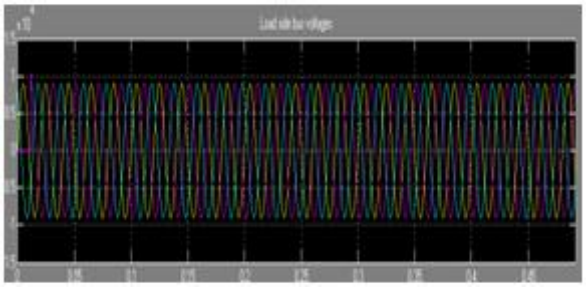
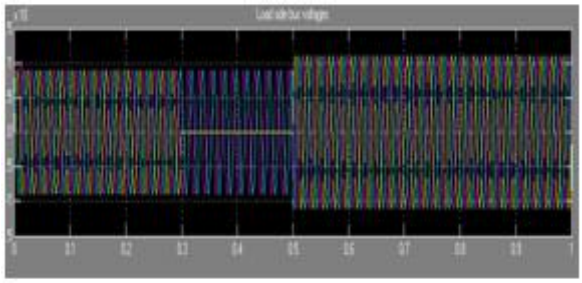
WAVEFROMS:

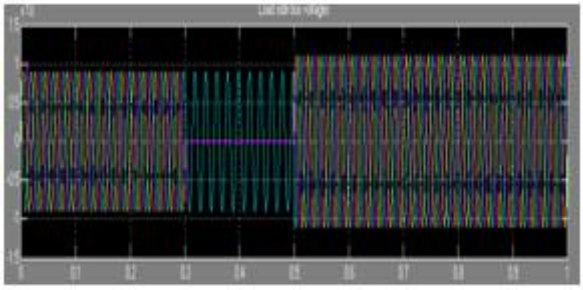
a) Under nominal Load bus voltages



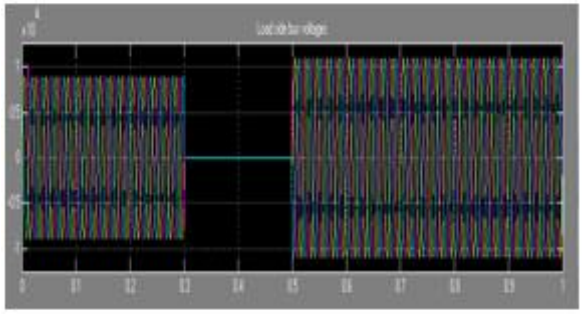
b) Under SLG fault at 0.3sec & UPQC getting into action at 0.5 sec



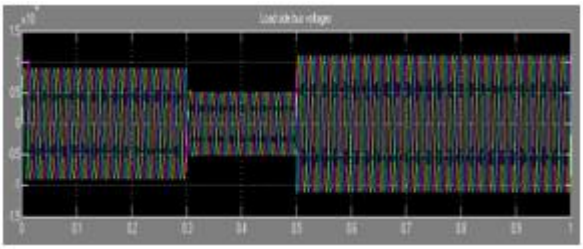
c) Under DLG fault at 0.3sec & UPQC getting into action at 0.5 sec



d) Under TLG fault at 0.3sec & UPQC getting into action at 0.5 sec



e) Under sag at 0.3sec and clearance at 0.5sec



V.CONCLUSION

In this paper, the post fault operation of UPQC is verified. The proposed framework is made out of series and shunt compensator, which can lessen the voltage sag, swell, intrusion, reactive power and harmonics. In the middle of series and shunt compensator one dc connection is joined This proposed framework's operation is dissected utilizing MATLAB modeling and recreation results affirm that the proposed framework works accurately. UPQC framework can enhance the power quality.

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