International Journal of Research
Available at https://pen2print.org/index.php/ijr/
e-ISSN: 2348-6848
p-ISSN: 2348-795X
Volume 05 Issue 23
December 2018

A Novel Hybrid Energy Source Based Unified Power Quality Conditioner with Effective Coordinate control

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ABSTRACT

This study presents a combined operation of the Unified Power Quality Conditioner (UPQC) with Photo voltaic & wind energy based hybrid system. The proposed system consists of a series inverter, a shunt inverter and a battery connected Photovoltaic array which is connected with the DC link of UPQC through a boost converter. The proposed system compensates the voltage sag, voltage swell, voltage interruption, harmonics, real and reactive power compensation. PV fed UPQC system with and without UPQC is simulated. The proposed system is validated with the results of computer simulation using Matlab-Simulink software. Sag is created by applying heavy load and swell occurs during light load conditions. These power quality problems are compensated with the help of UPQC fed Photovoltaic arrays.

1.INTRODUCTION

One of the most interesting structures of energy conditioner is two back-to-back connected DC/AC fully controlled converters. In this case, depending on the control scheme, the converters have different compensation techniques. For example, they can function as active series and shunt filters to compensate simultaneously both the load current harmonics and supply voltage fluctuations [1]. Increase in applications of electronic equipments has heightened the power quality problems [2].An active shunt filter is a suitable device for current-based compensation. It can compensate current harmonics and reactive power [3]. The active series filter is normally used for voltage harmonics and voltage sag compensation. The two inverters of UPQC shares one DC link capacitor for compensating the voltage sag and swell. The harmonic current and voltage affects the power flow and voltage stability [8]. Nevertheless, UPQC cannot compensate the voltage interruption due to lack of energy source in its DC link. Numerous studies are available on operation of UPQC and distributed generation [12]. Combined operation of UPQC and photovoltaic is proposed, in which the battery is connected to UPQC DC link through an uncontrolled rectifier [13-14]. The VA rating of series and shunt inverters of UPQC are estimated for proposed system.

2. BLOCK DIAGRAM OF UPQC

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The block diagram of the proposed system is shown in fig. 1. The Wind Energy is Considered as the Supply source as Renewable Energy plays a prominent role now a days. Here the battery energy is stored from the PV cell which is fed to the capacitor in the UPQC system. A PWM control scheme is used as controller [8-10]. Then using the series and shunt compensation the power quality problems such as voltage sag, voltage swell, real and reactive power are compensated[15].

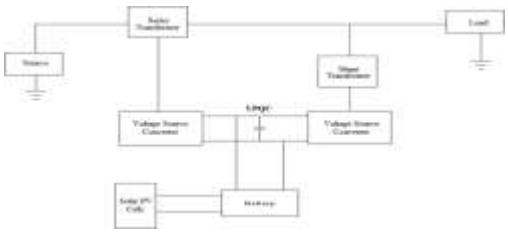

Fig. 1 shows the block diagram of PV fed UPQC

3. PROPOSED SYSTEM

The UPQC has a combination of series and shunt converter which is connected to a dc link capacitor. In the proposed system DC link capacitor is connected to a Battery Energy Storage System (BESS). The DC voltage for BESS is fed by PV Array [5-7] using MISO DC-DC converter. Here the BESS stores energy from PV array during the day time. To get a single DC output, the DC outputs from several PV arrays are combined using MISO DC-DC converter (Boost Converter) [4]. Thus the proposed system effectively compensates the power quality problems using the excess energy fed by PV Arrays.

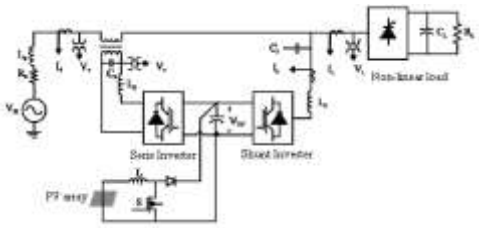

Fig. 2. Circuit Diagram of PV Fed UPQC System

4. SIMULATION RESULTS

In the proposed system MATLAB software is used for the line compensation. Fig 3 represents the simulation of PV fed UPQC [11] with Wind Energy as a Main generating Source. The corresponding voltage sag, voltage swell, real power and reactive power output is shown. Waveform below represents the comparison of the real and reactive power, with and without compensation.

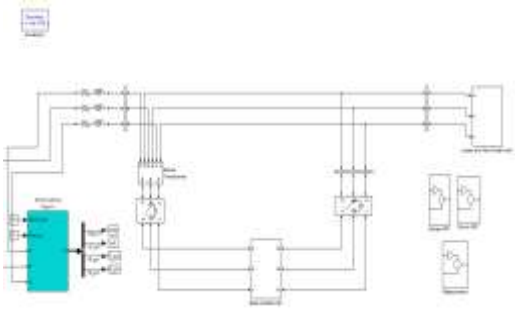

Fig.3 Matlab Simulation Circuit

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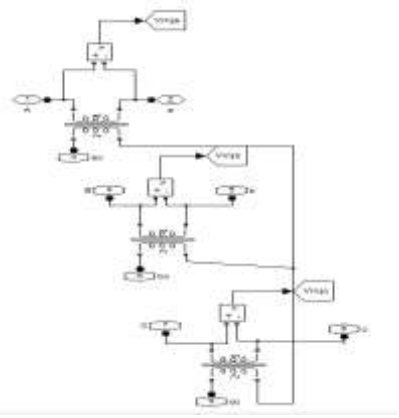

Fig.4 Series transformer

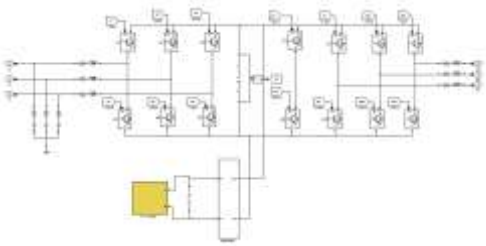

Fig.5 Upqc Back To Back Vsi

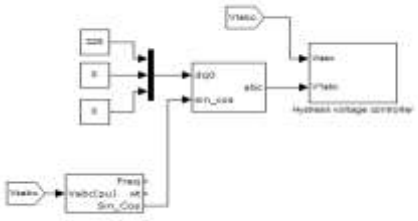

Fig.6 Series Apf control

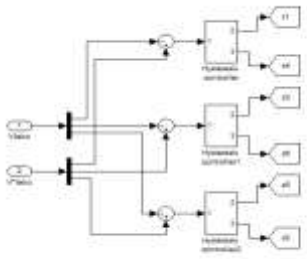

Fig.7 Hysteresis controller

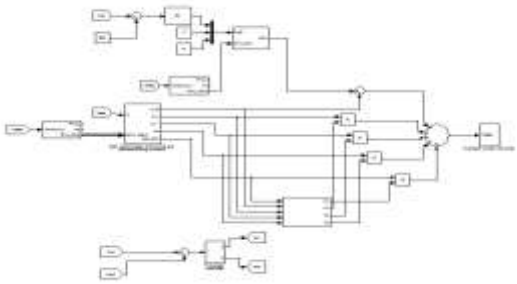

Fig.8 Shunt Apf Control

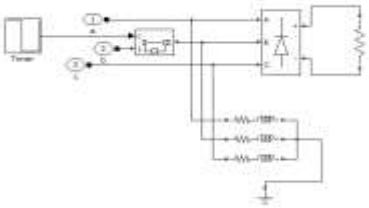

Fig.9 Linear Non Linear Load

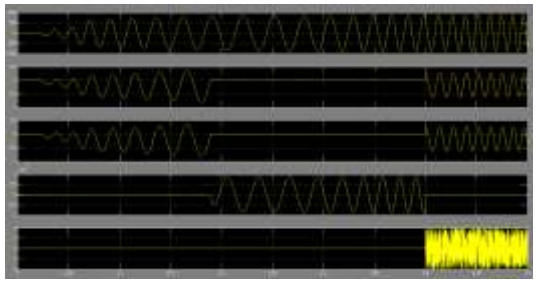

Fig.10 Simulation diagrams of Vsb , isb,ilb,icb and Vdc

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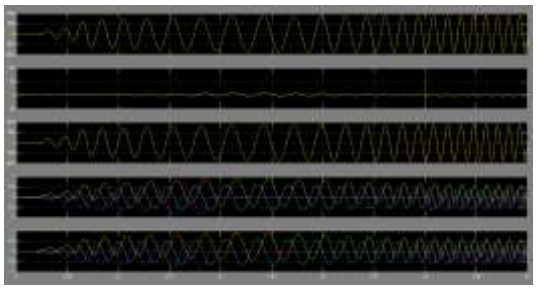

Fig.11 Dynamic response of UPQC for the compensation of client generated harmonics.

Fig.12 Matlab Simulation Circuit without UPQC

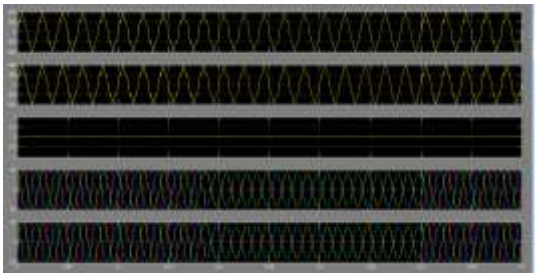

Fig.13 Response of without UPQC for the compensation of client generated harmonics

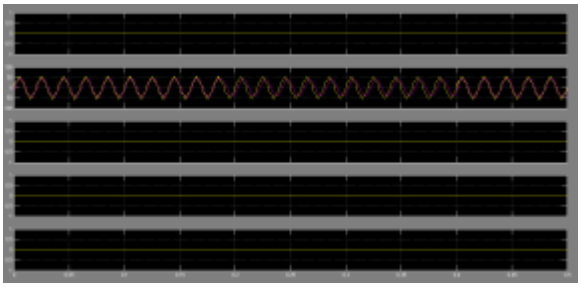

Fig.14 Dic Response of without UPQC for the compensation of client generated harmonics solely, total supply current harmonics only, total supply current harmonics and negative sequence parts solely, a total supply current harmonics, negative sequence parts and reactive power compensation

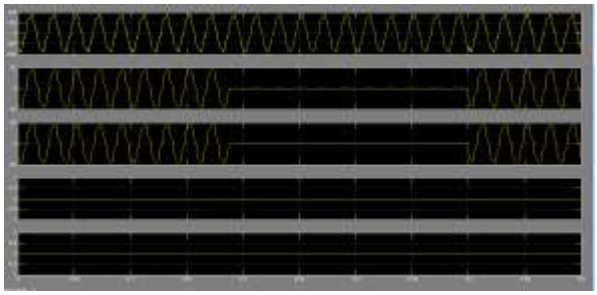

Fig.15 Simulation diagrams of Vsb , isb,ilb,icb and Vdc

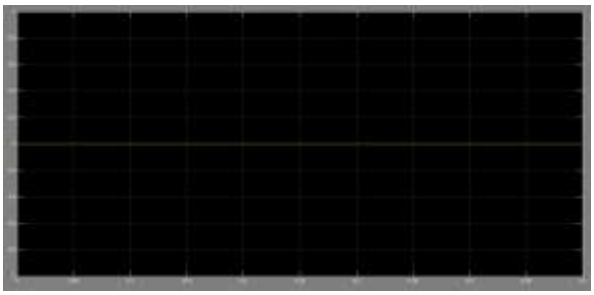

Fig.16 V_{dc}

CONCLUSIONS

This study describes a combined operation of the unified power quality conditioner with photo voltaic generation & wind energy hybrid system. The proposed system can compensate voltage sag, voltage interruption, harmonic generation and real, reactive power compensation. The VA rating of series and shunt inverters of UPQC are estimated for proposed system. The economic saving due to use of proposed system is estimated nearly 20%. Series converter draws supply from the main source and acts as a controlled rectifier for controlling the terminal voltage and Shunt

converter controls the power flow. Thus the both converters control the voltage sag and power flow. The circuit with series converter and shunt inverter section is simulated. The circuit is also simulated with photo volatile system, series and shunt inverter. The performances of both the model are compared. The combined circuit gives better performance in power quality problems. The circuit is implemented using Matlab-Simulink Software and results are verified.

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e-ISSN: 2348-6848
p-ISSN: 2348-795X
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