Improvement of Voltage and Current Profiles of Three Phase Three Wire System using Unified Power Quality Conditioner (UPQC)

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Abstract— Recently power quality has turned out to be more essential issue. Presently power electronics based machines are generally utilized as a part of ventures and in distribution framework which makes more power quality issues. The power electronics based power conditioning gadgets can be an effective solution to improve power quality in power system. Unified Power Quality Conditioner (UPQC) is one of the custom power gadget which are utilized to take care of voltage and current related issues all the while. In this paper, joined task of UPQC with Distributed Generation (DG) is talked about. The proposed framework can repay voltage interference and reactive power exchange to load and source in both interconnected and help to enhance control quality. The operation of UPQC with DG has been evaluated through simulation studies using MATLAB/SIMULINK software.

Key words: Unified Power Quality Conditioner (UPQC), Power Quality Improvement, Distributed Generation (DG), MATLAB/Simulink

I. INTRODUCTION

In electrical power system power electronics devices plays an important role.. In circulation framework it has three angle initial one is that presents profitable modern and local types of gear, second one is that makes issues, third one is that assistance to take care of issues. Now a day's modern semiconductor switching devices for example, controlled rectifiers, Uninterruptible Power Supplies (UPS), arc furnace etc. are generally utilized especially in local and industrial loads. These non linear loads make control quality issues, for example, voltage hang, voltage swell, voltage intrusion, voltage flashes, voltage spikes, harmonics and so on. Such poor power quality causes increment in power losses and other remarkable variations from the norm in distribution sides.

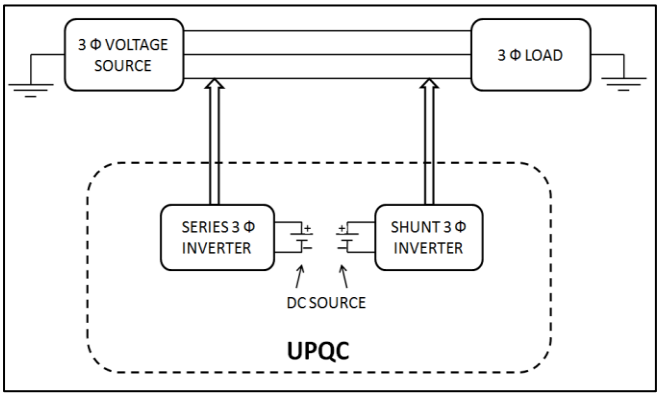

Fig. 1: Block diagram of system

In this way, it is critical to keep up an elevated requirement of power quality. Earlier passive filters were used to solve power quality problems. However because of some limitations of passive filters, now a days custom power gadgets are utilized to take care of power quality issues in circulation side. The repaying custom power gadgets are utilized for active filtering, load balancing, power factor improvement and voltage regulating. There are three types of custom power devices: Distribution Static Compensator (DSTATCOM), Dynamic Voltage Restorer (DVR) and Unified Power Quality Conditioner (UPQC). Unified Power Quality Conditioner (UPQC) is one of the custom power device, which can take care of voltage and current related issue at the same time. This is associated before load to make load voltage distortion free and in the meantime responsive current drawn from source side would be in phase with supply voltage. The interest for Distributed Generation (DG) has been expanded quickly in generation of renewable electrical energy. The overall worry about environmental contamination and the vitality deficiency has prompted the expanding interest for renewable electrical energy.

As Distribution Generation (DG) play very important role in power system. Assume important part in power system and help to take care of numerous issues that ac conditional power system has. There are a few DGs, for example, PV framework, energy unit, wind turbine. Wind control has turned out to be quickest developing vitality source among different sustainable power source. In this paper manages joined activity of UPQC with wind vitality and yield of DG framework is associated with DC transport of UPQC.

The UPQC with DG help to compensate Voltage and current power quality issues and have enable extra advantage by giving to load at whatever point voltage intrusion happen with source side.

This paper talked about joined task of UPQC with DG. The proposed system can compensate voltage sag/swell, load current disturbances. Additionally it can compensate voltage interruption and dynamic power exchange to load and source in both interconnected and islanding mode and help to improve power quality. The operation of UPQC with DG has been assessed through simulation studies using MATLAB/SIMULINK programming.

II. SYSTEM CONFIGURATION

A. PLL

The basic issue of a unified power quality conditioner is to find a calculation which can get an accurate harmonic reference signal for control reason. Regular control calculations, for example, using the quick reactive control hypothesis or momentary symmetrical parts, the shunt and series Active Filter currents/voltages are sensed and controlled to coordinate their

respective computed reference parts thereby increasing the number of sensors and computational delays. In this paper, a detecting method based on adaptive noise canceling theory is used and is received to measure the harmonic components of the nonlinear load current and load voltage are implemented.

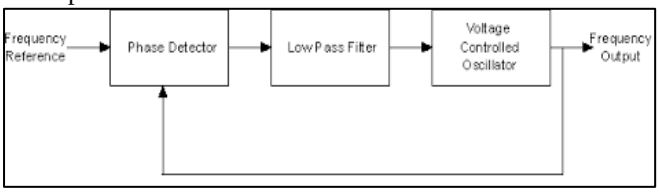

Fig. 2: PLL DIAGRAM

B. Hysteresis Controller:

This control technique requires defining upper hysteresis band limit and lower hysteresis band limit. In open loop control strategy, the variation in output DC voltage is common problem if load is variable, but we can get steady output if close loop strategy is used. In close loop control, output current signal is compared with reference current signal which is given. Which decrease the error in output and gives desired output The generated gate pulses can be controlled by PI or PID controllers. These signals are for power switching devices, when upper and lower limits of hysteresis bands are exceeded. In this technique, the power switching devices will not be switched if any major error is there.

C. Distribution Generation

Distributed generation, also distributed energy, on-site generation (OSG) or district/decentralized energy is electrical generation and storage performed by a variety of small, grid-connected devices referred to as distributed energy resources (DER).

Conventional power stations, such as coal-fired, gas and nuclear powered plants, as well as hydroelectric dams and large-scale solar power stations, are centralized and often require electric energy to be transmitted over long distances. By contrast, DER systems are decentralized, modular and more flexible technologies, that are located close to the load they serve, albeit having capacities of only 10 megawatts (MW) or less. These systems can comprise multiple generation and storage components; in this instance they are referred to as hybrid power systems.

DER systems typically use renewable energy sources,including small hydro, biomass, biogas, solar power, wind power, and geothermal power, and increasingly play an important role for the electric power distribution system. A grid-connected device for electricity storage can also be classified as a DER system, and is often called a distributed energy storage system (DESS). By means of an interface, DER systems can be managed and coordinated within a smart grid. Distributed generation and storage enables collection of energy from many sources and may lower environmental impacts and improve security of supply.

III. THREE PHASE INVERTER

Three phase inverters are used for variable-frequency drive applications and for high power applications such as HVDC power transmission. A basic three phase inverter consists of three single-phase inverter switches each connected to one of the three load terminals. For the most basic control scheme, the operation of the three switches is coordinated so that one switch operates at each 60 degree point of the fundamental output waveform. This creates a line-to-line output waveform that has six steps. The six-step waveform has a zero-voltage step between the positive and negative sections of the square-wave such that the harmonics that are multiples of three are eliminated as described above. When carrier-based PWM techniques are applied to six-step waveforms, the basic overall shape, or envelope, of the waveform is retained so that the 3rd harmonic and its multiples are cancelled.

IV. CONTROL STRATEGY

UPQC consist of two inverter for compensation of voltage sag and to neutralize the harmonic currents due to non linearity in the Load. One inverter is connected in series with the distribution system via transformer, this inverter basically deals with the compensation of voltage sag and reactive power management. The other inverter is connected ancient directly in shut with the transmission system, the role of this inverter is to neutralize the load harmonic current that may damage the sensitive equipment and we can conclude that this UPSC is a device which compensate the voltage sag as well as the load current harmonics.

V. RESULT

Performance studies of Shunt Active Filter under Sinusoidal current control strategy in grid integrated PV-Fuel Cell network has been simulated for a 3P3W system. The detailed control strategy of PV-FC hybrid system with grid integration is given in the figure 3. The control circuitry for 3P3W is modeled for grid connected system.

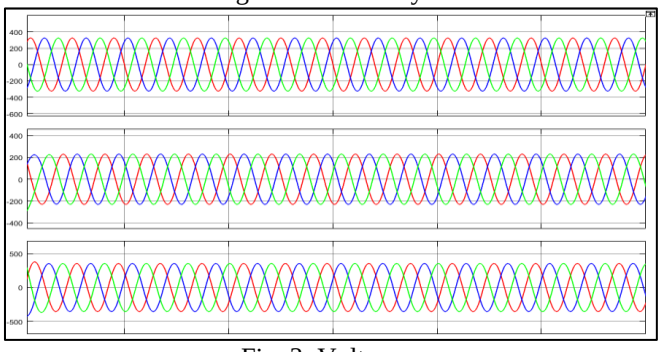

Fig. 3: Voltages

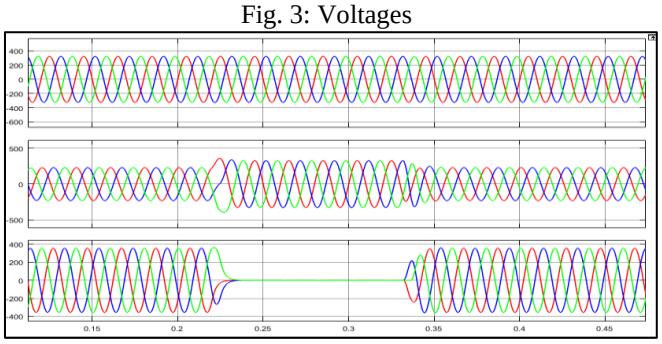

Fig. 4: Overcome voltage

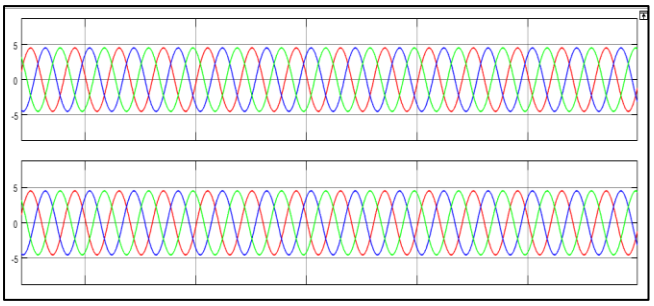

Fig. 5: Current

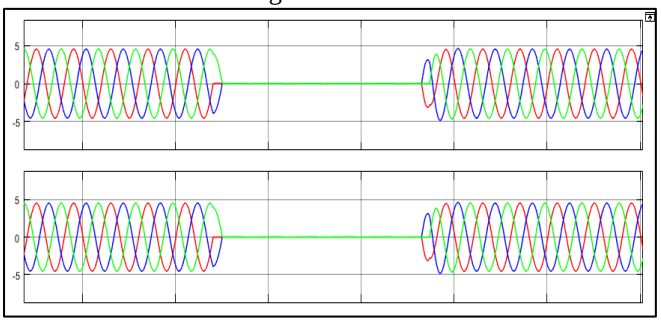

Fig. 6: Overcome current

VI. CONCLUSION

In this paper, the operation of UPQC was explained. The proposed system is composed of series and shunt inverter system connected to the DC source. The proposed system is able to compensate voltage sag, voltage swell, voltage interruption and current harmonics in interconnected and islanding mode. Hence, the proposed system improves power quality at the point of installation on power distribution system or industrial power systems. The operation of UPQC has been evaluated through simulation studies using MATLAB/SIMULINK software.

REFERENCES

[1] Rudranarayan Senapati, Rajendra Narayan Senapati, Manoj Kumar Maharana "Study and Analysis of Performance of 3-Phase Shunt Active Filter in Grid-tied PV-Fuel Cell System Employing Sinusoidal Current Control Strategy" INTERNATIONAL JOURNAL of RENEWABLE ENERGY RESEARCH, Vol.8, No.1, March, 2018.

[2] Sarita Samal and Prakash Kumar Hota "Harmonics Mitigation of a Microgrid System using Modified SRF-UPQC Method" Indian Journal of Science and Technology, Vol 10(16), DOI: 10.17485/ijst/2017/v10i16/109990, April 2017.

[3] Abhishek Singh1, A K Jhala2, Manish Prajapati "A Review on Unified Power Quality Conditioner for 3P4WSystem" © 2017, IRJET.

[4] Lutfu Saribulut, Mehmet Tumay, and Dlyas Eker "Performance Analysis of Fuzzy Logic Based Unified Power Flow Controller" International Journal of Electronics and Communication Engineering Vol: 2, No:9, 2008.

[5] Yash Pal1, A. Swarup, Bhim Singh "A Comparison of Three Topologies of Three Phase Four-Wire UPQC for Power Quality Improvement" 16th NATIONAL POWER SYSTEMS CONFERENCE, 15th-17th DECEMBER, 2010.

[6] Rodrigo Augusto Modesto, Sérgio Augusto Oliveira da Silva Azauri Albano de Oliveira Júnior, and Vinícius Dário Bacon "Versatile Unified Power Quality Conditioner Applied to Three-Phase Four-Wire Distribution Systems Using a Dual Control Strategy" 10.1109/TPEL.2015.2487867, IEEE Transactions on Power Electronics TPEL-Reg-2015-06-0923.R1.

[7] Jeno Paul, Ruban Deva Prakash, Jacob Raglend "Design and Simulation of Phase Locked Loop Controller Based Three Phase Unified Power Quality Conditioner for Non linear and Voltage Sensitive Loads" INTERNATIONAL JOURNAL OF APPLIED ENGINEERING RESEARCH, DINDIGUL Volume 1, No 2, 2010.

[8] Aparna B R, DR G C Shivasharanappa, Prof. Anguraja R, DR R Prakash "Unified Power Quality Conditioner (UPQC) in Alleviation of Power Quality Issues" International Journal of Scientific and Research Publications, Volume 6, Issue 8, August 2016.

[9] P. Prasad, Md. Khaja Jainuddin, Y. Rambabu, V. K. R. Mohan Rao "Unified Power Quality Conditioner (UPQC) With Storage Device for Power Quality Problems" International Journal Of Engineering And Science Vol.3, Issue 8 (September 2013), PP 19-26.

[10] Anagha R. Tembhurne, S. S. Dhamse "Power Quality Improvement using Unified Power Quality Conditioner with Distributed Generation" International Journal of Scientific & Engineering Research, Volume 6, Issue 7, July-2015.

[11] S. Thirukkovai, J. Venkatesan, Dr. S. M. Girirajkumar "Voltage Sag/Swell Mitigation Using UPQC" International Journal of Scientific & Engineering Research, Volume 5, Issue 4, April-2014.

[12] Vinod Khadkikar "Enhancing Electric Power Quality Using UPQC: A Comprehensive Overview" IEEE TRANSACTIONS ON POWER ELECTRONICS, VOL. 27, NO. 5, MAY 2012.

