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Design and Performance Analysis of Three-Phase Solar PV Integrated UPQC-A Review

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Abstract: *Today, it is important to provide consumers with clean, reliable and continuous energy from electricity. Because today many people buy and use electronic gadgets. Negative performance impacts such as voltage sags, swelling, and harmonics. For this reason, various energy sources are used to protect energy quality. This article uses a power generation system that combines photovoltaic arrays to maintain energy efficiency. UPQC is a combination of components and components that work together to improve power quality. Series converters compensate for line-side performance problems such as voltage dips and spikes and keep the load voltage constant. It also controls the PCC voltage. A shunt compensator compensates for existing trade-off problems caused by component imbalance. Draw energy from the solar power system. A reference signal is generated using a median filter as the sync reference frame control. A UPQC model was developed and simulated in MATLAB software by using the MATLAB Simulink results to compare results with and without UPQC.*

Keywords: Power Quality, shunt compensator, series compensator, UPQC, SolarPV, MPPT

I. INTRODUCTION

In recent years, the development of electronic devices has become a new trend. Due to the use of this current, non-electrical material flowing through the meter will generate harmonics in the form of 1's. An increase in customer demand on the load side can cause current dips that affect the amount of power. It is important that the energy company delivers the best power possible. Electrical equipment must transmit electricity reliably and continuously[4]. For this reason, many devices must be used to obtain a stable voltage between the grid and the load side. Therefore, this document describes the use of his UPQC device in photovoltaics. A UPQC consists of a series compensator and a shunt compensator connected back-to-back through a single DC link.

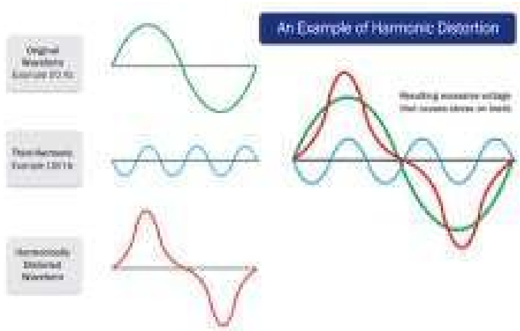

Fig1. Harmonic distortions of waveforms due to non-linear load

Using solar power instead of inverters gives you the advantage of clean energy. It provides protection against disruption of the main page by protecting critical components during migration. Comparison between connected power supply and built-in power supply. Combining integrated and combined power supplies (UPQC), accessory power supplies, and integrated power supplies can provide voltage regulation and control sinusoidal line current of integrated power supplies. The combination of UPQC and photovoltaics has the advantage of producing clean electricity and improving energy efficiency. In this work, we used synchronous component theory to generate the reference signal with a moving active filter. Active filter models with nonlinear features are used using Matlab Simulink software[6-7].

1.1 Objectives

- Study of the UPQC model.
- To Improvement of the current and voltage remuneration abilities of the 3-Phase 3 Wire system
- Using UPQC.
- To Design & Analysis of three-phase PV-UPQC under conditions of variable grid Voltage sags/swells.

II. LITERATURE SURVEY

1] M. J. E. Alam : "Assumption-based offline analysis tools may not provide sufficient and accurate information needed for corrective decision-making to mitigate the impact of photovoltaics (PV) on future grids. This is mainly due to the increasing penetration of intermittent power generation resources and fluctuations in consumer demand. Online assessment tools help manage and mitigate PV impact in real time".1][2].

2] Parchure : "The number of grid-connected rooftop photovoltaic systems is expected to grow significantly over the next few years. Many studies have been carried out to analyze the voltage stability of transmission levels with high penetration of PV, and recently the voltage stability of medium and low voltage distribution levels has also been analyzed" [4-5].

3] S.Devassy "This article presents the design and performance of a three-phase integrated UPQC (PV-UPQC) for photovoltaics (PV). The proposed system combines the advantages of distributed generation and active power filtering. PV-UPQC's shunt compensator compensates for load current harmonics and reactive power. The shunt compensator also draws maximum power from the PV system by operating it at the maximum power point (MPP). A series compensator compensates for grid-side problems with grid quality. B. The mains voltage is lowered/raised by injecting a corresponding voltage in phase with the mains voltage. The dynamic behavior of the proposed system is simulated in MATLAB-Simulink under a nonlinear load consisting of a bridge rectifier with a voltage supply load."[6-8].

4] S. Devassy : In this paper, we propose a modified p-q theory based on the control of an integrated single power quality regulator (PV-UPQC-S) for solar arrays. The fundamental frequency positive sequence voltage (FFPS) is extracted using generalized cascade delay signal suppression (GCDSC) used in pq-theory-based controllers to generate the reference grid current for the shunt compensator. A photovoltaic array (SPV) integrated into the UPQC's DC bus provides part of the active load power. [9-10].

5] B. Singh: This article describes a two-stage, three-phase, on-grid SPV (photovoltaic) power conversion system with an ANF (adaptive notch filter)-based control algorithm. The proposed SPV system is a multifunctional grid-tied solar PV power conversion system that, in addition to converting DC power from the SPV to the AC grid, includes reactive power compensation, harmonic current rejection, and three-phase load balancing. It is also possible to convert AC power distribution system. Compared with multiple devices with different functions, a multi-function SPV power conversion system with grid interface can save a lot energy.[13].

III. SYSTEM CONFIGURATION

UPQC is the grouping of series and shunt converter. The basic structure of UPQC is shown in figure 2. The of the series inverter is to inject a charging voltage in series with the load voltage when the supply voltage is unstable and not sinusoidal. Series compensators can solve voltage dips, spikes, and flickers by injecting or reducing voltages of desired magnitude and phase angle. In addition to reactive power , series inverters also absorb or inject power. Parallel converters can control the DC link voltage and compensate current associated with PQ problems such as harmonics, inter harmonics and reactive power. The construction of the PV-UPQC is shown in figure 3. The PV-UPQC is specially designed for three phase systems. The PV-UPQC has a balance and compensation connected to the DC bus. Connect the shunt compensator to the load side. The solar photovoltaic array is connected directly to the DC link if the UPQC vai reverse diodes. Series compensator for balancing voltage reducing voltage dips and swells. Shunts and series compensators are connected to the mains vai a series inductance. A series compensators inject voltage into the grid

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through a series injection transformer. Harmonics produced by the converter are removed using filters. The load used is non-linear and has a bridge rectifier and a voltage consumption load[11].

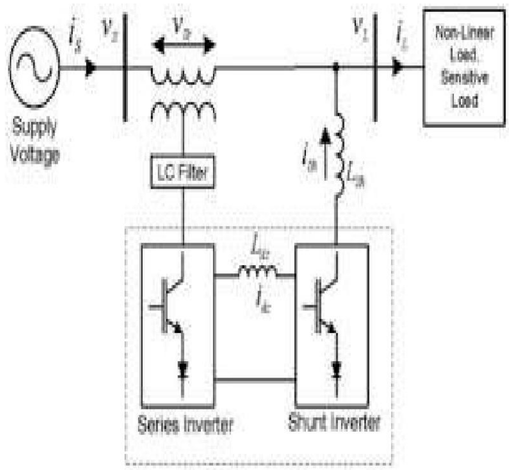

Fig 2. Basic structure of UPQC

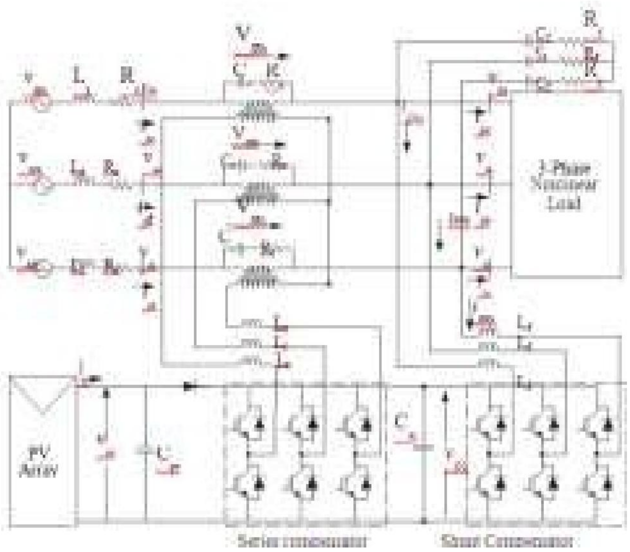

Fig 3. System configuration of UPQC

IV. CONTROL STRATEGY

Control Strategy for Shunt Converter

The measured load current is converted into a synchronous duo-reference system. With this transformation, the underlying positive-sequence components converted to d- and q-axis DC amplitudes can be easily extracted by a low-pass filter (LPF). Furthermore, all harmonic components are transformed into AC quantities with a fundamental frequency shift[3].

The shunt compensator operates at maximum power and draws maximum power from the PV system. The Maximum Power Point Tracking (MPPT) algorithm creates a DC link voltage reference for UPQC. Current from the intermediate circuit is transferred to the network by electricity. The mains current is compared with the target current and fed to the hysteresis controller. A hysteresis controller generates the gate pulse for the shunt converter[8].

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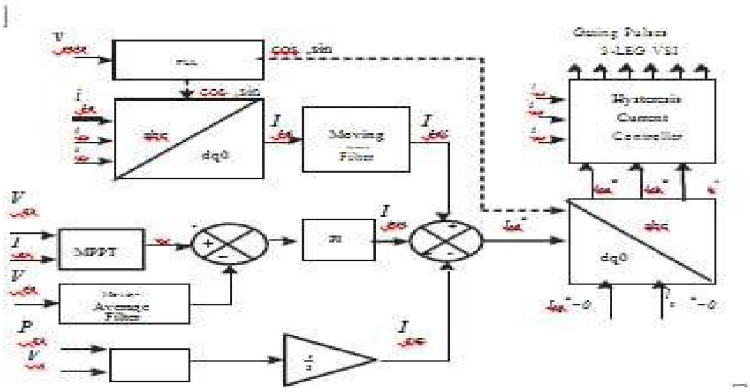

Fig.4.Control Structure of shunt Compensator

Control of Series Compensator

The bus voltage is sensed and converted to a synchronous dq0 reference frame. Series compensator control strategies include pre-embedded compensation, common-mode compensation, and power-optimized compensation. In this study, the series compensator applies a voltage that is in phase with the supply voltage, which helps to produce the minimum voltage applied to the series compensator. Figure 5 shows the control structure of the series compensator. The base component of the PCC voltage was extracted using the PLL and used to generate reference axes in the d-q-0 domain. The reference load voltage is generated using phase and frequency detection of the PCC voltage obtained with the PLL. The PCC voltage and the load voltage are transformed into the d-q-0 domain. The load reference voltage must be in phase with the PCC voltage, so the peak load reference voltage is the value of the d-axis component of the load reference voltage. The q-axis component is kept at zero. The change between the load reference voltage and the PCC voltage produces the reference voltage for the series compensator. The change between the load voltage and the PCC voltage produces the actual series compensator voltage. The change between the reference voltage and the actual series compensator voltage is fed to the PI controller to generate the appropriate reference signal. These signals are converted to the ABC domain and fed through a pulse width modulation (PWM) voltage regulator to generate a suitable gate signal for the series compensator [15].

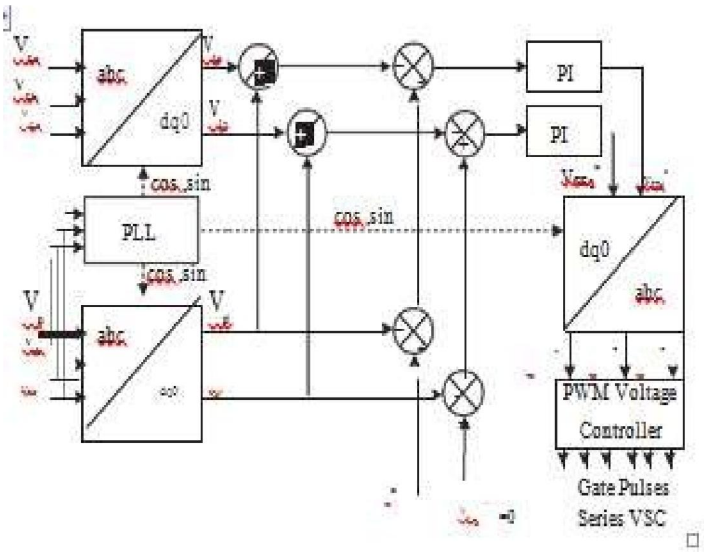

Fig 5. Control Structure of Series Compensator

V. FUTURE SCOPE

Analyze the design and performance of a three-phase PV UPQC under various insolation levels and grid voltage sags/wells. System performance was validated by testing a scaled-down model. PV-UPQC is proven to reduce

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harmonics caused by uneven components and keep the THD of existing grids within the limits of the IEEE 519 standard. The system has proven to be stable during voltage fluctuations, sags/swells and load imbalances. Use moving average filters to improve the performance of d-q control, especially for unbalanced loads. This shows that PV-UPQC is an excellent solution for modern power distribution systems by integrating distributed generation and power quality improvement.

VI. CONCLUSION

This review paper introduces the new capabilities of UPQC as a hybrid renewable energy device with energy management techniques. The simulation results show the efficiency of the power angle control and the efficiency of the distribution equipment filtering device during the entire UPQC reduction test. This approach also ensures a constant/required low voltage of high quality. This document shows how to easily tune serial and parallel APFs without losing the ability to improve power quality and eliminate persistent currents. This scheme shows that a small index of the operating level reduces the maximum value of vibration associated with the current position and the effective forces drawn from that position, and responds to APF. It should be noted that the research results show potential future applications in renewable energy sources and smart grids

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