ABSTRACT

Non-renewable technologies have traditionally been used to satisfy the world's electricity need, however that contributes to increased prices, environmental degradation and global climate change. The power industries now focus and use sustainable forms of electricity, including wind, hydro, tidal and solar and help them to solve the boundaries of conventional energy sources. Solar Photovoltaic (SPV) is apparently increasingly important among renewable energy sources due to its features such as static, noise-free, non-fuel requirements, easy to maintain and ecologically friendly functionalities. The power-conditioning circuitry connects the SPV system to the utility grid. This power-conditioning circuitry has an integrated filtering and grid interconnection functionality. In existing distribution systems, reactive loads like motor drives, fans, pumps and electronic power converter have produced a significant volume of energy usage. Usually such loads drain the lagging power factor sources and thus increase reactive power burden in an electric power distribution network.

Increased reactive power consumption resulted in low capacity, inadequate management of voltage, decreased feeding loss and a decrease in the distribution system's active power flow capability. In the case of non-linear loads, the condition worsens and causes problems with the distribution network with respect to the power output. Power electronic devices are the principal cause of non-linear currents from distribution networks. The deployment of such non-linear charges on the distribution systems results in harmonic current loads and the typical function of the electric machinery attached to the distribution network is disrupted. In order to limit current and vibration harmonic rates, harmonic restrictions and recommendations such as the Institute of Electrical and Electronics Engineers (IEEE) 519-1992 and International Electrotechnical Commission (IEC) 61000 are also applied. The harmonics should be alleviated with harmonic filters to meet these requirements. Both active and passive filters

are used to develop hybrid filters or to eliminate harmonics individually. Traditional power quality reduction device can only fix a particular issue of power quality, and the technology engineers have been drawn to establish competitive and flexible approaches to power quality issues.

Custom Power Devices (CPDs) are a new and very interesting solution category that solves the load current and/or supply voltage imperfections. Several distribution network issues are resolved by CPDs and CPDs to remove many of today's compensation devices which thus rising costs. Static Synchronous Compensator (STATCOM), Dynamic Voltage Restorer (DVR) and Unified Power Quality Conditioner (UPQC) are in the CPD family and are used to mitigate for current and/or voltage waveform power quality issues. The UPQC consists of Active Power Filters (APFs) both in shunt and series. Shunt and series connected APFs are among the best design control devices, which counteract the impact of current and voltage disturbance. The conventional UPQC is not supported by the Distributed Generation (DG). The DC- link of the UPQC is therefore supported by a storage capacitor. The UPQC with a DC-link storage condenser cannot provide long-term compensatory steps against current and voltage-based fluctuations and reactive strain as its storage capacity are insufficient. Since the UPQC utilizes DC power that is retained in the tiny DC-link capacitor during the whole voltage sag/swell, current and voltage harmonics and reactive power burden. The renewable power supply is employed to sustain UPQC's long-term current and reactive demand compensation in the power distribution network to resolve these limitations. The three-phase SPV supported UPQC is employed with the Power Angle Control (PAC) scheme has been proposed in this thesis.

The shunt APF delivers power from DG to associated load in SPV-interconnected UPQC, in addition to the supply of reactive control requests that result in the increase in the Volt-Ampere (VA) burden after its segmentation. The PAC scheme aims at the efficient usage of APFs by exchanging the reactive capacity of VA on APF shunt. The PAC strategy is focused on a simplified Synchronous Reference Frame (SRF) fitted with the Phase Locked Loop (PLL), based on Second Order Generalized Integrator (SOGI), which includes simple and basic equations, dynamic and using proposed UPQC integrated SPV system. SRF based PAC is used to optimize the ratings of the shunt and series APFs to acquire the maximum use rates of the power converters in the UPQC. Presented enhanced PAC scheme based SPV-UPQC has prominent features. This control scheme is used to diminish VA loadings of the proposed SPV-UPQC topology for the various long-lasting compensating processes. The enhanced PAC scheme utilizes a simple method for power calculation and power angle estimation, which does not include the complex calculations. This control scheme has a fast transient responded and it supports large values of power angle. The rating of series APF decides the upper limit on the power angle.

The SOGI-based PLL with the PAC control scheme determines the shunt and series APF reference signals. The SPV power generation system is used to sustain the UPQC's DC-link in the 3-phase 4-wire network for electrical power supply to mitigate current and voltage distortions. Active and reactive power support for the power grid during the compensation operation, the SPV power generation system supports UPQC. In the presence of non-linear and reactive burdens the implementation of the proposed UPQC incorporated by SPV is considered. Under grid disturbs, for example, voltage sags, swells, fluctuations in load and changes in sunshine, the dynamic performance of the SPV-UPQC is tested. Through the digital simulation and system experimental models tests, the feasibility of the proposed control method can be evaluated. The simulation and experimental study outcomes reported for the SRF-PAC control scheme with SOGI-PLL of SPV- UPQC indicate that the compensation is greatly accomplished in voltage sag, swell, and current harmonics.