ABSTRACT
This paper presents a novel control strategy for achieving maximum benefits from these grid-interfacing inverters when installed in 3-phase 4-wire distribution systems. The inverter is controlled to perform as a multifunction device by incorporating active power filter functionality. The inverter can thus be utilized as: A) power converter to inject power generated from RES to the grid, and B) shunt APF to compensate current unbalance, load current harmonics, load reactive power demand and load neutral current. All of these functions may be accomplished either individually or simultaneously. With such a control, the combination of grid-interfacing inverter and the 3-phase 4-wire linear/non-linear unbalanced load at point of common coupling appears as balanced linear load to the grid. This new control concept is demonstrated with extensive MATLAB/Simulink simulation studies and validated through digital signal processor-based laboratory experimental results.

Keywords— power quality (PQ), distribution system, grid interconnection, Active power filter (APF), distributed generation (DG), renewable energy.

I. INTRODUCTION
The increase in air pollution, concerns related to global warming, continuous reduction of fossil fuels and their increasing cost have made it necessary to look towards Renewable Energy Sources (RES) as a forthcoming potential energy solution. In finding solutions to overcome a global energy crisis the Photo Voltaic (PV) system has attracted significant attention in recent years. As the government is providing incentives for further increasing the use of grid connected PV systems the Renewable Energy Sources are increasingly integrated at the distribution level due to increase in load demand utility which utilizes power electronic converters. Due to the massive use of power electronic devices conflicts occur on the electrical supply network where these conflicts are raised due to the use of non-linear devices which introduces harmonics in the power system thereby causing equipment overheating or damaging devices and most often EMI related problems etc. Active Power Filters (APF) is majorly used to compensate the current harmonics and load unbalance which results in the additional hardware requirements. In this paper we propose that the existing PV inverter acts as Shunt Active Power Filter (SAPF) which is capable of simultaneously compensating problems like current unbalance, increase in current harmonics and also injecting the energy generated by RES since the shunt active filter is a voltage source inverter (VSI) that is connected in parallel with load and Shunt Active Power Filter has the ability to keep the mains current balanced and sinusoidal after compensation for various Load conditions. The distributed generation(DG) systems are mandatory to act in accordance with strict technical and regulatory frameworks to ensure safe, reliable and efficient operation of overall network with the advancement in power electronics and digital control technology where the DG systems can now be actively controlled to enhance the system operation with improved power quality (PQ) at PCC but the extensive use of power electronics based equipment and non-linear loads at PCC generate harmonic currents which may deteriorate the quality of power [3], [4]. The paper is being classified into five sections for easy understanding and each section has got its own importance and relevance in the implementation of project and overview of the individual sections is presented below: Section-1: This section gives the introduction to the project constituting overview of the proposed work. Section-2: This section gives the details of the topology used and the components used in the proposed system. Section-3: This section projects the
simulation and tabular results of the whole implementation of proposed work.

Section-4: This section gives the complete list of references used.

II. GRID TIE RENEWABLE ENERGY SYSTEM

The system consists of grid interfacing inverter with the RES and a set of three phase and single phase linear and nonlinear loads. The grid interfacing voltage source inverter delivers the generated power and the RES considered here is a dc source. A shunt active power filter is designed to be connected in parallel with the set of loads to detect the harmonic current. The Active Power Filter (APF) consists of four leg voltage source inverter. The three legs are used to compensate phase currents and one leg is specially designed to compensate the neutral current. The four leg inverter has the advantage of less DC link capacitance and full utilization of DC link voltage. The four leg inverter has eight IGBT switches and switching pulses are provided by using hysteresis controller. The basis block diagram is shown in Fig 1.

IV. RESULTS AND ANALYSIS

Figure 1 where the voltage source inverter is a key element of a PV system as it interfaces the renewable energy source to the grid and delivers the produced power since the Photovoltaic system is connected to grid with an inverter coupled to dc-link where the dc-capacitor decouples the Photovoltaic system from grid and also allows independent control of converters on either side of dc-link.

(a) PROPOSED TOPOLOGY

The active power filters are power electronic devices that cancel out unwanted harmonic currents by injecting a compensation current which cancels harmonics in the line current which is generated and the shunt active power filters compensate the load current harmonics by injecting equal-but opposite harmonic compensating current that is in general in a four-wire APFs have been conceived using four leg converters [5]. This topology has being proved better with respect to controllability [6] than the classical three-leg four-wire here in this paper it is shown that by adapting an adequate control strategy even with a three phase four wire system the topology of the investigated APF and its interconnection with the grid is presented in figure 1 and it consists of a three-leg four-wire voltage source inverter where the VSI operates as a current controlled voltage source in this application and the proposed system is a Three Phase Four wire which consists of Photovoltaic system connected to the dc-link of a grid-interfacing inverter as shown in
V. CONCLUSION

In this paper, the control algorithm for three phase four wire four leg shunt active filter has been proposed to improve the performance of active power filter. The simulation has verified the effectiveness of the control scheme. The simulation results prove that the Neutral current Compensation, Harmonic reduction and Power injection have been successfully achieved under unbalanced load conditions. Further, it has been proved that the PQ
improvement can be achieved under three different conditions. The current unbalance, current harmonics and load reactive power demand are compensated effectively such that the grid currents are always maintained as balanced and sinusoidal at unity power factor. When power generated from RES is more than the load power demand, the grid interfacing inverter delivers power to the grid at unity power factor.

REFERENCES