The Power Quality Improvement with Harmonic Reduction and Stabilizing main Grid

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Abstract - *This study provides a techniques for related power quality improvement of electrical generation, transmission and distribution system. The power system equipment in grid has been operating with deviation from the nominal voltage and frequency supplied the utility. Increase interest in these aspects is due to ever more stringent power quality requirements, deriving from new grid codes and compliance standards, aimed at limiting waveform harmonic distortion at all distribution system. However, power electronics equipment get damaged in case of possible in grid fault. This paper presents a novel control strategy for achieving maximum benefits from these grid-interfacing inverters when installed in 3-phase 4-wire distribution system. 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, grid-interfacing inverter, distribution system, 3-phase 4-wire distribution system, harmonic distortion.*

1. INTRODUCTION

The electric utility environment has not operated with constant voltage and frequency. Harmonics is one of the power quality issues that influence to a great extent transformer overheating, rotary machine vibration, voltage quality degradation, destruction of electric power components. Power quality improvement has been given considerable attention due to intensive use of non-linear loads and the limitations required by international standards such as IEEE519-1992.Those limitations are set to limit the disturbances and avoid bigger problems in power system. Since linear and non-linear single-phase loads are rapidly increasing, zero sequence component and current harmonics are generated. This causes overheating of the associate distribution transformers that may lead to a system is not working, especially in weak networks. Electric utilities and end users of electric power are becoming increasing concerned about meeting the growing energy consumption. 75% of total global energy demand is supplied by the burning of fossil fuels like coal, uranium etc. But increasing air pollution, global warming concerns, diminishing fossil fuels and their increasing cost of all these have made it necessary to look towards renewable sources as a future energy solution. Since the past, there has been an enormous interest in many countries on renewable energy for power generation system. The market liberalization and government's incentives have further accelerated the renewable energy sector development. Renewable energy source integrated at distribution level is termed as distributed generation (DG). The utility is concerned due to the high penetration level of intermittent RES in distribution systems as it may pose a threat to network stability, voltage regulation and power-quality issues. Therefore, the DG systems are required to technical and regulatory frameworks to safe, reliable and efficient operation of overall networks. With the advancement in power electronics technique and digital control technology, the DG systems can be active controlled to enhance the system operation with improved Power Quality at Power Control Centre. However, the extensive use of power electronics based equipment and non-linear loads at Power Control Centre generate harmonic currents, which may go down the quality of power. Generally, current controlled voltage source inverters are used to interface the in distributed system. Recently, a few control strategies for grid connected inverters incorporate power quality solution have been proposed. In an inverter operates as active inductor at a certain frequency to expend the harmonic current. But the exact calculation of network inductance in real-time is difficult and may be out of gear the control performance. A similar approach in which a shunt active filter acts as an active conductance to damp out the harmonics in distribution network is proposed, a control strategies for renewable interfacing inverter based on – theory is proposed. In this strategies both load and inverter current sensing is required to compensate the load current harmonics.

2. SYSTEM DESCRIPTION

The proposed system consists of Renewable energy sources connected to the dc-link of a grid-interfacing inverter as shown in this fig. below. The voltage source inverter is a key elements of a distribution generation system as it interfaces the renewable energy source to the grid and delivers the generated power. The renewable energy source may be a DC source or an AC source with rectifier coupled to dc-link for converting DC supply into an AC supply. Usually, the fuel cell and photovoltaic energy sources generate power at variable low dc voltages, while the variable speed wind turbines generate power at variable ac voltages.

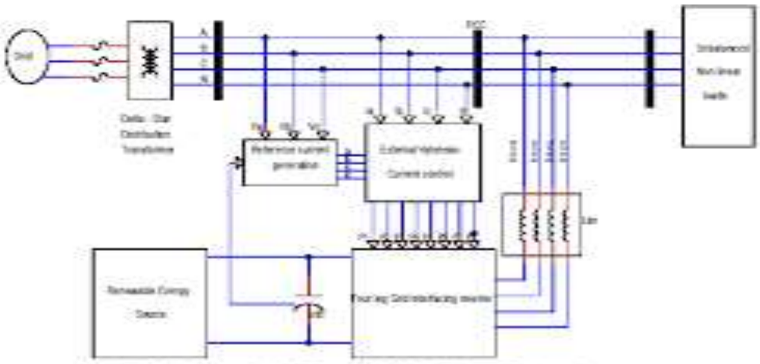


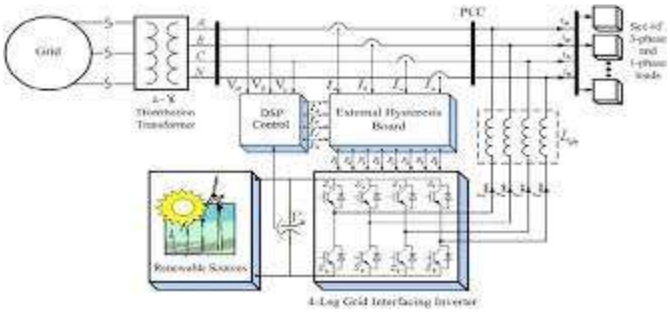
Fig.1 Schematic of Proposed Distributed Generation system

A.DC-Link Voltages and Power Control Operations

Due to the intermittent nature of renewable energy sources, the generated power is in a variable nature. The dc-link plays an important roles in transferring this variable power from renewable energy sources to the grids. Renewable energy source are represented as current sources connected to the dc-link of a grid-interfacing inverters.

B. Control of Grid Interfacing Inverters

In the control diagram of grid-interfacing inverters for a 3-phase 4-wire system, the 4th leg of inverter is used to compensate the neutral current of loads. The aim of proposed approach is to regulate the power supply. While performing the power management operations, the inverter is active controlled in such a way that it always supplies fundamental active power to the grid. If load connected to the Power Control Centre non-linear or the combination of both, the given control approach also compensates the harmonics, unbalance, and neutral current. The duty ratio of inverter switches are varied in a power cycle such that the combination of load and inverter injected in power appears as balanced resistive loads to the grid. The regulation of dc-link voltage carries the information regarding the exchanges of active power in between renewable sources and grid. Thus the output of dc-link voltage regulator result in an active current. The interfacing fig. of this system is given below.



CONCLUSIONS

This paper provide a power quality improvement in grid connected renewable energy sources at distribution by using three phase four wire inverters. The inverter is used to DC to AC at desired voltage level of the grid. Harmonics level of supply current is 28% without filtering, after implementing filter the harmonic level is reduced to 2.94%. The grid interfacing inverter injected real power from Renewable Energy Sources and effectively utilized at lagging demands. The neutral current is prevented to flow to the grid this is done by 4th leg of inverter to compensated neutral current as nearly equal to Zero. The Total Harmonic Distortion level of the grid current is reduced hence improved the power quality.

It is future demonstration the Power quality under 3 different conditions. PRES=0, PRES<total load power (PL); and PRES >PL. The current unbalance, harmonics at distribution system level, and active power support due to unbalance load connected to the distribution system.

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