Design and Implementation of Renewable Energy Based Shunt Hybrid Active Power Conditioner For Power Quality Improvement Under Different And Unbalanced RL Load

DEVARAJAN.S.V

Assistant Professor, EEE, Adhi College of Engineering and Technology, Dr.APJ Abdul Kalam Centre for Research,Chennai, TN, India
devaraja.eee@adhi.edu.in

Abstract

The extreme usage of power electronics devices like Adjustable Speed Drives(ASD), Variable Frequency Drives (VFD) and Computers in the distributed system leads to worsen the power quality by injecting significant harmonics in the utility supply source., This paper presents a Renewable Energy based Shut Hybrid Active Power Filter(SHAPF) system for advancing the power quality in the micro grid by improving utility power factor to unity, compensating reactive power, diminishing source current harmonicsand reducing Total Harmonics Distortion (THD) at the Point of Common Coupling (PPC). As a result power quality can be enriched meritoriously and also supplies energy to Micro Grid by using this topology. Finally A simulation of three phase renewable energy based Shunt Hybrid Active Power filter using PI controller is carried out using MATLAB-Simulink software and simulation results were observed. A single phase prototype model is designed and results were presented to show the validity and effectiveness in enhancement of power quality.

Keywords: Shunt Hybrid Active Power Filter (SHAPF), Total Harmonic Distortion(THD), Adjustable Speed Drive (ASD), Variable Frequency Drives(VFD), Point of Common Coupling(PCC).

INTRODUCTION

Now a day's power and its quality have created major impact in the distribution system. Renewable energy based micro grid become widespread recently due to its wonder full performance and is capable of generating energy from the solar [1]-[2].Energy generated from the solar is connected to the DC/AC voltage source converter (VSC) through a DC/DC boost converter to make the solar system force electric power to the AC source. Generally solar system used specifically to have non-linear load, like computers, LED lamps and all other home appliances, that produces a distorted current [3].

Design and development of a good harmonics compensator is become very essential in this situation that solar system have to provide the utility with distortion compensator with the capability of harmonics currents injection/absorption by utility to be sinusoidal [5]. Hence harmonics compensation operation can be appreciated by flexible control of DC/AC VSC. Instantaneous power theory has been effectively completed the active power filter designing with good performance [6]. However, the solar-APF arrangement is just gradually advanced for several years [7]. This arrangement has the ability to compensate power factor, current balance and current harmonics concurrently and also injects the energy produced by solar with low total harmonic distortion (THD). Even there is unavailability of energy from solar system, this arrangement ensures utility power quality[8]. In this study, solar system requires energy storage elements, it additionally increases the total cost. Moreover the mathematical model was not adequately afforded. Thereafter some efforts were taken to improve the control methods for solar based inverters with injection of real power andAPF [9]-[10]. However, their research had not been showed the consistency in results attained by their theories and they are valid only for a single phase system. The paper [11] which is recently published, uses current references in DC/AC controller; it matches with the fundamental ideas of this paper. In other hands the proposed Solar system - APF controller employs power references demonstrates some substantial developments in theory and simple control techniques. The Solar cell - APF system benefits the utility supply with a non-linear load, a unity power factor and a pure sinusoidal current by producing the oscillating and imaginary components. When there is surplus power, the solar unit will inject only average power to the utility. Therefore, this system be considered as a distributed APF, which is a better solution than adopting passive filters [12].

Identified and Unidentified Harmonic Producing Loads

Non-linear loads drawing non-sinusoidal currents from utilities are classified into identified and unidentified loads. High- power diode / thyristor rectifiers, cyclo converters, and arc furnaces are typically characterized as identified harmonic producing loads because utilities identify the individual non-linear loads installed by high – power consumers on power distributions systems in many cases.

The utilities determine the Point of Common Coupling (PCC) with high- power consumers who will install their own harmonic producing loads on power distribution systems, and also can determine the amount of harmonic current injected from an individual consumer.

A single low power diode rectifier produces a negligible amount of harmonic current. However, multiple low–power diode rectifiers can inject a large amount of harmonics into power distributions systems. A low power diode rectifier used as a utility interface in an electric appliance is typically considered an unidentified harmonic – producing load.

The proposed method here consists of dc link inverter fed drives and diode rectifier fed load can be treated as harmonic producing loads, which is considered as identified harmonic producing loads. Figure 1 shows the harmonic producing load model.