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Review on Microgrid Power Quality Improvement Using Active Power Conditioner

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ABSTRACT

This paper discusses power system power quality issues and possible remedies using power electronics. Several worldwide standards for power quality control are briefly discussed, as well as some significant methods for analysis. Non-sinusoidal waveforms are introduced and assessed in an electrical circuit. The compensatory features and principles of operation of passive filters, shunt, hybrid, and series active power filters are presented. For each type of power filter, the topologies and control schemes of various power circuits are examined. Simulation and experiment are used to prove the compensating features of each topology with its corresponding control scheme. Harmonic current, power factor, and load unbalance can all be compensated for by the filter. Harmonic current, power factor, and load unbalance can all be compensated for by the filter. A power filter that has been employed there continuously monitors the load current and adapts to changes in load harmonics.

Keywords: Microgrid, Power quality (PQ), Shunt active power Filter, Total harmonic distortion (THD).

I. INTRODUCTION

Now-a-days with the advancement in technology there is a drastic improvement in the semi-conductor devices. With this development and advantages, the semi-conductor devices got a permanent place in the power sector helping to ease the control of overall system. Moreover, most of the loads are also semi-conductor-based equipment. But the semi-conductor devices are non-linear in nature and draws non-linear current from the source. And also, the semi-conductor devices are involved in power conversion, which is either AC to DC or from DC to AC. This power conversion contains lot of switching operations which may introduce discontinuity in the current. Due to this discontinuity and non-linearity, harmonics are present which affect the quality of power delivered to the end user. In order to maintain the quality of power delivered, the harmonics should be filtered out. Thus, a device named Filter is used which serves this purpose.

There are many filter topologies in the literature like- active, passive and hybrid. In this project the use of hybrid power filters for the improvement of electric power quality is studied and analysed.

Increase in such non-linearity causes different undesirable features like low system efficiency and poor power factor. It also causes disturbance to other consumers and interference in nearby communication networks. The effect of such non-linearity may become sizeable over the next few years. Hence it is very important to overcome these undesirable features.

Classically, shunt passive filters, consist of tuned LC filters and/or high passive filters are used to suppress the harmonics and power capacitors are employed to improve the power factor. But they have the limitations of fixed compensation, large size and can also exile resonance conditions.

Active power filters are now seen as a viable alternative over the classical passive filters, to compensate harmonics and reactive power requirement of the non-linear loads. The objective of the active filtering is to solve these problems by combining with a much-reduced rating of the necessary passive components.

II. LITERATURE REVIEW

To overcome the problems caused by harmonics, filters are used. There are different filter topologies present in the literature for this purpose. At first passive filters are used but they are dependent heavily on the system parameters. They also have the problems of resonance with system impedance and are suitable for filtering out a particular frequency harmonic. Therefore, to overcome the problems of passive filters, active filters are used. These are used since 1970"s to compensate the reactive power, negative sequence currents.

The use of active power filters for power quality improvement is discussed in [2]. In this paper a review of active filter configuration for power quality improvement is presented along with control strategies. It is found that the active filters are facing some drawbacks when employed for power quality improvement. They are High converter ratings are required, Costlier when compared to its counterpart, passive filter, huge size, Increased losses.

Therefore, to overcome these drawbacks a hybrid power filter which is a combination of active and passive filters is proposed in [3]. This paper discusses how a combination of both active and passive filters is an economical solution for power quality improvement. To enhance the characteristics of passive filter and also the system, the active filter should be controlled properly. There are different control techniques for this purpose.

The main aim of any control technique is to make active filter inject a voltage in to the system that compensates the harmonics. To achieve this output voltage of the active filter is controlled such that it is equal to a pre-calculated reference value. The active filter is controlled better with instantaneous reactive power theory. This is presented in [4] and it discusses the different control algorithms from the formulations of instantaneous reactive power theory. Finally, it concludes that vectoral based theory yields better results with sinusoidal currents when compared with other algorithms.

The control of series active in conjunction with shunt passive filter using dual instantaneous reactive power vectoral theory is presented in [5]. In this paper the proposed theory is validated by simulating it in MATLAB SIMULINK environment. The proposed control strategy is simulated for both balance and unbalanced load conditions.

The study of a new control technique for three-phase shunt hybrid power filter scheme is studied by author, in that scheme three phase shunt hybrid power filter was used [6]. The author present improvement of power quality by means of unified power quality conditioner with the use of PID and fuzzy logic controller into the power system for harmonic deformation through the use of fuzzy logic controller technique is used [7]. it has proposed in PLL with PI, PID and Fuzzy Logic Controllers based Shunt Active Power Line Conditioners the three phase 415v,50hz supply given to the system the harmonics will reduces from the system [8]. The author shows that Shunt Active Power Line Conditioners for compensating harmonics and reactive power which is very useful to calculate total harmonic distortion in source current [9].

A hybrid passive filter configuration for VAR control and harmonic compensation scheme was proposed, the author the control strategy is based on the vectoral theory dual formation of instantaneous reactive power [10]. In this paper the author gives an sliding mode of control of selective and THD in voltage and current under non sinusoidal environment, which is proficient to reduce the harmonics of the power system [11].

Hybrid Active Filter for Reactive Power and Harmonics Compensation in a distribution Network by using this method the author reduces the THD in the system [12]. In this paper Compensation strategies performance comparison of shunt active filter and hybrid active filter used for improving the power factor of the system [13]. Active and passive filtering for harmonic compensation theory was proposed in which the control technique is based on the instantaneous reactive power theory for improvement of the power factor and to reduce total harmonic distortion to standard limits [14].

In [15], an adaptive fuzzy low pass filter for harmonic extraction has been proposed to ameliorate the performance of APF. three phase APF based on SRF theory with SVPWM control was proposed in [16]. PQ theory, active and reactive currents theory performance was studied under unbalanced voltage system in [17]. Study of PQ, SRF, constant active and reactive power theory, constant (unity) power factor algorithm, sine multiplication theory has been proposed in [18]. Sliding mode-based DC voltage controller for grid current's peak detection was proposed by [19]. The use of self-tuning filter in unbalanced distorted grid voltage conditions (STF) has been proposed by [20, 21, 22, and 23]. PQ, SRF, and modified PQ theory were studied in [23].

III. SHUNT ACTIVE POWER FILTER

Figure 1 depicts a shunt active power filter diagram. At the Point of Common Coupling, a shunt active power filter is connected in parallel (PCC). PCC refers to the point where the source and load meet in the middle. In most cases, the active power filter is used.

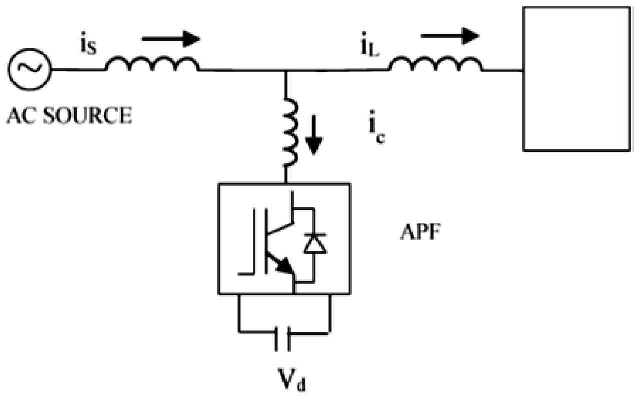

Fig 1: Shunt active power filter

The active power filter usually has an inverter structure, which can be either a voltage source inverter (VSI) or a current source inverter (CSI). Because CSI has some limitations, most of them choose VSI-based shunt active power filters. A dc link capacitor is linked to the VSI's output terminal, acting as an energy storage element and utilized to maintain a constant DC voltage with small ripple in steady state. In order to obtain better correction, the capacitor's dc link voltage must be maintained constant. This is accomplished by the use of a PI controller, which operates in a closed loop.

IV. CONCLUSION

The study of various types of filter systems is described in this research, which deals with difficulties linked to harmonics in power system networks. Several worldwide standards for the control of power quality issues are briefly presented, as well as several significant tools for electrical analysis. Non-sinusoidal waveform circuits are introduced and assessed. These tools are useful in the implementation of control algorithms for filters, among other things. Finally, new virtual impedance algorithms allow linking many active powers in the same power grid to run autonomously in decentralised microgrids, much like generation systems sharing load power. The active filters can help to improve power quality, increase grid dependability, and make dispersed microgrids more practicable.

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