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POWER QUALITY IMPROVEMENT BY USING ACTIVE FILTER-SAVING ENERGY

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ABSTRACT

In this paper deals with problems related with harmonics in power system network. Several international standard issues to control power quality are briefly described and some important methods to analyses Electrical Circuit with non-sinusoidal waveforms are introduced and evaluated. Shunt, hybrid and series active power filters are described showing their compensation characteristics and principles of operation .Different power circuits topologies and control scheme for each type of active power filter are analyzed. The compensation characteristics of each topology with respective control scheme are proved by simulation and experimentally. The filter can compensate for harmonic current, power factor and load unbalance. Active power filter which has been used there monitors the load current constantly and continuously adapt to the changes in load harmonics.

Keywords: **-** Active Power filter, Harmonics compensation, Power factor correction, Power quality.

I. INTRODUCTION

Power quality determines the fitness of electric power to consumer devices. Synchronization of the voltage frequency and phase allows electrical systems to function in their intended manner without significant loss of performance or life. The term is used to describe electric power that drives an electrical load and the load's ability to function properly. Without the proper power, an electrical device (or load) may malfunction, fail prematurely or not operate at all. There are many ways in which electric power can be of poor quality and many more causes of such poor quality power.

The quality of electrical power may be described as a set of values of parameters, such as:

•Continuity of service

•Variation in voltage magnitude

•Transient voltages and currents

•Harmonic content in the waveforms for AC power [1].

A power-quality problem is an occurrence manifested in a nonstandard voltage, current, or frequency deviation that results in a failure or a disoperation's of end-use equipment. Power quality is a reliability issue driven by end users. There are three concerns. The characteristics of the utility power supply can have a detrimental effect on the performance of industrial equipment [2]. A power quality problem exists if any voltage, current or frequency deviation results in a failure or in a bad operation of customer's equipment. So, for the better performance of the system it should be free from harmonics. For that purpose filters are used. There are so many types of filters such as active filter, passive filter, high pass filter, low pass filter etc. In that high-pass filters present disadvantages due to the resistance connected in parallel to the inductor, which increases the filter losses and reduces the filtering effectiveness at the tuned frequency. Conventionally, Passive LC filters were used to compensation of current harmonics. But, there are some limitations of using only passive filters such as fixed compensation, large size,

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bulkiness, occurring series and /or parallel resonance problem etc. To overcome these limitations combination of active and passive filters are used. In this paper a Series active with passive shunt filter is discussed. Series active with passive shunt filter topology is implemented with three phase PWM inverter connected in series with power lines and resonant LC passive filter are connected in parallel with power lines [3]. "Power quality" is defined as —the concept of powering and grounding electronic equipment in a manner that is suitable to the operation of the equipment in a manner that is suitable to the operation of that equipment and compatible with the premise wiring system and other connected equipment.

Power quality has become a strategic issue for the following reasons:

1. The economic necessity for businesses to increase their competitiveness.
2. The widespread use of equipment which is sensitive to voltage disturbances and /or generates disturbances itself.
3. The deregulation of the electricity market. In this context, it is essential for the utility and the customers to prevent and detect power quality problems and to have solutions available to fix them.
4. The power quality correction and harmonic filtering system give solution to solve the problems of harmonic disturbances and voltage fluctuations [4].

II. POWER QUALITY IN POWER DISTRIBUTION SYSTEM

Most of the more important international standards define power quality as the physical characteristics of the electrical supply provided under normal operating conditions that do not disrupt or disturb the customer's processes. Therefore, a power quality problem exists if any voltage, current or frequency deviation results in a failure or in a bad operation of customer's equipment. However, it is important to notice that the quality of power supply implies basically voltage quality and supply reliability. Voltage quality problems relate to any failure of equipment due to deviations of the line voltage from its nominal characteristics, and the supply reliability is characterized by its adequacy and availability. Power quality problems are common in most of commercial, industrial and utility networks. Natural phenomena, such as lightning are the most frequent cause of power quality problems. Switching phenomena resulting in oscillatory transients in the electrical supply, for example when capacitors are switched, also contribute substantially to power quality disturbances. Also, the connection of high power non-linear loads contributes to the generation of current and voltage harmonic components. Between the different voltage disturbances that can be produced, the most significant and critical power quality problems are voltage sags due to the high economical losses that can be generated. Short-term voltage drops (sags) can trip electrical drives or more sensitive equipment, leading to costly interruptions of production. For all these reasons, from the consumer point of view, power quality issues will become an increasingly important factor to consider in order satisfying good productivity. On the other hand, for the electrical supply industry, the quality of power delivered will be one of the distinguishing factors for ensuring customer loyalty in this very competitive and deregulated market. To address the needs of energy consumers trying to improve productivity through the reduction of power quality related process stoppages and energy suppliers trying to maximize operating profits while keeping customers satisfied with supply quality, innovative technology provides the key to cost-effective power quality enhancements solutions. However, with the various power quality solutions available, the obvious question for a consumer or utility facing a particular power quality problem is which equipment provides the better solution [5].

IMPORTANCE OF POWER QUALITY

Power quality is an increasingly important issue for all businesses. Problems with powering and grounding can cause data and processing errors that affect production and service quality.

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•LOST PRODUCTION: Each time production is interrupted, your business loses the margin on the product that is not manufactured and sold.

•DAMAGED PRODUCT**:** Interruptions damage a partially complete product, cause the items to be rerun or scrapped.

•MAINTENANCE: Reacting to a voltage disruption can involve restoring production, diagnosing and correcting the problem, clean up and repair, disposing of damaged products and, in some cases, environment costs.

•HIDDEN COSTS: If the impact of voltage sag is a control error, a product defect may be discovered after customer delivery. The costs of losing repeat sales, product recalls and negative public relations can be significant and hard to quantify [6].

III. POWER QUALITY PROBLEMS

Power quality problem exists if any voltage, current or frequency deviation results in a failure or in a bad operation of customer's equipment. One more problem is harmonics. Harmonics are produced due to non linear load. A classification method for power quality problems in electrical power systems to improve the electric power quality, sources of disturbances must be known and controlled. Power quality disturbance waveform recognition is often troublesome because it involves a broad range of disturbance categories or classes. This is a study of power quality problem classification using wavelet transformation and artificial neural networks. After training neural networks, the weight and bias is obtained for using to classify the power quality problems. The combined wavelet transformation with neural networks is able to classify all 6 types for power quality problems correctly [7].

SOLUTION OF POWER QUALITY PROBLEMS

The problems of power quality are diverse both in nature and also in terms of the power systems that must be considered. From high-voltage transmission systems to domestic supply problems due to natural phenomena and interference from polluting loads call for a very wide range of solutions. These solutions are now becoming available with the development of new and larger solid-state switching devices. This paper discusses some of the devices available to combat power quality problems including: static VAR compensators; STATCOM (static compensators); system interconnection using DC link; UPFC for power flow control; active filters; dynamic voltage restorers for voltage sag mitigation; energy storage; and the premium power park. There are two approaches to the mitigation of power quality problems. The first approach is called load conditioning, which ensures that the equipment is less sensitive to power disturbances, allowing the operation even under significant voltage distortion. The other solution is to install line conditioning systems that suppress or counteracts the power system disturbances [8].

POWER QUALITY IMPROVEMENT BY USING ACTIVE FILTER

Active filtering of electric power has now become a mature technology for harmonic and reactive power compensation in two-wire (single phase), three-wire (three phase without neutral), and four-wire (three phase with neutral) AC power networks with nonlinear loads. This paper presents a comprehensive review of active filter (AF) configurations, control strategies, selection of components, other related economic and technical considerations, and their selection for specific applications. It is aimed at providing a broad perspective on the status of AF technology to researchers and application engineers dealing with power quality issues [9].

Shunt active power filter compensate current sees the non linear load and the active power filter as an ideal resistor. The current compensation characteristic of the shunt active power filter is shown in Figure.

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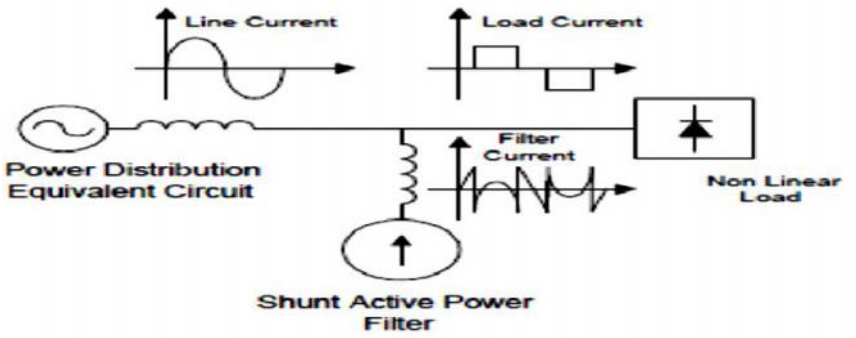

Fig. 1 Compensation characteristics of a shunt active power filter

Shunt active power filters are normally implemented voltage applications. Also, active power filters implemented with multiple VSI connected in parallel to a dc bus but in series through a transformer or in cascade has been proposed in the technical literature.

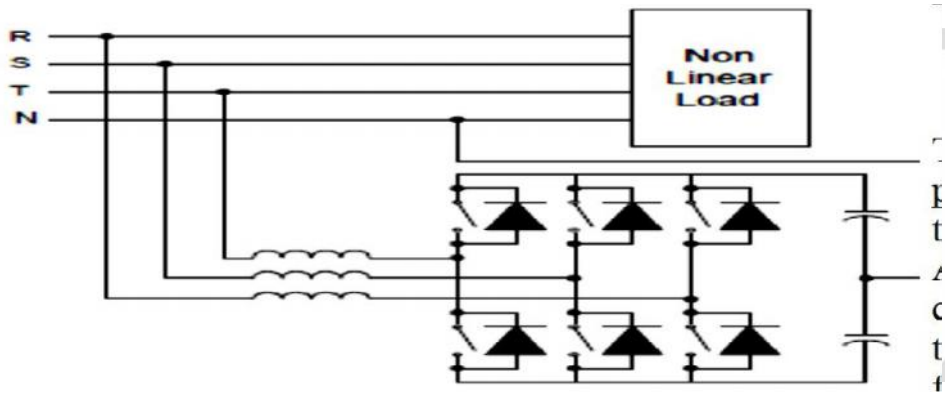

Fig. 2 PWM voltage-source inverters

Shunt active power filter topologies implemented with PWM voltage-source inverters the use of VSI connected in cascade is an interesting alternative to compensate high power non- control scheme.

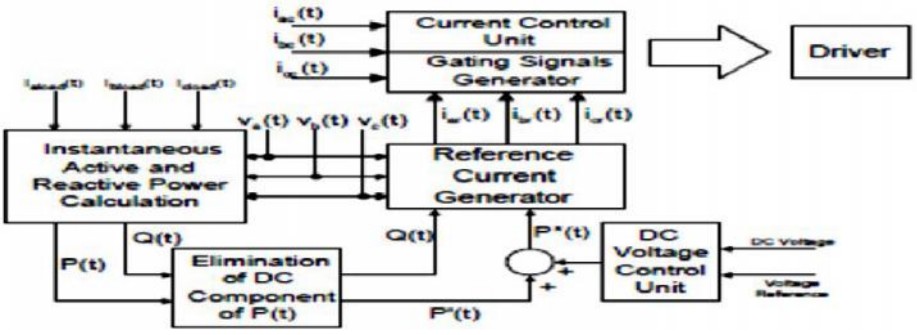

Fig. 3 The block diagram of a shunt active power filter

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IV. CONCLUSION

Harmonic distortion is a main cause of power quality degradation. For elimination of harmonics active filters are used. Because there is are some disadvantages of passive filter. Improve the compensation characteristic of passive filter. It eliminates the problems of using only a shunt passive filter. Also it improves the behavior of passive filter. It allows the use of active power filter in high power application at relatively low cost. Compensation characteristic of series active and shunt passive filter do not depend upon system impedance. It is achieve due to using Victoria power theory.

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