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Three Phase Five Level Inverter Based Shunt Active Filter For Power Quality Enhancement

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ABSTRACT

Interest of using shunt active power filters is increased in recent years. This paper presents an innovative synchronous reference frame (SRF) controlled five-level and seven-level cascaded multilevel inverter based shunt active filter for power line conditioners (PLCs) to improve the power quality in the distribution system. Synchronous reference frame is used to control reactive power and harmonics compensation due to non-linear loads. The cascaded multilevel inverter is controlled by the triangular wave produced by the SRF. PI controller is used to maintain almost constant under transient and steady state condition.

INTRODUCTION

The power quality and custom power have been hot topics because of the widespread use of nonlinear electronic equipment such as diode/thyristor rectifiers, switched mode power supply (SMPS), welding equipment, incandescent lighting, and motor drives are degrading power quality in transmission and distribution grid systems. These non-linear loads result in harmonic or distortion current and create reactive power problems. Harmonic suppression and reactive power compensation are essential for the construction of smart grid, which gathers, distributes, and acts on the behavior of suppliers and consumers in order to improve the efficiency and sustainability of electric services. With the increasingly widespread application of power electronic device, such as electronic appliances, switching model power supplies and electronic ballasts, the harmonic contamination they produce in grid has given rise to a variety of safety concerns.

In a comparative study, the traditionally proposed LC passive filter could only absorb harmonic waves of a specific frequency, whereas the active power filter (APF) is capable of handling harmonics ranging between fluctuating frequencies and simultaneously maintaining a good compensative performance These harmonics induce malfunctions in sensitive equipment, overvoltage by resonance,

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increased heating in the conductors and harmonic voltage drop across the network impedance that affects power factor. Traditionally passive filters have been used to compensate harmonics and reactive power; but passive filters are large in size; aging and tuning problems exist and can resonate with the supply impedance. Recently active power line conditioners (APLC) or active power filters (APF) are designed for compensating the current-harmonics and reactive power simultaneously.

For single-phase power systems with sinusoidal voltages and sinusoidal currents, quantities such as active power, reactive power, active current, reactive current, power factor, etc., are based on the average concept. Many contributors have attempted to redefine these quantities to deal with three-phase systems with unbalanced and distorted currents and voltages. Among them, Akagi et al. have introduced an interesting concept of instantaneous reactive power. This concept gives an effective method to compensate for the instantaneous components of reactive power for three-phase systems without energy storage.

However, this instantaneous reactive power theory still has a conceptual limitation as pointed out in the theory is only complete for three-phase systems without zero-sequence currents and voltages. To resolve this limitation and other problems, Willems proposed an attractive approach to define instantaneous active and reactive currents. His approach, however, is to deal with the decomposition of currents into orthogonal components, rather than with power components. Nonlinear loads such as diode/thyristor rectifiers, switched mode power supply (SMPS), welding equipment, incandescent lighting, and motor drives are degrading power quality in transmission and distribution grid systems.

These non-linear loads result in harmonic or distortion current and create reactive power problems. These harmonics induce malfunctions in sensitive equipment, overvoltage by resonance, increased heating in the conductors and harmonic voltage drop across the network impedance that affects power factor. Traditionally passive filters have been used to compensate harmonics and reactive power; but passive filters are large in size; aging and tuning problems exist and can resonate with the supply impedance.

Recently active power line conditioners (APLC) or active power filters (APF) are designed for compensating the current-harmonics and reactive power simultaneously. The controller is the most significant part of the APF topology and extensive research is being conducted to improve its control strategy. The problem of harmonic pollution has not become increasingly serious owing to the wide use of nor-hear loads. Conventionally, this problem can be solved by using passive filters whose main components are inductors and capacitors. Although this Lund of filter has the advantage of low hardware cost, the performance of this configuration is often significantly affected by system impedance and load characteristics. Besides, the salient problems including large volume, parallel resonance and series resonance may further offset the benefits of this method.

Some special designs for performance improvement have been suggested for the passive filters. However, their circuits are often complicated due to consideration of the varied power system impedance and load characteristics. With the emergence of power electronics, an active power filter that helps suppress the harmonics and upgrade the power quality was recently developed. Th~sp roposal was mainly based on the theory of harmonic current injection. In the circuit operation, the current-controlled power converter generates the harmonic current that is opposite to the load harmonic current injecting into the power feeders. Hence, the current harmonics can be effectively suppressed and only the fundamental component of load current is extracted. In other words, the active power filter can also be regarded as a harmonic current source that is allocated in parallel with the power system. Therefore, the notorious resonance problems can be easily avoided.

EXISTING SYSTEM:

This paper investigates mitigation of current harmonics using different configuration of cascaded multilevel inverter based shunt hybrid active power filter (SHAPF) and to improve power quality of the system.

The main objective of this paper is to develop and analyze the compensation characteristics of cascaded multilevel inverter based shunt hybrid active power filter by employing indirect current control algorithm.

The indirect current control algorithm is employed to generate reference current and phase disposition pulse width modulation technique is incorporated to generate gating signal for shunt hybrid active power filter strategy.

PROPOSED SYSTEM

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An innovative synchronous reference frame (SRF) controlled five-level and seven-level cascaded multilevel inverter based shunt active filter for power line conditioners (PLCs) to improve the power quality in the distribution system. Synchronous reference frame is used to control reactive power and harmonics compensation due to non-linear loads. The cascaded multilevel inverter is controlled by the triangular wave produced by the SRF. PI controller is used to maintain almost constant under transient and steady state condition.

CONCLUSION

The DC voltage used for inverter is obtained from non-renewable energy source. Thus obtained output AC of inverter contains harmonic content this harmonics are compared in SRF theory to produce a signal which is used as reference to compensate source harmonics. A comparison is illustrated between APF employing normal inverter and APF employing multilevel inverter. It is shown that APF employing multilevel inverter is more effective than APF employing normal inverter.

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