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Shunt Active Power Filter Based On Cascaded Transformers Coupled Withthree-Phase Bridge Converters

L.LINGARAJ SURESH , M.TECH (POWER SYSTEM), PRIST UNIVERSITY,THANJAVUR

ABSTRACT

In this paper five level Diode clamped and Cascaded H-bridge multilevel inverter based shunt APF is presented. Traditional two levels Shunt APF has disadvantage that its switching frequency is very high causing high switching losses. Also voltage stress on each switch is high equal to grid voltage. Multilevel inverters (MLI) have advantage of they can operate on low switching frequency; so switching losses are low.

The dv/dt stress on each device is very low. Also, in high voltage system high rating transformer is required with APF which causes high cost and bulky system. But application of multilevel inverter in active filters effectively reduces harmonics in high voltage system without use of transformer. T

The reference compensating currents are generated using Instantaneous Reactive Power Theory (P-Q Theory). Sinusoidal pulse width modulation scheme is implemented to generate switching signals.

INTRODUCTION

In recent years, the use of power electronics devices has been tremendously increased, with this the problem of power quality distortion also increased. The increased use of custom power devices which uses large number of power electronic switches, like IGBTs in UPS systems and transistors in computers, diode or thyristor bridges etc. work as non-linear loads. They draw non-sinusoidal current. So they introduce large number of harmonics in supply mains. Lots of literatures are available, which discusses above problems and techniques to mitigate these problems. Passive filters which use passive elements like L-C can be tuned to compensate a particular harmonic order or it may be used as high pass filter. As these techniques use passive elements, the system becomes bulky, costly and less attractive.

Also, they require frequent maintenance of capacitors, therefore, efficiency is low. On the other hand, active power filters (APF) effectively mitigates any order or range of harmonics. As they uses converters composed of switches, any shape of waveform can be generated just by switching. As they uses converters composed of switches, the system uses less number of passive elements. So, the system becomes cost effective, more attractive and efficient. Numbers of types of APFs are available, like Series APF, Shunt APF and UPQC etc. Shunt active power filter (Shunt APF) is used to compensate source current harmonics as well as to supply reactive power. Series APF is used to mitigate voltage harmonics. UPQC is able to mitigate voltage as well as current distortions. Large numbers of control techniques are developed by last two decades considering Shunt APF. They can be categorized as:

Two level inverter used for current harmonics mitigation works on very high switching frequency (> 10 KHz), so switching losses may very high. Also dv/dt stress on each switch is very high. Multilevel inverters enjoy advantages of reduced dv/dt stresses; therefore Electromagnetic Compability (EMC) problems can be reduced. Multilevel converters can operate at both fundamental switching frequency and high switching frequency PWM. [24] It should be noted that lower switching frequency usually means lower switching loss and higher efficiency. Also, in high voltage system high rating transformer is required with two levels APF which causes high cost and bulky system.

But application of multilevel inverter in active filters effectively reduces harmonics in high voltage system without use of converter topologies have been available, like Diode Clamped, Cascaded H-Bridges, Flying capacitor multilevel inverter. In this paper simulated results of Diode-Clamped and Cascaded H-Bridge multilevel inverter based Shunt APF are presented. P-Q theory is used for reference current generation. Sinusoidal Pulse Width Modulation (SPWM) technique is used for pulse generation. The efficiency of an APF is higher than as of a shunt passive filter, because the real power consumed by the APF is much smaller. Unlike the shunt passive filters, there is no need of connecting multiple branches for mitigation of several harmonic orders at once. One single APF is capable of mitigating up to a practical 30th–50th harmonic order, meeting the actual harmonic standards and regulations. Furthermore, the APFs can protect themselves against voltage imbalance and predistortion and keep the same good quality of the compensated harmonic current.

The harmonic compensation with APF is expected typically 5%–7% total harmonic distortion (THD*i*), while, with a passive filter, the THD*i* is within 10%–15%. However, the costs involved (i.e., equipment, installation, maintenance) of an APF are higher as compared to typical passive filters. To minimize the cost and retrofit existing passive-power filter installations, various types of hybrid topologies were introduced and successfully implemented in recent years. The hybrid filters mitigate the harmonic currents relatively well, and their cost is reduced as compared to a pure active-filter solution because of lower power-inverter rating. In spite of all these advantages, the hybrid filter is suitable for applications where there is a need of reactive-power compensation, just like in the case of the passive filter. The amount of reactive power is fixed from design stage according to the maximum demand and difficult to control, because it depends on the installed capacitors.

For adjustable speed drives (ASDs) based on frontend diode rectifier, the current displacement is close to unity; therefore, the use of hybrid filters is of a little interest because of the risk of generating leading power factor. In order to increase the value proposition of an APF without changing its design, one may further develop the control, including more features in terms of power-quality regulation, such as compensation of voltage unbalance, dips, swells, flickers, and damping network resonances. Nevertheless, any of the above increases even more the cost of harmonic mitigation, because the APF's inverter must carry a higher power.

EXISTING SYSTEM:

A l shunt active power filter (SAPF) based on cascaded transformer coupled with three-phase-bridge (TPB) converters is proposed .Such a structure is generalized for K-stages in which K transformers are coupled with K-TPB converters.

The transformers arrangement permits the compensator to use a single dc-link unit which simplifies the control strategy and number of sensors. Equivalent multilevel operation is achieved with reduced number of semiconductors devices if compared to conventional H-bridge (HB) one. The multilevel waveforms are generated by TPB converters by using suitable PWM strategy associated with the transformers turns ratio.

The modularity and simple maintenance makes proposed SAPF an attractive solution in comparison with some conventional configurations. Model and PWM control are presented

PROPOSED SYSTEM

A five level Diode clamped and Cascaded H-bridge multilevel inverter based shunt APF is presented. Traditional two levels Shunt APF has disadvantage that its switching frequency is very high causing high switching losses. Also voltage stress on each switch is high equal to grid voltage. Multilevel inverters (MLI) have advantage of they can operate on low switching frequency; so switching losses are low.

CONCLUSION

The shunt APF based on Diode-clamped and Cascaded H-Bridge multilevel inverter is implemented. Both the topologies can eliminate harmonics in supply system satisfactorily. But both of these have some advantages & disadvantages. Cascaded H-Bridge multilevel inverter doesn't require balancing circuit but it requires separate dc sources (capacitors) for each of the H-bridges.

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