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A Hybrid Statcom With Wide Compensation Range And Low Dc Link Voltage

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ABSTRACT

Problems related to power quality, which in the last years were responsible only for small losses in low-voltage distribution systems, are now causing damage to power apparatuses and financial losses also in medium-voltage systems. The necessity of a better quality of power supply encourages the development of new specific custom power devices directly connected in medium-voltage distribution systems.

It is well know that the multilevel converters are capable of being installed directly in the medium voltage, and presents several advantages when compared with conventional two-level converters. Some topologies, like the asymmetric cascaded multilevel converter, presents difficulties in regulating the voltages of all isolated dc-link capacitors.

In this context, presents an asymmetric nineteen-level D–STATCOM (Distribution Static Synchronous Compensator) with a reactive power and dc-link regulation control loops for generic cascaded multilevel converters in order to improve the power quality in medium-voltage distribution systems. The performance of the proposed control method for a multilevel D–STATCOM is presented and evaluated in a downscaled prototype.

INTRODUCTION

The increasing energy demand and the industrial plants modernization brought together an increasing number of power-electronics devices directly connected to the medium-voltage distribution systems. Several of these devices are assembled with diodes or thyristors, which cause severe distortions on voltages and currents, degrading the power quality and causing serious problems in distribution networks. Furthermore, the semiconductors have physical limitations on voltage and current, which restrict their use in high-power, high-voltage applications. Currently, these limits are 8 kV and 6 kA. Therefore, the use of a multilevel converter helps to minimize all these issues for medium-voltage applications.

Multilevel converters present many advantages when compared with conventional two-level converters, such as capacity to operate in high-voltage levels, smaller semiconductors devices and higher number of voltage levels in the output voltage. Moreover, multilevel topology also presents a lower total harmonic distortion (THD) and allows a reduction of switching frequency. Thus, the use of multilevel topologies combined with power quality conditioners, such as Static Synchronous Compensator (STATCOM, can improve power quality and efficiency in distribution systems. Several multilevel topologies have been reported in the last decade. The Neutral Point Clamped Converter (NPC) is the most mature technology among all available multilevel topologies. There are two converter topologies that might compete with the NPC: the Flying Capacitor Converter (FC), and the Symmetric or Asymmetric Cascade H-Bridge Converter (CHB). The symmetric CHB is one of the most promising topologies because it uses fewer components then the NPC and FC topologies for a same number of voltage levels in the ac output voltage.

The symmetric CHB topology can also be used in Modular Multilevel Converters (MMC). Recently, a variation of the symmetric CHB was proposed by means of chopper-cell modules instead of H-Bridge modules. As an example, Siemens already uses a half-bridge MMC topology known as HVDC PLUS for applications up to 1,000 MW. In this context, many works have been reported dealing with comparisons between several multilevel topologies. Although all multilevel topologies have similar performance, only the Asymmetric CHB is capable of producing the same output-voltage level with a minimum number of power semiconductors.

In order to achieve a better performance for the multilevel converters, not only the selection of the best multilevel topology for a specific application is important, but also the selection of an efficient switching strategy related to that topology should be taken into account. Several studies have contributed with a variety of switching methods for each converter topology. Recently, the carrier-shifting modulation method was proposed, claiming to produce the optimum harmonic cancellation for a symmetric multilevel converter. Another one, the phase-shifted PWM (PS-PWM) modulation was conceived for FC and CHB converters and introduces a phase shift between the carrier signals of contiguous cells. Different from

PS-PWM, the level-shifted PWM (LS-PWM) is a method where carries are arranged in vertical shifts.

Variations in the carriers arrangement results in different switching techniques, like the phase disposition PWM (PD-PWM), the phase opposition disposition PWM (POD-PWM), and the alternate phase opposition PWM (APOD-PWM). All those techniques are mainly applied to the symmetric multilevel converter and the NPC converter. For asymmetric multilevel converters, the best modulation method is the hybrid modulation that uses different frequencies for each power module. This allows a reduction in switching frequency, which leads to a reduction in the converter losses.

EXISTING SYSTEM:

To overcome the shortcomings of different reactive power compensators for transmission systems, this paper proposes a hybrid-STATCOM that consists of a thyristor-controlled LC part (TCLC) and an active inverter part.

The TCLC part provides a wide reactive power compensation range and a large voltage drop between the system voltage and the inverter voltage so that the active inverter part can continue to operate at a low DC-link voltage level.

The small rating of the active inverter part is used to improve the performances of the TCLC part by absorbing the harmonic currents generated by the TCLC part, avoiding mistuning of the firing angles, and preventing the resonance problem.

PROPOSED SYSTEM:

The necessity of a better quality of power supply encourages the development of new specific custom power devices directly connected in medium-voltage distribution systems. It is well know that the multilevel converters are capable of being installed directly in the medium voltage, and presents several advantages when compared with conventional two-level converters.

An asymmetric nineteen-level D–STATCOM (Distribution Static Synchronous Compensator) with a reactive power and dc-link regulation control loops for generic cascaded multilevel converters in order to improve the power quality in medium-voltage distribution systems.

CONCLUSION

An independent and improved dc-voltage control capable of regulating the isolated capacitors of an asymmetric converter, where a general solution for controlling different values of dc-voltages in

an asymmetric multilevel converter does not exist. This solution adds an active-voltage component with different amplitude for each module to the reactive compensating voltage reference, leading to the desired control for each dc-voltage.

This paper presents an independent and improved dc-voltage control capable of regulating the isolated capacitors of an asymmetric converter, where a general solution for controlling different values of dc-voltages in an asymmetric multilevel converter does not exist. This solution adds an active-voltage component with different amplitude for each module to the reactive compensating voltage reference, leading to the desired control for each dc-voltage. Furthermore, the asymmetric converter uses an enhanced hybrid modulation, proposed by the authors, reducing the switching losses without compromising the optimized harmonic cancelation.

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