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Investigative uses of overmodulation techniques in modular multilevel cascaded converter

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ABSTRACT

Sinusoidal pulse width modulation (SPWM) is a method to generate the switching gate pulse of the converter. Overmodulation is a method where the modulation index exceeds the unity value and the system goes into the nonlinear region. To maintain the system in a linear region when operating in the overmodulation region, some techniques are developed. These techniques helped to operate the system in the linear range. Medium and high-power energy conversion systems mostly use a modular multilevel cascaded converter (MMCC), which has been an issue improving significantly in recent years. In this article, MMCC-based overmodulation techniques are compared with conventional PWM and analyzed on DC bus utilization (DBU), and total harmonic distortion (THD). MATLAB/Simulink digital platform used demonstrate overmodulation technique.

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1. INTRODUCTION

A modern transmission and distribution system faces an increasing demand for large power with superior quality and excessive reliability at minimum cost. As we move towards renewable energy sources, more attention is on the efficient use of traditional and non-traditional energy sources. Energy efficiency is the implementation of using the least energy to provide the same amount of useful output in service [1]. The most effective controlling and modulation techniques introduced for this type of inverter are multilevel Sinusoidal pulse width modulation (SPWM), multiple particular harmonic eliminations, and space vector pulse width modulation (SVPWM) for the Modular multilevel cascaded converter (MMCC) scale-up controlling technique, in which more no. of sub-modules can be proposed by a small progressive group of sub-modules [2]. The MMCC has achieved substantial awareness and growth owing to its optimistic benefits such as superior output performance, higher modulation parameters, easy expandability, and low level of current and voltage rating demand for the power converter switches [3], [4]. The analysis for reliability is executed to differentiate the performance indices of the MMCC-based conventional modulation methods and scale-up controlling techniques [5].

For medium or high-power energy conversion systems, the MMCC has become more important. Significant research has been conducted in recent years to overcome the technical issues involved with the MMCC's functioning and control [6]-[8]. The MMCC outperforms typical two-level and multilevel