EFFECT OF VOLTAGE STRESS ON RELIABILITY OF THE 3-LEVEL ANPC MULTILEVEL INVERTER FOR WIND TURBINES

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Abstract

Wind power with low or no greenhouse gas emissions has been highly prevalent over the last decade. Modern renewable energy systems rely heavily on power electronic devices such as multilevel converters (MLC) to integrate renewables into the grid or provide electricity to islanding loads. These converters' power electronic switches have a high failure rate (approximately 34 percent). As a result, the reliability evaluation of these converters is vital. Most research has focused on developing a fault-tolerant, efficient and cost-effective topology that reduces components. Still, the reliability of these topologies has received relatively little attention. This paper studies the effect of voltage stress on three-level Active Neutral Point Clamped (ANPC) multilevel inverter reliability. The series redundancy is introduced in ANPC using redundant outer switches, making ANPC a fault-tolerant topology. The reliability of this fault-tolerant topology is compared with the fault-intolerant ANPC. The voltage stress factor is calculated for fault intolerant and proposed fault-tolerant ANPC topologies. Because of the reduced stress on the switches and redundant configuration of the outer switches, the proposed fault-tolerant ANPC is more reliable. The fault-tolerant topology proposed in this paper has the lowest voltage stress factor, resulting in better reliability.

Keywords: **Active Neutral Point Clamped (ANPC) multilevel inverter, Fault-tolerant topology, Multilevel converters, Reliability evaluation**

Introduction

Every year, the world's demand for electrical energy rises, and large-scale projects in renewable energy sources have been underway for years. The wind is one of these sources. Wind turbines ranging in output capacity from a few kW to 5MW in today's powerful turbines transform the wind's kinetic energy into electrical energy. And the goal is to increase output power even further in the future. Present wind turbines are designed to work with varying wind speeds and, as a result, variable rotor speeds. High-power inverters consisting of power electronics modules are used to achieve this. These inverters change a variable-frequency voltage into a voltage with a fixed output frequency (Mads, 2008). Due to the increase in the penetration of renewable like wind and solar, power electronic converters has drawn significant importance. In islanding mode, converters must integrate these renewable into the utility grid or deliver electric power to AC loads (Agelidis, 1998).

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