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Title: Study and Implementation of Multicell Converters Using Intercell Transformers for Application to Power Cable Diagnostic

Abstract

The purpose of this study is the design of a new application for parallel multi-cell converters. The aim is to setup a portable system that can inject a high current (several Amps current) within 2 s in the conducting core of a HVDC cable, and determinate the distribution of electrical space charge through the insulation using the Thermal Step Method (TSM). The proposed structure will be constituted of paralleled coupled multiphase buck converters using InterCell Transformers (ICT). A dimensioning theoretical approach of planar intercell transformer based on the magnetic core saturation condition is presented. The proposed method is based on calculating a generalized expression on the magnetic flux density matrix for any number of cells. Permutation method is used in order to reduce the magnetic core volume. Its principle is to reduce the flux concentration in the magnetic core by modifying the phase-shift of two successive cells.

Finally, the experimental prototype (12 cells 30 kW power converter) using cyclic planar ICT is designed and tested. The converter is used to generate regulated current pulses of 1200 Amps (its operating mode is similar to a current source). Experimental results (thermal step current measurements) are includes in order to confirm the ability of using the proposed solution for power cable dielectric characterization.

Keywords: Interleaved converters - intercell transformer - magnetic coupling - HVDC cable - thermal step method - ultracapacitor.