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Dielectric characterization of non-linear materials subjected to high DC and transient stresses

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In the recent years, HVDC extruded cables have been increasingly used for environmental as well as economical reasons. The use of extruded HVDC cables generally allows offering systems operating at higher conductor temperature and leading to substantially reduced manufacturing and laying costs as compared to the classic HVDC technology. The HVDC extruded cables have been most often associated with new generation conversion systems based on IGBT electronics and pulse width modulation. However, high frequency ripples or switching surges resulting from the operation of voltage source converters, and eventually lightning impulses, can induce high electric stresses at the interfaces between the extruded cables and their accessories that could cause a failure of the cable insulation.

In order to withstand DC as well as transient conditions, the interface extruded cable / accessory can be improved by applying a transition layer between the XLPE insulation and the rubber accessory. This layer typically consists of non-linear materials blended in a rubber matrix. This paper aims at dealing with the dielectric characterization of such compounds. Various materials were investigated at several applied electric fields and temperatures and over a wide spectrum of frequencies.

The authors propose a methodology to characterize non-linear dielectrics based on DC and impulse voltage measurements. The output parameters were introduced in multi-physics FEM models and were found to be highly relevant to carefully design accessories for HVDC extruded cables applications.