KTH Electrical Engineering

Dielectric response and partial discharge measurements on stator insulation at varied low frequency

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Abstract

This is a study of potential improvements of diagnostic methods used on high-voltage generators and motors. It considers offline electrical measurements on the main insulation of stator windings, where a sinusoidal voltage is applied between the winding and the stator-core, and the total current through the insulation (dielectric spectroscopy, DS) and the rapid current-pulses arising from discharges (partial discharge, PD) are measured.

The proposed methods differ from existing practice in industrial DS and PD measurements in that the applied voltage is varied in amplitude and in frequency, harmonics of the voltage and current are measured, and the DS and PD measurements are made simultaneously, with comparison of results. Based on literature, models and measurements, the problems and advantages of these methods are assessed in this work.

Harmonics provide a way of separating linear and nonlinear sources of current, and reveal the waveform of the current. Measurement of total PD charge by DS methods provides complementary information to the conventional PD measurement; the difference in results between these types of measurement is shown by literature and experimental results to be large. Simultaneous measurement allows direct comparison of the relation between the DS and PD results, and saves time compared to separate measurements. The varied frequency, down to the millihertz range, provides additional information about the insulation. Much of the potential for DS methods on machine insulation is spoiled by the end-winding stress grading. Models and measurements of the currents in this grading are presented, with discussion of how much effect the disturbance has and how well it can be predicted by modelling.

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