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Influence of test voltage shape and frequency on PD-activity of defects in XLPE-insulated medium voltage cables

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Abstract

Onsite PD measurement of XLPE-insulated medium voltage cable systems becomes more and more important. Due to the high capacitive load, alternative test voltage frequencies and shapes are often used.
The PD behaviour of a defect medium voltage cable joint is investigated at sinusoidal and cosine-rectangular test voltage. PD measurements on this joint are presented at variable voltage shape and frequency. PD fingerprints as well as PD pulse rates are considered.

Résumé

La mesure de décharges partielles sur les câbles MT à isolation PR sera de plus en plus importante. A cause de la charge capacitive du câble MT, des formes alternatives de tension d'essai sont utilisées. Le comportement en décharges partielles dans une jonction défectueuse sous différentes formes de tension est examiné. Un schéma ϕ-q-n' et la vitesse de répétition des décharges partielles sont présentés.

Introduction

Measurements of Partial Discharges (PD) are one of the most important diagnostic techniques used for high voltage insulation systems nowadays. For medium voltage cables it is well known that the expenditure for the generation of the test voltage at service frequency is large due to the high amount of reactive power. However, this can be effectively reduced by lowering the test voltage frequency or by changing the shape of test voltage. (e.g. to 0.1 Hz sine or cosine-rectangle). Since there is only little knowledge about the change of PD patterns and other PD parameters with frequency or shape of the test voltage, a very-low-noise high-voltage source was developed which is able to provide a free programmable voltage shape in the frequency range from DC up to 1 kHz with 60 kVpeak and a current of 100 mApeak. PD measurement results obtained with this technique on a defect joint are presented in the paper.

Test sample

The test sample is a joint of a 12/20kV medium voltage XLPE-insulated cable. It is constructed as a hot shrinking joint. Some of the shrinking layers of the joint did not keep the specified parameters, so that they did not shrink enough. Thin volumes were formed between these layers where PD take place already at service voltage.

In laboratory, this lead to a breakdown of that joint (after the PD measurements were performed) during a voltage step test as well as it was the case for other joints in service having the same construction fault.

System for PD measurements

The measurement setup consists of a very low noise high voltage source, a coupling circuit for the PD signal with an oscilloscope which digitizes the signal, and a Personal Computer (PC) with software for recording and visualization of the PD activity. Please refer also to fig. 1 for the high voltage source.
The high voltage test generator has already been described in [1] and [2]. It was recently completely redesigned and is now able to generate test voltages up to 60 kV_{peak} with a maximum current of 100 mA_{peak} in the frequency range from DC to 1 kHz. Any test voltage shape within this range can be