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On-line partial discharge detection and classification by pattern recognition on HV terminations

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Résumé
Il existe divers principes de détection des caractéristiques des décharges partielles basées sur une fréquence très élevée (VHF) . KEMA utilise deux approches différentes, l'une basée sur le couplage inductif et l'autre sur la technique d'interruption. Un mesurage relatif à la phase permettant la reconnaissance de schémas par ordinateur est possible. Des mesurages sur le terrain sont effectués afin de construire une base de données pour schémas de décharges partielles dans les éxtrimités. Ceci a résulté dans la possibilité de distinguer et de reconnaître les schémas mesurés sur site fondés sur cette base de données.

Abstract
Various principles to detect PD's based on very high frequency (VHF) characteristics exist, KEMA utilises two different approaches: one based on inductive coupling and one on an interruption technique. A phase resolved measurement is possible, which enables pattern recognition by computer. In order to build up a database for PD patterns in terminations, field measurements are performed. This resulted in the possibility to discriminate and recognise at-site measured patterns based on this database.

Introduction

In the early 90-s, some breakdowns of 150 kV XLPE cable terminations in The Netherlands were reason to identify the background of these breakdowns. Among others, it was clearly shown that these breakdowns were a consequence of electrical treeing in the interfaces of the cable and stress-cone. Moreover, it was shown that this electrical treeing already took place in a period of many weeks or maybe even months before the final breakdown occurred. These findings were reason to develop a partial discharge measurement technique that is able to diagnose these terminations at-site (on-line).

Since 1998, pattern recognition of the partial discharges is added to the 'traditional' partial discharge measurements. Pattern recognition is applied in order to have a better understanding of the background of the defects causing the partial discharges. The classification of partial discharges can help to identify the defects and its severity.

For the evaluation of a single measurement of a cable accessory, it is important to have a database that contains data from known defects. When the number of measured accessories is large, it is possible to compare the signals mutually to identify various groups of partial discharge patterns. This mutual comparison can be used to classify the condition of a particular cable termination.

Description of systems used

VHF PD Detection system Partial discharges (PD's) can be considered as electromagnetic pulses with a frequency spectrum up to 100's of MHz. This implies that a PD pulse can be considered as a travelling wave along the cable. Because of the semi-conductive layers in an XLPE cable, the higher frequencies are attenuated severely. Detection techniques based on these high frequencies are only effective close to the PD source. This, in fact, is an advantage because these techniques are focused on detecting PD's at accessories. The attenuation makes a clear discrimination between different accessories possible.

Various principles to detect PD's based on very high frequency (VHF) characteristics exist, KEMA utilises two different approaches: one based on inductive coupling and one on an interruption for high frequencies in the metallic screen of a cable [1, 2]. The inductive coupling technique, not used for the measurements referred to in this paper, can be used