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Partial discharge measurements on service aged medium voltage cables at different frequencies

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Abstract: For testing high capacitive objects like cables or generators the applied frequency of the high voltage is often not the rated power line frequency PLF. The necessary capacitive power for charging the device under test is limited by choosing e.g. a very low test frequency VLF of 0.1 Hz.

The aim of this contribution is to compare the results of partial discharge measurements at PLF and VLF with respect to the needs of on site diagnosis. Comparative measurements have been carried out on different test samples.

Keywords: Diagnosis, Partial discharge, Medium Voltage Cable, VLF, Inception voltage

Résumé: Pour essayer des matériels fortement capacitifs comme des câbles, la fréquence adoptée n'est souvent pas la fréquence minimale du réseau (PLF).

La puissance capacitive nécessaire pour charger le dispositif en essai peut être limitée en choisissant une très basse fréquence à 0,1 H_2. Le but de cette contribution est de comparer les résultats des mesures de décharges partielles en PLF et en VLF.

Des essais comparatifs ont été effectués sur différents échantillons.

Mots clés: Diagnose, Décharge partielle, VLF

1. Introduction

1.1 Aim of this paper

Diagnosis of cable systems is necessary to gather information on risks in operation. Diagnosis with very low frequency VLF test systems is well introduced and accepted for detecting potential defects by water trees in polymer cables. The main information is gathered by measuring the dissipation factor tan δ at different voltages. Most relevant for estimating the present condition of cable insulation is the absolute value as well as the rate of rise of dissipation factor Δtanδ versus the testing voltage.

Cables actually are still in good condition, if tan δ (2 U_o) < 1.2 ‰ and [tan δ (2 U_o) minus tan δ (U_o)] < 0.6 ‰.

Cables in bad condition (or to be replaced immediately) if tan δ (2 U_o) ³ 2.2 ‰ or [tan δ (2 U_o) minus tan δ (U_o)] > 1.0 ‰. [13]

Single defects are neither detectable nor located by tan δ measurement. Here partial discharge measurements have to be carried out. Still under discussion is the relevance of results at different test frequencies. This paper shall focus on characteristic PD measurements on service aged polymer cables. Results are compared with some results on model test installations. Experience with detecting faults on site by PD measurements on installed cable systems is presented.

1.2 General remarks on diagnosis

The aim of diagnostic measurements is to localize and to judge potential defects. Insulation without pre-damages shall not be endangered.

The insulation status of components and systems may be investigated by applying voltages comparable to the normal long term or short term operating stress with possibly increased test levels. This is a basic principle of insulation coordination. Other kind of stress like deviation in the voltage wave shape is acceptable if the result drawn from this for diagnosis purpose is comparable or better.

Routine tests for quality assurance in factory laboratories are typical insulation coordination tests. The stress of insulation during these tests shall be high enough to check the withstand capability. Voltage levels are chosen to levels which are admissible for extremely short period of time on non pre-stressed components.