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Optimised Cable End Termination Systems for Laboratory Tests on MV, HV and EHC Cables

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Abstract: The general design of cable test terminations with deionised water has been known for more than 30 years. The principle is the electric field control by using deionised water with a specific conductivity. A new series of cable end termination systems rated from 75 kV to 1000 kV AC with a modern, computer controlled water conditioning unit will be presented. Optimised calculated and designed shielding and guard electrodes allow both a PD free operation of the end terminations and an exact measurement of PD and $\tan\delta$. With a modern PLC concept a fully automatic control of the conductivity, temperature, filling and emptying process of the deionised water is realised.

Keywords: Cable testing, Water end termination, HV withstand test, PD and $\tan\delta$ measurement

1. Introduction

High-voltage (HV) tests on plastic-insulated cables are mainly performed with AC voltages of power frequency in accordance with the most common valid standards (e.g. [1]). The tests in the laboratories are executed on short cable samples and long delivery lengths within the framework of development, type, sample and routine tests on cables of all voltage levels from MV up to EHV. To check the cable insulation strength and its quality HV withstand tests, mostly combined with Partial Discharge (PD) or Dissipation Factor ($\tan\delta$) measurements, are performed.

While the electric basic field within the cable is a slightly inhomogeneous one, the field on the cable ends is characterised by locally very high field strengths of a strongly inhomogeneous field distribution. This prevents decisive HV tests on cables. Therefore the electrical field distribution on the cable ends has to be improved by a suitable field control, which is realised by the cable end termination. The

Résumé: La conception des extrémités de câble refroidies par l'eau déionisée sont bien connues depuis plus de 30 ans. Le principe est le réglage du champ électrique par application de l'eau déionisée d'une conductivité adaptée. Une série nouvelle d'extrémités pour les tensions de dimensionnement de 75 kV jusqu'à 1000 kV avec un poste de traitement d'eau contrôlé par ordinateur sera présentée. Les électrodes de blindage et de réglage bien adaptées aux extrémités permettent l'opération des extrémités sans DP et aussi la mesure précise des DP et du coefficient de dissipation. Avec la conception d'une commande automatique le réglage de la conductivité et de la température de l'eau et aussi le remplissage et la vidange de l'eau déionisée sont réalisés.

Mots clés : Essais des câbles, Extrémité de câble refroidie par l'eau, Essai à haute tension, Mesure des DP et du coefficient de dissipation

requirements on end terminations for cable testing are:

- suited for AC and impulse voltage as well as for PD and $\tan\delta$ measurement
- no source of disturbing signals at PD and $\tan\delta$ measurements
- easy and fast operation, assembling and dismantling of the end terminations
- repeated application for a long time
- ability to communicate with „intelligent“ control systems of HV test systems
- little consumption of cooling and pumping capacity
- low acquisition and operating costs.

The best compromise so far regarding these requirements is represented by water end terminations. These terminations are filled with deionised water of a specific conductivity. The water acts as forced resistive control and smoothes down the strongly inhomogeneous electrical field on the cable ends.