INVESTIGATION ON THE TECHNOLOGIES FOR DEFECT LOCALIZATION AND CHARACTERIZATION ON MEDIUM VOLTAGE UNDERGROUND LINES

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ABSTRACT

This study is based on the CORPRES project led by the utility Iberdrola and focused on improving the reliability of underground power lines of polymeric insulated Medium Voltage (MV) cables using the latest cable diagnosis technologies, mainly the analysis of partial discharges. The main concern is to detect and locate specific defects produced during the installation of the cable and of its accessories. The ageing of the cable is not considered in this research.

A real-scale test bench was built expressly to analyze the validity and the precision of each of the technologies available for the detection of defects and their location in underground cables, fundamentally through the analysis of partial discharges.

The voltage sources applied, the acquisition systems and the data analysis procedure were the basic differences between the different technologies used, which were: very low frequency (VLF), 50Hz resonant, resonant at variable frequency and damped alternating voltage (DAC). All the measurements were carried out by experts in each technology.

The results show important differences between technologies when we compare the results for the same specific defect and when we compare all the defects on the cables and their accessories.

This article describes the configuration of the test bench circuit and the criteria followed on designing the defects. A review of the technologies used was carried out with the aim of describing the main differences. The results obtained were analyzed from the point of view of the detection and of the location of defects. Finally, some processes were proposed for the standardization of the measuring equipment and procedures based on the results obtained.

KEYWORDS

Partial discharges, underground cable, underground cable accessories, time domain reflectometry.

INTRODUCTION

As the network expands and ages it is important to maintain its reliability. For this the utilities and the regulations of each country are developing test criteria for the commission and maintenance of cable systems.

Partial discharge tests are becoming the most appropriate tests for the commission of new cable systems, replacing the previous DC tests.

The partial discharge tests of cables systems on the field can be carried out using different types of energization sources, mainly very low frequency (VLF), 50Hz resonant, 20-400Hz variable frequency resonant and damped alternating voltage (DAC). The commercial units available on the market fixed the relationship between the measuring units and the high voltage sources used.

During the CORPRES project all these partial discharge analysis technologies were tested and compared on a test bench specially designed for this purpose. The objective was to verify the behaviour of the different field technologies used to detect defects in the cable installations.

The main objectives were: to establish the typology of defects caused during the installation of the cable and of its accessories, build a work bench reproducing this typology, and compare the technologies and the detection levels achieved by the latter.

WORK BENCH AND DESCRIPTION OF THE DEFECTS

As explained above, the first step was to establish the most common typology of defects caused during the installation of the cable and of its accessories. Using the historical data file of Iberdrola Distribution and the experience of the workforce, a catalogue of commonly found defects was obtained (see table 1).

Defects on joints	Example photos
Irregular cut of external semiconductor	
Longitudinal cut on the insulation	
Incorrect shape of the cable ends