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On-Line Cable Diagnostic Possibilities in an Artificial Aging Environment

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Abstract. Since more than a decade the development of reliable and accurate diagnostic tools for power cables is in the centre of interest of scientists and power utilities. With the developments in our power systems, like the increasing feed-in of renewable energy sources, several issues could be additionally generated, such as extreme concurrence factors, short- and long-duration variations, voltage imbalances, waveform distortions, voltage fluctuations and power frequency variations. These impacts affect the aging rapidity of the electrical equipment and finally of the entire the electrical distribution network. Using appropriate diagnostic methods, it is possible to determine the electrical equipment's condition. The significance of the results depends on the quality of the measurement system and of the data interpretation. Based on these results, a reliable maintenance and investment strategy could be made, and the reliability of the grid could be improved. With this goal, an accelerated aging project for MV PILC (paper insulated lead covered) cables was started. A specially designed aging system for the accelerated aging of MV cables has been developed to point out the most relevant aging parameters, their limits, their development and to upgrade the accuracy of the MV cable diagnostics in this way. In this paper, the diagnostic possibilities, mainly the dielectric loss factor measurement and its dependence on environmental influences are presented.

Key words

diagnostics, aging, cable, partial discharge, loss factor.

1. Introduction

Cables and their equipment represent one of the major investments for power supply companies. In addition, cables and sleeves are a frequent source of damages and accordingly a source of network faults and supply discontinuities. Since unexpected cable faults in MV cable networks appear more frequent, a lot of scientific research has been directed to determine the remaining cable life time (time to the first failure). In many cases only partial discharge measurement and analyses are used for the prediction of failures, their localization and selective replacement of defective cable sections. Thus far there are some diagnostic systems on the market developed for XLPE (cross-linked polyethylene) cables. In case of lead shielded cable types, these prediction systems do not deliver reliable prognostic data because the physical and chemical backgrounds are not comparable. In the future,

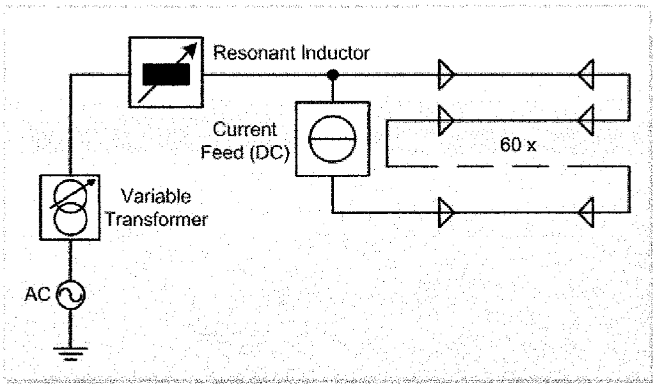

Fig. 1: Simplified structure of the ICAAS

the specific losses in the insulation system and therefore the loss-factor could be utilized as an indicator for the quality and status of the isolation material. Besides the PD-level-analyses, loss-factor measurements and other more specific and sophisticated criterion could build up a fundamental basis for the development of an accurate remaining lifetime diagnostics. Unlike to XLPE-cable analyses, where the PD-level is already a significant indicator for the cable status, PILC cables need an additional criterion. Because of their physical characteristics, the PD-

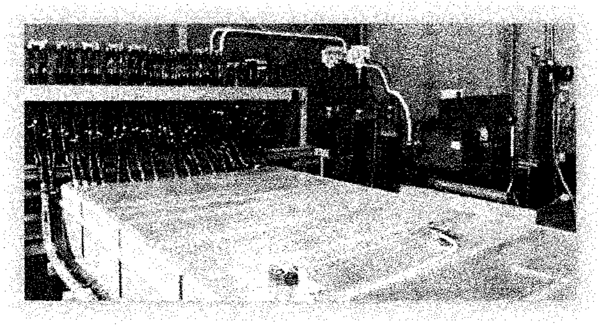

Fig. 2: The test site: cable samples, current transformer and rectifier, voltage source