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# Medium voltage cable testing by partial discharge location : A comparative discussion of field generated diagnostic results

MASHIKIAN M., HAN C., ZIEGLER S., IMCORPTtm, Storrs, USA

**Résumé**

Ce rapport présente une méthode de diagnostic basée sure le principe de la localisation des D.P. dans les câbles et accessoires lorsqu'ils sont soumis à une tension alternative 50-60 Hz supérieure à la tension de service. Il décrit l'instrument de mesure ainsi que les critères qui conduisent à identifier et évaluer la sévérité des D.P.. Sont présentés aussi les résultats obtenus suite à des tests sur site en Amérique du Nord et en Europe. Ces résultats concordent parfaitement avec les statistiques de défaillances collectés par les exploitants câbliers. A l'occasion, nous établirons un comparatif avec les résultats obtenus par d'autres méthodes de diagnostics. Finalement, nous présenterons les réticences et appréhensions de certains exploitants, et les facteurs pouvant affecter un bon diagnostic.

**Abstract**

The paper covers a diagnostic test method based on the location of partial discharge (PD) generated in a cable or its accessories when subjected to a 50-60Hz ac excitation voltage exceeding operating level. It briefly describes the instrument and the criterion used to assess PD severity. It presents results obtained in field tests performed in North America and Europe and shows how these match historic failure data compiled by cable owners. Whenever available, it draws comparisons with test results obtained by means of other diagnostic test methods. Finally, it discusses cable owner concerns and factors which may adversely affect test results.

## Introduction

### Statement of Need

In order to meet the competitive challenge created by free market electricity supply, the utility industry has to reduce the cost of its product, maintain high service reliability and improve customer satisfaction. In underground distribution circuits, this goal can be accomplished by insuring a low service outage rate and a controlled capital and operating expenditure. Assuring the quality of new and service aged installations by means of a non-invasive, predictive diagnostic test should help enhance reliability and reduce cost.

### Diagnostic Testing

Diagnostic tests can be divided into two broad categories aimed at (a) assessing the general condition of the cable system insulation or (b) locating discrete defects most likely to cause near-term failures in service. Several methods belonging to the first category have been reported [1,2,3]. They are generally based on polarization-relaxation dielectric phenomena. These methods require prior establishment of signature files for the various cable systems and are effective only for service-aged cables. The test results may correctly distinguish a very good from a very bad cable, but tend to often lead to ambiguous interpretation when they fall in the "gray" area between these two extremes. Recommendations based on these results tend to be conservative, assigning for replacement cables that are still serviceable. Defects in accessories, such as joints and terminations, known to be responsible for a significant proportion of service failures, cannot be identified by means of these tests.

### Partial Discharge Location

Partial discharge (PD) location is a diagnostic test method designed to pinpoint the sites of defects where near-term service failures are likely to occur. Defects may be introduced during the installation of a new system both in the cable and in its accessories. These lead to eventual failure if partial discharges were to occur repeatedly during operation. As a cable ages in service, its insulation system gradually deteriorates. The degradation is not uniform throughout its length. Failures tend to occur at the discrete sites of defects with the highest severity. In cables utilizing modern extruded dielectrics, deterioration can be manifested by the formation of large microcavities, microcracks, water trees and, ultimately, electrical trees. In paper insulated, lead covered (PILC) cables, oil-poor butt spaces and soft sections can be encountered both in the