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Practical experience in partial discharge site location of XLPE cables using a digital discharge detector

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Abstract

In recent years partial discharge detector designs a have been introduced that employ powerful microprocessors that can easily automate the routine control features of partial discharge detectors. Of particular interest to the manufacturers of power cable is the exact location of partial discharge sites so that the damaged sections may be removed. This paper describes a new partial discharge site location system that has been incorporated into a modern, digital partial discharge detector. The paper also presents site location data which demonstrates the accuracy of the system under normal factory conditions.

Résumé

Récemment, la mesure des télécharges partielles a utilisé la puissance des microprocesseurs pour automatiser le process. Ce qui intéresse les constructeurs de câbles est la localisation précise des sites DP afin de remplacer les tronçons endommagés. Cet article écrit un nouveau system de localisation des DP intégré dans un détecteur numérique de DP. Cet article présente aussi des éléments de validation de la précision du système.

Introduction

The current trend for manufacturers of MV and HV power cable is to produce longer lengths with lower partial discharge levels. In the USA, the desire to produce "master" lengths of MV cable ranging up to 5000 meters is driven by the demand for reducing the costs of production and to eliminate joints in cable installations. Since partial discharge testing is universally required according to the standards [1] any PD activity above the acceptance levels will cause the production length to be rejected. To find a defect, some manufacturers simply cut the rejected cable in half and retest each section until the defect was isolated. This is a time consuming and expensive process as the cable ends need to be terminated for each test. Often sections of good cable are scrapped unnecessarily using this technique. Electronic PD site location devices utilizing the transmission line characteristics [2] of coaxial power cable have been used [3] for some time with varying degrees of success. In general, the interpretation of test results using electronic PD site location systems has required a high degree of operator sophistication.

The commercially available electronic site location techniques all exploit the principal that a partial discharge pulse will travel in both directions in a cable from the fault [4]. By measuring the difference in time from the direct recording of the pulse to the time of arrival of the reflected pulse from the far end of the cable, the distance to the defect can be calculated knowing the propagation velocity of the cable or its length. For the most part, first and second generation partial discharge site locating apparatus has consisted of a digital recorder such as a commercial digital oscilloscope which used cursors to measure the time between somewhat difficult to read pulses manually. Automation of the "reading" process helped to advance the efficiency of such systems but interpretation of results required a skilled operator with experience in observing cable defects. Even with skilled operators, attenuation of the PD pulse and degradation of the rise time make measurements difficult. Early systems also have the problem of identification of multiple sites within a cable and they also are not optimized for finding sites at the cable ends

The system described in this paper advances the state of the art by adding a purpose built analog to digital converter to a previously developed, PC based, digital PD detector [5]. The system is controlled by a patented [6] software system that results in overall automation. that is fast and easy to use for inexperienced test personnel.