



B.3.3. Un essai de vieillissement accéléré à 500 Hz pour évaluer l'effet de l'eau sur les câbles

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B.3.3. An accelerated ageing test on the basis of 500 Hz for water treeing in cables

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Résumé

Dans le présent article, les auteurs présentent et discutent des résultats de recherches approfondies en laboratoire par le groupe de travail CIGRE 21-11, avec pour objectif de trouver un essai de vieillissement accéléré en quatre mois pour l'arborescence dans des câbles pleins. Une cellule d'essai a servi à évaluer l'efficacité d'un nombre de paramètres de vieillissement et les conditions, y compris la fréquence de 500 Hz, ont été prouvées efficaces dans le contexte de la réduction en ruptures électriques et en arborescence. Des essais complémentaires sur les câbles ont confirmé que la fréquence de 500 Hz fournit une accélération comparée à celle de 50 Hz, sans toutefois qu'il y ait des changements apparents au niveau du mécanisme de vieillissement, en comparant des câbles à entretien bon et mauvais. Sur la base des essais et du résultat du travail effectué, les auteurs considèrent que 3000 heures d'essai à 500 Hz, 5 kV/mm et 30°C est une option prometteuse dans le domaine de l'arborescence des câbles. Pour obtenir plus d'expérience dans ce domaine, ils pensent qu'il est recommandable d'analyser l'efficacité d'un essai 500 Hz sur une large gamme de câbles et de matériaux. De plus, une étude de 6000 heures et des essais prolongés à 50 Hz ainsi que l'usage d'un gradient de température ont également été recommandés.

Abstract

In this paper, the authors present and discuss the results of extensive laboratory investigations carried out by CIGRE Working Group 21-11 with the object to find a 4 month accelerated ageing test for water treeing in full size cables. A test-cell was shown to have ageing characteristics comparable to those of cables produced with the same materials and was therefore accepted as a feasible alternative to cable to assess accelerated ageing parameters. The test-cell was used to evaluate the effectiveness of a number of ageing parameters and a set of conditions, including 500 Hz frequency, was found to be effective with respect to reduction in electrical breakdown strength and water tree growth. Subsequent cable tests confirmed that 500 Hz provided acceleration compared to 50 Hz for bad service cables, without any apparent change in ageing mechanism, discriminating between cables with good and bad service performance. Based on the tests and the results of the work, summarized in this paper, the authors consider that a 3000 h test at 500 Hz, 5 kV/mm and 30 °C is a promising option to assess water treeing in cables. However, the work was carried out on 6 kV and 10 kV XLPE cables only and further experience is considered advisable by investigating the effectiveness of a 500 Hz test for a wider range of cables and materials. Further study of 6000 hour or 12000 hour tests at 50 Hz and the use of temperature gradient is also advised.

Introduction

Extruded polymeric insulated cables operating under wet condition may suffer from the phenomenon of water trees. Experiences of bad operation in service have occurred and, in particular, certain medium voltage cables manufactured in the 1970s and the early 1980s have failed after 10 to 15 years in service as a result of a combination of water ingress, the materials and the production processes used, so called bad cables in this paper. When cables fail as a consequence of water treeing, replacement of complete cable circuit lengths is often necessary at high cost.

Such water treeing problems have not been reported with high voltage extruded polymeric insulated cable networks, not only because watertight constructions are mainly employed at these higher voltages but also as a result of the use of cleaner materials and modern production facilities. This also applies to many medium voltage cables manufactured since the middle 1980s. In

addition, so-called water tree retardant materials are now available on the market.

Uncertainty about the progress of material development and the high costs related to water treeing problems have led to various activities worldwide to find effective accelerated ageing tests.

Long term water treeing tests on cables have been formulated with durations of up to two years. Various laboratories and cable manufacturers claim that these long term tests give effective measurement of the water tree resistance of full-size cables and have been included in the CENELEC medium voltage cable harmonisation documents presently being drafted. There remains however an urgent need from both manufacturers and users for a much shorter duration test on full-size cables. In particular, CIGRE Study Committees 21 (cables) and 15 (materials) have been active in trying to develop a short duration accelerated ageing test for cables and a water treeing method for materials, respectively.