B.8.4. L'étude du vieillissement accéléré des câbles à haute tension isolés avec le polyéthylène réticulé (XLPE) dans des conditions d'essais longue durée et d'exploitation réelle

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Résumé

L'objet du travail est une étude du vieillissement de l'isolation en XLPE des câbles à haute tension. On fait part des résultats des essais des échantillons des câbles terminés à 110 kV de la tension (l'épaisseur de l'isolation est près de 12 mm) et des échantillons de l'isolation de ces câbles. Les résultats confirment la présence d'une réserve considérable de tenue de l'isolation. On a présenté aussi des données de l'analyse du câble qui a subit pendant l'exploitation le claquage résulté d'un surchauffage intense avec une humidification simultanée faisant voir des mecanismes principaux de la destruction du diélectrique. Les auteurs appliquent pour les études également des méthodes de laboratoire traditionnelles et la microscopie vidéo avec l'accentuation vidéo des contrastes et un traitement digital des images.

B.8.4. Investigations of accelerated ageing of XLPE insulated HV cables under conditions of long-term tests and actual use

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Abstract

The subject of this paper is the study of the ageing of XLPE insulation for high voltage cables. The results of long-term tests on full-scale 110 kV cable specimens (insulation thickness of about 12 mm) and on insulation specimens of such cables are reported. These results confirm the expected long life span of the insulation. Data of analysis made on a cable which broke down in operation due to severe heating and intensive wetting demonstrates the main mechanisms of insulation failure. The authors used videomicroscopy with videoenhancement of contrast and computerized image analysis along with traditional laboratory methods in their study

1. Introduction

This paper covers intermediate results of an investigation of the main mechanisms of ageing and failure of high-voltage cables with extruded insulation.

The data obtained in the course of the study in their turn will be used for the development of new cable products, diagnostics and estimation of service life of the existing cable systems.

The research has been carried out on full-size 110 kV cable specimens with XLPE insulation thickness of about 12 mm, as well as on insulation specimens cut from such cables.

2. Experimental methods

2.1 Long-term tests of cables

Two cable specimens are being under such tests now. The first one is subjected to a continuous test voltage (Utest) equal to double rated phase voltage (U_0) with the conductor temperature kept at a constant level of 130°C. The second specimen is immersed in a NaCl water solution bath and subjected to a continuous application of Utest=1.5*U_0 with the conductor temperature being 90°C. Holes were pierced into a cable jacket thus providing a direct water access to the outer semiconducting screen, i.e. actually to the insulation. The moderate value of Utest allows to select cable samples for analysis from time to time and to continue the test after the jointing of the disconnected cable sections.

2.2 Long-term and short-term electric tests on models

They were carried out on insulation specimens in wet and dry conditions in uniform and highly divergent electric fields.

2.3 Laboratory analysis

Examination is carried out for the virgin cable and insulation specimens, the ones that were taken from the tests and those which have been in operation for some time.

Among the laboratory methods used for this purpose it might be well to point out the Differential Scanning Calorimetry and the Infra Red Spectroscopy. One of the most interesting methods is the videomicroscopy with the computerized image analysis. In short, the method is based on the combination of a microscope and TV system. The video signal through a Frame Grabber enters the PC memory to be subsequently processed with a special