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A.1.4. Développement d'un système de câble isolé au polyéthylène réticulé pour utilisation sous 400 kV

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Résumé

Les avantages des câbles à isolation synthétique extrudée par rapport aux câbles conventionnels comportant un fluide sous pression ont été démontrés jusqu'au niveau 300 kV en ce qui concerne l'installation, la maintenance, les coûts d'exploitation et les suggestions liées à l'environnement. Une expérience significative existe notamment jusqu'à 150 kV et continue de s'étendre même à des niveaux de tensions supérieurs ce qui est rassurant pour la fiabilité à long terme de ces matériels.

Cette communication décrit les travaux qui ont été entrepris pour étendre l'isolation PR jusqu'aux niveaux 345 et 420 kV. Un accent particulier a été mis sur l'importance et la nécessité de considérer un ensemble complet, ce qui correspond à la fourniture du câble et des accessoires et à la définition des conditions d'installation de ces matériels.

Des essais de courte durée ont été effectués sur l'ensemble câble-accessoires en suivant les dernières recommandations de la CIGRE. Les détails de ce programme d'essais sont décrits dans ce document.

A.1.4. Development of an XLPE insulated cable system for 400 kV operation

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Abstract

The advantages of the extruded cable system over the conventional fluid filled pressurised cable technology in terms of installation, maintenance, operating costs and factors affecting the environment have been demonstrated at voltages up to 300 kV. Significant experience has been built up, particularly at voltages up to the 150 kV level and continues to grow even at the higher transmission voltage levels, thus providing reassurance regarding long term reliability.

The paper describes the work that has been undertaken to extend XLPE technology to the 345 and 420 kV voltage levels. Emphasis has been placed on the importance and necessity to provide a complete cable system capability, that is the need to supply cable, accessories and installation as one package.

Short term type approval tests have been conducted on the cable system in accordance with the latest CIGRE recommendations. Details of the test programme are described.

Introduction

The advantages of an extruded cable system over the conventional pressurised fluid-filled cable can be readily identified and are issues that relate to various facets of underground cable systems. The absence of the hydraulic system give rise to the most important advantages in terms of both installation and operational considerations, including maintenance requirements. The presence of the insulation fluid introduces some complications and the need for specialised equipment. The increasing concerns about the environment leads to reluctance in continued utilisation of pressurised fluid insulation systems, because of the risk of leaks. It should be noted however that modern self contained fluid filled systems, correctly designed and installed exhibit excellent performance in this respect and reduce this risk to a minimum.

The 'availability' of distribution and transmission systems is becoming more important within electrical networks. Planned and unplanned maintenance activities need to be implemented in such a way as to minimise the time that equipment is not available for use. Extruded cables offer some advantages in this respect.

The main disadvantage however is associated with the uncertainty about the long term performance of such systems. Although there is significant experience with extruded cable system operating at system voltages up to 150 kV there is less experience at the higher voltage levels, where the operating stresses are higher.

There is also a lack of knowledge and experience with other factors that can affect reliability of the new technology. CIGRE Study Committee 21 is pioneering much of this work where a number of issues are being studied [1] including insulation ageing mechanisms, accessory design and performance, installation design including thermomechanical performance.

Cross linked polyethene is emerging as the most appropriate dielectric for EHV cables. Other types of materials are being utilised for accessories. Joints and terminations remain a very important part of the underground cable system. Compatibility of cable, accessories and installation practices have been extremely important with the well proven conventional technologies and are even more important with extruded cable systems. Fluid filled laminar insulation systems have proven to be very forgiving. Extruded insulation systems appear to be less tolerant and design and installation practices need to be well engineered and implemented.

This paper describes the development of a total extruded cable system for a 400 kV system. The development has been based on experience gained with extruded cable systems at lower voltage levels as well as experience with other conventional underground cable systems at both lower and higher system voltages.

The development programme was divided into a number of elements

- improvements in cable manufacturing technology
- evaluation of technology using statistical testing techniques
- improvements in accessory manufacturing technology
- evaluation of technology
- short term type approval testing