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Thermomechanical behaviour of 400 kV synthetic cables

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Summary

To achieve technico-economical optimum conditions for 400 kV bulk power underground transmission links, some evolutions are necessary both for cables and installation methods.

This article presents the main results of studies and tests performed in order to take into account the thermal and thermomechanical behaviour of XLPE cables in the design of installation conditions.

Résumé

L'optimisation technico-économique des liaisons souterraines 400 kV de grande puissance passe par des évolutions à la fois de la technologie des câbles et des conditions d'installation.

Cet article présente les principaux résultats des études et des essais engagés afin d'intéger le comportement thermique et thermomécanique des câbles isolés au polyéthylène réticulé dans la conception des méthodes d'installation.

1 - Introduction

In 1994, Electricité de France started a research program to optimise the design and the installation methods of the future 400 kV underground links for bulk power transmission (typically a 2000 MVA double circuit), with the contribution of cable manufacturers.

Preliminary studies have shown an important need to some cable and installation evolutions.

As far as the cable technology is concerned, the consequence has been the development of XLPE cables with large cross-section copper conductors (up to 2000 mm²) and lead-free metallic screen (an aluminium foil longitudinally welded ensures the water-tightness of the cable). The selection of installation methods was based on technical, economical and environmental criteria [1]. This has led EDF to choose installation in special backfills or in duct-banks.

This paper presents the main results of the different tests performed to optimise the design of the installations related to the thermomechanical behaviour of the cables.

One describes the tests which have been carried out to determine all the cable parameters that are needed to characterise and understand the thermomechanical behaviour of 400 kV XLPE cables.

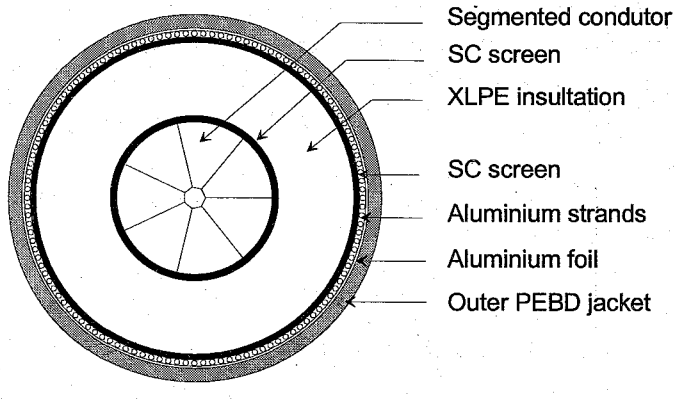

Figure 1 : The 400 kV cable design

2 - General considerations

The main aspects taken into account in the selection of installation methods were the following :

- To permit the operating of cables at high temperatures, since the ampacity of the cables is calculated on the basis of operating temperatures up to 90 °C in normal conditions and 100 °C in overload conditions.
- To reduce the environmental impact during installation (appreciated for instance throughout the space requirement of the jobsite, backfill volumes, progression speed,