



### A.1.1. Derniers développements des câbles 400 kV et 500 kV isolés au polyéthylène réticulé

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### A.1.1. Recent developments in 400 and 500 kV XLPE cables

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#### Résumé

L'expérience acquise dans le domaine des câbles 400 kV et 500 kV isolés au polyéthylène basse densité (PEBD) est grande et correspond à plus de 40 km de câbles (principalement en 400 kV).

Pour les câbles isolés au polyéthylène réticulé (PR) notre expérience remonte à 1981 et correspond à plus de 1800 km de câbles de 63 kV à 138 kV, ce qui est significatif ; en 225 kV, les premières liaisons fixes ont été installées récemment en France et en CHINE.

Dans ce rapport des résultats d'essais d'investigation et de qualification de câbles 400 kV et 500 kV isolés au PR avec les accessoires correspondants sont présentés. Ils montrent la faisabilité de ces matériels avec un gradient maximal en service de 15 - 16 kV/mm sur le conducteur du câble. Les matériels de raccordement utilisés sont de type préfabriqué et bénéficient d'un excellent retour d'expérience.

#### Abstract

Experience of 400 kV and 500 kV low density polyethylene (LDPE) cables is large and corresponds at more than 40 km cables (mainly in 400 kV).

With XLPE cables our experience goes back to 1981 and corresponds at more than 1800 km of cables in the range 63 kV - 138 kV which is significant ; in 225 kV, the first links have been installed recently in FRANCE and in CHINA.

In this paper, results of investigation and qualification tests concerning XLPE 400 kV and 500 kV cables and accessories are presented. They demonstrate the faisability of these materials with a maximum electrical stress on the cable conductor of 15 - 16 kV/mm. Accessories are of the prefabricated type and their in service experience is excellent.

## 1 - INTRODUCTION

XLPE extruded cables are more and more used, because they present some advantages over other extruded cables (LDPE or HDPE) with regard to the allowable operating temperatures, specially interesting in overload conditions.

On the other hand, when XLPE insulation is used, prefabricated accessories are generally preferred, because they allow a significant reduction of the installation period compared with field moulded accessories.

For normal service life, with the operating temperatures usually adopted by utilities, XLPE cables behave as other extruded cables and thermomechanical problems are handled in the same way.

As far as the manufacturing process of XLPE cables is well managed, using the appropriate raw materials and the most modern insulation techniques, the development of EHV XLPE systems will depend largely on the development of suitable accessories, preferably of the prefabricated type. Based on a very large experience of EHV extruded cable systems [table 1], including for many years prefabricated 400 and 500 kV accessories, and EHV XLPE cable systems were successfully developed using XLPE cables extrapolated from the 63 to 225 kV XLPE cables already supplied [table 2] since 1981.

| U kV | Length of cables km | Number of terminations | Number of joints | Date of first installation |
|------|---------------------|------------------------|------------------|----------------------------|
| 225  | 1195                | 3223                   | 2055             | 1969                       |
| 400  | 40                  | 176                    | 22               | 1985                       |
| 500  | 0                   | 2                      | 1                | 1990                       |

Table 1 : In service experience (January 1, 1995) of LDPE EHV extruded cables systems

| U kV      | Length of cables km | Number of terminations | Number of joints | Date of first installation |
|-----------|---------------------|------------------------|------------------|----------------------------|
| 63 to 138 | 1843                | 4555                   | 1843             | 1981                       |
| 225       | 26                  | 32                     | 48               | 1994                       |

Table 2 : In service experience (January 1, 1995) of 63 to 225 kV XLPE cables systems

## 2 - XLPE INSULATION DIELECTRIC ENDURANCE TESTS

Various electrical investigation tests were performed on materials and cable samples in order to assess the service life of XLPE EHV cables.

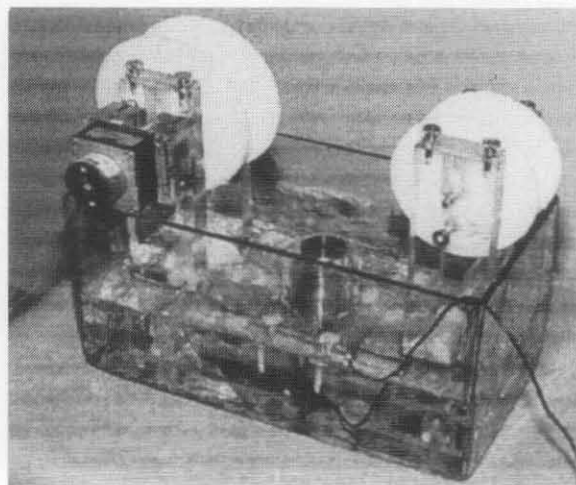


Fig 1: Automatic test stand for thin samples