## B.3.4. Comparaison des méthodes d'essai de longue durée sur les câbles PR 20 kV

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**Résumé**

Des essais de longue durée conditionnés pour la croissance d'arborescences dues à l'eau ont été développés et introduits dans beaucoup de pays. Un problème est le manque d'information concernant la corrélation entre résultats d'essais et performances en service. Un vieux câble non utilisé de 1976 disponible a pu être essayé suivant une vieille méthode interne et une méthode moderne standardisée. Les résultats d'essais ont été comparés aux informations sur les performances en service disponibles.

## B.3.4. Comparative long-term testing on 20 kV XLPE cables

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**Abstract**

Long term tests under water tree growth conditions were developed and introduced in many countries. One problem is the lack of information on the correlation between test results and service performance. An old unused cable from 1976 could be tested according to an old own method and a modern standardized method. The test results are compared with the available information on the service performance.

### Introduction

When the first reports about bad experience with some MV PE cables were published by Vahlstrom [1] in 1971, the amount of such cable installed in Germany was relatively low. The same problems as in the USA were not expected, because the cables had from the very beginning extruded conductor screens and PVC sheaths. The insulation screen made up of layers of graphite and conductive tapes was controlled by stringent partial discharge measurements ($q \leq 5$ pC at 2 $U_o$).

Nevertheless the first failures in 20 kV PE cables due to watertreeing were observed at the beginning of the eighties. As a consequence, the production of PE cables was stopped and the design of XLPE cables was changed. An extruded tightly bonded insulation screen was introduced.

Many failures in PVC sheaths occurred during laying and installation. This allowed the penetration of water. Therefore, the red PVC sheath was replaced by a black MDPE sheath with a greater wall thickness which improved the mechanical resistance considerably. Another advantage is the lower water diffusion rate of PE compared to PVC.

In parallel to the improvements of design, materials and compounds, the development of test methods for accelerated ageing under wet conditions took place. One goal was to have a tool at hand for discriminating between "bad" and "good" cables to prevent the further production of "bad" cables.

Another more ambitious goal was and still is to allow estimations of the life time. The latter is extremely difficult, because the test methods are rather new and old cables are no longer available.

By chance, we got an unused 20 kV XLPE cable made in 1976. It was tested according to two methods. The results are compared with previous ones and service performance.

### Test Methods

The first tests with XLPE cables were carried out according to AEIC [2] about 20 years ago. The microscopic examination revealed very large bow tie trees which was contradictory to the watertree pattern of cables which had failed in the field. It was assumed that the difference was caused by the high test temperature; whereas, cables in service usually operate at a lower conductor temperature. Therefore, the test conditions in Fig. 1 were chosen. This method was applied since 1982 [3].

Other cablemakers and research institutes had used different long term ageing methods, so that results were not always comparable. It was a strong concern of German utilities to establish a common method: An agreement on the test parameters (Fig. 1) was reached in 1990. The requirements are published in a draft standard DIN VDE 0276, part 620. The method is published in the CENELEC Document HD 605 subclause 5.4.5.