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State of the art in EHV XLPE cable systems

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Abstract

In the year 1998 the first cable installation of 400 kV XLPE cables for the German utility Bewag Berlin was put successfully into operation. In parallel a prequalification test in the voltage range 500 kV has been completed in April 1999. It has been shown that the cable and accessories are suitable to withstand the electrical stresses in the 500kV level which are 25% higher compared to 400kV. Furthermore, a 400kV XLPE cable system test demonstrating the overload capability of a service aged 400kV cable installation has also been successfully completed.

The results which have been reached so far could be achieved taking advantage of an overall qualification system starting from selected raw materials and ending up with sophisticated testing methods for routine and after installation tests. In this paper information is given about the improvement of insulation systems, their cleanliness and investigation methods. The paper also provides the general review of the status of technology in the field of EHV XLPE cables and related accessories.

Résumé

En 1998, le premier réseau de câbles 400 kV isolés au XLPE a été mis en service avec succès pour le compte de la compagnie allemande Bewag Berlin. Parallèlement, une campagne d'essais de préqualification pour le niveau 500 kV a abouti en avril 1999. On a pu montrer que les câbles et les accessoires étaient capables de résister aux contraintes électriques du niveau 500 kV, qui sont supérieures de 25 % à celle du 400 kV. Par ailleurs, on a mené à bien un essai sur un réseau de câbles 400 kV au XLPE pour démontrer la capacité de tenue aux surcharges d'une installation de câbles 400 kV depuis longtemps en service.

Les résultats obtenus ont pu être atteints grâce à la mise à profit des avantages procurés par un système de qualification global, allant de la sélection des matières premières aux méthodes de test sophistiqués pour les essais individuels et les essais après pose. Ce rapport informe sur les améliorations des systèmes d'isolation, de leur propreté et des méthodes d'examen. Le rapport fournit aussi une vue générale de l'état de l'art dans la technologie des câbles THT à isolation extrudée de PE réticulé (XLPE) et des accessoires correspondants.

1 INTRODUCTION

Demand for bulk-power transmission is growing, not only for systems feeding dense urban areas, but also in meshed transmission networks, where operators are upgrading their installed capacity in response to factors such as network stability requirements and transmission de-regulatory policy. This, together with the increasing importance of environmental considerations in designing and constructing new lines, has stimulated the need for efficient HV and EHV underground transmission cable systems offering high power ratings with reduced transmission losses [1,2].

Pirelli has been manufacturing and delivering XLPE insulated high voltage (HV) cable systems for more than twenty-five years. Based on a broad expertise in the voltage range up to 150kV the development of XLPE cable systems up to the extra high voltages (EHV), i.e. 400 and 500kV, resp. was started in the mid 80ies. Since then extensive test programmes

which included all kinds of internal development tests, official type tests in accordance with international specifications and independently witnessed prequalification and qualification tests have been carried out [3].

The successful completion of this great variety of tests was a major precondition for the acquisition of one of the world's first orders for the installation of a 400kV XLPE cable system in 1996, i.e. the bulk power supply of the city of Berlin. This project includes appr. 20 km of single core XLPE cables, 6 GIS terminations and 24 prefabricated slip-on joints. It has been commissioned in late 1998 [4].

As a matter of fact since completion of the initial 400 kV Prequalification test, marked improvements have been achieved allowing the adoption of higher design stresses in cables and accessories operated in 400 and 500kV networks. The following items are especially noteworthy: