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Development of 500 kV DC XLPE cable system and its pre-qualification test
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Abstract

This paper deals with the development of XLPE cable system for a HVDC link and refers to Pre-Qualification test.

An XLPE material, free from the accumulation of space charges, was applied to make a DC extruded cable. And the factory joint was made with an extruded molded joint.

A yearlong performance test (long-term test) carried through on the DC XLPE cable system, which resulted in no breakdown. Subsequently, a number of sample pieces underwent an impulse test as superimposed on the DC voltage, and with success. In conclusion, the DC XLPE cable system had its performance confirmed: the makings of HVDC transmission.

Keywords: XLPE cable, DC transmission, Space charge, Pre-Qualification Test

1. Introduction

The DC power cable transmission is more suited to long distance or high power, than the AC transmission. The conventional DC power cables have been of an oil-filled (OF) cable or mass impregnated non-drain (MIND) cable. But the OF cable can hardly carry thorough a distant transmission, within the limits of its irksome oil-refilling, and the MIND cable can rarely carry high power, due to the rather-low, tolerable, operating temperature.

In contrast, the AC transmission has been applying XLPE insulated power cables in widespread use. Practically, 500kV XLPE insulated power cables are applied in commercial line[1]. The XLPE insulated cable, free from oil or grease, is friendly to the environment and preferable, and then expected to perform in the DC power transmission.

Against the background, the authors developed a 500kV DC XLPE cables[2][3]. This paper describes the proceedings of developing the DC cable (500kV DC XLPE cable), along with its pre-qualification test.

Résumé

Cette publication rapporte la mise au point d'un câble à isolant polyéthylène réticulé (XLPE) pour les lignes de transport de courant continu haute tension (HVDC), ainsi que les résultats des tests de préqualification.

Nous avons utilisé l'isolant XLPE pour fabriquer un câble de transport de courant continu extrudé. Cet isolant présente peu d'accumulation de charge d'espace. De plus, la jonction de câble effectuée en usine a été moulée par extrusion.

Nous avons mesuré sur un an les paramètres du test à long terme des échantillons de câble XLPE et n'avons pas constaté de rupture au terme de l'essai. Ces câbles présentent une excellente tenue aux essais d'impulsions sous courant continu, effectués à la suite du test d'un an. Nous avons ainsi pu confirmer les excellentes propriétés du câble XLPE pour des lignes CC.

Mots clés: câble XLPE CC, lignes CC, charge d'espace, tests de préqualification

2. Characteristics of insulating materials for DC XLPE cable

The foregoing researchers or studies on the application of AC XLPE cables (AC: designed for AC use) to DC power transmission, indicate the space charges accumulate in their insulation. As a result, local high electric field, thereby lowering the insulation performance. Therefore, space charges ought to be suppressed by design, in terms of the performance characteristics for the XLPE insulation material under DC voltage.

The following factors in dielectric breakdown characteristics are native to the DC voltage:

1. Heat generated due to current in the insulation (Joule heat)
2. Local high electric field due to space charge.

Consequently, the markings of the insulating material for DC XLPE cables require:

1. High resistivity to reduce leakage current, and suppress heat generation
2. capable of minimizing space charges