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B.7.3. Propriétés électriques et méthodes d'essais recommandées pour les câbles HT à isolation PR et leurs accessoires

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Résumé
Les besoins de câble à polyéthylène réticulaire augmentent chaque année. Entre autres, des câble PR de classe 275kV sont mise en application ces dernières années à des lignes de transmission à longue distance. Afin d'établir donc des critères et des méthodes d'éssai pour ces câble, nous avons étudié des propriétés de câbles PR récents et leurs accessoires et évalué des performances requises pour les circuits de ces câbles: ce qui nous à permis de proposer des méthodes recommendables d'éssai à haute tension. Ces résultats obtenus serviront à établir des critères applicables à des câbles HT à isolation PR et leurs accessoires.

B.7.3. Electrical properties & recommended test methods for HV XLPE cable and accessory

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Abstract
The needs for XLPE cables increase every year. 275kV-class XLPE cables with joints have already been applied for long-distance power cable transmission lines in Japan. We have investigated recent properties of recent XLPE cables and their accessories. We have evaluated the required performance of cable circuits, and recommended the high voltage test methods. The authors think that the results will be useful in establishing standards for HV XLPE cable and accessories in the future.

1. Introduction

The use of XLPE cable in Japan is increasing year by year, and recently it has been adopted for 275kV long-distance power transmission lines and 500kV short-distance lines in power stations. On the other hand, while the standards for high voltage testing of XLPE cable and accessories were established for the 11kV to 77kV in 1980, the specifications for other voltage classes were set by the electric power companies. Thus, with the purpose of setting new standards for XLPE cable and accessories up to 275kV, we investigated data on their various properties and the performance required of the lines, and recommended high-voltage test methods.

2. Present Test Methods

In present test methods, type tests and routine tests are prescribed [1],[2]. Type tests which use samples are for verifying lifetime and system resistance to lightning impulse voltage levels; they are subjected to AC withstand voltage tests and lightning impulse withstand voltage tests. For accessories, heat cycle tests are used to verify thermo-mechanical behavior. Routine tests are for verifying that products have been correctly manufactured; they are subjected to AC withstand voltage tests and partial discharge tests, and to microscopic examination of sliced samples to determine the level of defects in insulation. These tests are based on the following considerations.

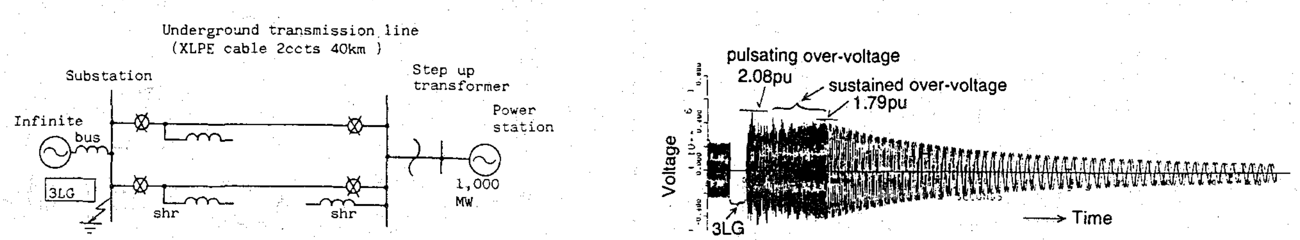
1) The test voltage values are determined by multiplying the rated voltage by the temperature coefficient, deterioration coefficient and allowance for uncertainties.
2) The relationship between the AC voltage and the time to breakdown (the V-t characteristics) is expressed as $V^n \cdot t =$ constant, and the lifetime exponent n is set to 9.
3) Although it is considered that there is no deterioration due to repeated lightning impulse voltage, the effect of the AC superimposed lightning impulse voltage is unconfirmed, so an allowance (10%) is adopted. A test voltage of negative polarity is applied 3 times.
4) The temperature coefficient is obtained from the ratio of room-temperature breakdown value and the high-temperature breakdown value. It is adopted 1.1 for AC voltage and 1.25 for lightning impulse voltage.
5) With the routine tests, withstanding the system over-voltage is verified, while avoiding consumption of lifetime.
6) Lightning impulse test can be used for switching impulse test.

3. Required Line Performance

Power transmission lines must be capable of withstanding the various over-voltages that occur during the period of use, as well as, of course, the rated voltage. We therefore investigated the system over-voltages.

3.1 AC Over-voltage

(a) For an effectively grounded system
The EMTP analysis results of over-voltage in a 275kV system supposed the severest conditions for the load rejection are shown in Fig.1 [3]. The over-voltage is divided into the pulsating over-voltage, which is generated several cycles (max. 0.05 s) by LC (reactance-capacitance) resonance after the load rejection and the



(a) Analysis Model (b) Results

Fig.1 EMTP Analysis results of AC Over-voltage for 275kV system