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Transmission capacity design of underground power cables

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Résumé

Un des moyens les plus efficaces de réduire les coûts de transmission sur les cables enterrés, consiste à augmenter leur capacité de transmission. Pour cette raison, un comité a été organisé par les représentants des sociétés de distribution, les principaux fabricants de câbles et divers chercheur, tout cela dans le dessein de revoir les méthodes de calcul de la capacité de transmission.

De nouvelles données concernant les constantes qui influent sur la capacité de transmission ont pu être ainsi obtenues. Parmi elles, citons la résistance du conducteur en courant alternatif pour les câbles PR, la constante de perte diélectrique, la perte de blindage métallique, la résistance thermique du sol et la température du sol.

Cet article présente les résultats des optimisations de capacité de transmission.

Abstract

One of the most effective measures to reduce the transmission costs on the underground cables is to increase its transmission capacity. For this purpose, a committee was organized by representatives of power utilities, major cable manufacturers and some intellectuals to reevaluate the calculation method of the transmission capacity.

Various new data on parameters affecting the transmission capacity, were obtained. For example, AC conductor resistance of XLPE insulated cables, dielectric loss constant, metallic sheath loss, thermal resistance of soil, and soil temperature.

In this paper the results on the optimizations of transmission capacity, are presented.

1. INTRODUCTION

XLPE cables and oil-filled cables are being used as underground transmission lines up to 500 kV in Japan, and they are playing an important role in the power system. Now, the reduction of cost is considered to be necessary in construction of the equipment and its operation. As one method of cost reduction, revision of the calculation of transmission capacities are discussed.

The Central Research Institute of the Electric Power Industry made extensive research into the transmission capacities of cables in 1965. [1] After that, the Electric Technology Research Association performed a research concerning permissible maximum conductor temperatures in 1984. [2] The use of XLPE cables has been increasing, and new technologies have been developed, including insulated-strand conductors, and stainless steel-sheathed cables in order to reduce transmission loss. New findings and data about the calculation method of transmission capacity and its parameters has been compiled.

Therefore, a committee was formed with the cooperation of domestic power companies and cable manufacturers, the Central Research Institute of Electric Power Industry, and other experts. With the technical trends and results related to XLPE and oil-filled cables, the committee reviewed the calculation method of transmission capacity and discussed rational techniques for increasing transmission capacity and forward-looking issues. [3]

This paper reports the effectiveness of rationalization made in a review of the calculation method of XLPE cables laid in ducts considering AC conductor resistance, loss, and calculation method of soil thermal resistance.

2. CONCEPT OF CONTINUOUS CURRENT CARRYING CAPACITY CALCULATION

The continuous current carrying capacity of cable laid in