Close and Return

A7.3

Thermal design of controlled backfills

ARGAUT, P., LESUR F., SAGEM SA, Montereau, France
MERMET G., PROTAT F., SPORŘEL U., SUPELEC, Gif sur Yvette, France

Résumé

La capacité de transport des câbles de puissance dépend fortement du milieu environnant. Les caractéristiques thermiques du sol sont un paramètre critique qui conditionne le risque de migration d'humidité et d'emballement thermique. Des remblais spéciaux peuvent remplacer avantageusement le sol qui a été creusé.
Le texte ci-après présente des résultats comparatifs à partir de quelques méthodes permettant de calculer la résistance thermique externe T_4 lorsque le sol n'est pas homogène.
Des données économiques peuvent dès lors être utilisées pour un dimensionnement optimisé des remblais, selon le critère du ratio entre puissance transitée et coût global de la tranchée.

Abstract

Ampacity of power cables is significantly dependent on the surrounding medium. The thermal characteristics of the soil is a critical parameter increasing the risk of moisture migration and thermal instability. Special backfills may be used to replace advantageously the local excavated soil.
The following paper presents some comparative results from a few methods to calculate external thermal resistances T_4 when the soil is not homogeneous.
Economical data may be introduced to lead to an optimum design of backfills, according to a criterion of ratio between cable ampacity and global cost of a trench.

1. Heat transfer for buried cable systems

Total losses generated in buried power cables flow through the soil to the ground surface and are dissipated into the atmosphere. The conductor temperature rise of these cables is due for its major part to the soil, and analysis to one factor sensitivity studies show that the depth of laying and thermal characteristics of the soil are critical parameters.

Granular particles greatly affect the thermal behaviour of the soil according to their constituents, size distribution, density and moisture content. Cavities between the more or less compacted particles are filled with water or air. If the moisture migrates from the soil, the thermal resistivity rises, increasing the cable temperature and intensifying the losses. It contributes to speed up moisture migration and a thermal instability arises.

Because thermal resistivities of mineral constituents and water are out of proportion with the one of air, it is essential to maximise the amount of solid and water. A high density due to compaction improves the series of parallel paths in the global structure. Therefore special backfills (selected sands, stabilised or fluidised backfills) may be used to replace the local excavated soil.

2. Cable systems in backfills

The computation of ampacities of cables systems in backfills is a current practice. It applies to cables laid in a well-conducting material to improve heat dissipation and to ducts installed in layers of concrete. In both configurations, the surroundings are a material which has a different thermal resistivity from that of the native soil.

We will consider the installation of three cables in flat formation described in Electra #98 [4].

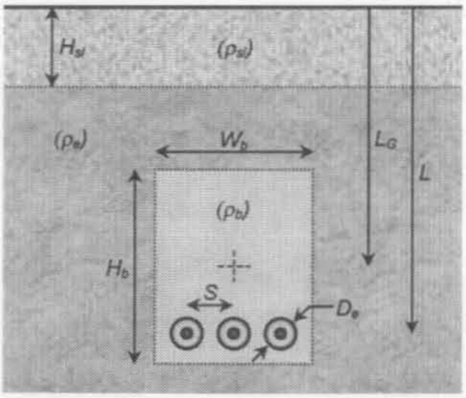

fig.1 : Three cables in a backfill, flat formation