A7.2

Potential overheating in the event of a cable crossing

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Résumé

On étudie le cas général d'un ensemble de câbles enterrés, d'abord sans tenir compte de la conduction longitudinale des conducteurs et des écrans. Cette première approximation est souvent suffisante, mais ne l'est pas pour un croisement.

Dans ce cas il est nécessaire de tenir compte de la conduction longitudinale, ce qui conduit à une solution faisant intervenir une équation différentielle du quatrième ordre. La résolution de cette équation nécessite le passage à une méthode informatisée.

Le procédé est étendu au cas où il y a une conduite isotherme.

Summary

We study first the general case of buried cables without take into account the longitudinal conduction of the conductors and the screens. This approximation is often enough. However, more must be done for a cable crossing.

In the cable crossing case, it is necessary to take into account the longitudinal conduction. This brings into effect a solution including an equation with a differential to the forth order. The calculation of this equation requires a computer.

This process is also extended to the case where there is an insulated iso-thermal heated pipe.

Calculation method

We will calculate, within a limited zone, the overheating of a group of buried cables. This overheating effect is composed of two elements:

1. Overheating due to the part of the cable located in the central zone
2. Overheating due to the part of the cable located in the external zone.

In the central zone, the longitudinal conduction from the metallic components, conductor and screen of the cable will be taken into account.

In the external zone, the assumption will be made that the cables are aligned with a negligible longitudinal heat flow.

The cable model includes its transversal and longitudinal thermal resistances.

The overheating calculation will not take into account longitudinal thermal resistance. This first approximation of the solution is sufficient if the position of the cables does not change too rapidly. This is generally the case. However at a cable crossing , it is necessary to take into account the longitudinal conduction. A variation of this calculation adapted to the case of a cable crossing where there is a isothermal heated pipe will also be examined.

The calculation model

To help illustrate this situation, a model will be used for the calculation.

The cable path will be given as a function of its curve abscissa " s " : $x_s, y_s, z_s = f(s)$

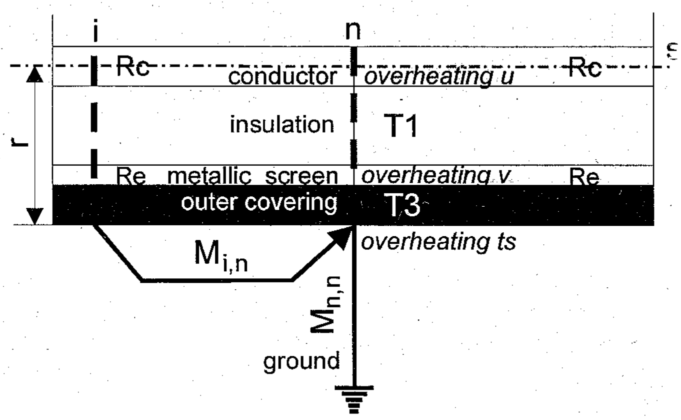

figure 1 : Cable model

The cable characteristics are as follows :

Rc transversal thermal resistance of conductor per unit length in K/W/m

Re transversal thermal resistance of metallic screen per unit length in K/W/m

T1 longitudinal thermal resistance of insulation per unit length in K.m/W

T3 longitudinal thermal resistance of outer covering per unit length in K.m/W

$M_{i,n}$ mutual thermal resistance between point « i » and point « n » in K/W

r external radius of cable in m

The losses and overheating as a function of the abscissa « s » will be indicated as follows :

Wc_s conductor losses per unit length in W/m

We_s screen losses per unit length in W/m

Wt_s total cable losses per unit length in W/m