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D.2.10. Optimisation de l'insertion de câbles isolés HT et THT dans une ligne aérienne

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D.2.10. Optimization of the insertion of insulated HV and EHV cables in overhead lines

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RESUME

Il est bien connu que le courant capacitif généré par les câbles réduit les possibilités de transit de puissance et limite la longueur des liaisons souterraines, mais la notion classique de longueur critique doit être utilisée avec précaution.

La problématique économique n'est pas la même pour les lignes aériennes et pour les liaisons souterraines, du fait du poids relatif du coût d'investissement et du coût des pertes sensiblement différent pour les lignes et les câbles.

Dans l'optique de l'insertion d'un tronçon souterrain dans une ligne, l'exploitation de la capacité de surcharge des câbles permet d'envisager un dimensionnement des câbles pour une intensité de l'ordre de 0,8 fois l'Intensité maximale admissible en permanence par la ligne.

SUMMARY

It is well known that the capacitive current generated by cables reduces their power transmission capability and limits the length of underground cable links. The conventional concept of critical length has to be employed with caution however.

The economic considerations are not the same for underground cables and overhead lines, due to the relative weight of the capital investment cost and the cost of losses, which are considerably different for the lines and the cables.

When inserting an underground section into an overhead line, use of the cable overload capacity allows the cable to be dimensioned for a current of the order of 0.8 times the maximum allowable continuous current in the line.

1 - INTRODUCTION

High Voltage and Very High Voltage underground cables are generally of short length, laid either inside a power station or sub-station or in an urban zone, extending the overhead line used to provide a supply to a sub-station or to a customer.

Nowadays, the use of insulated cables is also contemplated for the creation of underground runs inside overhead power transmission lines, in order to deal with any local constraints such as are found in the proximity of an airport or of a protected site.

The optimisation of such a link concerns a number of parameters which are frequently interdependent, of a technical, economic, or environmental nature (space on the ground, nuisance caused by works, etc.).

Following a concise presentation of the dimensioning rules for the current links, we will look at the following two particular aspects:

- the electrical behaviour, dealing with the influence of capacitive current generated by the cables, which limits power transmission capability over long distances,

- presentation of the economic considerations, which are not the same for the overhead element and the underground part of the line, due to the relative weight of the capital investment cost and the cost of losses, which are quite different for the lines and the cables

2 - THERMAL DIMENSIONING OF UNDERGROUND LINKS

The most usual practice is to lay cables in troughs set 1.3 metres deep. In order to remove the risk of thermal runaway, cables with synthetic insulation are employed at a maximum core temperature of 70°C in continuous operation, resulting in ground temperatures which are less than the critical value (some 60°C), above which the risk of ground drying-out arises.

When dimensioning a link, two cases must be considered in addition to the continuous-working case:

- (long-term) overload : This case will arise only occasionally, and may repeat itself, possibly lasting for several hours at a time (as when feeding a transformer operating as long-term back-up). It is similar to the continuous case but without the ground-temperature limitation. The core temperature can rise to the maximum temperature allowable for the insulating material, plus 5°C (giving 75°C for PEBD insulation).

- (short-term) emergency : This case will arise only occasionally, with a very low probability of occurrence and with a duration limited to 20 minutes. The core temperature can rise to the maximum temperature allowable for the insulating material, plus 10°C.

In practice, dimensioning of an underground link is frequently effected on the basis of the long-term overload conditions :

$$Id = F * MCAL$$