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Effect of power cable installation on current rating, magnetic fields and reliability

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Abstract: Utilities often deal with increasing power demands and an increasingly higher loaded infrastructure. Also, governments sometimes urge utilities to diminish magnetic fields around their infrastructure. Together with clients demanding both more energy and a higher reliability, these issues result in complex considerations about the electrical infrastructure.

A number of common installation methods will be discussed in terms of the exerted magnetic field, the maximum current carrying capacity and the dynamic overload possibilities. Depending on the utilities' motives, several choices between common installation methods either excelling in low magnetic fields or in high overload possibilities can be made.

Keywords: Ampacity, Magnetic Field, Reliability

Résumé: Les services publics se voient confrontés à des demandes d'électricité croissantes et à une infrastructure de plus en plus lourde. Parfois les pouvoirs publics pressent également les entreprises d'électricité de réduire les champs magnétiques autour de leur installation. Les clients demandent à la fois plus d'énergie et une plus grande fiabilité, et ces problèmes débouchent sur des considérations complexes en matière d'infrastructure électrique.

Plusieurs méthodes d'installation communes seront abordées en termes de champs magnétiques rayonnés, d'intensité maximale admissible et de possibilités de surcharge dynamique. En fonction des objectifs des entreprises d'électricité, il est possible d'effectuer plusieurs choix entre les méthodes d'installation communes qui se distinguent soit par de faibles champs magnétiques, soit par des possibilités de surcharge élevée.

Mots clés: Courant Admissible, Champ Magnétique, Fiabilité

1. Introduction

When an underground power connection is designed, choices about the current carrying capacity (referred to as 'ampacity' in this article) throughout the cable lifetime have to be made. After circuit installation a long period of operation commences in which the circuit loading will most likely grow because of the ever-growing energy demand. Therefore, the choices made in the engineering stage are usually choices to increase the ampacity of the circuit.

Besides an expected growing energy demand in the future, there is also a tendency towards more environment friendly and safe energy transmission. Regarding this tendency, magnetic fields form a difficult issue ever since possible relations have been described between magnetic fields and leukaemia (see for example [1,2]). Based on these possible relations, more and more governments apply a precautionary principle and urge utilities to design power connections with low to extremely low magnetic fields (e.g. down to below 1 μT).

Regarding underground power cables, it is not an easy task to diminish magnetic fields. Shielding is expensive and difficult, and choices that can be made during the engineering stage to diminish magnetic fields are contradictory to the choices that increase the maximum transmission capacity (ampacity) of power cables.

To aid utilities in reaching decisions about the installation of circuits, in which an optimal balance between magnetic fields and ampacity has to be achieved, a number of basic cable installation possibilities will be examined in this article. These different cable installation possibilities will be presented in section 2. Also the used dynamic ampacity model and magnetic field model will be introduced in this section. In section 3 both stationary