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On-site follow up of the characteristics of controlled backfill, using the TDR moisture-measurement method

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**Abstract:** As part of an important project involving tractive power supply to the high-speed trains running between Brussels and the German border, Belgium's Transmission System Operator has imposed particularly stringent conditions on the carrying capacity, which resulted in considering a 150 kV underground link with 3 cables per phase, the third cable being installed only to face the situation in which one circuit failed. To avoid the cost of a third cable, a system with 2 cables per phase was finally chosen, based on a number of assumptions, one of these the taking into account of a thermal resistivity value of 0.7 K.m/W for the controlled backfill (generalised in Belgium) instead of the usually adopted value of 1 K.m/W. In order to validate this calculated value, tests were performed at a pilot site. This paper describes the organisation and the implementation conditions of the tests, together with the highly encouraging results that have confirmed the validity of the assumptions made.

**Keywords:** controlled backfill, thermal resistivity, carrying capacity, Time Domain Reflectometry method, moisture contents.

#### 1. Introduction

The Belgian power sector has for many years used controlled backfill for its high-voltage underground links, aiming to achieve the optimal carrying capacity considering the investment made.

When building an underground link, this means creating an as heat conductive environment as possible, since the maximum acceptable load for an underground cable depends significantly on the thermal properties of its environment. In order to improve the soil's thermal conductivity, selected materials and appropriate implementation are essential.

The controlled backfill consists of dolomite, the heat resistivity of which remains low even when it has dried out. Applying the dolomite at the site calls for

**Résumé:** Dans le cadre d'un important projet conduisant à alimenter le train à grande vitesse entre Bruxelles et la frontière allemande, le Gestionnaire de Réseau de Transport belge a imposé des conditions de capacité de transport très contraignantes qui ont conduit à envisager une liaison 150 kV avec 3 câbles par phase, le troisième câble n'étant présent que pour faire face à une situation de perte d'un terme. Afin d'éviter les coûts de ce troisième câble, un système à 2 câbles par phases a été retenu moyennant certaines hypothèses, dont la prise en compte d'une valeur de résistivité thermique du remblai contrôlé (généralisé en Belgique) de 0,7 K.m/W au lieu de 1 K.m/W habituellement retenu. Afin de contrôler cette valeur obtenue par calculs, des essais ont été réalisés sur un site pilote. L'article décrit l'organisation et les conditions de mise en œuvre de ces essais ainsi que les résultats obtenus extrêmement encourageants qui ont confirmé les hypothèses retenues.

**Mots clés:** remblai contrôlé, résistivité thermique, capacité de transport, méthode Time Domain Reflectometry, teneur en humidité.

defining the conditions that ensure its correct application : in particular, the thickness of the layers, the number of passages of the ramming machine, and the moisture contents.

The standard thermal resistivity value adopted for the backfill in Belgium is 1 K.m/W, this being for correctly placed dolomite, i.e. having the specified moisture contents and density of the material.

As part of an important project involving tractive power supply to the high-speed trains operated between Brussels and the German border, Belgium's Transmission System Operator has imposed particularly stringent conditions on the carrying capacity, which called for reviewing a number of the usually applied hypotheses.