A pilot using water pressure to install 2 150 kV cable circuits in a horizontal directional drilling

Jacco **SMIT** , Roy **ZUIJDERDUIN;** TenneT TSO, (The Netherlands), jacco.smit@tennet.eu, roy.zuijderduin@tennet.eu
Willem **GRIFFIOEN**, Plumettaz SA, (The Netherlands), willem.griffioen@plumettaz.com

☐ **Young Researcher** (Proved full-time engineering and science university researchers and Ph.D.students under 35 YO)

ABSTRACT

The space required and available to install cables in a cable trench using open excavation is becoming less and less available. TenneT will therefore increasingly want to install cables using long-length directional drilling. The desired longer lengths of directional drilling will exceed 2000 metres. Traditionally, the cables are then pulled in with a winch wire. When pulling in the cables, the maximum tensile forces and the so-called side-wall pressure on the cables must not be exceeded, this influence the maximum cable length. Another possible installation method could be water pressure to float in cables. To build up experience a pilot was started.

KEYWORDS

Long cable lengths, horizontal directional drillings, water pressure, floating in cables, tensile forces.

INTRODUCTION

The cross-border grid operator TenneT owns about 1800 km of 110 kV and 150 kV cable and 80 km of 220 kV and 380 kV cable circuit in the on-land power grid of the Netherlands. In the coming years the cable length will continue to grow. The forecast of the grid expansion is about 3000 km.

Due to the limited areas to get permits, install and operated high voltage cables more and more horizontal directional drillings (HDD) will be in place. Also the HDD's will become longer and longer. TenneT is aiming for HDD's lengths of > 3000 meter.

At longer HDD lengths and big cable cross sections the maximum allowed pull force on the cables and side wall pressure will exceeded using a winch wire. Therefore alternative installation methods are needed and TenneT is actively looking for and piloting the new methods. One of the methods used is using water pressure to float in cable into the plastic ducts in the HDD's. This paper describes technical features of the technique, the pilot using this technology and lessons learned.

PILOT PROJECT DESCRIPTION

Scope

To enable the construction of a new residential area, part of the above-ground 150 kV overhead lines had partially to be undergrounded.

For this purpose, 2 times 7 plastic ducts (200/163 mm) with a length of over 1100 m and a maximum depth of approximately 25 m were installed with two HDD's. Traditionally, the 150 kV cables are installed in the pipes with a winch wire. In this 150 kV cable project, the water pressure method was used for the first time as an alternative to pulling in with a winch wire. The water pressure method is an innovative technique for 110 / 150 kV cables, where hydropower is used to force the cables through the plastic ducts. The tensile forces on the cable are mitigated by the water-powered propulsion of the water pressure method. A total of 6 cables were installed using a winch wire and 6 cables using the water pressure method.

Cable type

Two types of cables types were used, cable type 1 is a 87/150 kV cable with 1200 mm2 solid Aluminium core, having a diameter of ~ 93 mm and a mass ~ 8,8 kg/m. Cable type 2 is basically the same cable, but with an extra layer with optical fibre inside, having a larger diameter of ~ 98 mm and a mass of ~ 9.1 kg/m. The maximum pulling force is 24000 N (pulling head on core) and 8800 N (cable sleeve). The minimum bend radius is 1.46 m (installed) and 2.44 m (during pulling).

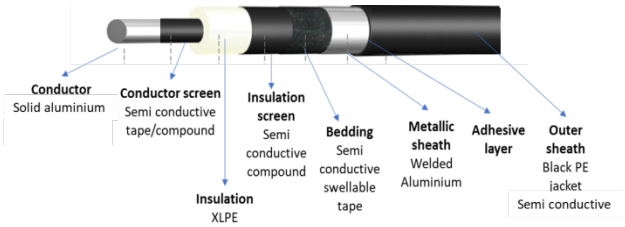

Fig. 1 Cable type 1 used in the pilot project

TECHNIQUES TO INSTALL WITH WATER PRESSURE

Traditional winch pulling

The traditional way to install cables into pipes is pulling them with a winch. For this first a pulling rope has to be installed. Also installation equipment and people are required at both ends of the pipe. Furthermore the capstan effect (friction of the cable under tensile load in bends) limits the cable lengths which can be installed in one pull. Synchronization between winch and drum pay-off is often troublesome.

Fig. 2 schematic overview 'winch pulling'