Belgian experience with real time thermal rating system in combination with distributed temperature sensing techniques

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ABSTRACT

The first real time thermal rating (RTTR) monitoring system of Elia is installed on a 33 km long cable link of 150 kV between Koksijde and Slijkens (type EAXeCeW 87/150 kV 1x2000/211). This link is highly loaded due to the connection of offshore wind farms (e.g. Thornton Bank). The load will even increase with the future connection of other planned wind farms (e.g. Norther). The measurement data of the distributed temperature system (DTS) is transferred to a RTTR system. The EMS systems sends further input to the RTTR. The RTTR sends the results of the calculations, the real time load capability of the cable link, to the EMS system. With the technique of RTTR, Elia has the opportunity to follow up the load in real time and to have an idea of the maximum instant load and the overload capabilities of the cable system. This paper explains the experience of Elia with the installation of the RTTR system and the first insights about the overload capability of the 150 kV link.

KEYWORDS

RTTR, DTS, overload capability, DRS, dynamic rating, temperature measurement

INTRODUCTION

In the late 90's, the Belgian TSO Elia decided to integrate optical fibres in HV cable systems of 150 kV for temperature monitoring. Up till now these fibres were used for ad-hoc temperature measurements on the cable circuits by means of a mobile DTS system. The goal of this technique was to locate hot spots in the circuit and to verify the ampacity calculations made during the engineering and construction phase of the circuit. There was no direct need for permanent temperature measurement due to the relative low load of these cable systems. Meanwhile the situation has changed and several cables are already or will be highly loaded in the near future due to decentralized and renewable energy (RES) production, especially wind energy production. The load situation in the grid is changing rapidly from a unidirectional to a bidirectional network. At this moment there is a need from the grid operations side to be able to operate certain cable systems on a dynamic way by using permanent RTTR systems.

Description of the 150 kV cable

The 150 kV cable link between Koksijde and Slijkens is 33 km long. The cable type EAXeCeWB 87/150 kV 1x2000/211 is composed of an aluminium conductor, XLPE insulation, Cu wire screen combined with an aluminium foil (see figure 1) and was installed in 2006 in a controlled backfill, trefoil configuration with direct cross-bonded of the screens.

One phase of the cable link is equipped with integrated optical fibres (FO). These fibres are located under the outer sheath of the cable. Two different types of fibres are used: multimode (MM) fibres and single mode (SM) fibres. The MM fibres are preferentially used for temperature measurements with MM DTS systems, due to the higher accuracy and the lower spatial resolution. The SM fibres are used for longer ranges, were the MM DTS systems are not capable to measure the complete cable length.

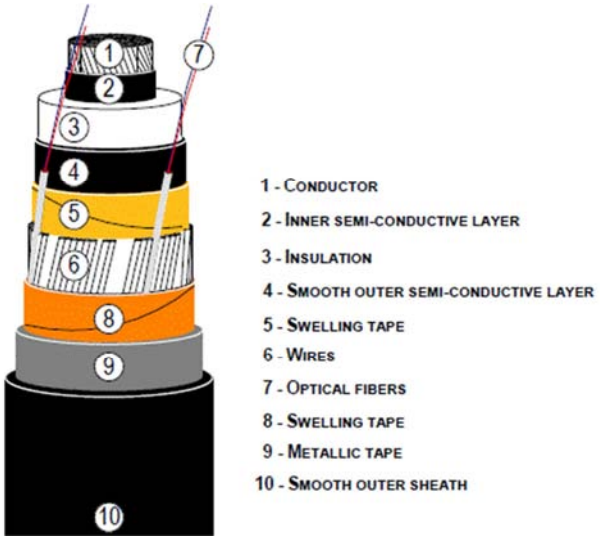

Fig. 1: overview of 150 kV cable

The fibres are installed in a stainless steel tube, placed under the metallic radial water barrier of the cable.

Increasing RES at coastal region

The growth of decentral production at the coastal region is expanding rapidly.

At the coastal region different offshore wind parks are located. The C-power wind park, with a capacity of 325 MW, is directly connected at the substation of Slijkens. Other wind parks, like Northwind (216 MW) and Belwind (165 MW), have a total capacity of 380 MW in april 2015. Other wind parks are planned with an expected total energy production of more than 2000 MW. Beside wind energy also solar power increases the power production with an expected raise of ~100 MW. See figure 2 of a complete overview.

The peak power plant at Herdersbrug (300 MW) helps to balance the production and demand in Belgium. These RES and peak demand production are all connected to the the 150 kV grid in the coastal region. The underground cable link between the 150 kV substations of Koksijde and Slijkens is a major connection in the region.

As a consequence, in order to transport the additional wind power inland, a fluctuation of the cable load with peaks exceeding the maximum transport capacity during