Localized Temperature Sensing (LTS) as new approach to HV cable system monitoring and uprating

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ABSTRACT

Even if distributed temperature sensing (DTS) has been accepted as the best way to manage undergrounded HV cable systems' exploitation, there are several inconveniences that have stopped its general usage and with it, the installation of fibre optics in cable screens.

The concept of Localized Temperature Sensing (LTS) tries to give an answer to utilities' needs of monitoring the real operation temperature of certain existing lines, in order to be able to optimize their exploitation regimes even if there is no fibre optics inside cable screens.

Accurate passive sensors operated at distance open a new field for dynamic cable rating.

KEYWORDS

Temperature, dynamic rating, LTS, DTS, Bragg.

INTRODUCTION

As power generation and consumption are having a shift in what was considered the status quo and international HV connections grow, changing the predefined power flows, some HV connections are being forced to reach its theoretical limits of power transmission capacity.

Most of these underground cable connections do not include fibre optic cables within their metallic sheaths, thus are not prepared for the conventional Distributed Temperature Sensing (DTS) methods of dynamic cable rating.

With this problem in mind, and by request of Union Fenosa Distribución (UFD), a new concept of temperature measurement in cables has been developed.

The initial requirements where temperature measurement accuracy of 1ºC or less, passive technology that would not interfere with the operating links and would require no power feeding, on line data availability and ad hoc sensor designs easy to install at any accessible point of the cable route.

LTS SENSORS

Bragg modified fibre optic sensors where chosen as the best solution to measure temperature with the required accuracy, time response and passivity.

These sensors act as mirrors at certain wave lengths, and this property is affected by temperature and strain, shifting the central wave length at which it reflects the light.

As it is know from other temperature measurement experiences with Brillouin, disassembling the strain effect from the temperature effect is not easy when the measurements are affected by both, so the approach was to design a sensor that would avoid any possible strain to the Bragg fibre.

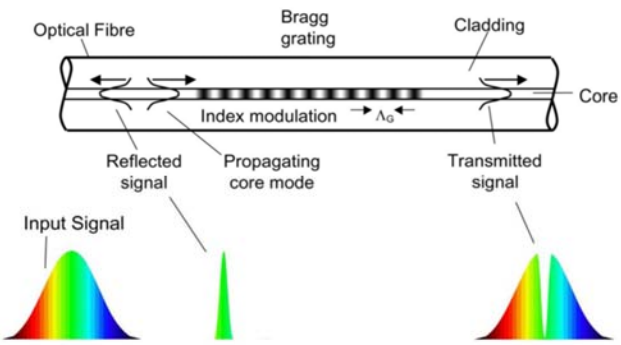

Fig 1: Bragg principle

The sensors, consisting of the modified Bragg fibre with the specially designed protection capsule, are intended to be installed on the cable outer sheaths with standard plastic clamps and are connected to each other by means of standard G652 single mode fibre optics that may or may not follow the cable route. This implies that different circuits can be monitored with one measuring unit, with the consequent economic saving.

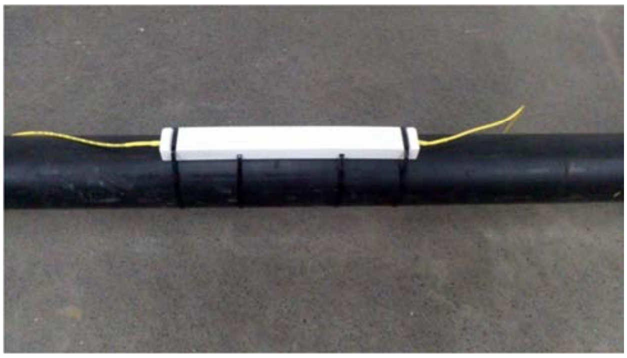

Fig 2: LTS sensor

The sensors are individually calibrated inside an oven, with controlled temperature conditions in order to define each unit's temperature – wave length (pm/ºC) ratio and the central wave length at 20ºC.

It is important to notice that this ratio does not change with the time (it does not suffer aging), but in order to assure the best accuracy and increase the confidence in the measurement, as well as having a method for the detection of any damage in the case that the sensors want to me moved from site to site, a simple on-site calibration is recommended.