

Solutions to thefts in overhead-underground transition towers in Red Eléctrica de España

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ABSTRACT

From 2009, thefts of earthing cables from screens and arresters started to occur in overhead-underground transition towers.

To prevent these thefts, Red Eléctrica de España has designed and implemented a type of shield for these earthing cables.

When the first types of shield started to be used, the number of thefts decreased, although they did not stop altogether. For this reason, the initial design was developed into another design, which was more effective.

The results obtained so far using the latest types of shield are considered to be the best, because, up to date, there have not been any thefts from the towers where these have been installed.

KEYWORDS

Theft, shield, earthing box, overhead-underground transition tower, crossarm, earthing cables, sheath voltage limiter (SVL).

INTRODUCTION

Red Eléctrica de España (hereafter REE) is a Transmission System Operator and the main owner of transmission assets in Spain. Its responsibilities include management, development and maintenance operations. Red Eléctrica de España currently owns 40,044 km of 400 kV, 220 kV and 66 kV overhead and underground transmission lines.

The first theft of earthing cables from a screen and arrester in an overhead-underground transition tower (hereafter TT) in the Region of Madrid occurred on 3rd June 2009. During 2010 and 2011 sporadic thefts occurred, and from 2011 this type of vandalism increased. These thefts initially occurred in Madrid but then spread to other areas of Spain (Valencia, Valladolid and the Canary Islands).

At first, REE simply replaced the stolen items and repaired the damage caused. However, when some of the items that had been stolen were stolen again, REE identified the need to protect the TTs with shields.

The thefts, which initially affected only the segment nearest to the ground, evolved over time. Later on they began to occur even when there was some type of shield installed and from higher areas of the tower, just a few centimeters away from the terminations.

REE has gradually improved its shields. The first method of protection involved placing a tube, secured by standard clamps, around the earthing cables of the screens and arresters. Subsequently, this became a more comprehensive design in which the tower was fully

shielded from the inside of the base to the terminations and surge arresters' support.

To date, there have been no thefts from the towers that have this kind of "super-shield". Therefore, we can deduce that this system is working well.

THEFTS OF EARTHING CABLES

The increase in the price of copper in recent years has meant that thefts of copper cables have become increasingly frequent as the thieves receive significant amounts of money when they sell them. These cables are in the overhead-underground TTs and are used to earth the screens of the isolated cables and arresters.

Evolution of the thefts

The thefts began in 2009, which coincided with the start of the economic crisis in Spain. They increased before reaching a maximum in 2012.

The first thefts occurred in the outskirts of the capital of Madrid and its metropolitan area where there are a large number of overhead-underground TTs (REE has around 100 of these towers in this area). They spread from here to other areas of Spain where there are a few concentrated areas of these types of tower (Valencia, Valladolid and the Canary Islands).

Consequences of the thefts

The theft of the earthing cables has different consequences depending on the configuration of the earthing connections of the line's screens. Some examples are given below:

Configuration of single point earthing, with sheath voltage limiter (hereafter SVL) in the overhead-underground TT

The least serious of all of the scenarios is when the earthing cables are stolen from the overhead-underground TT. Since the earthing box with SVL is in the tower (see Fig. 1), the other end is still directly earthed, so if there is no fault, the line continues to work under the same conditions for which it was designed. These conditions only change when the voltage is increased in the screen due to some external cause (for example, if there is a fault on the line).

In case of theft, a planned outage occurs and the damage repair is