

Investigation of Overvoltages in HV Underground Sections Caused by Direct Strokes
Considering the Frequency-Dependent Characteristics of Grounding.

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ABSTRACT

Nowadays, the analysis of the lightning performance of high-voltage (HV) underground sections has become increasingly important, thanks to their increasing usage with overhead transmission lines. In this way, the objective of this paper is to investigate the sensitivity of the overvoltages, at the terminal of underground cables (UCs), due to the incidence of negative lightning flashes at the shield wire or the tower top. It is done by means of different representations of the grounding behavior, different points of lightning incidence, different values of soil resistivity, and considering or not the variation of the soil electrical parameters with frequency. It is observed that a reliable investigation on lightning overvoltages is important and it must consider a suitable representation of the grounding behavior. An improper modeling can lead to nonrepresentative results. In this way, it is highlighted how the frequency dependence of the soil parameters influences the results in many different situations. For long distances from the UCs and low soil resistivity regions, all the grounding models produce similar results. On the other hand, for regions with high soil resistivities, the use of a proper model for the tower grounding is important, since the discrepancies between the results produced considering or not the dependence of the soil parameters with frequency become substantial. The inclusion of the grounding behavior with frequency allows to obtain reliable simulations of the transient behavior of the insulated cables, which constitute the underground section under study.

Index Terms—Grounding, insulated cables, lightning overvoltage, lightning strike, soil resistivity, underground section, variation of soil parameters with frequency.