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Statistical analysis of lightning-induced voltages on a matched experimental overhead line

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ABSTRACT

Understanding the characteristics of the lightning overvoltages is an essential step for a more accurate estimation of the lightning performance of overhead distribution lines and for selecting the most efficient protection method. This paper presents an analysis of lightning-induced voltage waveshapes recorded on a 2.7 km long, matched, un-energized overhead line without shield wire, neutral conductor, and equipment such as transformers and surge arresters. For the first time, the statistical distributions of the main parameters of induced voltages on a line with such a basic configuration are presented and discussed.

The voltages are subdivided into four types, and simulations confirm their basic characteristics. About one-third of the voltages were classified as bipolar, and it is demonstrated that they may present oscillations even in the case of a matched line without protective equipment. Concerning the unipolar voltages, the analysis indicated that the use of the standard lightning impulse voltage (1.2/50 μs) for testing power equipment insulation seems to be on the safe side since only in 5% of the cases the front time was shorter than 1.5 μs and in 95% of the cases the time to half-value was shorter than 45.4 μs.