

Lightning Performance of Overhead Power Distribution Lines in Urban Areas

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ABSTRACT

Buildings nearby urban overhead power lines are expected to reduce the number of direct strikes to the line conductors and also to attenuate the lightning electromagnetic pulse (LEMP) radiated by indirect lightning strokes. The statistical method described in IEEE Std. 1410 for the lightning performance assessment, as the other methods available in the literature, includes only the former effect. In order to take into account also the latter effect, in this paper, the LEMP attenuation due to the buildings is represented by means of specific weighting functions applied to the LEMP analytical expressions valid for open terrain. For both the cases of ideal and lossy ground, the parameters of the weighting functions are identified through the least-square minimization of the differences with the results provided by a finite-element method model that is assumed as reference for the configurations analyzed. The weighting functions can be used for lightning return stroke current waveform and distances between the line and the stroke location different from those used for their identification with reasonable accuracy. Finally, this paper compares the lightning performances of a power line evaluated with and without the presence of nearby buildings.

Index Terms—Lightning performance, lightning protection, lightning-induced voltages, power distribution lines, shielding effect.