Lightning-Induced Currents in Buried Coaxial Cables

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We present a review of theoretical methods to compute lightning-induced currents and voltages on buried cables. The evaluation of such induced disturbances requires the calculation of the electric field produced by lightning along the cable path. We show that the Cooray's simplified formula is capable of predicting accurately the horizontal electric field penetrating the ground, at distances as close as 100 m. Regarding the parameters of the buried cable, a comparison of several approximations of the ground impedance is presented. It is also shown that, within the frequency range of interest, the wire impedance can be neglected, due to its small contribution to the overall longitudinal impedance of the line. The ground admittance, however, can play an important role at high frequencies (1 MHz or so) especially in the case of poor ground conductivity. The ground admittance needs to be taken into account in the calculation of lightning-induced currents and voltages on buried cables. This is in contrast with the case of overhead lines in which its contribution is generally negligible even in the MHz range.
Experimental results on lightning-induced disturbances in buried cables have been obtained at the International Center for Lightning Research & Testing (ICLRT) at Camp Blanding, Florida, where, during 2002 and 2003, currents induced by triggered lightning were measured at both ends of a buried coaxial power cable, both in the shield and in the inner conductor. The obtained experimental data are used to test theoretical models and computer codes developed for the calculation of lightning-induced currents in buried cables. Field-to-buried cable coupling equations are solved using a frequency domain approach. The coupling to the inner conductor is evaluated using the concept of cable transfer impedance.