Lightning Responses on a Finite Cylindrical Enclosure

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Lightning coupling to the enclosure interior can occur in three distinct ways: (1) lightning can attach to the enclosure and the resulting lightning current flowing in the enclosure wall can cause voltage inside the enclosure wall (an attachment); (2) lightning can strike a conductor close to the enclosure (but not the enclosure) and the resulting magnetic flux can induce a voltage inside the enclosure (the distance from the line source to the enclosure can vary theoretically from 0 (closest induction coupling) to some distance (close coupling)); (3) lightning can strike further away from the enclosure (uniform field-drive induction).

In all three cases, the voltage on a single –turn loop inside an enclosure characterizes the enclosure shielding effectiveness against a lightning insult. In this paper, the maximum induced voltage on a single-turn loop inside an enclosure from lightning coupling to a metal enclosure wall is expressed in terms of two multiplicative factors: (A) the normalized enclosure wall peak penetration ratio (i.e., ratio of the peak interior electric field multiplied by the sheet conductance to the exterior magnetic field) and (B) the DC voltage on an ideal optimum coupling loop assuming the ideal penetration ratio of one. As a result of the decomposition, the variation of the peak penetration ratio (A) for different coupling mechanisms is found to be small; the difference in the maximum voltage hence arises from the DC voltage on the optimum coupling loop (B).