Evaluation of lightning shielding analysis methods for EHV and UHV DC and AC transmission lines

Abstracts

This brochure aims at the application of leader models to the shielding failure analysis of EHV/UHV transmission lines and providing an alternative to the Electro-Geometric Model (EGM). Based on the data from operating experience of the EHV/UHV transmission lines, this brochure critically assesses the existing methods, including EGM and leader-type models, for the shielding failure analysis of EHV/UHV transmission lines. In order to make it robust, the main parameters of leader progression-type models, including downward leader model and upward leader model, leader inception model, cloud potential, charge distribution in the leader channel, charge of upward leader, velocity of upward leader and downward leader, initial velocity of upward leader, and final jump model, are ascertained and suggested, and a sensitivity analysis is carried out to assess its ability in simulating the lightning stroke to transmission lines. The influence of operating voltage on the leader progression process and the shielding failure of EHV/UHV, DC and AC transmission lines, are investigated, too. From statistical results and experimental experiences, it is suggested that EGM can be applied to lightning protection of single-circuit transmission lines with operating voltage lower than 500 kV, but it is not that suitable for EHV/UHV transmission lines of 500 kV and above due to neglecting the upward leader from conductors. It is better to use the LPM or fractal model to analyze the shielding failure of EHV/UHV transmission lines of 500 kV and above, and multi-circuit-tower transmission lines. Then a suitable procedure for the shielding failure analysis of EHV/UHV transmission lines is provided. Improved EGMs with an acceptable prediction accuracy for 500 kV and above transmission lines are obtained for engineering applications. Finally, the proposed procedure is applied for the lightning shielding failure analysis of 1000-kV AC and ±800-kV DC UHV transmission lines.