A Method for Designing Booster Sheds on Post Insulators under Icing Conditions

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Keywords: Icing

A serious problem with overhead power transmission lines, in cold climate regions, is atmospheric ice accretion on outdoor insulators. In the last decades, researchers and electric equipment manufacturers have tried to improve the performance of insulators in that respect. Much interest has been focused on EHV porcelain post station insulators as they are more susceptible to flashover than line insulators due to their higher electric field strength and lower shed spacing. Hence, some mitigation options have been proposed, including using booster sheds or new designs of semiconducting glaze station insulators.

For instance, it was found that booster sheds can prevent ice bridging by allowing the creation of "controlled" artificial air gaps along the iced insulator. As the booster sheds have been proven to be efficient and easy to use on already installed post station insulators, this option seems to be a very interesting solution to this problem.

In order to further the previous studies on booster sheds, a method based on electric field calculation and laboratory validation has been undertaken. More precisely, it deals with optimizing booster shed parameters, such as position and diameter.

The average length of the ice, L, as a function of the accumulation time in the space of booster sheds is:

$$L0\ (cm) = 0.24 * t\ (min) \tag{1}$$

The relationship between the breakdown voltage, V, and the air gap length, x, (between the tip of icicle and the surface) is:

$$V\ (kVrms) = 4.09x\ (cm) + 8.97 \tag{2}$$

The voltage drop on the booster sheds is simulated by the Finite Element Method. The analysis of the experimental results for a 30-mm ice accumulation for 6 booster sheds shows that the length of the icicles on the booster sheds from top to bottom are: (L1=0.5*L0, L2=0.75*L0, L3=L0, L4=1.25*L0, L5=1.5*L0, L6=1.75*L0)

The ice accumulation duration was 70 min and the applied voltage was set at 285 kV. From the obtained experimental data, electric field calculations and equations, the optimized values of the diameters and positions of the booster sheds were determined. It should be noticed that this method can be generalized for other types of insulators such as suspended insulators.