Effect of Pollution Layer Thickness on Electric Field Distribution Along a Polymeric Insulator

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Abstract

Pollution flashover is a major concern for power transmission and distribution industry. High voltage insulators are used in outdoor environments and are exposed to various types of contamination. Theses contaminants can range from sea salt to cement dust and various type of fertilizers used for agricultural purpose. Deposition of pollution constituents on the insulator surface may not influence its dielectric characteristics during dry conditions but during rain, mist or cold fog, the insulator surface becomes wet and forms a conductive layer. Leakage current is driven along the wet insulator surface due electric field. The flow of leakage current along the insulator surface leads to surface heating, dry band formation, partial arcs and under certain conditions leads to flashover. In this study the insulator of Fig.1 was used to study the effect of pollution layer conductivity and thickness on the electric field distribution.

Electric field and potential distribution along a standard 33 kV polymeric insulator was calculated in COMSOL Multiphysics. Electric currents formulation was used to study the effect of pollution conductivity on the electric field distribution. Thickness of pollution layer was changes from 0 to 2 mm in steps of 0.5 mm with different combination of layer conductivity to investigate effect of pollution layer thickness on electric field and potential distribution.

Electric field potential distribution along a standard 33 kV polymeric insulator was calculated. Change in electric field intensity with changes in pollution conductivity and layer thickness was studied. Resistive losses along the insulator surface due to flow of leakage current were also studied.

Based on the simulation results it was concluded electric field is greatly influenced by pollution layer conductivity and thickness while there is very little influence on the potential distribution. Resistive losses along the insulator surfaces increase with increase in pollution conductivity and layer thickness.

Reference

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Figures used in the abstract

Figure 1: 33 kV Polymeric Insulator

Figure 2

Figure 3

Figure 4