Potential Distribution Along a 500kV Polymer Insulator in Presence of a Pollution Layer

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Abstract

The objective of this study is to assess polymeric insulators subjected to polluted environments. The study cases were conducted on polymeric insulators of 500 kV lines. All analyses were carried out with computer simulations, employing the software COMSOL Multiphysics® to calculate the voltage distribution on the surface of the insulators with deposits of pollution layers. Pollution in the presence of moisture generates partial discharges that can lead to the total collapse of these units, causing great concern to the electricity sector regarding the system. Important conclusions have been obtained, which contribute to the assessment of these events.

Thanks to the finite element method it is possible to transform a problem with an infinite number of unknowns (variables on points of a continuous domain) into a problem with a finite number of variables, COMSOL Multiphysics is a software that apply this technique to solve these types of problems. Due to the complexity of the insulator's geometry (Figure 1), CAD Import Module was used to import the geometry of the polymeric insulator .Using the Electrostatics physics interface and the PDE interfaces it was possible to verify the potential distribution along a clean polymer insulator when applied operational peak voltage, and model the pollution to evaluate its behavior on potential distribution.

Using the Electrostatics physics interface, a model was built to simulate the insulator's operating conditions, an insulator surrounded by air and under a high voltage at the bottom pin and no voltage at the top pin (Figure 2). The curve of electric potential distribution along the polymeric insulator without the presence of pollution (Figure 3) was obtained. The expected results for the potential distribution behavior under the pollution effect are quite similar to those obtained for distribution insulators, acquired by others authors (Figure 4), but in this case applied to a higher voltage insulator.

It is important to register how the efficient performance of insulators heavily depends on the level of pollution, and depending on this level, some units may still be subject to intermittent discharges, causing the gradual degradation of the dielectric and leading the insulator to bad functioning. COMSOL Multiphysics is a powerful tool that helps the understanding of this problem and, in the future, the results could be used to develop some device to monitor the insulator performance when operating in polluted environment.

Reference

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Figures used in the abstract

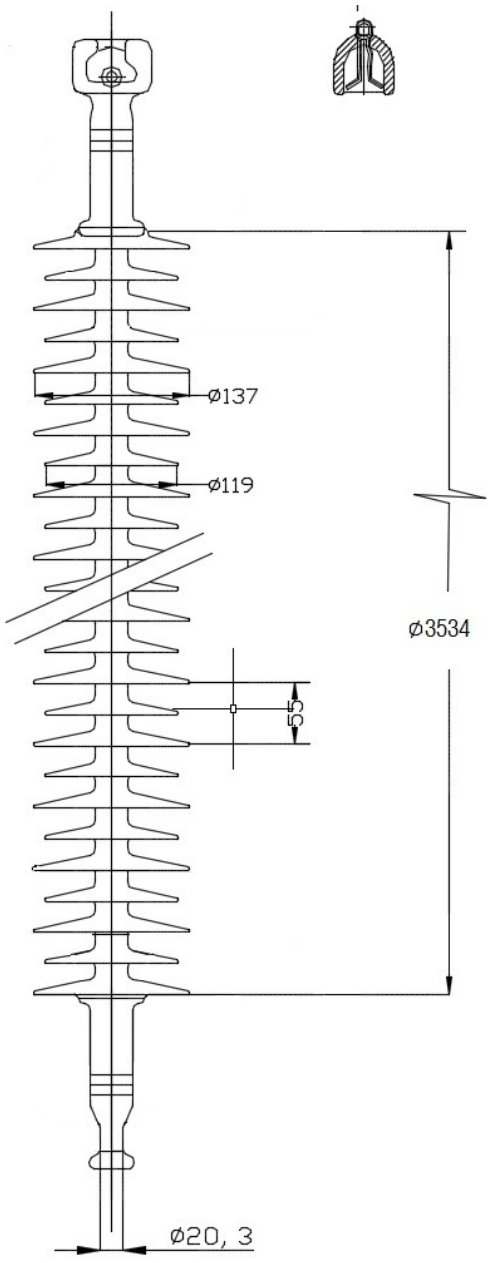

Figure 1: Insulator's Geometry.

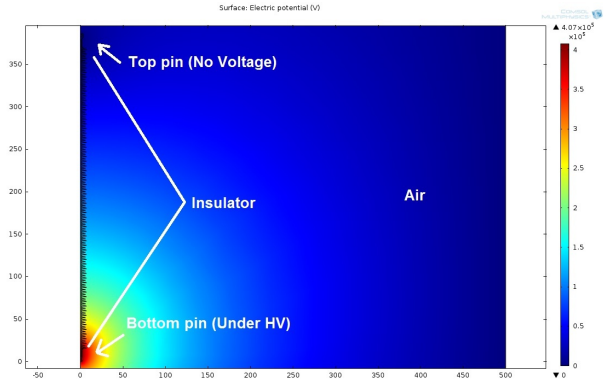

Figure 2: System Built at COMSOL Multiphysics.

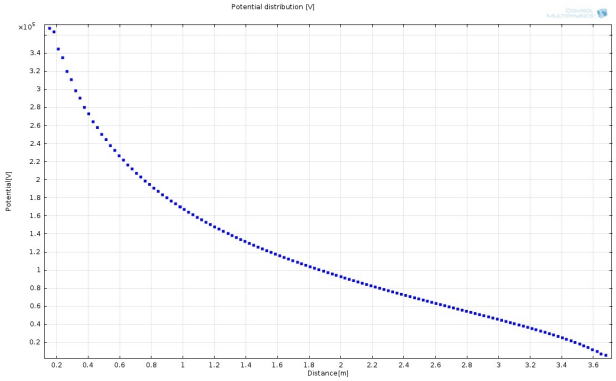

Figure 3: Potential distribution in a clean insulator.

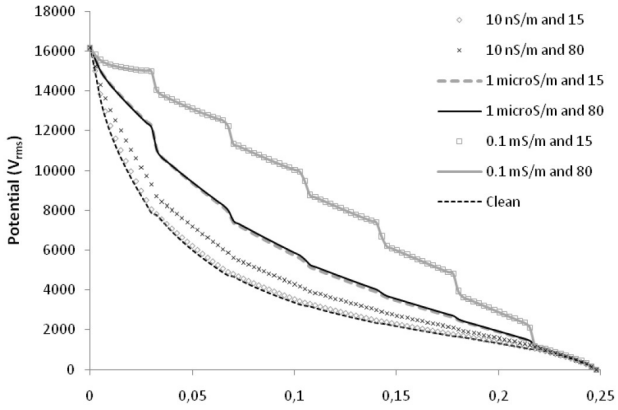

Figure 4: Expected results