

Brittle Fracture of Non-Ceramic Suspension Insulators with Epoxy Cone End-Fittings

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Abstract

The purpose of this research is to establish the critical loading conditions that could promote brittle fracture in suspension insulators with epoxy cone-type end-fittings. Two issues have been addressed in this paper. First, a suspension composite insulator with epoxy cone end-fittings has been modeled by finite-element techniques. Local and global deformations of the end-fitting have been determined by assuming different frictional properties of the interface between the fitting and the rubber sheath as a function of external tensile load. In addition, internal stresses in the glass-reinforced polymer (GRP) composite rod and epoxy cone have been evaluated for different frictional properties of the interface and applied loads. Second, a transverse brittle fracture crack in the GRP rod has been modeled by performing three-dimensional finite-element computations. An attempt has been made to establish a critical size of brittle fracture cracks in suspension non-ceramic insulators. Results obtained in this study showed that excessive tensile loads applied to composite insulators either in service or during manufacturing can cause internal cracking of the epoxy cones. The cracks, in combination with interfacial gaps at the rubber-sheath/metal-end-fitting interface, might allow easy access of moisture and environmental contaminants to the surface of the GRP rod, causing brittle fracture. The finite-element computations of brittle fracture cracks in the GRP rod showed that the numerical stress intensity factors determined at the tip of the crack appear to be significantly higher than the critical stress intensities required to generate brittle fracture. Numerical evaluation of a critical size of brittle fracture cracks was not therefore possible.