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Effects of Contamination Accumulation on The Surface Temperature Distribution of a Glass Insulator String

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A study is carried out on a uniformly contaminated cap and pin insulator string consisting of 10 glass discs, using a Finite Element Analysis software. A CAD design of the insulator is such that a thin conductive water layer covers the entire glass region. This water layer represents acid rain. 150μS/cm conductivity is applied to the water layer to represent an approximate 5% concentration of sulphuric acid at -1oC. The insulator is energized by applying 100kV to its High Voltage end. The highest temperatures were observed at the edges of the insulator and can be attributed to higher power dissipation in these regions. This causes dry band formation on the insulator surface and possible partial discharge (pd) activities. The temperature at the glass and metal component junction remains lower than those at the edges, but high enough to cause an expansion and contraction activity in this region which could lead to an insulator failure due to thermal stress. The percentage concentration of the acid was varied by varying the conductivity of the water layer. While similar results were obtained, the temperatures of the narrow edges increased with increase in conductivity and decreased when the conductivity was reduced. A simulation was carried out without the conductive layer and a uniform temperature was observed across the insulator. The distribution of the electric field on the insulator' s surface is also calculated. The regions of the insulator surface having the highest electric field intensity are the points susceptible to pd activities. As conductivity of the water layer in this work is determined by the percentage concentration of the acid, which in turn explains the level of contamination on the insulator, it is evident that monitoring of pollution severity of HV insulators in harsh environments will provide necessary information for prevention of insulator failure.

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