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Effect of insulator application on the leakage current performance of woodpole distribution line structures

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ABSTRACT

Medium voltage distribution networks use woodpole structures extensively. Woodpole structures are susceptible to burning, referred to as pole-top fires which can result in a loss of supply and electrocution hazard to the public and animals in the area. Leakage current flowing inside or on the surface of the wood is the cause of pole-top fires. Leakage current measurements on woodpole structures were conducted for varying insulator material, insulator shape and positioning on the cross-arm. This comprised laboratory measurements on a reduced scale woodpole structure that was artificially polluted to obtain a baseline. To substantiate the results, measurements on full scale woodpole structures exposed to natural pollution are presented. Leakage current performance of a woodpole structure was found to be most impacted by the choice of insulator material followed by insulator profile for silicone rubber insulators and insulator orientation for porcelain insulators. Structures with silicone rubber insulators recorded low leakage current magnitudes. The structure with Room Temperature Vulcanized (RTV) silicone rubber coated insulators yielded the most improved structure leakage current performance provided hydrophobicity is retained. The structure insulators require reapplication of the silicone rubber coating after a certain period in service. Therefore, the use of High Temperature Vulcanised (HTV) silicone rubber insulators with a wide and short profile and alternating sheds was identified to be the most attractive solution for reducing the risk of pole-top fires occurring. For cases when only porcelain insulators can be used, mounting the insulators horizontally results in less leakage current flow on the structure compared to mounting the insulators vertically. The classic woodpole distribution structure has a combination of unfavourable insulator material and orientation, close proximity to sources of pollution and critical wetting can therefore lead to severe burning at the insulation coordination gap during light pollution as shown from visual inspections. The evaluated structure cases all exhibited a voltage at the insulation coordination gap implying an existing risk of burning at the gap. Suggestions for insulator application for improved structure leakage current performance to reduce the risk of pole-top fires are offered.