

Significant partial discharge in silicone insulated HV joints during livening

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ABSTRACT

Partial discharge testing was carried out to investigate the root cause of two failed 220kV silicon insulated cable joints. Remarkably PD bursts up to 8nC were discovered during network switching. This activity was intermittent lasting less than 20ms, therefore unable to be detected during routine insulation testing.

This phenomenon remains largely unresearched, however poses significant risk to HV cable joints all over the world. This paper shares valuable results and insight gained from this investigation.

KEYWORDS

Silicon joints, silicon insulation, HV, partial discharge, electrical treeing, insulation breakdown, switching, livening, measurements.

INTRODUCTION

An investigation was carried out to determine the root cause of two failed 220kV cable joints. These joints have silicon insulating sleeves and were located at different joint bays of the same circuit. This 11km long cable circuit comprises 16 joints bays and two sets of terminations. The cable has XLPE insulation.

Both joints failed immediately as they were returned to service from routine maintenance. This coincidence immediately raised suspicions if network switching is a contributing factor, hence was a key focus of this investigation.

Failed joints were removed, physically examined, and then sent to the manufacturers laboratory for further analysis.

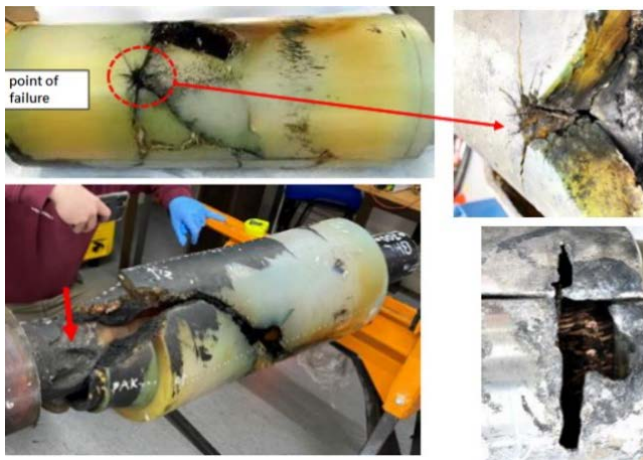


Fig. 1. 2020 failed yellow phase joint.

(Arcing exit hole identified in top images, damaged corona shield identified in bottom images.)



Fig. 2. 2021 failed blue phase joint. (Failed blue phase is the top joint in the photo.)

LABORATORY ANALYSIS

Samples of failed and serviceable cable and joints were removed from site and sent to the manufacturer's laboratory for analysis. Cable XLPE insulation was evaluated as defect-free, without electrical treeing.

Alarming extensive electrical treeing was discovered in the silicon insulation of cable joints that had not failed yet. Therefore a PD phenomenon must be taking place deteriorating cable joint silicon insulation.



Fig. 3. Electrical treeing observed in joint insulation

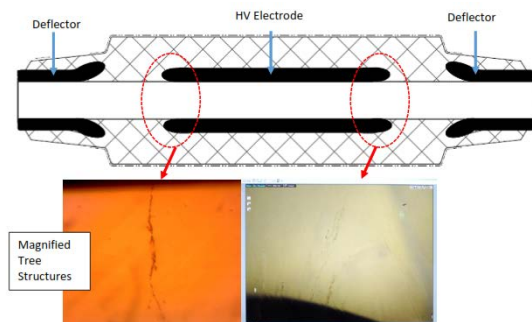


Fig. 4. Treeing in silicon joint insulating sleeves