[2]DIAGNOSTIC FOR PAPER CABLE CONDITION ASSESMENT

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ABSTRACT

Off line diagnostic method had been defined to detect cable links with failure risk due to presence of joint with water penetration. This method, based on tan delta measurements completed with partial discharges measurements has been applied in real conditions of replacement operations. Specific decision criteria and application results are presented. Economical aspects related to diagnostic integration in a replacement policy to prevent failures during hot summers are discussed.
EDF R&D program for cable system condition assessment is presented

KEYWORDS

MV Cable, diagnostic, PILC, joints, water penetration, underground, network.

INTRODUCTION

French MV underground network had been early and massively developed with innovative and reliable synthetic cable which represent 85 % of the MV underground network. However Paper Insulated Lead Covered (PILC) cables, mainly installed 40 years ago, are still operated, particularly in French major cities. As it could need a significant amount of investment replacement of those cables is anticipated by EDF asset management to define the adequate renewal strategy. For that, accurate condition assessments based on diagnostic tools are needed. Even if most of PILC cables are still in good condition, presence of such cable lead to fault rate increase, specifically during hot summer. This is mainly due to transition joint with water penetration, so efforts on diagnostic methods were first focused on those bad joints. Managed in a second stage cable assessment is becoming soon the central activity.
The off line diagnostic method developed and applied by EDF R&D for preventive joint replacement operations is first described. Then program in order to reach more accurate diagnostic criteria and to reduce resources involved in diagnostic are presented.

OFFLINE DIAGNOSTIC METHOD FOR TRANSITION JOINT WITH WATER INGRESS

Background

Following increasing of fault rate observed during summer 2003 heat wave, works were engaged by EDF R&D to explain degradation mechanisms involved and define preventive method in order to limit failure occurrence. Expertises hold on failed transition joints shown that water ingress in joint insulation paper was observed in most of the cases. Tan delta measurements were rapidly applied in order to characterise temperature behaviour of bad joints because this well known method is used for many years in order to appreciate insulation performance. More over, previous works performed at EDF R&D and by other research teams shown that tan delta measurement performed at very low frequency (or in a range of low frequency like dielectric spectroscopy) [1], [2] were able to detect moisture or interface phenomena. Thus such phenomena could be observed due to presence of water in the paper/oil impregnation complex.
Test carried on several joint samples removed from networks showed both :

- Dramatic decrease of insulation dielectric characteristics versus temperature increase and good correlation with water content in insulation papers after joint expertise,
- Ability of 0.1 Hz tan delta measurement performed at ambient temperature to differentiate the bad joint behaviour at higher temperature.
- Three type of behaviour were identified as shown in fig. 1:
- Type 1 : Slight increase of tan delta versus temperature and water content in paper < 1%,
- Type 2 : Moderated increase of tan delta versus temperature and water content in paper between 1 and 2 %,
- Type 3 : Dramatic increase of tan delta versus temperature and water content in paper > 2%.

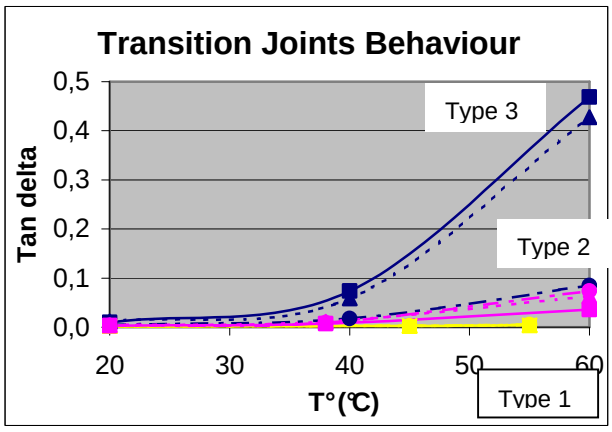

Figure 1