MV CABLE TERMINATION FAILURE PREVENTION, ONLINE DIAGNOSTIC METHOD APPLICATION.

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ABSTRACT

This paper presents the definition of an on line method dedicated to prevent failure of specific MV cable terminations with very restricted accessibility. Specifically of interest are cables with large cross sectional area (1200 and 600 mm²) in HV/MV indoor substations. The methods used and on site experiment are presented.

The purpose of the work is to give accurate criteria decision for termination replacements. For that, behaviour before failure had been characterised with components removed from the network. In a first stage, the feasibility of partial discharge detection had been verified. Then criteria based on partial discharge activity versus thermal constraint have been set.

The method described uses spot measurements to identify first level risk and partial discharges monitoring in order to identify characteristic behavior on weak components that have to be removed as a priority. The initial results of a monitoring device installed in an urban HV/MV substation are also presented.

KEYWORDS

MV cable, Diagnostic, Partial Discharges, Terminations, Large cable cross section.

INTRODUCTION

Underground MV network asset management is a major issue for the EDF Group to ensure a high level of Distribution performance. Off line diagnostic tools are currently used to detect and remove weak points and avoid short-term failure. Most of the time, on-line methods have to be improved for efficient application in failure prevention. That is particularly true for a global underground network survey on line system that complies with all ERDF requirements.

Nevertheless, existing on line diagnostic tools can be usefully used for specific applications in the range of compliance. Then the main challenge is to define accurate criteria for replacement decision.

Failures had been observed on MV cable terminations in HV/MV substations. The cables considered are those with large cross sectional area (600 and 1200 mm²). Such failures are very rare but when terminations do fail, material and service quality impacts can be heavy. A specific type of termination has been identified and replacements are planned. Even if the number of replacement is limited, important and complex works are needed and during the progression failure must be avoided. As cable sections are rather short and accessible, on line partial discharge (PD) measurements can be fairly considered. Failure prevention in urban HV/MV indoor substations are specifically focused. In this kind of equipment some terminations are not accessible. In these cases sensors for PD measurements can't be set at the optimal location and solutions have to be found to compensate this potential lost of sensitivity. So characterisation of the PD signal due to the focused degradation mechanism and its evolution before failure has been engaged.

DECISION CRITERIA DEFINITION

Degradation mechanism

Visual inspection on failed terminations has shown degradation of the stress control material at the end of the external semi conductive screen. Bad adhesion of the mastic has been observed and traces of electrical erosion have been found on the cable insulation surface.

In order to follow PD evolution during degradation, thermal ageing has been performed on terminations removed from a substation where failure occurred. As the whole cable sections had been replaced after termination failure, 5 healthy but critical terminations have been collected for tests. Two of them, with the worst initial PD measurements were selected for thermal ageing. Breakdown occurred on one of them after 1 month while sequences of thermal constraint and 12 kV nominal voltage had been applied. Comparison of the defect after lab breakdown and the one observed after on site breakdown shows that causes were likely to have been the same.

Moreover, temperature increase of the stress control material has been observed under nominal voltage application.

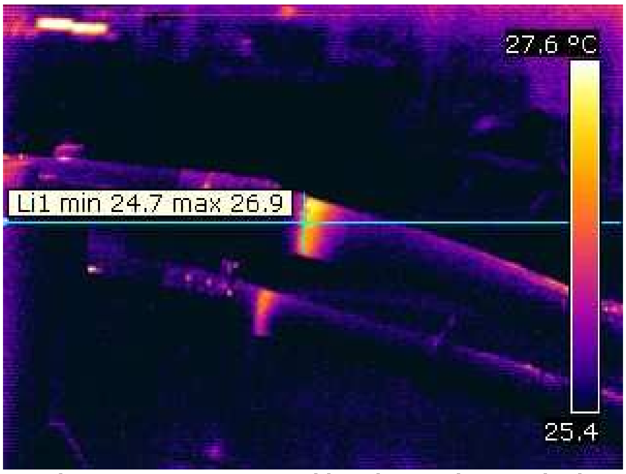

Figure 1 : Stress control heating under nominal voltage

A combination of initial bad adhesion and thermal degradation of the stress control material due to load and