Risk management in the presence of partial discharges in HV joints by means of periodic monitoring

Xabier **BALZA**; Prysmian Group (PG), (Spain) xabier.balza@prysmiangroup.com

ABSTRACT

It is common knowledge that partial discharges in extruded insulations lead to sudden breakdowns and are to be avoided at any expense, but when they are found on site, usually in accessories, is not always easy and possible to solve the problem immediately.

This article presents the successful result of a delicate eight month risk assessment through on-line partial discharge measurements and cable system knowledge in 6 joints with different installation defects as well as the result of the autopsy of the joints and their link to the measured patterns.

KEYWORDS

Partial discharges, risk assessment, installation, accessories, high voltage, on-line, condition assessment.

INTRODUCTION

It is general knowledge that internal partial discharges and extruded insulations such as the XLPE for insulated cables are dangerous because the time to breakdown is short and not predictable.
This is the main reason to insist on having PD free cables, accessories, and installations when speaking of extruded insulations.
Nevertheless, even though the stochastics behaviour of PDs, there are some cases where a proper knowledge of the PD patterns, the accessories and cables designs, and a suitable PD measuring equipment and personnel, may allow a certain time of extra service with controlled risks, making possible the programmed replacement of the accessories with PDs.
In 2017 the need to move some old 66kV cables to a temporary location, and having them jointed to some new, and different cables was presented by a client; the difference in diameter over insulation required either new moulds for special transition joints, either the installation of thermo-shrinkable joints.
As the joint service life was foreseen to be 6 months, and the quantity was not justifying the cost of a new mould, the second option was proposed and approved.
After the installation of the joints, on line PD measurements showed the presence of PDs in all the joints, but on the contrary of the natural reaction when in presence of PDs, we presented a risk management plan that allowed a controlled service life until the controlled removal of the joints.
In the following sections we will explain the process, the materials, the logic behind the decisions, and the outcomes of the after-service autopsy performed to the 6 joints in our installations.

THE CABLE SYSTEMS

There were 2 circuits to be moved, with old 66kV cables to be connected to new 66kV cables, all of them with different conductor materials and cross sections.

A) 36/66kV 1x630Cu H25
B) 36/66kV 1x400Cu H25
C) 36/66kV 1x1000Al H135

The joints were straight joints, and the installation was performed in the basement of a GIS substation, in conditions of very limited space and big density of existing HV cables as can be seen in figure 1.

Fig. 1: Substation cable arrangement

The differences in dimensions (Table 1) of the required combinations (A-C and A-B) and the temporality of the connections lead to the selection of thermos-shrinkable technology.

This joint technology (thermo-shrinkable) is not part of our portfolio of products, so it was bought to an external provider, and the installation of the joints, not having certified jointers for them, had to be subcontracted too.

Cable type	$Ø_{cond}$ (mm)	$Ø_{insul}$ (mm)	$Ø_{ext}$ (mm)
36/66kV 1x630mm2 Cu	29,6	55,1	64,0
36/66kV 1x400mm2 Cu	22,6	43,0	52,3
36/66kV 1x1000m2 Al	38,2	60,8	77,0

Table 1: Cable dimensions

Initial state tests

It is our general procedure to perform an initial PD measurement to any cables to be moved, to have the picture of what it is the status of the cables and accessories we will have to work with and establish a clear liability.
Being old cables and accessories, it is not rare the presence of PDs, generally in the accessories.
In this case some PDs where measured, but they were linked to the old GIS terminations that had to be cut and recycled. There was no sign of internal PDs coming from