Cold Shrink Joint with embedded sensor for Voltage or Partial Discharges Detection in Medium Voltage Network

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ABSTRACT

This paper describes a cold shrink joint for Medium Voltage networks equipped with an internal sensor that allows the detection of the presence of voltage. Also, the sensor can pick up signals coming from partial discharge activities in the insulation of the circuit.

KEYWORDS

Cold Shirink Joint; Maintenance; Verification of the Absence of Voltage, Voltage Presence, Partial Discharges

INTRODUCTION

The maintenance of Medium Voltage (MV) lines in tunnels requires the Verification of the Absence of Voltage (VAT) before any maintenance work on the line [1]. Many different solutions have been developed to check the presence of voltage, also, to ensure the safety of workers, the spiking of cables is performed in many countries [2], which destroys the insulation and can cause big damages to the surrounding assets if by error the cable line is under voltage when it is spiked.

In MV lines the VAT can be performed in correspondence of the terminations by using the sensors embedded in the switchgear cabinets or by the test point of the terminations [3, 4] based on a capacitive voltage dividers. Along long cable lines, where it is not always possible to see the correspondence of the cables with the terminations, it is necessary to employ other tools. This task is particularly difficult in MV networks because the cables are completely screened, so it is not possible to use simple contactless voltage detectors as in low voltage distribution networks.

In the market there are joints equipped with capacitive test points, like the test points of the separable connectors, but this feature requires a non-elastic portion of the joint, so it is not suitable for cold shrink joints, where the joint body is fully elastic and metallic parts as the traditional test point cannot be integrated. On the other hand cold shrink joints have several advantages, including the easiness of installation, the presence of a metal braid to drain fault currents to ground and an improved resistance to water penetration. For these reasons a new solution has been developed, based on a flexible sensor which can be embedded in a cold shrink joint.

DESCRIPTION OF THE SOLUTION

The solution described in this paper was achieved by adding a sensor to an existing model of joint, i.e. the Coldshink Elaspeed™ joint, that has been designed and manufactured by Prysmian Group [5].

This cold shrink joint has its body manufactured by an extrusion line (i.e. it is not molded) and it is fully elastic. For this reason, a flexible sensor has been designed, so to be installed on the external surface of the outer semiconductive, SC, layer of the joint body [6]. A schematic picture of the positioning of the sensor inside this new Smart Joint is reported in Figure 1.

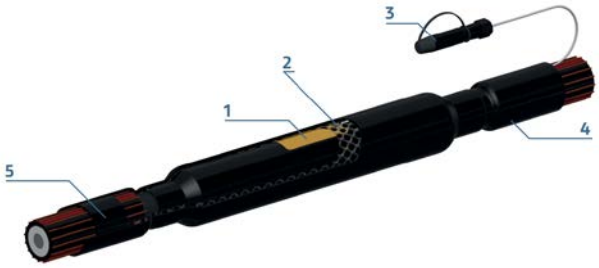

Fig. 1: Cold shrink joint with embedded sensor. 1) Sensor, 2) copper braid, 3) connector, 4) outer jacket, 5) water sealing

Being external to the main insulation of the joint, the sensor does not affect the electric field distribution inside it, so there is no change in the electrical stress of the insulation with respect to the joint without sensor.

When the inner conductor of the joint is subjected to AC voltage, a capacitive current flows radially in the insulation, it is collected by the outer semiconductive layer and it is drained to ground. The sensor is designed to pick up the voltage drop across a small portion of semiconductive layer due to the capacitive current flowing in it. Thus, the sensor is made, on one side, by a measuring electrode and one or more ground electrodes placed at small distance (e.g. 10 – 20 mm) on the outer semiconductive layer. The other side of the sensor is covered by a conductive layer which provides screening against electromagnetic interference.

The sensor together with the remaining part of the joint body are covered by a metallic braid, as in the joint without sensor, in order to drain to ground the fault currents. This