B1 - INSULATED CABLES
PT 1 Fault localization

New CFL-pipes for effective fault localization of power cables

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Polymer pipes, which are now widely used for laying cables, do not provide reliable testing of cables and detecting damages, in view of their dielectric properties. As a result, facility acceptance does not cover testing of cables laid in pipes; hence, they may be put into operation with defects that may eventually lead to a breakdown and failure of the cable line. In addition, these problems are especially topical during operation with periodic tests and cable fault location in pipes, that is also noted in CIGRE technical brochure No. 773 "Fault location on land and submarine links (AC & DC)".

To solve these problems, special CFL-pipes (cable fault locating) have been first developed, offering to detect the fact of damage to the cable sheath and accurately locate the place of damage.

Today, more and more projects include laying of cables in pipes, with pipelines being as high as 60% of the length of a cable route and exceeding trench laying in distances. This is due to the fact that the laying of cables in pipes not only protects the cable lines at the intersection of communications and provides passages that are not possible by the traditional trench method but also contributes to a significant reduction in the time and cost of construction work.

However, in view of the fact that most of the today's pipe cable channels are made of ordinary plastic pipes with walls having a high electrical resistance, it is not possible to reliably test the cable outer sheath before putting the line into operation (Fig. 1).

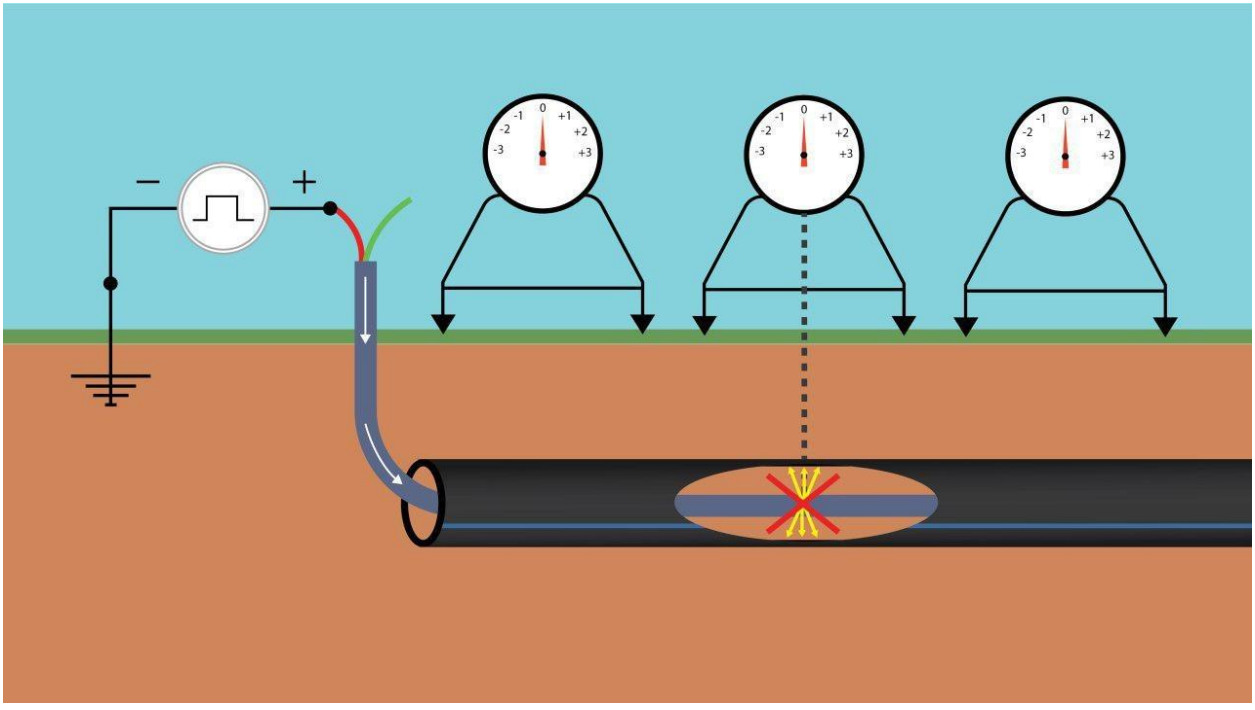

Fig. 1. Cable outer sheath testing in ordinary plastic pipes

As a result, these sections of the cable line remain untested, and if their total length, as noted earlier, is 60% of the entire length of the route, then the cable line is put into operation with less than half of it having been tested.

Accordingly, the damage within the pipes cannot be detected in a timely manner, which increases the accident rate of the cable line and leads to a decrease in its reliability.

Since the problem of cable sheath fault detection/location in plastic pipes is generally topical for the global electric power industry, the report considers both domestic know-how and foreign know-how.

The foreign know-how may be based the theses from the technical brochure No. 773 of the Conseil International des Grands Réseaux Électriques (CIGRE) "Fault location on land and submarine links (AC & DC)", which points out that:

- locating cable damage in plastic pipes is problematic;
- acoustic methods for detecting damages in pipes are ineffective;
- to search for a damage, construction companies are forced to cut pipes;
- presence of a semi-conducting/graphite layer on cable sheath does not solve the problem of locating the damaged place.

As a solution to the problem of detecting and locating the damaged place of a cable outer sheath within a pipe, the report considers special CFL-pipes (cable fault locating) that have no analogues in both the Israel and foreign markets. The main purpose of this product is to increase the reliability of cable lines by timely detecting damage to the cable sheath.

CFL-pipes provide detection of damage to cable outer sheath within a pipe and accurate location of its place at the stage of acceptance tests, while significantly reducing the time and cost of repair and restoration work. This is due to the fact that when testing the cable outer sheath with a direct voltage of 10 kV, the CFL-pipes do not prevent the test current from escaping through the damaged outer sheath and on through the pipe wall into the surrounding soil (Fig. 2).

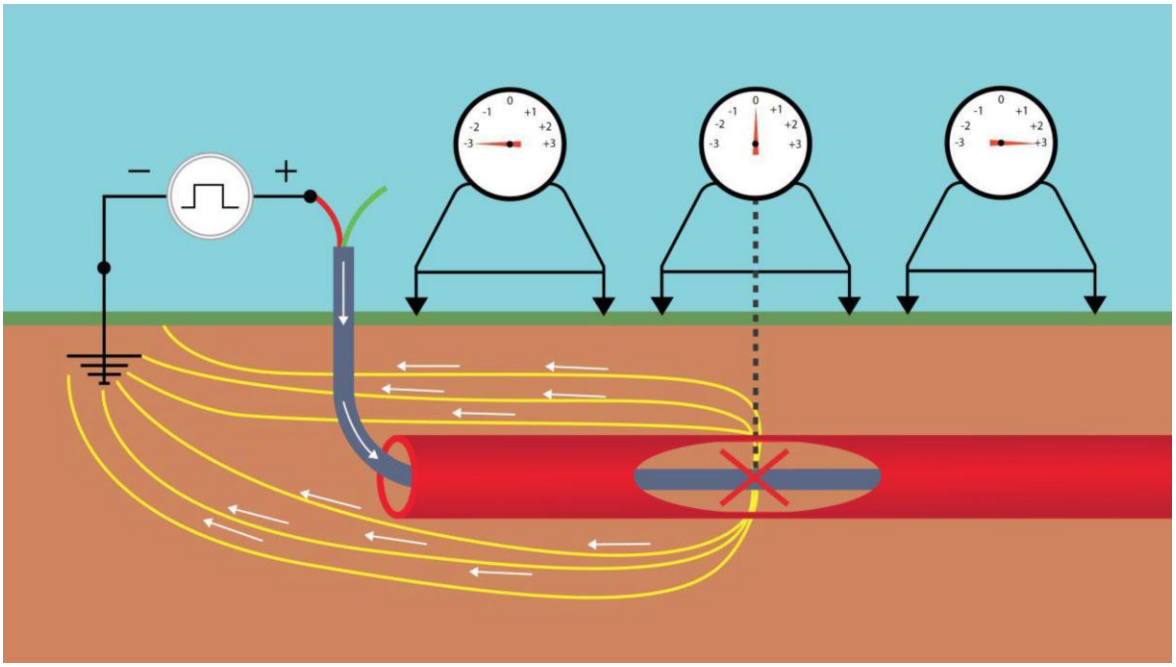

Fig. 2 Cable outer sheath testing in new generation of polymer pipes (CFL-pipes)

The cost-to-use analysis of CFL-pipes involved the comparison of the costs of repair and restoration work to eliminate cable damage in the CFL-pipe and traditional plastic pipe. The analysis was carried out on a cable with a 110 kV nominal voltage, laid in a 200 m pipe channel and having outer sheath damaged. The analysis, as provided in the report, clearly showed that the use of CFL-pipes offers a reduction of repair and restoration costs by more than 10 times, while greatly reducing their duration.

This is due to the fact that in the case of traditional plastic pipes that do not offer to detect damage to the cable sheath before the line is put into operation, repair and restoration work is carried out after several years of operation of the cable line, when moisture penetrates through the damaged sheath into the insulated part to lead to cable breakdown. This will require repair work by replacing either a cable piece or the whole cable length on the entire pipe section, with the costly and time-consuming location of the damaged site and purchase of new cable and joints.

Since the CFL-pipes offer detection and accurate location of the damaged place in the sheath even before the cable is put into operation, repair work does not require disconnecting the line and does not cause equipment downtime. The cable sheath, due to timely detection of the defect, is restored by installing a heat-shrinkable sleeve.

With the advantages of the CFL-pipes: detection and location damaged place in the cable, the power grid companies can benefit from these pipes ensuring timely repairs of the cable even at the construction stage, eliminating the likely failure of the cable line during operation, reducing repair and restoration work and line downtime.