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TRANSITION JOINTS

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ABSTRACT

This article clarifies RTE (the French Electricity Transmission System Operator) and EDF R&D works on optimization concerns for future underground links and on adjustment of existing network necessities.

The working group concludes with the definition of a specific method to qualify transition joints allowing connection between dissimilar cables.

The use of these transition joints offers a reliable answer for the requirements of the French Grid.

KEYWORDS

Joints.

INTRODUCTION

Nowadays, RTE gets for each underground line the whole cable system (cables and accessories) from a single manufacturer. The same manufacturer is required for the system assembly.

In order to guarantee the best reliability, RTE qualifies all equipments before their installation on the network. The qualification process concerns the whole system: cable and accessories are approved as a package. This process guaranties the compatibility among the tested cables and accessories. It is adapted for the installation of lines which are homogeneous all along their route.

RTE intention is to keep optimizing new underground lines. Indeed, an underground current rate mainly relies on its thermal environment. The route link doesn't usually offer an homogeneous environment. For example, an obstacle often has to be avoided by using great depth drilling installation. This special route point will oblige the use of high section cables, while the rest of the route only needs smaller section cables. Therefore, in order to decrease the lump sum of the line, the connection between dissimilar cable sections would be an interesting solution.

Furthermore, RTE has to realize more and more operations on existing lines :

- Partial cable changes, to renew the network and to answer costumer requests,
- Extension of the existing underground network.

Cables and accessories used for these 'old' lines are not manufactured or available any more when the change of the whole underground line cannot be taken into consideration. That is why a connection between two different cable generations has to be validated.

Then, RTE and EDF R&D started a combined reflection to find solutions to both objectives – connection between cables with different sections and connection between old generation cables and new ones – with the same reliability as connection between identical cables.

Paper insulated cables maintained by RTE are old and are to be replaced following the development on the network. The group decided to limit the scope of their study on XLPE insulated cables only. About 3000 km are involved, the oldest ones were installed around forty years ago.

METHODOLOGY

RTE wishes to dispose of the necessary transition equipments to fulfil these new necessities. In order not to degrade the grid's conditions of operation, the reliability of transition joints between two different types of cable should be the same as usual joints. The traditional approach would have been "one need of transition joint = one test". Though, it is not conceivable to achieve the whole qualification process for each and every existing cable combination: costs and achievement delays would have been too important.

EDF R&D established a new process, based on the characterisation of determining parameters and the associated risk analysis. This process gives parameters to support decision for different cables linking feasibility.

Aim:

« MERPILS HTB »: Méthodologie Et Recommandations Pour l'Interchangeabilité des Lignes Souterraines HTB (Methodology and Recommendations for the Interchangeability of HV underground lines) is a process to optimize qualification costs and delays. It gives qualification extension rules by sections, but also qualification extension rules between different manufacturers and/or existing techniques. At last, it can reduce the number of tests and puts forward essential credibility data in order to assess the equipment on file.

Methodology:

With the knowledge of cables and joints characteristics, the process goes through seven analysis steps that help to deduce the possibilities to connect the two cables concerned with the studied transition joint. The two cables can have dissimilar constructions and/or can come from different manufacturers. These seven steps consist in :

- dimensional compatibility,
- validating that asymmetry has no wrong effect,
- dissimilar forms and adherence types of the external semi-conducting screen,
- dissimilar material type of the oversheath,

- material compatibility at the insulation and semi-conducting interfaces,
- network laying techniques,
- installation and accessory assembly recommendations.

The method brings to three possible results:
- "Yes" - the two cables can be connected thanks to the studied transition joint,
- "No" - the two cables can not be connected thanks to the studied transition joints,
- "Perhaps" – the two cables could be connected thanks the studied transition joints, but another test has to be realized to confirm the results.

TESTS

When the method can not ensure a precise conclusion, other tests have to be realized to approve the good joint operating.

Tests have to be selected by using a special specification.

This specification establishes the hardness of the tests the joint has to pass. The hardness depends on the differences between the cables that need to be connected. It could be the nature of the conductors, the conductor sections, the insulation thickness, the metallic sheath…

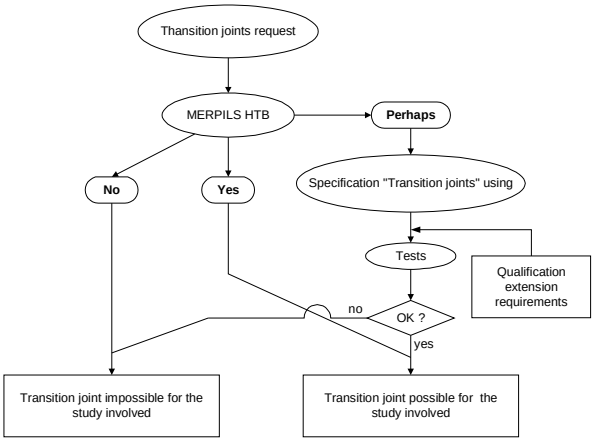

Figure 1: Method diagramme

Figure 2: Thermo - mechanical tests area

For most of the cases, the long term test of the French Standards or the pre-qualification test of the IEC would be too important for cables with such limited differences. However, it is obvious that a minimum of checking is required even for an elementary qualification.

After analysis, most of these cases can be qualified thanks to a suitable thermo-mechanical test.

Dedicated test area development

A new dedicated test area was built to check the equipment performance and to lower qualification costs for the validation of these joints.

This specific area will also be useful to check a significant number of cables and accessories improvements, taking into account recommendations from the Working Group CIGRE B106.

This new test area can:
- simulate rigid or flexible laying techniques for cables, by using suitable fixation clips.
- offer a large place for the installation of up to four transition joints, in order to test all combinations of laying techniques described over,
- test this loop from 104kV to 400kV.

Figure 3: Thermo – mechanical tests area

REAL CASE EXPERIMENTATION

The MERPILS methodology was first applied on 90kV taped joints, for the building of a new line in Normandie–(France).

This line covers a length of 12km. Environmental concerns required drilling installation. The depth of these crossways couldn't afford any more the current rating required when using the first cable section chosen. The use of a greater cable section for the whole line would have increased the global cost, detracting from the interest of the project.

The use of transition joints allowing section jumps appears to be a correct solution to these problems. The methodology application concludes with the necessity to realize test validations. These tests are currently being processed and the line construction can begin after their achievement.

CONCLUSION

RTE and EDF R&D have acquired a method allowing the qualification of joints for connection between various cables.

These equipments offer solutions for operating necessities on the existing network and offer optimization for future links.

The MERPILS method allows cost mastering as well as transition joints qualification delay control. The reliability guaranty required by the French grid is still maintained.

These equipments offer a more well adjusted underground cable section to environmental constraints, thus make easier economic acceptability of the links and therefore improve their use in France.