# WORKING OUT EXTENSION OF QUALIFICATION PROCEDURES FOR HV AND VHV CABLE SYSTEMS

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## ABSTRACT

*For a long time, EDF has been using in-house specifications defining the design of HV and VHV cable systems, and their qualification procedures, including a long duration test under voltage and thermal cycles, as a type test.*
*When a functional approach was introduced, it was necessary to establish procedures for the extensions of qualifications to take advantage of technological improvements, as quickly as possible.*
*The so-called project « Material Finger Printing » was launched with the objective to define simple tests, preferably on materials rather than cable systems, to be performed to validate possible changes in cable systems.*
*As a result of this work, RTE introduced, in 2010, in its specification for HV and VHV cable systems, a guide for extension of qualification.*
*This article presents the methodology applied and illustrates the resulting rules through three examples.*

## INTRODUCTION

To assess the reliability of underground links, Transmission System Operators generally rely on in-house specifications which detail the functional characteristics required for the cables and their accessories, and the tests to be performed to check the products meet these requirements.

Type tests have to be carried out before supplying on a general commercial basis a type of cable system, in order to demonstrate satisfactory performance characteristics to meet the intended application.

Once successfully completed, type tests need not be repeated, unless changes are made in the cable or accessory materials or design or manufacturing process, which might change the performance characteristics.

Accordingly, the consequences of any modification proposed by a supplier have to be studied to detect which performance characteristics may be adversely affected and to select tests to be repeated to assess the satisfactory quality level of the new product.

To take advantage of technological improvements as quickly as possible, while minimising the cost of testing, RTE launched in 2001 the so-called project « Material Finger Printing » (MFP), with the objective to define simple tests, preferably on materials rather than cable systems, to be performed to validate possible changes in cable systems.

## « MATERIAL FINGER PRINTING » APPROACH

For a.c. HV and VHV underground links, RTE uses only XLPE insulated single-core cables, with a conductor either in aluminium or copper. The RTE cable system specification [1] requires a lead-free metal screen, involving a laminate foil, bonded to a polyethylene outersheath, as a water barrier. A bedding, optionally water blocking, may be applied on the outer semi-conductive layer.

Type approval needs completion of tests which, for most of them, are specified in international standards such as IEC 60840 [2] and IEC 62067 [3], for HV cables up to 150 kV, and VHV cables above 150 kV respectively.

The pre-qualification test specified in IEC 62067, to assess long-term performance of cable systems, is included in RTE specification as a type test.

To define extension of qualification rules, the adopted methodology was based on :

- a functional analysis of cable components, with respect to electrical, mechanical, thermal…concerns
- the identification of possible threats in case of changing, and, accordingly, materials or designs characteristics to be checked.
- the selection of existing standard tests which are relevant to validate changes.
- the consideration of new tests to be carried out, preferably on materials rather than complete cable.
- the definition of development tests (to be performed by system suppliers at design stage), where necessary.

The MFP project, led by RTE, has been conducted in association with several cable manufacturers and EDF R&D.

To illustrate the project content, this approach is detailed in the case of a changing in the polyethylene compound used for cable outersheating, and general considerations are given, which apply to any change.

Then two development tests are presented, to be applied in case of an evolution of the bedding used to limit mechanical stresses on the metal screen, due to the thermal expansion of the insulation.

Finally, a so-called “thermo-mechanical test” is introduced, to check the behaviour of a cable system with respect to thermo-mechanical stresses.