

## "BEST-OFFER" PURCHASING OF MEDIUM VOLTAGE JOINTS BASED ON ROBUSTNESS TEST

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### ABSTRACT

ERDF aims to improve the reliability of medium voltage underground network by increasing the robustness of straight-joints. In order to build its MV underground network, ERDF installs each year 35 000 cold-shrink joints equipped with mechanical connectors. In 2009, a robustness test has been applied to these accessories. The test results have been used as a "best-offer" criteria to renew the national market purchases.

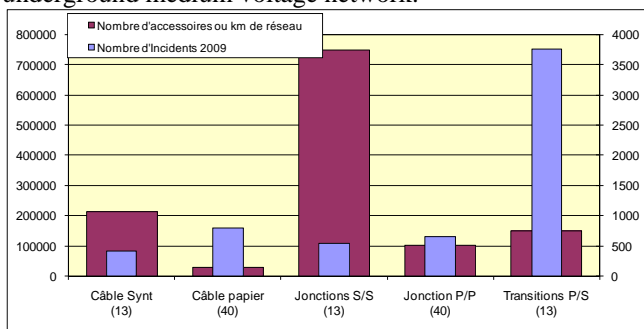
The EDF specification HN 33-E-03, published in November 2008, describes the test which aims to evaluate the behaviour of accessories when submitted to a long stay in water. Accessories are submitted to thermal cycles applied through conductor heating in order to simulate the effects of the load. As well, thermal cycles are applied to the water, in order to simulate thermal variations of the environment. The test highlights possible weaknesses of accessory sealings.

The comparison of breakdown voltage values after the test and breakdown voltage values of the same but of new accessories determinates a technical rank, which represents the Robustness of each accessory. Results of the test have been assessed enough discriminatory to attribute the main part of market to the more reasonable offer, from the following criteria : price and technical rank according to Robustness test.

### INTRODUCTION

Medium voltage underground network of ERDF (Electricité Réseau de Distribution France) accounts for 243 000 km large and more than 1 million of accessories.

During the year 2009, 7 700 failures have occurred on the underground medium voltage network.



Picture 1 : Failures on the medium voltage underground network of ERDF

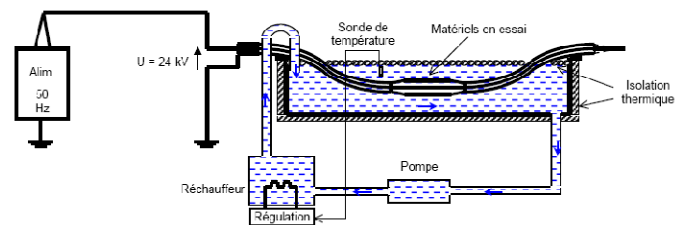
Accessories are mainly polymeric cable joints : 750 000 on the network. They are basically 13 years old. They represent 535 failures per year, corresponding to a failure rate inferior to 1 for 1000. But what about the situation in 20 or 30 years ? From the field experience on the transition joints, ERDF has developed diagnostic tools and decided to increase requirements of qualification tests.

In fact, most of the failures are due to water penetration in accessories.

### ROBUSTNESS TEST

#### Principle of test

The EDF test specification HN 33-E-03 has been published in November 2008. This test consists of maintaining accessories in water and applying thermal cycles on the water and the conductor. Thermal cycles of water simulate environmental temperature variations. Cycles of conductor simulate the load of the network. The test allows highlighting eventual weaknesses of sealing of accessories.

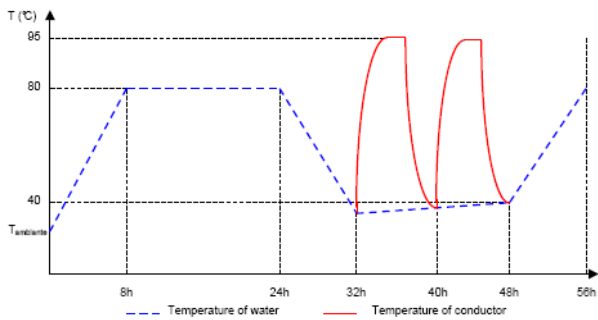


Picture 2 : principle of installation

Six single-core joints are installed on NF C 33-226 cable, by each supplier. The cross-section of the cable is 150 mm<sup>2</sup> (mainly used by ERDF).

3 fresh joints, in new state, are tested with voltage step until breakdown.

3 joints, heat treated in robustness test, are also evaluated as the latter ones. The water level is 0.6 cm. The values of water and conductor temperature are recorded during the test. Accessories are tested during 45 cycles. Each cycle corresponds to 48 hours, as shown in Picture 3.

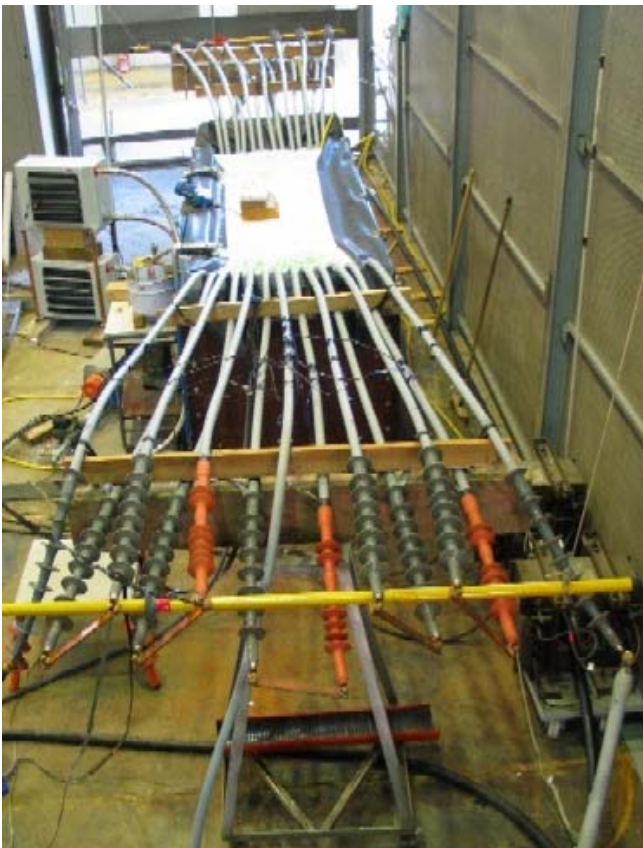


Picture 3 : Illustration of a single heating cycle in water and conductor

Each one of them includes a 24-hour heating with a step of 16 hours at maximum temperature, and a 24-hour cooling. Water temperature varies between 40 and 80°C. Maximum temperature recorded in the conductor is about 95°C.

After the joints are investigated in withstand voltage of external jacket, and in voltage step until breakdown as the fresh joints.

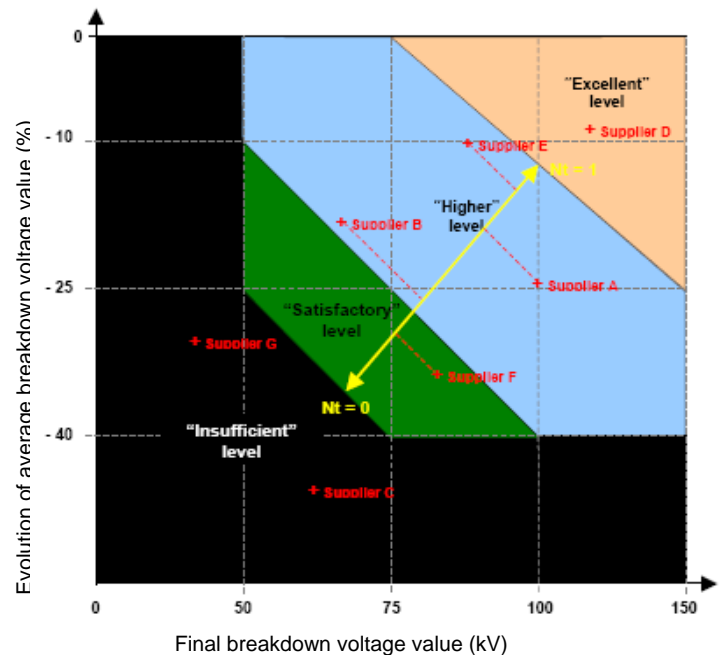
All accessories are examined during a visual inspection after tests.



Picture 4 : Installation of Robustness test for cold-shrink joints in 2009

### Classification

For each type of joint (fresh and aged), the average of the 3 breakdown voltage values is calculated. Averages are used to define the level of each accessory model, as shown in Picture 5.



Picture 5 : Determination of the technical notation

Accessories whose values are in the black zone are not accepted. Those located in green and blue areas are classified with its  $N_t$  value, varying between 0 and 1. Those situated in brown area are automatically given a  $N_t$  value of 1.

Furthermore, clauses of non-acceptance are mentioned in the specification :

- failure during the immersion test,
- failure during electrical withstand of external jacket,
- water penetration in accessories (visual inspection),
- breakdown voltage value too low (inferior to 50 kV),
- difference in breakdown voltage value between fresh and aged joints (lower than 40%).

### “BEST-OFFER” PURCHASING

In May 2009, in order to renew the market of medium voltage accessories, ERDF presents a “tender” in the

JOUE<sup>1</sup>. Each year, ERDF installs about 35 000 cold-shrink medium voltage joints.

For that purpose, ERDF has decided to select suppliers from financial and technical criteria : price and technical note from robustness test.

## **CONCLUSIONS**

The robustness test has been sufficiently discriminatory for ERDF to purchase accessories, which have longer life expectancy.

Beyond the market assignment, this test has permitted to evaluate the control of the cold-shrink technology for each supplier.

Now, ERDF wishes to carry out the same test on transition joints (paper/polymeric cable). For this investigation, 3 technologies will be tested : cold-shrink, heat-shrink and taped accessories.

In the future, ERDF wants to apply the "best-offer" principle for other materials.

## **REFERENCES**

**HN 33-E-03** :Essai de robustesse pour jonctions et transitions HTA  
(<http://norm.edf.fr/pdf/HN-33-E-03Novembre2008.pdf>)

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<sup>1</sup> JOUE : Official Journal of European Union