New qualification tests for high loaded joints

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ABSTRACT

Cable links with a high cyclic current load become more usual, especially with wind power generation and third party access to medium voltage cable networks. Analyses of failed medium voltage joints from high cyclic loaded cable links in The Netherlands tend to indicate that cyclic thermo-mechanical forces play an important role in most failure mechanisms. Those cyclic forces are never considered during the qualification of the accessories according to the relevant standards. In order to overcome this issue, different tests covering the potential consequences of those forces were carried out. The results could form a basis for the definition of new qualification tests or guidelines and recommendations for installation of cable accessories.

INTRODUCTION

During Jicable 2011, a paper describing the thermo-mechanical behavior of joints in high and cyclic loaded MV cable systems was presented by several Dutch companies [1]. The project was started due to a high failure rate of MV joints in the Netherlands. Theoretical background of forces induced on connectors by thermal expansion of the conductors and results of mechanical push-pull cycle tests on different connectors were discussed.

Since 2011, other countries have joined the project, progress has been done in the understanding of the issue and tests have been developed.

Measurements of real forces due to thermal expansion of 240 mm² and 630 mm² aluminium conductors were measured and thermal cycles on fastened cable systems were performed at Laborelec [2].

Tests reproducing those forces on cable systems were done at DNV GL (formerly known as Kema).

In order to avoid an unmanageable quantity of costly and complex tests on the various connector/joint combinations, it was decided to separately handle the three main causes of failure due to high and cyclic loads: water ingress in joints due to degradation of the interface between cable and joint, thermo-mechanical impact on behavior of the connector resistance and thermal behavior of joints under high and cyclic loads.

Learning from so far gathered experience, knowledge and results of studies and investigations, 3 different tests were determined:

- Mechanical (cyclic) test on connectors.
- Improved water penetration test on joints.
- Thermal stability test for joints.

The results of these different tests are described in the paper.

MECHANICAL TESTS ON CONNECTORS

In the tests made in the past, different forces/stresses have been used and up to 200 push/pull cycles have been performed (table 1).

	Cross section	F/mm²	F
Laborelec [2]	240 mm²	27.92 N/mm²	6700 N
Laborelec [2]	630 mm²	28.41 N/mm²	17900 N
Lovink [1]	240 mm²	18.75 N/mm²	4500 N
IEC 61238-1 [3]	240 mm²	40.00 N/mm²	9600 N
IEC 61238-1 [3]	630 mm²	40.00 N/mm²	25200 N

Table 1: Values from previous tests or standard

To evaluate the behaviour of the conductor connections, a dedicated test set-up (Fig. 1 : Schematic of the test set-up) was built at Euromold to allow for the application of higher forces and evaluation of the conductor slippage.