

Operating a 10 kV XLPE cable on a voltage level of 20 kV: The long term test

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With approximately 40.000 km of underground MV cables, Alliander is one of the two biggest distribution system operators in the Netherlands. This MV network is mainly operated on a voltage level of 10 kV however on the longer term, due to increasing energy demand, Liander will expand their network on a 20 kV voltage level.

In 2010 Liander started a feasibility study if the current standard 10 kV 1x630 Alrm XLPE power cable can be utilized on the voltage level 20 kV for the remaining life time of the 10 kV cable. The main goal of this study is the proof of principle of this concept thinking. If this concept is appropriate for use Liander can achieve minimum environmental impact and big spend reduction in the 20 kV grid development.

In the feasibility study a literature study and heavy electrical tests were conducted. This paper deals with the final test i.e. a long term test for the final proof of principle. For the test set-up a 'in service' 10 kV cable was taken from the field to a laboratory environment and placed in a test set-up with use of 20 kV accessories and end terminations. For the 20 kV joint 4 different joint types were selected from the Liander standard. For the voltage and current source respectively a 20 kV power transformer and controlled current transformers were used. The test set-up was controlled by thermocouples, event recorders, controllers.

The long term test is in line with the Dutch MV cable standard NEN-HD 620. In this standard a conductor temperature is required of 90-95°C with in the heating up phase of one complete heat cycle. To reach this temperature a current of 1300 A was necessary. One complete cycle consist of 8 hours of heating and 16 hours of cooling. From the literature study it was conducted that a voltage of 1.8 U₀ for 3 months was necessary for a simulated life time consumption of 50 years. During the test several hold points were built in to perform PD measurement whereas the set-up at the begin of the test was PD free. The main criteria of a successful test outcome were 'no breakdown during the testing time' and 'the PD level after the test must be equal to the start of the test'. The test set-up did withstand the severe test criteria bravely and hence successful. This outcome opens the door to the next step: a real field test were the cable and accessories are acting in the real surroundings.

In the total project Liander, Liandon, DNV GL, the technical university of Delft and manufacturers were involved. More detail of the literature study, test results and used parameters will be described in the paper.

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In the picture underneath the test set-up is shown. The test setup consists of total of 100 m 6/10 kV power cable, 10 pieces of 20 kV joint and 4 end terminations.

