THE 33 KM LONG 87/150(170)KV KOKSIJDE-SLIJKENS LINK

Didier LIEMANS, Nexans Benelux, (Belgium), didier.liemans@nexans.com
Yves LE ROY, Nexans Benelux, (Belgium), yves.leroy@nexans.com
François GAHUNGU, Nexans France, (France), francois.gahungu@nexans.com
Alain GILLE, Bel Engineering, (Belgium), alain.gille@bel-engineering.com
Bart MAMPAEY, Elia, (Belgium), bart.mampaey@elia.be

ABSTRACT

A 87/150 kV underground link of 33 km has been built in the north of Belgium. This paper describes the different steps between the start of the project, to the final acceptance tests, with special consideration of the AC voltage test after installation on such a long link.

KEYWORDS

XLPE cables, long link, after installation tests, direct cross-bonding, thermal backfill, temperature measurement by optical fibres.

AN UNDERGROUND TURNKEY PROJECT

Elia is the Belgian electricity transmission operator, dealing with voltage levels from 36 kV to 400kV. For the need of reinforcement and extension of its network, a 150 kV link was necessary in the north part of Belgium, between the Koksijde and Slijkens substations. For this project close to the coast, Elia decided that this link would be an underground XLPE system and a turnkey project.

The system cable-accessories

To transmit the required power a cross-section of 2000mm² aluminium XLPE cable has been chosen, with cross-bonding of the metallic screens.

The cross-bonding is a direct system, without SVL, as the joint and the cable have an intrinsic protection level allowing a surge voltage level of 75kV between screens and earth, and 150 kV between screens.

One phase of the three is equipped with optical fibres in the screen, in order to have a distributed temperature sensor integrated in the cable, allowing temperature measurement when needed.

The use of direct cross-bonding doesn't means that there are no more boxes for connecting the metallic screens: there are still boxes at some parts of the link to allow disconnecting of the screens for DC testing of the outer sheath (to limit the charging current); these boxes also allow to have connections points to the optical fibres for temperature measurements, allowing a better precision on the temperature and on the location of an eventual hot spot than on the complete link.

This 33 km cross-bonded link is divided in 30 sections, with 29 joint pits.

On the Koksijde substation side, the terminations are of composite type, filled with oil with a silicon insulator.
On the Slijkens substation side, the terminations are dry GIS terminations.

The cable, the joints and the composite termination where already qualified for former links for Elia. The dry GIS termination has been qualified during the execution of the project, following IEC 60840 and customer's requirements. A non-qualification at due time of the dry GIS termination would have lead to the use of GIS terminations filled with oil, but this was not necessary, as the tests were successful.

The civil works

The trench

The cable was laid in trefoil, with the use of thermal backfill (dolomite) around the cables.
Several thermal resistivity measurements of the native soil were performed in order to check that the required ampacity could be met. At some places, a part of the native soil has been removed, as its thermal resistivity was not good enough.
At some road crossings, where the cable is laid at higher depth and where the thermal resistivity was poor, the cable has been laid in flat formation, in pipes filled with a mix of bentonite-sand and water, in order to meet the required ampacity.

The technical tunnel

On one part of the project, near the Slijkens substation, the link crosses the Oostende-Brugge channel and the cable has been laid in an existing technical tunnel under this channel.
This concrete tunnel has 25m depth shafts at both sides, a horizontal length of 120m, and a diameter of 2.5m
In order to avoid propagation of eventual fire in the tunnel, a special coating has been placed on the PE sheath of the cable after it was installed.

The tests

After laying of each section of cable

On the phase equipped with optical fibres, a measurement of the attenuation of the fibres is performed just after laying, in order to be sure that there was no damage during the pulling of the cable.

After the laying of the three phases of one section, and after covering the phases with the first layer of the backfill, a DC voltage test of the outer sheath of the cables is performed in order to check their integrity

After completion of the joints

After jointing, the attenuation of the optical fibres, and the DC voltage test on the outer sheath of the cable and on the outer protection of the joint are performed

On the complete link

AC voltage test of the insulation had to be performed at $2U_o$ (174 kV) with a frequency in the range 20-300hz, with resonance generators.
This 33 km long link has a capacitance of more than 10µF. With the available generators, it would have laid to problems of too high capacitive currents tests, or problem of having the test frequency out of the needed range.
It has been decided to divide the complete length to test in three parts, in order to have lower capacitance to test.
The sub-links to test were respectively 11km, 12km and 10km long.

In order to perform the tests on the sub-links, laboratory water terminations and stop joints (blind terminations) have been used. The water terminations allows to inject the $2U_o$ voltage on the sub-link of which is on the middle, and also on the sub-link on the Slijkens side where the terminations are GIS type. The stop joints allow not using terminations where it is not necessary (see Figure 1)
With this way of doing, the 6 terminations (3 composite and 3 GIS) and 81 joints on the 87 could be tested. Only 6 joints could not be tested at $2U_o$.

The tests on the sub-links were successful. The measured frequency was between 27.7 Hz and 31 Hz, and the test current between 100 A and 112 A, depending of the length of the sub-link.

After theses $2U_o$ tests, the stop joints and the laboratory terminations were removed, and replaced by the 6 definitive joints. In order to test the 6 last joints, a 24h soak test (U_o without load), which is an existing possibility of IEC 60840, was successfully performed on the 33 km link.

The link has been put in service begin of May 2006.

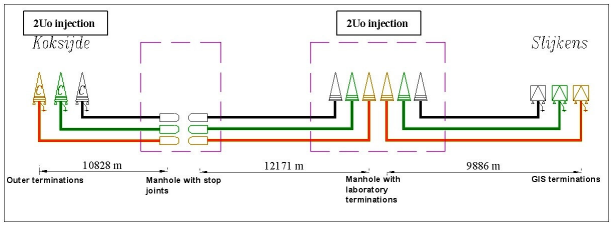

Figure 1: Testing the link in three sub-links with temporary accessories

Figure 2: temporary termination used for testing the link in three sub-links (injection of $2U_o$)

Figure 3: stop joints (blind terminations) used for testing the link in three sub-links