Worldwide experiences and challenges with EHV XLPE cable projects 330 kV to 500 kV

Andreas **WEINLEIN**, Ulrich **PETERS**, Uwe **LAAGE**, Horst **MEMMER**; Südkabel GmbH, Mannheim (Germany),
andreas.weinlein@suedkabel.com, ulrich.peters@suedkabel.com, uwe.laage@suedkabel.com,
horst.memmer@suedkabel.com

ABSTRACT

With an experience of more than 1,300 km underground EHV XLPE cables, the technical solutions and concepts for development, manufacture, assembly, testing and operation are largely confirmed.

As two special highlights of the EHV cable technology one of the longest 500 kV cable systems installed in Moscow (Russia) and one of the most voluminous 400 kV projects in London (UK) are described. The project in Moscow was planned in order to replace a 11 km long 500 kV double system overhead transmission line. With 10 new 400 kV cable systems in 32 km new tunnels the London power tunnel project reinforces the EHV network in London.

In addition to the major projects with large system lengths in metropolises, cable projects in the most remote regions of the world, very often connections within cavern hydropower plants between main transformer and switchgear, require a very high wealth of experience in design, grounding concepts, transportation as well as in laying and fixation concepts.

KEYWORDS

330-500 kV XLPE cable system, laying concept, fixation concept, commissioning test, PD measurement on-site, metropolises, cavern hydropower plant, laminated sheath design, welded aluminium sheath design, compact plug-in sealing end, one-piece type joint

INTRODUCTION

With an experience of more than 1,300 km underground XLPE cables and more than 2,650 accessories (almost 1,700 joints) for operation voltages 330 - 500 kV over a period of 20 years, the technical solutions and concepts for development, manufacture, assembly, testing and operation are largely confirmed by the manufacturer [1]. Concepts are introduced and the advantages and disadvantages are balanced compared to other directions of development.

As a special highlight of the EHV cable technology one of the longest 500 kV cable systems installed in Moscow (Russia) known under Skolkovo project is described with its current operating experience. After a rather short project running time of less than 17 months between order intake and commissioning the project has been completed in May 2012. A total amount of 70 km 500 kV XLPE cable, 138 joints and 12 outdoor terminations have been manufactured, delivered, installed and commissioned successfully for the customer FSK-Meszentra (Russian National Grid Company). The project was planned in order to replace a 11 km long 500 kV double system overhead transmission line. The cables which are laid in trefoil in ground have a conductor cross section of 2500 mm² oxidised copper wires, an insulation thickness of 27.5 mm, copper screen wires and a laminated HDPE sheath.

A second highlight in the EHV technology is the replacement of a number of fluid filled buried 275 kV cable circuits in the city of London (UK) which are nearing the end of their service life. The new 10 400 kV cable circuit connections with 196 km cable core including 60 pluggable GIS cable sealing ends and 186 one-piece joints between the substations Hackney - St Johns Wood, St Johns Wood - Willesden and Kensal Green - Wimbledon will allow for the phased decommissioning of some fluid filled circuits across London in future years. The first stage of the project with 4 circuits including 66 accessories was commissioned in March 2015. The cables which are installed in flat formation in 32 km 3 m and 4 m tunnels show a conductor cross section of 2500 mm² oxidised copper wires, an insulation thickness of 25 mm, longitudinal welded aluminium sheath of 1.5 mm thickness to withstand a short-circuit current requirement of 63 kA and finally a HDPE sheath. Besides the requirements regarding the type and prequalification tests according to IEC 62067 [10] and further additional tests of the already approved 330 - 500 kV system [1] advanced tests of the cable system were executed. Thereto belongs a mechanical load test of buried joints, short-circuit current test on longitudinal welded aluminium sheath [6], load cycle tests of cable fixations with cleated longitudinal welded aluminium sheath cables and a flexible cleat evaluation under cable sealing ends as well as a heating concept of accessories down to -45 °C.

High reliability, reduced repair times and decreasing cable and accessory prices make the EHV XLPE cable system competitive with overhead lines, especially in difficult terrain or environment, urban areas, industrial plants and with high land prices. In addition to the major projects with large system lengths in metropolises, such as currently installed in Moscow and London, cable projects are found in the most remote regions of the world, very often connections within cavern hydropower plants between main transformer and switchgear. They require a very high wealth of experience in design, grounding concepts, transportation, laying and fixation concepts, as well.

500 KV MOSCOW PROJECT

Due to the 20-year-old close cooperation with utility customers in Russia and the first successful delivery of XLPE cable systems on the 220 kV and 500 kV level by the manufacturer to Moscow and the Russian far east, for the Russian customers there is a foundation of trust in the EVH cable systems and the expertise of the manufacturer. Therefore, it was applied to a strategic project of the Russian government for the construction of the Skolkovo innovation centre northwest of the city of Moscow. The city is supplied by a 500 kV overhead line transmission ring and because of the expansion of the city and high