

Experiences and Challenges with the 420 kV XLPE Cable Systems of the London Power Tunnels Project

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ABSTRACT

As one of the most voluminous 400 kV projects, London Power Tunnels (UK) is a highlight of EHV cable technology. The 10 new 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 cables which are installed in flat formation in 32 km of 3 m and 4 m tunnels show a conductor cross section of 2500 mm² of oxidised copper wires, an insulation thickness of 25 mm, longitudinal welded aluminium sheath and finally a HDPE sheath. The last of the 3 stages was commissioned in October 2017. Including tunnelling, on completion this is the largest infrastructure project in London over the last 40 years.

KEYWORDS

400 kV XLPE cable system, fixation concept, ventilated tunnel, k_s-factor, commissioning test, PD measurement on-site, welded aluminium sheath design, compact plug-in termination, one-piece type joint

BRIEF PROJECT DESCRIPTION

As one of the most voluminous 400 kV projects, London Power Tunnels (UK) is a highlight of EHV cable technology. The development concepts, technical solutions, manufacture, assembly, testing and operation are largely confirmed by the manufacturer with an experience of more than 1,600 km underground XLPE cables and in excess of 3,900 accessories for operation voltages 330 - 500 kV over a period of 25 years [05, 06, 07, 08].

In 2011, the manufacturer received from National Grid the order for the design, manufacture, delivery, installation and commissioning of ten high-voltage cable systems. National Grid is one of the world's largest companies in the transmission of electricity and gas. National Grid owns and operates the entire high voltage grid in the UK and owns most of the HV grid on the US east coast. London is one of the mega metropolises that built up a comprehensive supply of electrical energy at a very early stage. Most of the infrastructure was built more than 60 years ago and the cables with oil-impregnated paper insulation used at that time are now obsolete and their reliability and transmission capacities no longer meet today's demands. These old buried oil cables, which have been supplying London with electrical power for years, will now be gradually shut down and disposed of. Modern, reliable and environmentally friendly plastic-insulated cables now supply vital parts of London with electrical energy.

The 10 new 400 kV cable circuit connections totalling 196 km of cable core including 60 pluggable dry GIS cable sealing ends and 186 one-piece joints between the substations St Johns Wood to Highbury and Highbury to Hackney, St Johns Wood to Kensal Green, Kensal Green to Willesden and Kensal Green to Wimbledon will allow for the phased decommissioning of aging fluid filled circuits across London. The first stage of the project with 4 circuits including 66 accessories was commissioned in March 2015, the second stage with 4 circuits including 102 accessories in October 2016 and the final stage with 2 circuits including 78 accessories in October 2017.

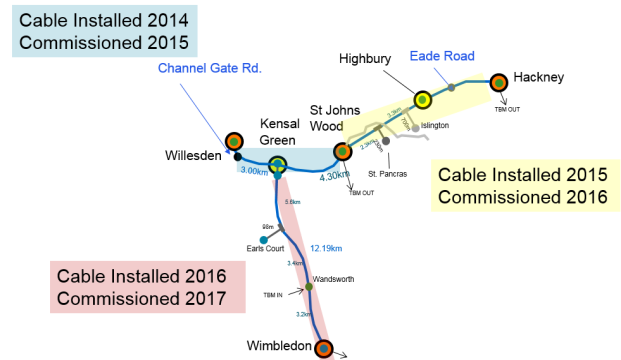


Fig. 1: schedule of 400 kV tunnel project in 3 stages

The 3 m tunnels between St Johns Wood - Willesden and Kensal Green - Wimbledon have a total length of 7.4 km and 12.1 km. The tunnel between Hackney - St Johns Wood has a length of 12.5 km. For the section between Highbury - St Johns Wood a 4 m tunnel is built to accommodate an additional six 132 kV cable circuits alongside the two 400 kV circuits. 32 km of cable tunnel is built at a depth of between 30 m and 60 m beneath London to accommodate the 400 kV and 132 kV XLPE cables.

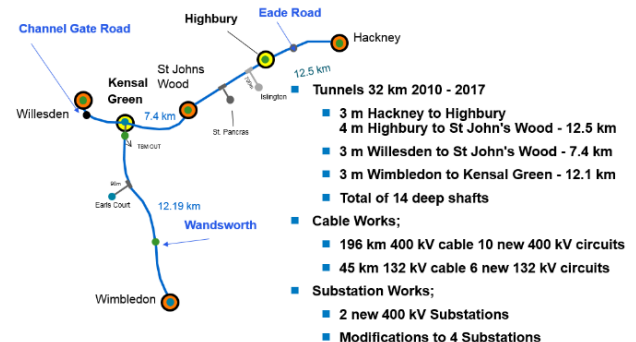


Fig. 2: overall overview of London Power Tunnels