

# STATISTICS ON AC UNDERGROUND CABLE IN POWER NETWORKS

Final Report of CIGRE Working Group B1.07

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Table G2: Overview of significant underground cable projects constructed since 1996. Projects are arranged in order of country and geographical location

Country	Location	Project name	kV	Conductor (mm2)	Conductor material	Insulation material	Circuits	Cores per phase	route length (km)		Date
Australia	Sydney	Sydney South to Sydney Central	330	1600	Cu	PPL/DDB	Single	1	28	Direct buried, ducts, tunnel	
Austria	Wienstrom	Wienstrom	380	1200	Cu	XLPE	Double	1	5.2	Direct buried & tunnels	2005
Belgium	Belgian coast	Koksijde - Slijkens	150	2000	Al	XLPE	Single	1	30	Direct buried	May-06
Belgium	East of	Tihange - Avernas	150	2000	Al	XLPE	Double	1	30	Direct buried	Nov-03
Denmark	Copenhagen	Metropolitan Power Project	400	1600	Cu	XLPE	Single	1	12.0, 9.0	Direct buried	1997
Denmark	Copenhagen	Metropolitan Power Project	400	1600	Cu	XLPE	Single	1	12.0	Direct buried	1999
Denmark	Jutland	Aarhus-Aalborg	400	1200	Al	XLPE	Single	2	2.5,4.5,7.5	Direct buried or duct	Aug-04
Denmark	Jutland	Karlgårde-Blåvand	150	1200	AL	XLPE	Single	1	35.0	Direct buried	2001
Denmark	Jutland	Tinghøj - Haverslev	150	1200	AL	XLPE	Single	1	21.0	Direct buried	
Denmark	Jutland	Mesballe-Aastrup	150	800	Al	XLPE	Single	1	27.6	Direct buried or duct	2000
Denmark	Jutland	Trige-Aastrup	150	800	Al	XLPE	Single	1	27.7	Direct buried or duct	2000
Denmark	Lolland	Radsted - Vantore Str.	132	1200	Al	XLPE	Single	1	18.0	Direct buried + ducts	2002
Denmark	Lolland	Radsted-Rødby	132	630	Al	XLPE	Single	1	25.0	Direct buried + ducts	1999
France	Alpes-Maritimes	Antibes - Mougins	225	1200	Cu	HDPE	Double	1	11.3	Duct bank	1997
France	Brittany	Locmalo-Plouay	63	800	Al	XLPE		1	19	Ducts in soil	
France	Ile de France	Avenir - Sausset	225	1200	Cu	XLPE	Single	1	17.9	Duct bank, trough and t	2001
France	Loire-Atlantique	Chabossière - Montluc	63	400	Al	XLPE	Single	1	10.1	Duct bank	2003
France	Pyrénées-Atlantiques	Mouguerre - Tarnos	225	1000	Al	HDPE	Single	1	9.4	Duct bank and trough	1996
Germany	Berlin	Berlin Diagonal	380	1600	Cu	XLPE	Double	1	6,3 and 5,2	Tunnel	1998 / 2000
Germany	Schleswig-Holstein	Lubeck - Siems	220	1200	Cu	XLPE	Double	1	10.2	Pipes,direct buried	2004
Germany		Goldisthal Pumped Storage	380	630	Cu	XLPE	Four	1	0.4	Tunnel	2002
Ireland	Dublin	Shellybanks	220	1600	Cu	XLPE	Single		14	Direct buried, river cros:	1997
Italy	Milan	Turbigo-Rho	380	2000	Cu	XLPE	Double	2	8.4	Direct buried	2006
Italy	Milan	Pioltello	220	1600	Al	XLPE	Double	1	3+3	Direct buried	2005
Japan	Chubu	Shinmeika-Tokai	275	9400	Al	GIL	Double	1	3.3	Tunnel	1998
Japan	Chubu	Kawagoe-Nishinagoya	275	2500	Cu	XLPE	Double	1	14.4	Tunnel	2002
Japan	Tokyo	Shinkeiyo-Toyosu	500	2500	Cu	XLPE	Double	1	39.8	Tunnel, Bridge	2000
Korea	Inchon	Sinbupoung-Seoinchon	345	2000	Cu	PPL	Single	1	17	Tunnel	2002
Korea	Inchon	Sinbupoung-Seoinchon	345	2000	Cu	PPL	Single	1	17	Tunnel	2002

## SP13: The World's First Long-Distance 500 kV XLPE Cable Line (Japan)

### Overview

A plan has been developed to supply the growing power needs of central Tokyo directly with a 500kV underground line using XLPE cable, which has a number of advantages over oil-filled cable. In this project, extending over a period of several years, a compact cable for a long-distance line with an insulation thickness of 27mm (no larger in diameter than oil-filled cable of comparable rating) has been developed, together with associated extrusion-molded joints (EMJs). Tokyo Electric Power Co. has decided to use the cable and joints in the Shin-Toyosu Line (39.8km, 2circuit).

### Design and structure of cable

Based on various design parameters and the insulation characteristics of the treated portion of the insulation shield for EMJs, it was determined that the insulation thickness required for the cable would be 27mm, the conductor size was 2500 mm<sup>2</sup> and the metal sheath was of corrugated aluminum.

### Technical Details

The Shin-Toyosu Line is a 39.8km underground transmission line connecting the Shinkeiyo Substation on the 500kV overhead grid line system surrounding Tokyo, to the Shintoyosu Underground Substation newly constructed in central Tokyo. This is the first time that 500kV XLPE cable has been used on a long-distance line anywhere in the world and it is the longest underground transmission line in Japan. Virtually the entire route, with the exception of ducts under bridges and elevated expressways, is enclosed in a tunnel. Part of the route runs along the shore of Tokyo Bay and advantage was taken of this fact by transporting long-length cables from the factory by sea, and laying them from a base yard situated at the landing point, there by minimizing the number of joints.

The line specifications are as follows

- Number of circuits 2 (3 in future)
- Transmission capacity 900MW/cct (1200MW/cct in future)
- Laying configuration : Trefoil formation in tunnel troughs, and in ducts under bridges and elevated expressways.
- Number of intermediate joints per phase 40
- Type of joints EMJ
- SF6 gas-immersed sealing ends : Silicon oil impregnated.

For the part of the route along the shore of the bay, where both duct and tunnel existed, the use of the base yard was impracticable. Thus long-length cables delivered by sea were reloaded onto a special trailer equipped with a pay-out machine and transported for the very short distance overland to the pay out point. In order to allow laying operations on roads even when using large drums, a traverse method was developed and implemented whereby the space occupied on roads during installation was reduced and cable of about 1200-m in length could be laid.

The world's first 500kV long-distance underground transmission line using XLPE cable has operated since 2000.

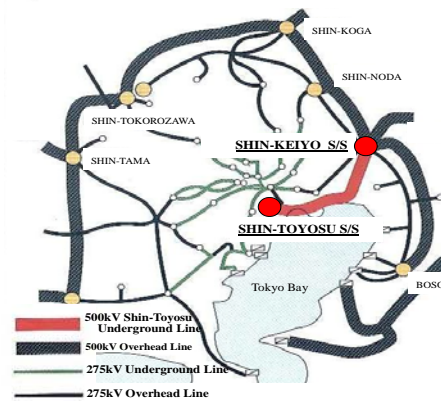


Fig.1 Cable route



Fig.2 Laying Cable