# APPLICATION OF XLPE SUBMARINE POWER CABLE FOR EXTRA HIGH VOLTAGE

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## *ABSTRACT*

*220kV 3-core XLPE submarine cables incorporated with two 20-core fiber optic units have been newly applied to the transmission lines between Vladivostok and Russky Island in Russia. Mechanical and electrical / non electrical qualification tests in accordance with CIGRE Electra 171 and IEC62067 have been successfully completed. After the completion of the production, the 220kV submarine cables have been delivered to Russia. In addition, 230kV 3-core XLPE submarine cable incorporated with two 24-core fiber optic units is also going to be subjected to the qualification test in accordance with AEIC CS9.*

## *KEYWORDS*

XLPE Submarine cable, Extra high voltage, Qualification test, Mechanical type test

## 1) INTRODUCTION

High voltage single core XLPE insulated submarine cables have been developed since the 80's; the world first 132kV XLPE submarine cable was installed in Hong Kong in 1989[1][2]. For extra high voltage submarine cables, however, oil-filled cables were still mainstream for a long time.

Recently, because of environmental friendliness, less costs and maintenance free, the demands of XLPE insulated submarine cables have been increasing for transmission lines between islands, windmill farms and offshore oil or gas platforms. Along with that, the demands of XLPE submarine cables require higher voltages, bigger conductor sizes and longer lengths. In several cases, 3-core cables are more preferable than single core cables to save the cost of production and installation of submarine cables up to 230kV.

Based on the experience of supplying approx. 90km of 3-core 66kV class submarine cables with factory joints, further studies in higher voltage XLPE submarine cables with the applied rated voltage up to 230kV class have been attracting more attention.

220kV 3-core XLPE submarine cables have been applied to transmit the power at the rating of 163MW from Vladivostok to Russky Island in Russia as a part of national project of Russia for APEC Russia 2012.

Prior to commencement of the cable production, qualification tests in accordance with CIGRE Electra 171[3] and IEC62067[4] have been successfully completed on the proto-type submarine cable with the same design.

## 2) DESCRIPTION OF CABLE ROUTE

The 220kV XLPE insulated submarine cable line is approximate 2.2km in length across Eastern Bosporus Strait between Peninsula Side and Russky Island. The maximum sea depth along the route is approximate 43m and the burial depth of the cable is 1.5m to 3.0m. The transmission system consists of two circuits, each with the capacity of 163MW. Both ends of the submarine cables are landed and jointed to the 220kV single core, 630mm$^2$ aluminum conductor, XLPE insulated underground cables which are supplied by others. The pre-fabricated type joints[5] are applied as transition joints to connect between the submarine and underground cables. Additionally two spare cables are installed along the route. The conductors of the spare submarine cables are earthed and sealed at the jointing pit after landed. Fig.1 shows the line diagram.

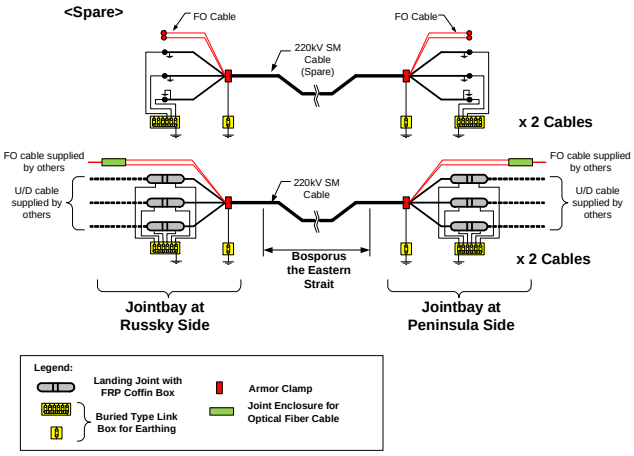


**Fig.1: Line diagram of 220kV XLPE submarine cable**

## 3) DESIGN OF CABLE AND ACCESSORIES

### Submarine Cable

The 220kV XLPE submarine cable core is composed of 500mm$^2$ watertight and compact round, stranded, annealed uncoated copper conductor, XLPE insulation and individual lead alloy sheath over a longitudinal water repellent layer. The lead alloy sheath was covered with a layer of semi-conductive tapes.

Two fiber optic units, each of which is composed of 16-core single mode fiber and 4-core multi mode fiber, incorporate the submarine cables. The single mode fibers are used for telecommunication where as the multi mode fibers are for distributed temperature sensing (DTS) system. These units are the grooved spacer type with 4-core taped fiber laid into the spiral grooves of the spacer.

Three power cores and two 20-core fiber optic units are laid up with polypropylene fillers before an anti-teredo protection layer of uncoated copper tapes and a single layer of galvanized steel wire armour are applied over the laid up cores. Overall diameter of the cable is approximate 219mm and the unit weight is approximate 95kg/m.

The photograph of the submarine cable is shown in Fig.2 and the cable construction is summarised in Table 2.