

1. SCOPE

1.1 This specification is for three core composite submarine cables with copper conductor and undersea Fibre optic cable for operation at a.c. voltages of 19000 Volts to sheath, 33000 Volts between conductors and highest system voltage of 36000 Volts.

1.2 This specification covers the following cable sizes:

3core x 630mm² copper with 48 cores optic fiber submarine cable

2.0 REFERENCES

The following documents were referred to during the preparation of this specification; in case of conflict, the requirements of this specification shall take precedence.

IEC 60502-2: Power Cables with extruded insulation and their accessories

IEC 60228: Conductors of insulated cables.

BS 6622: Specification for cables with extruded cross-linked polyethylene or ethylene propylene rubber insulation

3.1 SERVICE AND SYSTEM CONDITIONS

3.1.1 The cable shall be laid directly on the sea bed to connect two substations; one on the main land (Likoni) and the other on an island (Mbaraki). The cable shall be used across the sea at the Likoni channel.

3.1.2 To ensure the cable does not sway with ocean currents it shall be secured on the sea bed by anchoring it or covering it with graded material or with modular protective units of polyurethane.

3.1.3 The cables shall be connected to underground system operating at a nominal voltage of 33kV, 50Hz and maximum voltage of 36kV and are solidly earthed at the transformer neutrals. The system falls under category A as defined by IEC 60502-2.

3.1.4 The system design fault level is 25kA, 3 seconds.

4.0 MATERIALS AND CONSTRUCTION

4.1 Design

4.1.1 The cable shall be designed and manufactured in accordance with BS 6622, IEC 60502-2 and the requirements of this specification.

4.1.2 All materials used shall be compatible and suitable for the continuous operating temperature of the cable of 90°C and short circuit temperature of 250°C (5 seconds max duration) as per IEC 60502-2.

4.1.3 The cable shall be 3 core composite submarine cable i.e. three core copper power conductor integrated with 48 cores fibre optics submarine cable.

4.2 Conductor

The cable shall be made from stranded compacted circular plain copper conductors that conform to IEC 60228.

The submarine optic fiber cable shall meet technical requirements given in the section 8 and 23 of the tender document.

4.2.1. Conductor Screen

4.2.2 A conductor screen consisting of an extruded layer of cross-linkable semi-conducting compound shall be applied over the conductor and cover the surface of the conductor completely.

4.2.3 The extruded conductor screen shall be applied in the same operation as the insulation and be fully bonded to the insulation.

4.3 Insulation

4.3.1 The insulation shall be cross-linked polyethylene (XLPE) conforming to the requirements of IEC 60502-2.

4.3.2 The insulation shall be applied by extrusion and cross-linked to form a compact and homogeneous layer.

4.3.3 The cables shall have following at least insulation and protection layers; Black Outer corrosion protection sheath, galvanized steel tape armour, Water blocking tape, steel wire armour, LDPE separation sheath, lead Alloy E sheath, semi-conductor water blocking tape, Extrude semi-conductive XLPE (strippable) and XLPE insulation.

4.3.4 The colour of the insulation shall be such that it is easily distinguishable from the screening materials.

4.3.5 Individual cores shall be identified by colored tape over the insulation and the colors shall be Red, Yellow and Blue.

4.4 Insulation Screen

4.4.1 There shall be an insulation screen consisting of a cross-linked extruded semi-conducting layer in combination with a metallic layer.

4.4.2 The extruded semi-conducting layer shall consist of a strippable semi-conducting compound capable of removal for jointing and terminating. It shall be applied in the same operation as the insulation, directly over the insulation and shall cover the surface of the core completely.

4.4.3 A metallic screen shall be applied around each core. The screen shall consist of helically applied overlapped copper tape.

4.4.4 Laying up

4.4.4.1 The cores shall be laid-up with a right hand direction of lay. Fillers of non-hygroscopic material shall be used to form a substantially compact and circular cable.

4.4.4.2 The metallic screens of the three cores shall be in contact with each other.

4.4.5 Water Barriers

Water barriers shall be provided to prevent water penetration between and among the various layers in the cable.

4.4.6 Metallic Sheath

4.4.6.1 The cable shall have a positive barrier to water and other solvents and insolvents that may be present in service conditions.

4.4.6.2 The metallic sheath used shall be impervious to water and details of the material used shall be stated in the guaranteed technical schedules.

4.4.6.3 The metallic sheath shall be capable of carrying the earth fault current without exceeding 250°C.

4.4.6.4 The grain size of the sheath shall be uniform and the sheath shall exhibit no marked change after application, installation or in-service, particularly under extended periods of operation at elevated temperatures or under repeated cyclic variations of load.

4.4.7 Separation Layer

There shall be water blocking tapes and extruded separation sheath between the metallic sheath and armour.



THREE CORE COMPOSITE XLPE SUBMARINE CABLE (COPPER CONDUCTOR AND OPTIC FIBER) WITH LEAD SHEATH AND STEEL WIRE ARMOUR.

4.4.8 Armour

There shall be round wire armour of galvanized steel wire banded with galvanized steel tape. A water blocking tape shall be applied between the armour and over sheath.

4.4.9 Over sheath

4.4.9.1 There shall be an extruded over sheath of suitable material for intended service conditions described in the tender document.

4.4.9.2 The cable shall be clearly and permanently embossed with the following information throughout the length of the over sheath.

- i) 33000 VOLTS XLPE SUBMARINE CABLE PROPERTY OF KPLC;
- ii) Name of manufacturer;
- iii) Year of manufacture;
- iv) The number of cores, type and nominal area of conductors.
- v) Size of the cable.

Letters and figures shall be raised and consist of upright block characters. Minimum size of characters shall be not less than 15% of average overall cable diameter and the distance between one set of markings and the next shall not exceed 500mm.

4.5 STANDARD SIZES AND CHARACTERISTICS

The standard sizes for the submarine cables shall be as follows:

Cable type	3 core copper submarine cable with Fibre optic		
Conductor nominal sectional area	mm ²	630	
Voltage Designation U _o /U (U _m)		19/33 (36) kV	
Conductor shape		Stranded compacted circular	
Thickness of insulation	mm		8.0
Thickness of separation layer	mm		2.3
Thickness of over sheath(min),	mm		4.3
Maximum conductor resistance	Ω/km		0.100
Diameter of conductor	mm		29.8
Lead sheath thickness	mm		1.9
Diameter over insulation	mm		48.6
Outer diameter of the cable	mm		152.0
Cable weight(copper)	Kg/m		49.7
Capacitance	uF/km		0.35
Phase Charging current at 50Hz	A/km		2.9
Inductance	mH/km		0.32

Note: The Current Carrying Capacity of the cable under the sea, underground and in air shall be stated by the manufacturer in the clause-by-clause in the guaranteed technical schedule.

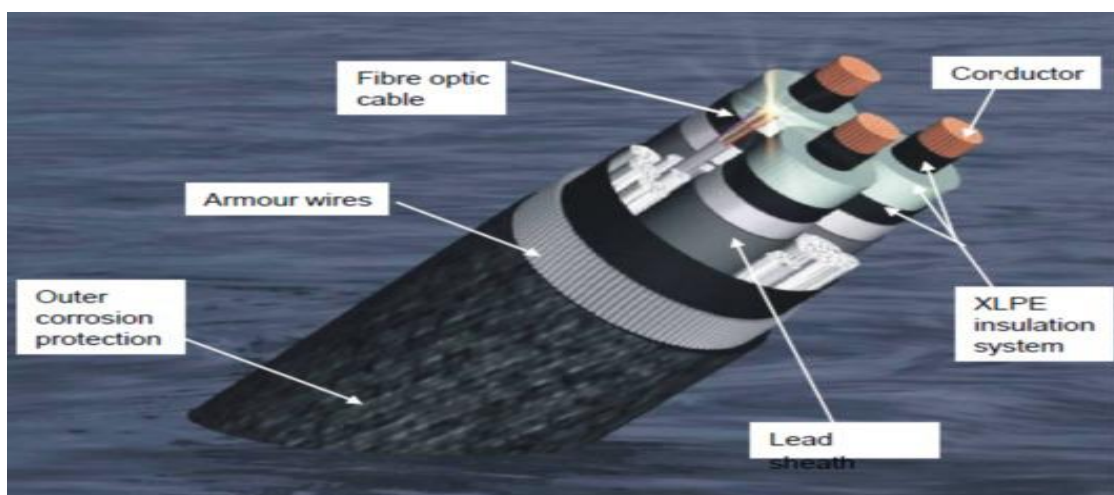
5.0 TESTS AND INSPECTION

- 5.1 The cable shall be inspected and tested in accordance with the requirements of this specification, IEC 60228, IEC 60502-2 and the test standard declared by the manufacturer. It shall be the responsibility of the manufacturer to perform or to have performed the tests specified and whatever other tests he normally performs at works.
- 5.2 Certified true copies of previous design/type test reports by the relevant International or National Testing/Standards Authority of the country of manufacture (or ISO/IEC 17025 accredited laboratory) shall be submitted with the offer for evaluation. A copy of accreditation certificate for the laboratory shall also be submitted (all in English Language).
- 5.3 Routine and sample test reports for the cables to be supplied shall be submitted to KPLC for approval before shipment/delivery of the goods.

6.0 MARKING, LABELLING AND PACKING

- 6.1 The finished cable shall be wound on wooden drum such as to prevent damage during transportation and handling. The drums shall be made from treated timber resistant to termite attack. The actual length of cable shall not be less than the length indicated on the drum.
- 6.2 Both ends of every drum length of cable shall have been sealed to prevent the ingress of water during transportation, storage, handling and installation. Both ends shall be secured to the drum to prevent mechanical damage.

Fig. 01: Illustration of an XLPE submarine power cable with Fibre optic





THREE CORE COMPOSITE XLPE SUBMARINE CABLE (COPPER CONDUCTOR AND OPTIC FIBER) WITH LEAD SHEATH AND STEEL WIRE ARMOUR.