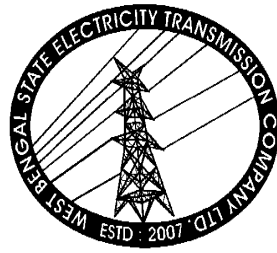


XLPE CABLE SUITABLE FOR USE IN UN EARTHED 33 KV SYSTEM



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Engineering Department

WEST BENGAL STATE ELECTRICITY TRANSMISSION COMPANY LIMITED

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TECHNICAL SPECIFICATION FOR XLPE CABLE SUITABLE FOR USE IN UN EARTHED 33 KV SYSTEM

1. SCOPE :

The specification covers the design, manufacture, testing, supply and delivery in proper packed condition of different grades of 1 core or 3 Core copper Conductor, Cross-linked poly ethylene (XLPE) insulated, screened, Armoured, PVC sheathed Power Cables.

2. DEVIATION :

Normally the offer should be as per Technical Specification without any deviation. But any deviation proposed must be mentioned in the 'Deviation Schedule' with reasons and advantage of such deviation. Deviation not mentioned in 'Deviation Schedule' will not be considered after tender opening.

3. STANDARD :

The cables covered by this specification shall be designed, manufactured and tested in accordance with following Indian Standards as well as relevant IEC's.

Sl. No.	Standards	Title
1.	IS : 5831	PVC Insulation and sheath of electric cables.
2.	IS : 3961 (Part 2)	Recommended current ratings for cables of PVC insulated and PVC sheathed heavy duty cable.
3.	IS : 8130	Conductor for insulated electric cables and flexible cord.
4.	IS : 1885	Electric Cables.
5.	IS : 3975	Mild steel wire, formed wires and tapes for armouring of cables.
7.	IS:7098(PartII)	Specification for cross-linked polyethylene insulated PVC sheathed cables for working voltages from 3.3KV to and including 33KV.
8.	IS : 10418	Cable Drums for Electric Cables.
9.	IS10810:1984	Method of tests for cables.

4.LOCATION :

4.1 The Cables may be laid buried directly in ground at a depth of one metre in average, any where in West Bengal and terminate for outdoor connection to a power transformer or to overhead lines.

4.2 The Cables may also be laid within covered cable trenches, in cable racks or open air laddertrays etc. for certain portions of lengths.

5 SYSTEM DETAILS :

5.1 Voltage grade (KV) of cable required : 33KV/33KV

5.2 Service Voltage :: 33 KV

5.3 Highest Voltage :: 36 KV

5.4 EarthingSystem :: Un Earthed

5.5 B.I.L. For Cable :: 170 KV for 33 KV Grade

5.6 Fault Level (Maxm.) :: 25KA for 1 sec

5.7 Frequency :: 50 C/S

6.0 WEATHER CONDITION :

6.1 Monsoon prevails generally from the month of June to October with showers some times heavy, acidic, smoky, industrial and foggy.

6.2 Maximum ambient temperature :: 50 degree C.

6.3 Minimum ambient temperature :: 4 degree C

6.4 Thermal resistance of soil :: 150 degree C-Cm/Watt

6.5 Maximum Daily average ambient temp :: 40 degree C

6.6 Maximum relatively humidity :: 100.00%

6.7 Average rainfall per annum :: 200 cm

6.8 Maximum height above the Sea level :: 1000 Meters

Monsoon prevails generally from the month of June to October with showers some times heavy, acidic, smoky, industrial and foggy.

The cable, joints, outdoor termination and their accessories and fittings may conform to other Indian and/or equivalent Standards or important publications to improve upon their performance, but shall not fall short of the requirement of this specification. The tenderer shall clearly indicate such standards in their offers.

7. ELECTRICAL CHARACTERISTICS & PERFORMANCE:

33/33 KV Grade 1/3 core:

7.01 Description of Cable: Untinned annealed copper of class 2 as per IS 8130/1984 and any latest amendments to it. The shape of conductor shall be compacted, stranded, and circular, shielded with conductor screen of black extruded semi-conducting XLPE compound, XLPE insulation, shielded with insulation screen of black extruded semi-conducting XLPE compound, black semi-conducting tape and metallic screen of copper tape, Inner sheath extruded PVC type ST2, single

layer of strip /round steel or round hard drawn aluminium wire armoured as per IS :7098 part II and black extruded FR PVC (TypeST-2) overall sheathed, conforming generally to IS:7098(PartII).

7.02 Voltage Grade: 33KV /33KV (For 33 KV System)

7.03 Size of Cable: As per S.T.P.

7.04 Service Voltage: 33 KV

7.05 Maxm. Conductor temp: 90 degree C at maxm. continuous current.

7.06Maxm. Permissible short circuit Temperature: 250 degree C for one second

7.07 Approx. length of Cable in a Drum
500Metres + 5%(for 1 Core) or as per S.T.P.

7.08 End Sealing : H.S. Caps (See Clause 8.11) (Heat Shrinkable)

8. CABLE CONSTRUCTION :

XLPE Underground Cable is to be manufactured in continuous catenary process at controlled elevated temperature and pressure in inert atmosphere with use of suitable materials for XLPE main insulation and XLPE semi-conducting Insulation & XLPE screen. The inner and outer semi conducting sheaths and main polyethylene insulation between the sheaths are to be simultaneously extruded during the triple Extrusion Process of manufacturing and main insulation of the Cable is to be extruded unfilled. The XLPE Cable in this specification does not have any metal sheath and the short circuit rating of the cable will depend on the conductivity and continuity of the strands of the armour wires which shall be ensured by guarding against corrosion.

8.1 Conductor: Material to IS: 8130, untinned annealed Class 2, stranded compacted circular

8.2 CONDUCTOR SCREENING:

A semi-conducting cross-linked polyethylene (XLPE) screening shall be extruded over the conductor to act as an electrical shield which together with the elimination of the so called "Strand Effect" prevents to a great extent air ionisation on the surface of the conductor. Thickness as per IS 7098 part II.

8.3 INSULATION:

The main insulation of the Cable shall be extruded unfilled, chemically cross-linked polyethylene (XLPE) inert gas cured satisfying the requirement of IS: 7098(Part-II). **Insulation thickness should not be less than 9.5 mm(Nominal).**

8.4 INSULATING SCREEN:

Combination of black extruded semi-conducting compound & semi- conducting tape as the non-metallic part and annealed copper tape lapping as metallic part metal screen eliminates tangential stress of rotating electrostatic field surrounding the conductor and uniform electrical stress on the insulation. Metal copper screen should be able to carry a short circuit current of 1KA for 1sec. The semi-conducting polyethylene (XLPE) screen shall be extruded over the main polyethylene insulating wall to prevent partial discharge at the surface of the insulation. The copper tape shall be wrapped over the semi conducting tape or extrusion as mentioned earlier for 3 core cables. The metal

screen so formed around the cores shall be in contact with one another as the cores are laid up at triangular configuration. For single core cable, Aluminium wire armouring shall constitute the metallic part of insulation screen. Conductor screening, insulation and insulation screening shall be extruded in triple extrusion process as to obtain continuously smooth interfaces.

The mechanical and chemical properties of the materials for semi conducting screens are much more important than their electrical properties, but for obtaining the high overall degree of electrical properties of an H.V. cable, the inner and outer semi conducting screens and the main polyethylene insulation between the screens shall be simultaneously extruded during the manufacturing process known as "triple extrusion".

8.5 INNER SHEATH :

The cable core shall be supplied with bedding of PVC (inner sheath) in the form of extruded PVC Type ST-2 compound for 33 KV.

8.6 ARMOUR: Galvanized round steel wires or galvanized formed wires for 3 core cable as per IS 7098 part II. Single layer of round hard drawn aluminium wire for 1 core cable as per IS 7098 part II to ensure an adequate return path for the flow of fault current and also to provide suitable mechanical protection. For 1 core aluminium Wires of required size in requisite number shall be laid closely in the spiral formation to protect the circumference of the cable fully and to provide adequate cross sectional area for flow of maximum fault current within limits of specified temperature rise and duration of fault. The direction of the lay of the armour shall be opposite to that of the cable cores.

8.7 OUTER SHEATH:

Black extruded FR PVC Type ST-2 compound to IS:5831 and thickness shall be as per IS 7098 part II. A reliable serving shall be necessary for maintaining conductivity of the armour particularly under corrosive condition in the form of jacket. The cable shall therefore be finished with an extruded PVC over sheath of thickness as per IS 7098 partII.

The quality of PVC over sheath (Jacket) shall be ensured for service reliability against moisture intrusion and shall conform to type ST-2 of IS:5831.

The sheaths shall be protected against white ants, vermin and termites by suitable, reliable and durable measures.

The supplier shall suggest suitable materials for use, in the event of damage to over sheath to prevent passage of moisture along the cable.

8.10 CABLE IDENTIFICATION:

The following shall be embossed on the outer sheath for the identification.

- a) Manufacturer's Name
- b) Voltage Grade.
- c) Nominal section & Material of conductor and number of cores.
- d) Year of manufacture.
- e) Inscription for length of cables at 1.0 meter interval.
- f) Name of the purchaser: WBSETCL
- g) Marking "Electric" shall be embossed throughout the length of the Cable at 10 metres spacing.
- h) Type of insulation i.e. XLPE.

8.11 SEALING OF CABLE ENDS :

The cable ends of cable in the wooden drum for delivery shall be sealed with heat shrinkable caps.

9. WOODEN DRUMS :

The Cable shall be packed in non-returnable wooden drums.

9.1 The following information shall be marked on each drum.

- a) Drum identification No.
- b) Manufacturer's Name, Trade Name/Trade Mark, if any.
- c) Nominal sectional area of the conductor of the cable.
- d) No. of Cores.
- e) Type of Cable and Voltage Grade with Cable Code.
- f) Length of the Cable in Cable Drum.
- g) Direction of rotation of Drum (by means of an arrow)
- h) Approximate Weight : Tare : Gross
- i) Year and Country of Manufacture.
- j) Purchase Order No.
- k) Date of Delivery.
- l) Name of the Purchaser: WBSETCL

Drums shall be proofed against attack by white ants or termite conforming to IS: 10418.

The Drums may also be marked with ISI Certificate Mark, if applicable. 2 Safe Pulling Force: 30 N/mm² (for Conductor)

10. TESTS AT MANUFACTURER'S WORKS AND TEST CERTIFICATES:

- (i) Each type and size of cable shall comply with the requirements of routine test as per relevant Indian Standard.
- (ii) All routine and Acceptance tests shall be carried out at the manufacturer's works on every lot of offered different type and sizes of cables as per relevant Indian Standards. Selection of samples for acceptance test as well as rejection and retesting shall be guided by relevant IS. The entire cost of acceptance and routine tests that are to be carried out as per relevant IS shall be treated as included in quoted price of control and power cable. Three (3) copies of test reports shall be submitted to the Chief Engineer, Engg. Deptt., WBSETCL, Vidyut Bhawan (9th floor), Kolkata – 700 091 for approval and distribution to site. The contractor shall give at least 21 (twenty one) days advance notice to the Chief Engineer, Engg. Deptt. intimating the actual date of inspection and details of all tests that are to be carried out.

10.1. TEST REPORTS AND TYPE TESTS :

Only type tested XLPE Cable Power Cables are to be offered conforming to our technical specification, and relevant IS and IEC. XLPE Cables offered should be similar with ones on which type testing has been carried out as per relevant IS and IEC. Three sets of complete type test reports carried out in Govt. recognized Test House or Laboratory /NABL accredited laboratory shall have to be submitted by successful bidder positively along with submission of drawings during detailed Engineering. The submitted type test report shall proof that the type tests have been carried out within five years from the date of submission of bid. Successful bidder may require to produce original copies of type test reports at the time of detail Engineering if asked by WBSETCL.

Each type test report shall comply with the following information with test result

- i) Complete identification, date and serial no.
- ii) Method of application ,Where applied , duration and interpretation of each test

10.2 ROUTINE TESTS :

The routine test shall be carried out on all cables manufactured in accordance with the specification.

The following routine tests shall be made on cable length as specified in the ISS.

- a) Conductor resistance test.
- b) Partial discharge test on full drum length.
- c) High voltage test

10.3 Acceptance Test: The following shall constitute Acceptance Tests:

- a) Conductor resistance test.
- b) Test for thickness of insulation and sheath.
- c) Hot set test for insulation.
- d) Tensile strength and elongation at break test for insulation and outer sheath.
- e) P.D. test (for screened cables) only on full drum length.
- f) High Voltage test, and
- g) Insulation resistance (VOLUME RESISTIVITY) TEST
- j) Test of cross linking for extruded semi conducting screen.
- k) Oxygen Index (Test on FR)
- l) Flammability test (Test on FR)

Standard Technical particulars:

Description of Cable	:	Stranded compacted circular Copper conductor , shielded with conductor screen of black extruded semi conducting compound, XLPE insulated, shielded with insulation screen of black extruded semi conducting compound, Metallic screen of copper tape, Inner sheath Extruded PVC ST-2 followed galvanized round steel wires or galvanized formed wires for 3 core cable as per IS 7098 part II or single layer of round hard drawn aluminium wire for 1 core cable as per IS 7098 part II and black extruded FR PVC (Type ST 2) overall sheathed conforming generally to IS : 7098 (Part-II)
Voltage grade	:	33KV (UE) (for 33KV System).
Size of Cable	:	As per requirement
Insulation thickness	:	9.5 mm(Nominal thickness).
Max. Conductor Temp.	:	90°C at maximum continuous current.
Short circuit current	:	25KA for 1sec main conductor and 1KA for 1 sec for copper screen.
Maximum permissible emergency overload temp. at 25% over load to 100	:	130°C for one hour.
Maximum permissible short cut temperature.	:	250°C for one second.
Approximate Length of cable in a drum	:	500 metres /250 metres with a tolerance range of $\pm 5\%$. Or as per requirement.
End sealing	:	Heat shrinkable Caps.

GUARANTEED TECHNICAL PARTICULARS FOR XLPE CABLES

(To be filled in by the Supplier)

1. Manufacturer's Name &Address ::

2. Voltage Grade. ::33KV/33 KV

(For 33 KV Sys.)

3. Core & Cross Section ::

4. Type &Designation(as per IS) ::

5. List of Standards applicable ::

6. Suitable for system with

(a) Service Voltage ::

(b) Neutral Earthing ::

7. Maximum Conductor temperature ::

(a) Continuous (in Deg. C) ::

(b) Short time (in Deg.C) ::

8. Conductor :

(a) Material to IS-8130(Class/Grade) ::

(b) Size (Sq.mm.) ::

(c) No./Nominal diameter of wires in ::
each Conductor (no./mm.)

(d) Form of Conductor (Circular/shaped) ::

9. Shielding/screening on Conductor ::

(a) Material. ::

(b) Type. ::

(c) Whether thermosetting ? :: (Yes/No.)

10. Insulation ::

(a) Material. ::

(b) Type ::

(c) Nominal Thickness (mm) ::

(d) Minimum Thickness (mm) ::

(e) Whether triple co-extrusion :: (Yes/No)
With radiant curing process ?

11. Shielding / screen

Metallic ::

12. Inner – sheath ::

(a) Material ::

(b) Type ::

(c) Thickness (mm.) ::

(d) Extruded/Wrapped. ::

(e) Approx. outside diameter ::

over sheath (mm.)

13. Armouring ::

(a) Material. ::

(b) Size ::

(c) D.C. resistance at 20 deg.C ::

(Ohm/Km.)

(d) A.C. resistance at 20 deg.C ::

e)Approx. dia. over armour

14. Overall Sheath ::

(a) Material ::

(b) Type ::

(c) Thickness (mm.) ::

15. Approx. overall diameter of the ::
Cable (mm.)

16. Standard Drum length with ::
tolerance (Mtr.)

17. Net Weight of Cable(approx.)Kg/Km ::

18. Continuous current rating for ::
standard condition, laid direct

(a) In ground at temp. 30 deg.C ::

(b) In duct at temp. 30 deg.C ::

(c) In air at temp. 40 deg.C ::

19. Charging current at rated system voltage ::

20. Short Circuit Current (Maxm.) ::

(a) for 1 sec. ::

(b) for 0.5 sec. ::

21. Electrical Parameters ::

a) Maxm. D.C. resistance/km ::

of conductor at 20 deg.C

b) AC resistance/kilometre of max.operating temp:

c)tan-Delta at U_0 ::

d) tan-Delta at $1.5 U_0$::

e) tan-Delta at $2 U_0$::

22. Vol. Resistivity at 27 deg.C(ohm/Cm) ::

23. Recommended minimum bending radius ::

24. Derating factor for following ambient ::
temperature in Air/Ground.

(a) at 30 deg. C ::

- (b) at 35 deg. C ::
- (c) at 45 deg. C ::
- (d) at 50 deg. C ::

25. Type test results of the similar Cable to be ::
furnished with Tender (as specified
under Clause-10 of the Spec.)

(a) Tests on Conductor :

- (i) Tensile test (for aluminium) ::
- (ii) Wrapping test (for aluminium) ::
- (iii) Resistance test ::

(b) Test for armouring wires/strips ::

(c) Test for thickness of insulation & sheath :

- (i) Tensile strength & elongation at break ::
- (ii) Ageing in air oven ::
- (iii) Hot test ::
- (iv) Shrinkage test ::
- (v) Water absorption (Gravimetric) ::

(d) Physical :

- (i) Tensile strength and elongation at break::
- (ii) Ageing in air oven ::
- (iii) Shrinkage test ::
- (iv) Hot deformation ::
- (v) Loss of mass in air oven ::
- (vi) Heat shock ::
- (vii) Thermal stability ::

(e) Partial discharge test ::

(f) Banding test ::

(Volume resistivity)*Test

(i) Heating Cycle test ::

(j) Impulse with stand test ::

(k) High Voltage test ::

(l) Flammability test ::

26. Cable Drums :

- (a) Length/Drum (Kg) ::
- (b) Dimension of Drum ::
- (c) Shipping weight (Kg) ::

27. Safe pulling force (Kg.) ::

28. Partial discharge value ::

29. Details of the protective measures ::
against attack by white ante, vermins
etc. to be XLPE's outer sheath during
manufacture.

30. Type of curing of XLPE insulations ::

31. Cut ends of the Cable shall be sealed ::
with

32. Cable identification shall be made as per ::
per class 8.10 (Yes/No)

33. Cable Drums shall be marked with the ::
with the informations of Clauses 9.1
conspicuously (Yes/No)

Signature

Name.....

Seal of the Farm.....

Name of the Farm.....