XLPE CABLE
(11KV - Aluminium)

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Engineering Department

WEST BENGAL STATE ELECTRICITY TRANSMISSION COMPANY LIMITED

পশ্চিমবঙ্গ রাজ্য বিদ্যুৎ সংবহন কোম্পানি লিমিটেড

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Updates for WBSETCL / TECH SPEC / Rev.-1.1

7. CABLE DESIGN & CONSTRUCTION

7.3 Insulation(modified): The insulation shall be ~~preferably~~ fire ~~resistant~~ retardant and resistant to chemicals like acids, alkalis, oils and ozone. Colour code as per voltage class to be explored. (Mimic). R[1.1]

TECHNICAL SPECIFICATION OF 11 XLPE ALUMINIUM CABLE

1. SCOPE:

This specification covers design, manufacturing, testing, packing, supply and delivery of 11 KV cross linked polyethylene (XLPE) insulate, P.V.C. sheathed Aluminium cable for various substations of WBSETCL.

2.DEVIATION:

Normally the offer should be as per technical specification without any deviation but any deviations proposed must be mentioned in the deviation schedule Deviations not mentioned in "Deviation Schedule" will not be considered afterwards each deviation may or may not be accepted.

3. SERVICE CONDITION:

Material supplied against this specification shall be suitable for satisfactory continuous operation under the following tropical conditions.

Max. ambient temperature of the air in shade (°C)	: 50
Daily avg. ambient temperature(°C)	:45
Max. relative humidity	:100
Avg. annual rainfall(cm)	:200
Max. wind pressure (Kg/M2)	:150
Earthquake acceleration	:0.04X2g
Height above sea level	:not exceeding 1000m

The cables may be laid buried directly in ground at a depth of one metre in average.
The cables may also be laid within covered cable trenches, in cable racks or open air ladder trays etc. for certain portions of lengths.

4. STANDARDS:

Sr. No.	Standard No.	Title
1.	IS:8130 * 1984	Conductors for insulated electric cables and flexible cords.
2.	IS:7098(Part2)/ 1985	Cross linked Polyethylene (XLPE) Insulated PVC sheathed cable for working voltages from 3.3 kV up to and includingSSkV
3.	IS:5831 * 1984	PVC insulation and sheath of electric cables.
4.	IS:3975 * 1988	Mild steel wires, Formed wires and Tapes for armoring of cables.
5.	IS:0462 (Part I)/1983	Fictitious calculation method for determination of dimensions of protective coverings of cables
6.	IEC 60502-2	Cables for rated voltages from 6 kV (um = 7,2 kV) up to 30 kV(um = 36kV)
7.	ANSI/ICEA S-94 649:2004	Standard for concentric neutral cables rated 5 through 46KV

5. SYSTEM PARAMETERS:

5.1	Voltage grade(U0/U) KV	:	6.35/11
5.2	Nominal system voltage KV	:	11
5.3	Highest system voltage KV	:	12
5.4	System frequency HZ	:	50
5.5	Variation in frequency %	:	+/- 3
5.6	System earthing	:	Solidly earthed
5.7	1.2/50 microsecond lightning Impulse withstand voltage Wave value for cable KVp	:	75
5.8	5 min. power frequency withstand Voltage for cable	:	17

The Maximum continuous operating temperature (combination of ambient temperature and temperature rise due to load) shall be 90^0C under normal operation and 250^o C under short circuit conditions.

6. GENERAL TECHNICAL REQURIMENTS:

6.35/11 KV earth grade XLPE 3 core power cables shall be of high conductivity, stranded compacted, HD aluminum circular shaped conductor with cross linked polyethylene (XLPE) insulation provided with shielding of extruded semi conducting materials over conductor and XLPE insulation. Each insulated core shall have copper tape screen, laid up together with filler and binder tapes and provided with common covering of PVC inner sheath(extruded). Overall galvanized steel strip/round wire armoured and PVC outer sheath shall be provided.

Specification for manufacturer of cable shall be conforming to latest edition with amendments of IS7098(partII).

XLPE underground cable is to be manufactured in continuous centenary 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 semiconducting 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.

7. CABLE DESIGN & CONSTRUCTION

7.1 Conductor:

Electrolytic grade aluminum conductor shall be of H4 grade of class 2 as per IS 8130/1984 and any latest amendments to it. The shape of conductor shall be compacted, stranded, and circular.

7.2 Conductor screen/Shield:

The conductor screen shall be an extruded layer of black, semi-conducting compound. The allowable operating temperatures of the conductor shield shall be equal to or greater than those of the insulation. The conductor screen shall be extruded in the same operation as the insulation. The semi-conducting screens should be effectively cross linked to achieve 90iC cable rating. The interface between the extruded conductor screen and insulation shall be free of any voids.
The thickness of the semiconducting screen should have a thickness of 0.5 mm.

7.3 Insulation :

The insulating material shall be Cross Linked Polyethylene (XLPE) cured by dry curing process and applied by extrusion process as per IS-7098 and its latest amendments. The insulation shall be an extrusion of dry cured thermosetting cross linked poly ethylene water tree retardant material rated for 90°C continuous operation.

The insulating material shall have excellent electrical properties with regard to resistivity, dielectric constant and loss factor and shall have high tensile strength and resistance to abrasion. This shall not deteriorate at elevated temperatures or when immersed in water. The insulation shall be ~~preferably~~ fire ~~resistant~~ retardant and resistant to chemicals like acids, alkalis, oils and ozone. Colour code as per voltage class to be explored. (Mimic) R[1.1]

The insulation properties shall be stable under thermal conditions arising out of continuous operation at conductor temperature of 90°C rising momentarily to 250 °C under short circuit conditions. It shall be free from any foreign material or porosity visible to the unaided eye. The insulation shall be so applied that it fits closely on the conductor and it shall be possible to remove it without damaging the conductor. Nominal thickness of insulation should not be less than 3.6mm.

7.4 Insulation Screen/ Shield:

Extruded Semi-conducting screening and metallic screening of copper tape shall be generally as per IS: 7098 (Part-ll) with latest amendments. The semi conducting compound shall be suitable for the operating temperature of the cable and compatible with the insulating material.

The insulation screen shall be an extruded layer of black semi-conducting compound and continuously covers the whole area of the insulation. The semiconducting screens should be effectively cross linked to achieve 90 degree. C cable rating. The contact surface between insulation and insulation screen shall be smooth and free from protrusion and irregularities.

The interface between the insulation and insulation screen shall be free of any voids. Insulation screen shall be strippable type.

The metallic screen shall consist of a layer of copper tape applied in helical form

7.5 Core Identification:

Individual core of multi-core cables shall be colour coded and/or numbered for proper identification in accordance with clause 13.1 of IS: 7098 (Part II).

7.6 Laying up of cores:

In three core cables, the cores shall be laid together with a suitable right hand lay. The interstices shall be filled with non-hygroscopic material. Further, the compounds used with fillers shall be such as to have no deleterious effect on other components of the cable and to be stable at cable temperatures.

7.7 Inner Sheath:

The laid up cores shall be provided with inner sheath applied by extrusion process. It shall be ensured that the shape is as circular as possible. It shall be applied to fit closely on to the laid up cores and shall be possible to remove easily without causing any damage to the underlying insulated cores and screens.

The thickness of the inner sheath shall be as per IS: 7098 (Part - II).

7.8 Armoring:

The armouring shall be of galvanized round steel wires /steel strip for multi core cables. The galvanized steel wires/steel strip shall comply with the requirements of IS: 3975-1988 with latest amendments.
The dimensions of the galvanized steel wire/steel strip shall be as per IS: 7098 (Part-ll).

7.9 Outer Sheath:

The outer Sheath shall consist of extruded PVC compound. The PVC compound for the outer sheath shall conform to type ST-2 of IS: 5831 -1984 with FR properties. The colour of the outer sheath shall be black.

8. CABLE IDENTIFICATION:

The following shall be embossed on the outer sheath for identification. a)manufacturer's name or Trade mark.
b)Voltage grade
c)Normal section & Material of conductor and number of cores.
d)year of manufacture.
e)inscription of length of cables at 1.0 meter interval.
f)name of purchaser: WBSETCL
g)Marking "Electric" shall be embossed throughout the length of cable at 10meters spacing
h)Type of insulation i.e. XLPE.

9. SEALING OF CABLE ENDS:

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

10. <u>WOODEN DRUMS:</u>

The cable shall be packed in non-returnable wooden drums.
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 arrow)
h)Approximate weight:Tare: gross
i)Year ad 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.

Safe Pulling force:30N/mm2(for conductor)

11. <u>Tests:</u>

The following tests shall be carried out on the cables as per IS: 7098 (Part- II) with latest amendment.

11.1 Type Test :
All the tests mentioned below are to be made as per details given in 15:10810 a)
Tests on conductor

i) Tensile Test (for aluminium) ii) Wrapping Test (for aluminium) iii) Resistance Test.

b) Tests for armouring Wires strips

c) Test for thickness of insulation and steath

d) Physical test for insulation
   i) Tensile strength and elongation at break.
   ii) Ageing in air oven. iii) Hot test.
   iv) Shrinkage test
   v) Water absorption (Gravimetric)

e) Physical tests for outer sheath
   i) Tensile strength and elongation at break.
   ii) Ageing in air oven. iii) Shrinkage test. iv) Hot deformation. v) Heat shock.
   vi) Loss of mass in air oven. vii) Thermal stability.

f) Partial discharge test.

g) Bending test.

h) Dielectric power factor test.

i) As a function voltage.
   ii) As a function of temperature.

i) Insulation resistance (Volume resistivity) Test.

j) Heating cycle test.

k) Impulse with stand test.

l) High voltage test.

m) Flammability test.

If a sample fails in test (g) one more sample shall be taken for this test, preceded by tests (b) & (e).

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11.2. ACCEPTANCE TESTS:

The following shall constitute Acceptance Tests :

a) Tensile test (for aluminium)
b) Wrapping test (for aluminium)
c) Conductor resistance test.

d) Test for thickness of insulation and sheath.
e) Hot set test for insulation.
f) Tensile strength and elogation at break test for insulation and outer sheath.
g) P.D.test (for screened cables) only on full drum length.
h) High Voltage test, and
i) Insulation resistance (VOLUME RESISTIVITY) TEST
j)Test of cross linking for extruded semi conducting screen.

11.3. ROUTINE TESTS:

The routine test shall be carried out on all cables manufactured in accordance with this 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 for 5 mins as per Cl.19.7.2 IS 7098(Part II)

12. <u>TEST WITNESS:</u>

All acceptance test tests shall be performed in presence of purchaser's representative.
The contractor, shall give at least fifteen (15)days advance notice for witnessing such tests.

13. <u>TEST CERTIFICATE :</u>

13.1 Certified copies of all routine tests carried out at Works shall be furnished in Three (3) copies for approval of the purchaser.

13.2 The cables shall be despatched from Works only after receipt of Purchaser's written approval of shop test reports.

13.3 Type Test Certificates of the Cable offered shall be furnished. Otherwise the cable shall have to be type tested on similar rating as per Clause - 13 free of any charges to prove the design.

14. <u>TESTING FACILITIES:</u>

The supplier / Tenderer shall clearly state as to what testing facilities are available in the works of manufacturer and whether the facilities are adequate to carry out type, routine and acceptance tests mentioned in specified IS. The facilities shall be provided by Bidder to purchaser's representative for witnessing the tests in the manufacturer works. If any test cannot be carried out at manufacturer's work reasons should be clearly stated in the tender.

When requested a certified test report shall be supplied for production runs of cable. The report is to include all actual production test values required by the referred specifications. The manufacturer should provide the traceability information from cable till the materials used in the manufacturing.

15. GUARANTEE:

The Supplier of insulators shall guarantee overall satisfactory performance of the insulators. In case of failure of materials to meet the guarantee, WBSETCL shall have right to reject the material.

16. DESCRIPTIVE LITERATURES, TEST RESULTS ETC. :

The following details for the cable shall be submitted with bid.

a) Manufacturer's Catalogue giving cable construction details and characteristics.

b) Manufacturing process in detail for cables highlighting the steps to control.

i) Contamination, ii) Formation of water trees, iii) Effects of byproducts of cross-linking, iv) Stress control etc.

c) Cross section drawing of the cable.

d) Cable current ratings for different types of installation inclusive of all de rating factors due to ambient temperature, grouping etc.

e) Over-Load characteristics of the cable without endangering the normal life and electrical quality of the insulation.

f) Complete technical data of the cables.

g) ***Type Test Report conducted on similar type of Cable from NABL accredited LAB / Central Govt.LAB/ approved Accredited Testing Laboratory***

17. PACKING AND MARKING:

17.1Packing

The cables shall be supplied in wooden drums conforming to IS: 10418 with latest amendment. The standard length of the cable in each drum shall be 0.25 KM ±5% or as per requirement.

17.2Marking:

The cable drum shall carry the information as per requirement of IS: 7098 (Part – II) with latest amendment

The manufacturer's name or trade mark, the voltage grade, year of manufacture, etc. may be embossed on the cable as stipulated in IS: 7098 (Part – II) with latest amendment with name of WBSETCL and marking on each meter length shall be embossed.

GUARANTEED TECHNICAL PARTICULARS

(To be filled in by the Supplier)

1.	Manufacturer's Name & Address	::	
2.	Voltage Grade	::	6.35/11 KV (For 11 KV Sys.)
3.	Core & Cross Section	::	
4.	Type & Designation (as per ISS)	::	
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)) Minimum Thickness (mm) ::

(d) Whether tripple co-extrusion With radiant curing process ? :: (Yes/No.)

11. Shielding / screening on insulation ::

(a) Material ::

(b) Type ::

(c) Thickness (mm) ::

i) Non-metallic ::

ii) Metallic (Copper tape) ::

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 ::

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/kilometer of :: conductor at 90 deg.C(approx.) (c) Reactance/kilometer(appnox.) ::

(d) Capacitance/Kilometer(approx.) ::

(e) Di-electric losses at rated :: (Uo/U) system KV, 50 cycles/sec. in Watts/KV/Phase)

(f) i) tan-delta at 0.5 Uo ::
ii) tan-Delta at Uo :: iii) tan-Delta at 1.5 Uo :: iv) tan-Delta at 2 Uo ::

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. Cable Drums :

(a) Length/Drum (Kg) ::

(b) Dimension of Drum ::

(c) Shipping weight (Kg) ::

26. Safe pulling force (Kg.) ::

27. Partial discharge value ::

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

29. Type of curing of XLPE insulations ::

30. Cut ends of the Cable shall be sealed :: with ……..

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

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