



BHARAT HEAVY ELECTRICALS LIMITED

TRANSMISSION BUSINESS ENGINEERING MANAGEMENT

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TYPE OF DOC.	TECHNICAL SPECIFICATION			SIGN		
TITLE 33kV(UE) 1Cx300 mm2 XLPE Cable				NAME	TTR	SKS
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				GROUP	TBEM	W.O. No
Customer	Power grid Corporation Of India Ltd. (POWERGRID)					
Project	±800kV, 6000MW HVDC Raigarh – Pugalur Terminals					
CA NO.	CC-CS/651-SR2/HVDC-3063/7/G10/CA-I/5817-5821 date: 2017-01-25					
Station	Raigarh & Pugalur					
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1 Scope, Quantities and Specific Technical Requirements

1.1 Scope

This technical specification covers the requirements of design, engineering, manufacture, inspection, packing, loading at works and transport to *site* of 33kV(UE) 1Cx300 mm² XLPE Cable complete with all accessories etc. as mentioned in this section and in various other sections of this specification.

The equipment is required for the following project:

Name of customer : Power Grid Corporation of India Ltd (POWERGRID)

Name of the project : ±800kV, 6000MW HVDC Raigarh – Pugalur Terminals

Site : Raigarh & Pugalur

Refer section-3 of this document for project details and general specification.

In case of any conflict among the various sections of this specification, the order of precedence shall be section 1, section 2 & the section 3.

1.2 Quantities

S. No.	Item Description	Unit	Quantity		Remarks	
			Raigarh	Pugalur	Raigarh	Pugalur
1	33kV (UE), XLPE Insulated, 300sqmm Stranded Circular and compacted Aluminium Conductor, Single Core Power Cable	mtrs	14000	15000	Qty Variation ± 40%	Qty Variation ± 40%

Notes:

Cables shall be supplied as per the specified drum lengths at contract stage.

No negative tolerance shall be acceptable on the specified drum lengths and a positive tolerance up to 5% shall be acceptable. Lengths beyond the above shall not be payable.

Cables shall be supplied in non-returnable, wooden or steel drums as per applicable standards. Drum details & drawing shall be subject to purchaser/customer's approval at contract stage.

1.3 Specific Technical Specification

S. No.	PARTICULAR	UNIT	DATA
1.	Rated Voltage	kV	33
2.	Type of Insulation		XLPE
3.	Single core / Multi core		Single
4.	Armoured /Unarmoured		Armoured
5.	Material of Conductor		Aluminium

S. No.	PARTICULAR	UNIT	DATA
6.	System		Un grounded system
7	Highest System Voltage	kV	36
8.	Conductor Size	mm ²	300
9.	Material		Aluminum
10.	Shape of conductor		Compact Circular
11.	One minute power frequency dry and wet withstand voltage (rms)	kVrms	95
12	Full wave impulse withstand voltage (1.2/50 microsec)	kVp	250
13.	Continuous Withstand Temperature	°C	90
14.	Short Circuit Withstand Temp.	°C	250
16.	Oxygen Index		Min 29 (as per ASTM D 2863)
17	Short circuit current	kA/sec	25

The equipment must conform to the latest revision of all relevant IEC standards.

1.4 Type tests

Offered equipments should have been type tested in accordance with the applicable IEC/IS and the detailed type test reports (on identical equipment) shall be submitted for approval. The type test reports submitted shall be of tests conducted within last 10 years prior to the date of 28.07.2015. The bidder should have conducted type test on identical or similar equipment/ components to those offered. In case type test reports are found to be technically unacceptable to BHEL/PGCIL, the type test shall be conducted without cost and delivery implication to BHEL.

During the final/stage inspection, as applicable as per the agreed quality plan, the routine & acceptance tests shall be carried out on each drum length in accordance with the applicable IEC or equivalent Indian Standards. Inspection shall be carried out by BHEL/PGCIL representative at supplier's works.

1.5 Qualifying requirements

The cable shall be from the manufacturer who must have designed, manufactured, type tested and supplied at least 8 (eight) km of 33kV or higher grade XLPE insulated cable which must be in operation for at least 2 (two) years as on date of 19th May 2015.

1.6 Manufacturing quality plan

Bidder to follow valid POWERGRID approved Quality Plan (QP) at contract stage.



1.7 Deviations

The bidder shall list all the deviation from the specification separately. Offers without specific deviation will be deemed to be totally in compliance with the specification and NO DEVIATION on any account will be entertained at a later date.

2 Equipment Specification

2.1 General

This section covers the general technical requirements of 33kV (UE) 1Cx300 mm² XLPE Cable. In case of any discrepancies between the requirements mentioned in this section and those specified in section-3 of this specification, this section shall prevail and shall be treated as binding requirement.

2.2 Standards

The 33kV(UE) 1Cx300 mm² XLPE Cable and accessories shall conform to the following standards.

IS 7098 1993 (Part-III)	XLPE insulated PVC sheathed cable For working voltage from 66kV up to and including 220kV
IEC 840	XLPE Power cables for rated voltage above 36 kV
IEC 60811	Common Test Methods for Insulating & Sheathing Materials of Electric Cables
IS 5831 1984	PVC insulation and sheath of electric cables
IS 8130 1984	Conductors for insulated electric cables and flexible cords
IS 3975 1988	Mild steel wires, formed and tapes for armouring of cable.
IS 10810 1984	Method of test of cables
IEEE-383 1974	Standard for type test of class IE electric cables, field splices, and connections for nuclear power generating stations.
ASTM-D2843 1993	Standard test method for density of smoke from burning or decomposition of plastics.
ASTM-D2863 1991	Standard test method for measuring minimum oxygen concentration to support candle - like combustion of plastics (oxygen index).
NEMA-WC7 1992	Cross Linked Thermo setting Polyethylene Insulated Wire and cable for the transmission and distribution of Electrical Energy.
IEC 754-(Part-1) 1994	Test on gases evolved during combustion of electric cables -(Part-1):1994 Determination of the amount of halogen acid gas evolved during combustion of polymeric materials taken from cables.
IEC 60332 (Part I):1993	Test on electric cables under fire conditions Test on a single vertical insulated wire or cable.
IEC 3981 (Part II) 1967	Recommended current rating for cables- PVC insulated and PVC sheathed Heavy duty Cables
IS 10418 1982	Drums of electric cables

2.3 Technical Requirements

2.3.1 General

- 1) The cables shall be suitable for laying in racks/trays, ducts, trenches, conduits and underground buried installation with uncontrolled backfill and with chances of flooding by water.
- 2) They shall be designed to withstand all mechanical, electrical and thermal stresses under steady state and transient operating conditions.
- 3) The HV (6.6 kV to 33 kV) power cables shall withstand without damage a 3-phase fault current of 40 kA (rms) for at least 0.12 second, with an initial peak of 110 kA in one of the phases, when the insulation screens are insulated at one end.
- 4) The armour for XLPE insulated power cables shall be capable of carrying 45 kA for at least 0.12 seconds without exceeding the maximum allowable temperature of PVC outer sheath.
- 5) During a short circuit as specified above, the XLPE insulated cables shall be capable of withstanding a conductor temperature of at least 250°C.
- 6) The measured value of temperature index shall be 21 at a temperature of 250 degree Celsius, in line with IS 1554 (Part 1).
- 7) The cables shall have outer sheath of a material with an Oxygen Index of not less than 29 at 27+/- 2 degrees in line with IS 1554 (Part 1).
- 8) Repaired cables shall not be accepted.
- 9) Maximum acid gas generation of weight as per IEC-60754(I) shall not be more than 20% of the outer sheath material. The cables shall meet the requirements of light transmission of 40 % (min) and shall be tested as per ASTM D-2843. Smoke density rating – Maximum 60% (to ASTM D 2843).
- 10) All cables shall be armored and of fire retarded low smoke type.

2.3.2 Constructional requirements

- 1) The HV cables shall conform to IS-7098 (Part III) or relevant IEC read along with latest amendments and this Specification.
- 2) The conductor shall be stranded aluminium, circular and compacted.
- 3) The conductor screen and insulation screen shall both be of extruded semi-conducting compound and shall be applied along with the XLPE insulation in a single operation by triple extrusion process so as to obtain continuously smooth interfaces.
- 4) The metallic part of insulation screen of each core shall consist of copper tape, which shall be capable of carrying an earth fault current of 300 amperes for at least two (2) seconds.
- 5) The Aluminum/copper wires used for manufacturing of the cables shall be true circular in shape before stranding and shall be of uniform good quality, free from defects. All aluminum used in the cables shall be of H2 grade as per IS-8130, Clause 3.1.
- 6) The fillers and inner sheath shall be of non-hygroscopic, fire retardant material, softer than insulation & outer sheath and suitable for the operating temperature of the cable.
- 7) Strip wire armoring following method (a) mentioned in the relevant IS shall not be accepted for any of the cables.
- 8) Progressive sequential marking of the length in meters at every one meter shall be provided on the outer sheath of all cables.

- 9) Allowable tolerance on the overall diameter of the cables shall be as per the relevant IS/IEC standard.
- 10) The minimum bending radius for the cables shall be equal to 12*D; where D is the overall diameter of the cable.

2.3.2.1 Construction

1) Conductor Screening

The conductor screening shall be of non-metallic material and shall consist of a layer of extruded Semi-conducting compound which shall be firmly bonded to the inner surface of the insulation.

2) Conductor Insulation

The conductor insulation shall be of extruded Cross Linked polyethylene over compacted circular stranded Aluminium conductor.

3) Insulation Screening

Insulation screening shall consist of a layer of extruded Semi-conducting compound simultaneously extruded with the conductor screening layer and XLPE core insulation. This shall be followed by two layers of copper tape. The extruded Semi Conducting layer shall be strippable.

Obtain a rigid bond between the extruded conductor screening, XLPE insulation and the extruded insulation screening.

4) Inner Sheath and Filler

The laid up cores shall be provided with inner sheath applied by extrusion. The fillers and the inner sheath shall not be harder than XLPE and PVC used for insulation and outer sheath respectively. Fillers and inner sheath material shall be chosen to be compatible with the temperature ratings of the cable and shall not have any deleterious effect on any other component of cable.

5) Armouring

All cables shall be Armoured with hard drawn round aluminium wire. The armouring shall conform to the requirements specified. The armour for XLPE insulated power cables shall be capable of carrying 45kA for at least 0.12 seconds without exceeding the maximum allowable temperature of PVC outer sheath.

6) Outer Sheath

The outer sheath shall be extruded PVC to type ST-2.

All the cables shall pass fire resistance test as per IS 5831. Suitable chemicals shall be added to the outer sheath of all cables to protect from rodent, vermin and termite attack.

2.3.3 Current rating

Normal current rating shall not be less than that covered by IS 3961.

Vendor shall submit data in respect of all cables in the prescribed format.

XLPE insulated cables shall be suitable for continuous conductor temperature of 90°C. Tables giving de-rating factors for various conditions of cable installation including the following, for all types of cables shall be furnished -

- Variation in ambient air temperature.
- Variation in ground temperature.
- Depth of laying.
- Cables laid in the ground
- Cables laid in trench
 - Cables laid in ducts
 - Soil Resistivity.
 - Grouping of cables.

The value of short circuit withstand current ratings of all cables shall be indicated for 3 second duration and should also specify the maximum temperature rise during short circuit.

The following factors shall also be accounted for, while specifying the maximum short circuit withstand of the cables.

Deformation of the insulation, due to Thermo-mechanical forces produced by the short circuit conditions, can reduce the effective thickness of insulation.

Conductor and core screens can be adversely affected with loss of screening effect. Likewise the thermal properties of the outer sheath material can be the limitation.

It is essential that the accessories, which are used in the cable system with mechanical and/or soldered connections, are suitable for the temperature adopted for the cables.

Formula for calculating short circuit current for different duration or curve showing short time current v/s time for different sizes of cables shall be furnished by vendor.

2.4 Cable drums

- 1) Cables shall be supplied in non-returnable wooden or steel drums of heavy construction. Wooden drum shall be properly seasoned sound and free from defects. Wood preservative shall be applied to the entire drum. Drums offered shall conform to relevant standards. The ends of the each length of cable shall be sealed before dispatch.
- 2) Each drum shall contain one continuous length of cable. Owner shall have the option of rejecting cable drums with shorter lengths. The cable length per drum is allowed a tolerance of +5%.
- 3) A layer of water proof paper shall be applied to the surface of the drums and over the outer most cable layer.



- 4) A clear space of at least 40 mm shall be left between the cables and the lagging.
- 5) Each drum shall carry the manufacturer's name, the purchaser's name, address and contract number and type, size and length of the cable, net and gross weight stencilled on both sides of drum. A tag containing the same information shall be attached to the leading end of the cable. An arrow and suitable accompanying wording shall be marked on one end of the reel indicating the direction in which it should be rolled.
- 6) Packing shall be sturdy and adequate to protect the cables, from any injury due to mishandling or other conditions encountered during transportation, handling and storage. Both cable ends shall be sealed with PVC/Rubber caps so as to eliminate ingress of water during transportation and erection.



3 General Technical Requirements

Please refer TB-391-316-000 Rev. 00: 'General Technical Requirements- Section 3'

Generally applicable clauses are 3.1 to 3.11; 3.13, 3.14, 3.16.2, 3.16.4, 3.17, 3.18, 3.22, 3.25.