

BIDDING DOCUMENT

FOR

Procurement of XLPE Power and Control Cables

**ASSAM ELECTRICITY GRID CORPORATION
LIMITED**



VOLUME II: TECHNICAL SPECIFICATION

BID IDENTIFICATION NO:

AEGCL/MD/CGM(O&M) LAR/CONTROL CABLE/MIRZA GSS/2026/BID/002(R)

CHAPTER 1: INFORMATION TO BIDDERS (ITB)

2.1 Terminology Used in Technical Specifications:

- 1) AEGCL, Purchaser, Owner etc., shall mean AEGCL or authorized person by AEGCL.
- 2) Bidder, Supplier, Vendor, Manufacturer shall mean EPC Contractor or represented by him.

2.2 Equipment Selection Criteria:

The equipment to be offered under the specifications shall be of current & proven design by way of commercial operation for a minimum period of three 10 (ten) years. Bidders shall furnish documentary evidence of satisfactory commercial operation / performance of equipment from a minimum of two actual users in the form of authenticated certificate and reference list of Users.

2.3 Approved Manufacturers:

All the equipment and items offered shall be of any one of the approved makes: The equipment shall generally be for use in moderately hot and humid tropical climate conducive to rust and fungus growth unless otherwise specified.

2.4 Scope of supply & Works:

2.4.1 Design, Engineering, Manufacture, FAT, Supply and delivery of equipment as specified in this document as per this tender specification and Bill of quantities.

2.4.2 All transportation of materials that is covered in the scope of works shall be ensured to be transported without damage to these materials; the liability in this context is with the contractor. Temporary power supply if required, for field works is in the scope of the bidder.

CHAPTER 2: DRAWINGS AND DOCUMENTS

The contractor will furnish drawings/ documents for all the items included in the BOQ. Circulation of drawings/ documents shall be strictly followed during contract stage. Any equipment purchased by the contractor without the approved drawing will be treated as a breach of contract. The drawings/Documents which require the Employer's approval shall be as per the under mentioned sequence:

- i) Submission of drawings shall begin within 30 days from award of contract.
- ii) AEGCL shall convey the approval / acceptance/ rejection /observations on these drawings & documents within 20 days.
- iii) Resubmission of drawings shall be made within 10 days.
- iv) The same sequence shall follow till final approval, but contractor shall make best efforts to obtain approvals in first submission in order to avoid delays in approval & project execution.
- v) 6 sets of drawings in white plots in AutoCAD of 2007 version or above and readable and editable softcopies shall be submitted for approval till approval is obtained.
- vi) 6 sets of AS-BUILT drawings shall be submitted along with softcopies.
- vii) 6 sets of hard copies of drawings shall be submitted to the design wing of AEGCL (civil and electrical) for necessary checking.
- viii) Drawing has to be submitted in sequence as per list of drawings as Approved by Employer's.

CHAPTER 3: TECHNICAL SPECIFICATIONS OF XLPE INSULATED COPPER CONTROL AND POWER CABLE (Whichever is Applicable)

This technical specification intends to cover the following:

Technical specifications for design, engineering, manufacturing, inspection, testing at manufacturer's works, packaging and delivery by road (properly packed in non-returnable steel drums), various sizes of copper conductor, XLPE insulated, voltage up to and including 1100 Volts, extruded PVC inner sheathed, extruded FRLS PVC outer sheathed, GI round wire armoured cables, suitable for solidly grounded system. The cables shall confirm to IS 7098-Part 1 with latest amendments. For cable list refer Table-1 (Sl. no. 1.1 to 1.19).

Note:

- 1) Tenders will only be considered from the cable manufacturers and any one supplier to whom manufacturer can authorize. The bidder shall have adequate experience of at least 10 years in manufacturing of LT/MV & HT cables and field proven experience of min 5 years.
- 2) Copper samples from the finished cable drums shall be tested at any 3rd party NABL accredited lab to ensure its purity.
- 3) The following document shall be attached with technical part of the bid:
 - i) Duly filled & Signed copy of Annexure-I, II, III & IV
 - ii) Deviation sheet, if any

Table 1

Sl. No	Power Cable
1	3C X 2.5 Sq.mm, Copper Power Cable Type: 2XWY
2	4C X 2.5 Sq.mm, Copper Power Cable Type: 2XWY
3	3C X 4 Sq.mm, Copper Power Cable Type: 2XWY
4	4C X 4 Sq.mm, Copper Power Cable Type: 2XWY
5	3C X 6 Sq.mm, Copper Power Cable Type: 2XWY
6	4C X 16 Sq.mm, Copper Power Cable Type: 2XWY

Sl. No	Power Cable
7	3C X 10 Sq.mm, Copper Power Cable Type: 2XWY
8	4C X 10 Sq.mm, Copper Power Cable Type: 2XWY
9	3C X 16 Sq.mm, Copper Power Cable Type: 2XWY
10	2C X 16 sqmm
11	2CX50 sqmm
12	3.5 C X 35 sqmm
13	3.5 CX70 sqmm
14	3.5 C X 95 sqmm
15	3.5 C X 150 sqmm
16	3.5 C X 300 sqmm
17	1 C X 1000 sqmm
18	2C X 6 sqmm
Control Cable(Copper)	
1	2 C, 1.5 sq mm
2	4C, 2.5 sq mm
3	5C, 2.5 sq mm
4	7C, 1.5 sq mm
5	7C, 2.5 sq mm
6	10 C, 2.5 sq mm
7	12 C, 2.5 sq mm
8	12 C,1.5 sq mm
9	14 C, 2.5 sq mm
10	17 C,1.5 sq mm
11	19 C,1.5 sq mm
12	19C,2.5 sq mm

Technical Specifications for 1.1 kV grade, Copper conductor, Power and Control cable

This section covers the technical specifications for design, engineering, manufacturing, inspection, testing at manufacturer's works, packaging and delivery by road (properly packed in non-returnable steel drums), 1.1KV grade, Multi-stranded Copper conductor, XLPE insulated, extruded PVC inner sheathed, GI round-wire armoured, extruded FRLS PVC ST2 outer sheathed. Power Cables and Control Cables for effectively grounded system, conforming to the latest revisions of IS: 7098 (Part –I), 1988 & as per the technical specifications attached herewith.

3.1 STANDARDS

The design, manufacture and testing of the cable shall comply with the latest editions/amendments of the following Indian Standards, unless otherwise specified. Equipments complying with equivalent standards shall also be acceptable.

- | | | |
|----|---------------------------|--|
| a. | IS-7098, 1998
(Part-I) | : Cross linked polyethylene insulated
PVC sheathed cables for working up to 1100V |
| b. | IS-3961 | : Recommended current ratings for cables |
| c. | IS 8130-
1984 | : Specification for conductors for insulated electric
cables and flexible cords |
| d. | IS-3975,
1999 | : Low Carbon galvanized steel wires, formed wires &
tapes for armouring of cables |
| e. | IS-4759 | : Specifications for Hot dipped galvanized coating
on round steel Wires |
| f. | IS-5831 | : PVC insulation and sheath of electric cables. |
| g. | IS-10418 | : Drums for electric cables. |
| h. | IS-10810 | : Method of test for cables. |

3.2 SERVICE CONDITION

Service Condition shall be as per General Technical Requirements (GTR).

3.3.1 General

The cables supplied under this specification shall be adequate insulated to operate continuously at the specified voltage with a high degree of safety and reliability throughout the life of the cables. The sheathing material shall be high quality PVC based compound. The construction of cable shall be as per IS: 7098 (Part I) – 1988.

Cable shall be designed and manufactured to prevent damage during transportation, installation & operation under all climatic & operating condition.

3.3.2. Technical parameters

i. Quantity	: Refer Table-1
ii. Packaging	Steel drum packaging, each having single length cable $\geq$ 500 metres. (for size less than 1000sqmm.).
iii. Cable Type	A2XWY/ 2XWY (refer Table- 1 for details) Shall be decided during detailed engineering (Cable sizing calculation)
iv. No. of Cores	1.1Kv
v. Voltage Level	Solidly Grounded
vi. System Grounding	
Nominal System voltage	: 415V $\pm$ 10%
Nominal System Frequency	: 50 Hz
Maximum conductor temperature at rated current	: 90 deg C
Maximum conductor temperature at Short-circuit	: 250 deg C
Conductor Material	: H4-Grade Aluminium of purity > 99.6% Electrolytic grade Copper, Purity > 99.97%
Conductor type	: Stranded with number of strands as per IS 8130 (Part-I) 1984
Insulating material	: Cross-Linked-Polyethylene (XLPE) Compound.
Core Identification Strips	: Red, Yellow, Blue & Black (for neutral)
Material of Inner Sheath	: FRLS, PVC ST-2 Compound

3.4 Conductor

COPPER

The conductors shall be made from high conductivity copper rods complying with IS: 613-1964. The conductor material used shall be electrolytic grade with high purity. Two sample conductor randomly selected from finished lot of cables, shall be tested for its purity at any 3rd party NABL accredited

lab. The conductors shall conform to appropriate dimensions, resistance and number of wire in the conductor (number of strands) as given in IS 8130 (Part I): 1984.

3.5 Insulation

The insulating material for power and control cables shall be extruded cross linked polyethylene (XLPE) compound as per IS-7098(Part-I)-1988. The minimum thickness of insulation shall not be less than the values specified in Table-2 of IS-7098 (Part-I)-1988. No negative tolerance shall be applicable for the thickness. The insulation of the cable shall be designed and manufactured for the specified system voltage. The manufacturing process shall ensure that insulation shall be free from voids. The insulation shall withstand mechanical and thermal stress under steady state and transient operating conditions. The cores shall be identified as per the following colour scheme:

3-Core - Red, Yellow & Blue

3 ½ or 4-Core - Red, Yellow, Blue & Black

3.6 Inner Sheath

The inner sheath shall be extruded FRLS PVC, Type ST2, compatible with thermal rating of insulation conforming to IS-6380-1984. The sheath shall have adequate thickness, mechanical strength and elasticity, as specified in IS 5831. The material shall be soft thermoplastic type, applied by extrusion method. The thickness of the inner sheath shall be as per IS: 7098 (Part I) and the color of the inner sheath shall be Grey. The inner sheath shall be so formed that it fits closely on the laid up cores and could be easily removed without damaging insulation. One or more layer of proofed plastic tape shall be provided over the laid up core before extrusion.

3.7 Outer Sheath

Extruded outer sheath shall be provided over the armouring. The material used for sheathing shall be FRLS PVC sheath, Type ST-2 base compound conforming to IS 1554/ IS 5831 for power and control cable. The outer sheath shall be so formed that it fits closely on the laid up armour and could be easily removed without damaging the intermediate sheath and insulation. The colour of the outer sheath shall be black. The thickness of outer sheath shall be in accordance with the IS 1554 (Part-I)-1988. Suitable additives shall be added to prevent attack by rodents and termites. All serving must be given anti-termite treatment.

Cables shall have suitable fillers laid up with the conductor to provide a substantially circular cross section before the sheath is applied. Fillers shall be suitable for the temperature of the cable and compatible with the insulating material. The material shall be of the best quality and workmanship. The fillers and sheath material shall be non-hygroscopic. All materials shall be new, unused and of the finest quality.

3.8 TESTS

All the tests specified below shall be carried out in accordance with the Indian Standards by the manufacturer in the presence of Purchaser's representative. If the cable fails to pass the test specified, the Purchaser shall have the option to reject it. Shipping release shall be obtained from the Purchaser's representative. The Purchaser, however reserves the right to waive off the inspection.

The tests at works shall include electrical, mechanical and hydraulic tests in accordance with the appropriate clauses of Statutory Regulation, relevant codes and standards, in addition any test called for by the Purchaser or his representative to ensure that the equipment being supplied fulfils the requirement of the specification.

For test not covered by any code or specifically mentioned in this specification, the test procedures are to be agreed with the Purchaser.

3.9 Pre Dispatch Inspection

The manufacturer shall be given at least 15 days advance notice prior to the commencement of testing, so that Purchaser's representative can plan to witness the tests.

All the tests indicated in the test clause of this specification shall be carried out in the presence of Purchaser's representative by the manufacturer and shall provide all the facilities and equipment for testing.

Six copies of the Test Certificate shall be furnished to the Purchaser for approval prior to dispatch of cables from factory.

Visual check to conform the details given in this specification is to be done. In addition to the above, the general workmanship of the cable drums and cables laid in drums shall be checked.

Manufacturer shall have proper test set up for testing all the routine tests & type tests on finished cables as per IEC.

List of type tests mentioned in the tender specifications shall be conducted on four drum irrespective of type test certificates given or not.

3.10 Type Test

Type tests on four randomly selected cable drums will have to be conducted in the presence of the department's representative. The test samples will be taken from finished cables. This test shall be in accordance to IS: 7098, Part-1,1988.

a. Test on Conductor

- i) Annealing test for copper conductors
- ii) Tensile test for aluminium conductor
- iii) Wrapping test for aluminium conductor
- iv) Conductor Resistance Test

b. Test on Insulation

- i) Physical dimension measurement
- ii) Tensile strength and elongation at break
- iii) Hot set test
- iv) Shrinkage test
- v) Ageing in air oven
- vi) Water absorption test

c. Test on round Armour

- i) Physical dimension measurement
- ii) Tensile strength
- iii) Elongation at break
- iv) Torsion test for round wires
- v) Winding test for firmed wire
- vi) Mass of zinc coating.
- vii) Uniformity of zinc coating
- viii) Resistivity measurement, Resistance test for armour

d. Test on Sheath

- i) Physical dimension measurement
- ii) Tensile strength & Elongation at break test
- iii) Ageing in air oven

iv) Loss of mass in air oven

v) Shrinkage test

vi) Hot deformation test

vii) Heat shock test

viii) Thermal stability test

e. Insulation Resistance Test

f. High Voltage Test at room temperature

g. Volume resistivity at room temperature & at 90° C. (IS-10810-Part 43)

h. Flammability test

1. Test requirement of FRLS inner and outer sheath

The inner and outer sheath of cables shall meet the following test requirements related to flame retardant, low smoke emission, low acid and toxic gas emission. The BIDDERS shall have proper test apparatus to conduct all the relevant tests as per the applicable standards:

i) Flame retardant test on single cable.

ii) Oxygen Index Test

The critical oxygen index value shall be minimum 29 when tested at 27±2°C as per ASTM-D-2863

iii) Temperature index test

Temperature index value shall be minimum 250°C at oxygen index of 21 when tested as per NES 715.

iv) Flammability test

v) Smoke Density Test

The cables shall satisfy the tests conducted to evaluate the percentage obscuration by smoke in an optical system placed in the path of the smoke. The maximum smoke density rating shall not be more than 60% when tested as per ASTM-D-2843.

vi) Acid Gas Generation test (halogen acid gas evolution)

The hydrochloric acid generation when tested as per IEC 754-1 shall be less than 20% by weight.

vii) Test for specific optical density of smoke

Anti termite and rodent property test

The sequence of electric tests shall be as per the relevant Indian/International standards. The Bidder shall submit the sequence of tests for the approval of the purchaser before conducting the tests. A copy of the adopted standard shall also be supplied.

3.11 Routine Test (On each drum)

The following routine tests shall be carried out by the Manufacturer on each and every length of the cable in the presence of Purchaser's representative at manufacturer's works.

- a. Resistance test for conductors
- b. Insulation resistance test
- c. High voltage test

3.12 Conductor purity test

Two samples of aluminium and copper shall be taken from any of the finished set of cables at random and the sample shall be tested for its purity at a NABL accredited lab.

Qualifying Criteria:

The test results should be within limits as per IS 7098. All the routine tests as per IS 7098 / IEC shall be conducted and passed as per the limits given in the standards.

All the bought out certificates will be verified and the test results shall be as per respective standards.

3.13 Identification

The following details shall be marked sequentially for each meter run length of the cable by non-erasable embossing on the outer sheath:

- a. Reference to Indian Standard
- b. Name of the manufacturer/ Trade Name
- c. Name of the project:
- d. Configuration of the cable: viz. Voltage grade, no. of Core, Sq. mm,
A2XWY/2XWY/YWY / YY as applicable

e. Year of manufacturing

f. Sequential marking of running meter length

The running length of the cable shall be identified at regular intervals of one meter (Increasing order from inner end to outer end of the cable)

3.14 PACKAGING

Each drum shall consist of single length cable ≥ 500 metres (for sizes less than 1000sqmm.).

The cable shall be wound on *non-returnable steel drums* of suitable size, packed and marked. Packing shall be sturdy to protect the cable from any injury during transportation, handling and storage. The cut ends of the cable shall be sealed by means of non- hygroscopic sealing material preferably Heat shrinkable end caps.

One end of the cable shall be brought out of the drum and suitably clamped to the drum flange with proper mechanical protection. Location of the other end may be marked on the drum.

The cable shall be placed on drums in such a manner that it will be protected from injury during transit. Each end of the cable shall be firmly and properly secured to the drum. No undue stress shall appear on cables when laid on drums.

The cable drum shall carry the following information stencilled on a metallic label, securely attached to each end of the drum:

- i) Reference to the Indian standard
- ii) Manufacturer's name, brand or trade mark
- iii) Type of cable and voltage grade
- iv) No. of cores
- v) Nominal cross-sectional area of conductor
- vi) Cable code
- vii) Length of cable on drum
- viii) No. of lengths on reel, drum or coil (if more than one)
- ix) Gross weight
- x) Country of manufacture
- xi) Year of manufacture
- xii) Direction of rotation of drum (an arrow)
- Xiii) ISI certification mark

3.15 PREFERRED MAKE

POLYCAB/KEI/KEC or reputed brand possessing system certification of ISO 9001:2008, ISO14001:2004, OHSAS18001:2007 & EN 16001-2009 and product certifications IS: 7098 (Part-I), CE, UL etc. Quotations without these certification details will not be considered for technical evaluation.

Preferred make of bought out material:

- | | | |
|----|----------------------------|--|
| a. | Aluminium for Conductor | Hindalco/Balco/Nalco or any other approved make at the time of detailed : engineering. |
| b. | Copper for Conductor | Hindustan Copper/Hindalco or any other approved make at the time of detailed : engineering |
| c. | XLPE compound of Insulator | Dow/Borealis at the time of detailed : engineering |

3.16 GUARANTEE

All the cables shall be guaranteed against faulty material, defective design & poor workmanship for a period of 18 months from the date of commissioning. The materials becoming defective during the guarantee period shall be replaced free of cost and the defects arising out of the works shall be rectified free of charge without delay.

ANNEXURE-I

Technical Data Format for 1.1KV, XLPE Insulated, Copper Cable

The tenderer shall furnish all technical details as called for in the following format for all sizes of cables failing which the tender shall be considered as incomplete. *The details shall be furnished separately for all the cables.*

SI. No.	Particulars	Details
A	Cores	
1	No. of cores	
2	Nom Area of conductor in sq mm.	
3	Voltage Grade	
B	Conductor	
1	Standard Applicable	
2	Material Copper Grade	
3	Purity	
4	Nominal Cross Sectional Area	
5	Form of conductor/circular shaped	

6	No. of strands	
7	Nominal dia of each strand	
8	Temperature co-efficient of resistance at 20 degree celsius	
C	Insulation	
1	Standard Applicable	
2	Material (Mention Type)	
3	XLPE is cured by steam process or Gas process?	
4	Minimum Average Thickness	
5	Tolerance on the smallest of the measured values of thickness of Insulation	
6	Minimum volume resistivity at 27 deg cel	
7	Minimum volume resistivity at 70 deg cel	
8	Colour Scheme for identification of cores	
9	Average Dielectric Strength	
D	Inner Sheath	
1	Standard Applicable	
2	Material for inner sheath	
3	Minimum thickness of inner sheath	
4	Whether extruded	
E	Armour	
1	Standard Applicable	
2	Shape	
3	Size	
4	Material for Armour	
F	Outer Sheath/Overall Covering	
1	Standard Applicable	
2	Material (type)	
3	Whether extruded	
4	Minimum average thickness	

5	Whether anti-termite treatment has been given in the outer sheath	
6	Whether flame retardant low smoke compound added in the outer sheath	
G	Electrical Properties	
1	Maximum DC Resistance of conductor at 20 deg Celsius in ohms/km	
2	Maximum DC Resistance of armour at 20 deg Celsius in ohms/km	
3	Maximum Permissible conductor temperature	
	Under continuous full load	
	Under transient conditions	
4	Loss Tangent at normal frequency	
5	Reactance at maximum operating temperature 50 Hz (ohm/km)	
6	Capacitance at maximum operating temperature 50	
	Hz (ohm/km)	
7	Total Impedance at maximum operating temperature 50 Hz (ohm/km)	
8	Recommended continuous current rating	
	In Ground at 30 deg C Ground Temperature (A)	
	In Trench/Ducts at 40 deg C (A)	
	In Air at 40 deg C ambient Temperature (A)	
9	Short Ckt Current Rating for 1 sec duration (in KA)	
	Conductor	
	Armour	
10	Minimum volume Resistivity of insulation	
	At 27 °C in Ohm cm	
	At Max operating temperature in Ohm-cm	
11	Approximate AC resistance at max. Operating temperature	

	Phase	
	Neutral	
H	Mechanical Data	
1	Overall Dia of the cable	
2	Dia of the cable under the sheath	
3	Diameter under armour	
4	Diameter over the stranded cores	
5	Wight of cable per km.	
6	Drum length	
7	Tolerance on drum length	
8	Total weight of the drum	
9	Dimension of the drum	
10	Recommended minimum installation radius/ bending radius	
11	Maximum safe pulling force	
12	Whether identification as per clause of the specification is being provided	
13	Whether packing has been done as per clause of the specification	

PURCHASER'S REQUIREMENTS

2.1.0 SCOPE OF WORK:

- 2.1.1 This section of the specification deals with the technical information & criteria for 33kV 400 Sqmm XLPE cable. The Contractor's proposal shall be based on the use of materials complying fully with the requirements specified herein. The work involves design, engineering, manufacture, assembly, inspection, testing at manufacturer's works before dispatch, packing, supply, including insurance during transit, delivery at site of various equipment and materials including substation steel structures as specified in subsequent Clauses and Sections.
- 2.1.2 It is not the intent to specify completely herein all details of design and construction of the equipment and accessories. However, the equipment and accessories shall conform in all respects to high standards of engineering, design and workmanship and be capable of performing in continuous operation up to the bidder's guarantees in a manner acceptable to the Purchaser. The Purchaser will interpret the meaning of drawings and specifications and shall be entitled to reject any work or material, which in his judgment is not in full accordance therewith.
- 2.1.3 The various items of supply are described very briefly in the schedule of Bid Form, Prices & Other Schedules and annexure. The various items as defined in these schedules shall be read in conjunction with the corresponding section in the technical specifications including amendments and, additions if any.

2.2.0 CONTRACTOR TO INFORM HIMSELF FULLY

- 2.2.1 The contractor should admit that he has examined the general condition of contract, specifications and schedule and has satisfied as to all the conditions and circumstances affecting the contract prices and fixed his price according to his own views on these matters and acknowledge that no additional allowances except as otherwise provided therein will be levied. The purchaser shall not be responsible for any misunderstanding or incorrect information obtained by the contractor other than information given to the contractor in writing by the purchaser.

2.3.0 STANDARDS

- 2.3.1 The equipment covered under this bidding document shall, unless otherwise stated be designed, constructed and tested in accordance with the latest revisions of relevant Indian Standards and shall conform to the regulations of local statutory authorities. In case of any conflict between the standards and this specification, this specification shall govern.
- 2.3.2 Equipment conforming to other international or authoritative Standards which ensure equivalent or better performance than that specified under Clause 2.18.0.0 above shall also be accepted. In that case relevant extracts of the same shall be forwarded with the bid.

2.4.0 ENGINEERING DATA

- 2.4.1 The furnishing of engineering data by the Contractor shall be in accordance with the Bidding Document. The review of these data by the Employer will cover only general conformance of the data to the specifications and not a thorough review of all dimensions, quantities and details of the materials, or items indicated or the accuracy of the information submitted. This review by the Employer shall not be considered by the Contractor, as limiting any of his responsibilities and liabilities for mistakes and deviations from the requirements, specified under these specifications.
- 2.4.2 All engineering data submitted by the Bidder after final process including review and approval by the Employer shall form part of the Contract Document and the entire works performed under these specifications shall be performed in strict conformity, unless otherwise expressly requested by AEGCL in Writing.

2.5.0 DRAWINGS AND DOCUMENTS FOR APPROVAL

- 2.5.1. All necessary drawings and documents required for completion of the project is to be submitted by the contractor for approval. The drawings provided with bid (if any) are for indicative purpose only and fresh drawings are to be prepared by the contractor as per actual site condition after survey. The drawings and documents are to be approved by AEGCL before procurement or commencement of work.

- 2.5.2 All drawings submitted by the Contractor including those submitted at the time of Bid shall be with sufficient detail to indicate the type, size, arrangement, dimensions, material description, Bill of Materials, weight of each component break-up for packing and shipment, fixing arrangement required, the dimensions required for installation and any other information specifically requested in these specifications.
- 2.5.3 Each drawing submitted by the Contractor shall be clearly marked with the name of the Employer, the specification title, the specification number and the name of the Project. All titles, noting, markings and writings on the drawing shall be in English. All the dimensions should be to the scale and in S.I. units.
- 2.5.4 **The Bidder shall submit 4(four) sets of drawings/ design documents/ data/ test reports as may be required for the approval of AEGCL.** One print of such drawings shall be returned to the Contractor by the Employer marked "approved/approved with corrections". The contractor shall there upon furnish the Employer additional prints as may be required along with one reproducible in original of the drawings after incorporating all corrections.
- 2.5.5 The Contractor shall perform the work strictly in accordance with these drawings and no deviation shall be permitted without the written approval of the Employer, if so required.
- 2.5.6 All manufacturing, fabrication and erection work under the scope of Contractor prior to the approval of the drawings shall be at the Contractor's risk. The contractor may make any changes in the design which are necessary to conform to the provisions and intent of the contractor and such changes will again be subject to approval by the Employer.
- 2.5.7 The approval of the documents and drawings by the Employer shall mean that the Employer is satisfied that:
- a) The Contractor has completed the part of the Works covered by the subject document (i.e. confirmation of progress of work).
 - b) The Works appear to comply with requirements of Specifications.
- 2.5.8 In no case the approval by the Employer of any document does imply compliance with neither all technical requirements nor the absence of errors in such documents. If errors are discovered any time during the validity of the contract, then the Contractor shall be responsible of their consequences.
- 2.5.9 For equipment and items in the scope of supply, the bidder has to submit
- a) General arrangement drawing with full dimensions.

All Designs/Drawings/Calculations/Data submitted by the contractor, from time to time shall become the property of the Employer and Employer has the right to use or replicate such designs for future contracts / works without the permission of the Contractor. The Employer has all rights to use/ offer above designs/drawings/data sheets to any other authority without prior Permission of the Contractor.

2.6.0 FINAL DRAWINGS AND DOCUMENTS

- 2.6.1 The successful Contractor shall require to provide following drawings and documents in printed form:
- a) All approved drawings (AS BUILD) of equipment in three (3) copies.
 - b) Copies of routine test reports (in triplicate) of relevant equipment.
 - c) Final Guaranteed and Other technical particulars of relevant equipment.
 - d) In addition to the above the Contractor shall provide four (4) sets of all the drawings and documents to Employer in printed form for his reference and record.

2.7.0 QUALITY ASSURANCE, INSPECTION & TESTING

- 2.7.1 To ensure that the supply and services under the scope of this Contract whether manufactured or performed within the Contractor's works or at his Sub Contractor's premises or at site or at any other place of work are in, accordance with the specifications, the Contractor shall adopt suitable quality assurance programme to control such activities at all points necessary. Such programme shall be outlined by the Contractor and shall be finally accepted by the Employer after discussions before the award of Contract.
- 2.7.2 The Quality plan shall be mutually discussed and approved by the Employer after incorporating necessary corrections by the Contractor as may be required.

2.8.0 QUALITY ASSURANCE DOCUMENTS

- 2.8.1 The Contractor shall be required to submit all the Quality Assurance Documents as stipulated in the Quality Plan at the time of Employers inspection of equipment/material.
- 2.8.2 The Employer or his duly authorized representatives reserves the right to carry out Quality Audit and quality surveillance of the systems and procedures of the Contractors/his vendors Quality Management and Control Activities.

2.9.0 EMPLOYER'S SUPERVISION

- 2.9.1 To eliminate delays and avoid disputes and litigation it is agreed between the parties to the Contract that all matters and questions shall be resolved in accordance with the provisions of this document.
- 2.9.2 The manufacturing of the product shall be carried out in accordance with the specifications. The scope of the duties of the Employer, pursuant to the contract, will include but not be limited to the following:-
- a) Interpretation of all the terms and conditions of these Documents and Specifications.
 - b) Review and interpretation of all the Contractors drawings, engineering data etc.
 - c) Witness or authorize his representative to witness tests at the manufacturer's works or at site, or at any place where work is performed under the contract.
 - d) Inspect, accept or reject any equipment, material and work under the Contract, in accordance with the Specifications.
 - e) Issue certificate of acceptance and/or progressive payment and final payment certificate.
 - f) Review and suggest modification and improvement in completion schedules from time to time, and
 - g) Supervise the Quality Assurance Programme implementation at all stages of the works.

2.10.0 INSPECTION AND INSPECTION CERTIFICATE

- 2.10.1 The Employer, his duly authorized representative and/or outside inspection agency acting on behalf of the Employer shall have, at all reasonable times, access to the premises and works of the Contractor and their sub-contractor(s)/sub-vendors and shall have the right, at the reasonable times, to inspect and examine the materials and workmanship of the product during its manufacture.
- 2.10.2 All routine and acceptance tests whether at the premises or works of, the Contractor or of any Sub-Contractor, the Contractor except where otherwise specified shall carry out such tests free of charge. Items such as labour, materials, electricity, fuel, water, stores apparatus and instruments as may be reasonably demanded by the Employer/inspector or his authorized representative to carry out effectively such tests in accordance with the Contract shall be provided by the Contractor free of charge.
- 2.10.3 If desired by the Employer, the Contractor shall also carry out type tests as per applicable Standards for which Employer shall bear the expenses except in cases where such tests have to be carried out in pursuance to **Clause 3.13.3**. The Contractor is required to quote unit rates of type test charges in a separate Schedule (if such schedule is provided in the Bidding Document) in pursuance to this Clause. However, these type test charges shall not be taken into account in comparing Price Bid.
- 2.10.4 The inspection by Employer and issue of Inspection Certificate thereon shall in no way limit the liabilities and responsibilities of the Contractor in respect of the agreed Quality Assurance Programme forming a part of the Contract.

2.11.0 TESTS

- 2.11.1 The type, acceptance and routine tests and tests during manufacture to be carried-out on the material and equipment shall mean as follows:
- a) Type Tests shall mean those tests, which are to be carried out to prove the process of manufacture and general conformity of the material to this Specification. These tests shall be carried out on samples prior to commencement of commercial production against the order. The Bidder shall indicate his schedule for carrying out these tests.
 - b) Acceptance Tests shall mean those tests, which are to be carried out on samples taken from each lot offered for pre-dispatch inspection, for the purposes of acceptance of that lot.
 - c) Routine Tests shall mean those tests, which are to be carried out on the material to check requirements, which are likely to vary during production.

- d) Tests during Manufacture shall mean those tests, which are to be carried out during the process of manufacture and end inspection by the Contractor to ensure the desired quality of the end product to be supplied by him.
 - e) The norms and procedure of sampling for these tests will be as per the Quality Assurance Programme to be mutually agreed to by the Contractor and the Employer.
- 2.11.1 The standards and norms to which these tests will be carried out are specified in subsequent Sections of this Specification. Where a particular test is a specific requirement of this Specification, the norms and procedure of the test shall be as specified or as mutually agreed to between the Contractor and the Employer in the Quality Assurance Programme.
- 2.11.2 For all type and acceptance tests, the acceptance values shall be the values specified in this Specification or guaranteed by the Bidder or applicable Standards, as applicable.
- All routine and acceptance tests shall be conducted as per IEC60840/IEC62067. All type tests conducted during last five years from the date of NIT as per IEC 60840/ IEC 62067 including its amendments on the XLPE insulated HT cable should be submitted. The diameter of test cylinder during bending test shall be as per IS:7098 (Part3) or the diameter of drum barrel to be used for dispatch of cables whichever is lower. For accessories type test reports should be submitted as per IEC 60840/ IEC 62067 & including amendments.
- Following additional type tests shall be carried out on outer sheath of XLPE insulated HT cable.
- a. Oxygen index and temperature index test as per ASTM D-2863.

All tests as prescribed in IEC-60840 shall be performed after installation of cable.

2.12.0 TYPE TEST REPORTS

- 2.13.1 Materials, which have never been tested for critical performance, shall not be accepted. In such cases, a promise or agreement by a bidder to have the equipment tested after award of a contract is not acceptable.
- 2.13.2 All Bids must be accompanied by the Type Test Certificates of materials offered (refer Clause 3.13.5 below). Such type test certificates shall be acceptable only if:-
- a) Tests are conducted in an independent testing laboratory with NABL accreditation, or
 - b) Tests are conducted in manufacturer's own laboratory.

In case of (a) the laboratory must have NABL accreditation; and

In case of (b) tests have been witnessed by technically qualified representatives of earlier clients or purchaser.

- 2.13.3 Test reports to be acceptable must be related directly to the equipment offered i.e. it is fully identical in design, rating and construction with the equipment for which the type test certificates have been submitted. Test reports for higher class (by capacity/voltage etc.) of equipment are acceptable with commitment to perform the type tests free of any charge on the particular equipment after the award of contract.

2.14.0 GUARANTEED TECHNICAL PARTICULARS

- 2.14.1 The Guaranteed Technical Particulars of the various items shall be furnished by the Bidders with the Technical Bid in the prescribed Schedules of the bidding document. The Bidder shall also furnish any other information's as in their opinion is needed to give full description and details to judge the item(s) offered by them.
- 3.14.2 The data furnished in Guaranteed Technical Particulars should be the minimum or maximum value (as per the requirement of the specification) required. A Bidder may guarantee a value more stringent than the specification requirement. However, for testing purpose or from performance point of view, the material shall be considered performed successfully if it achieves the minimum/maximum value required as per the technical specification. No preference whatsoever shall be given to the bidder offering better/more stringent values than those required as per specification except where stated otherwise.

2.15.0 MATERIALS HANDLING AND STORAGE

- 2.15.1 All the supplies under the Contract as well as Employer supplied items (if any) arriving at site shall be promptly received, unloaded and transported and stored in the stores by the Contractor.
- 2.15.2 Contractor shall be responsible for examining all the shipment and notify the Employer immediately of any damage, shortage, discrepancy etc. for the purpose of Employer's information only. The Contractor shall submit to the Employer every week a report detailing all the receipts during the week. However, the Contractor shall be solely

responsible for any shortages or damages in transit, handling and/or in storage and erection at site. Any demurrage, and other such charges claimed by the transporters, railways etc., shall be to the account of the Contractor.

- 2.15.3 The Contractor shall maintain an accurate and exhaustive record-detailing out the list of all items received by him for the purpose of erection and keep such record open for the inspection of the Employer.
- 2.15.4 All items shall be handled very carefully to prevent any damage or loss. The materials stored shall be properly protected to prevent damage. The materials from the store shall be moved to the actual location at the appropriate time so as to avoid damage of such materials at Site.
- 2.15.5 All the materials stored in the open or dusty location must be covered with suitable weather-proof and flameproof covering material wherever applicable.
- 2.15.6 The Contractor shall be responsible for making suitable indoor storage facilities, to store all items/materials, which require indoor storage.
- 2.15.7 The Contractor shall have total responsibility for all equipment and materials in his custody, stored, loose, semi-assembled and/or erected by him at site. The contractor shall make suitable security arrangements including employment of security personnel to ensure the protection of all materials, equipment and works from theft, fire, pilferage and any other damages and loss.

2.16.0 **STANDARD & CODES**

- 2.16.1 The works covered by the specification shall be designed, engineered, manufactured, tested and commissioned in accordance with the Standards as specified in the table below.
- 2.16.2 Other internationally accepted standards which ensure equivalent or better performance than that specified in the standards referred shall also be accepted. Copies of such standards shall be submitted by the bidder along with the bid.

IS 7098 : Part 2	Cross-linked polyethylene insulated thermoplastic sheathed cables: For working voltage 33KV
IS 8130 : 1984	Conductors for insulated electric cables and flexible cords
IS 5831 : 1984	PVC insulation and sheath of electric cables.
IS 1255 : 1983	Code of practice for installation and maintenance of power cables upto and
IS 3975 : 1999	Mild steel wires, formed wires and tapes for armouring of cables.
IS 5831 : 1984	PVC insulation and sheath of electric cables.
IS 6380 : 1984	Elastomeric insulation and sheath of electric cables.
IS 8130 : 1984	Conductors for insulated electric cables and flexible cords.
IS10418 : 1982	Drums for electric cables
IS 5 : 1994	Colours for ready mixed paints and enamels.
IS 617 : 1994	Aluminium and aluminium alloy ingots and castings for general engineering
IS 3043 : 1987	Code of practice for earthing.
IS 5578 : 1984	Guide for marking of insulated conductors.
IS 11353 : 1985	Guide for Uniform System of Marking and Identification of
IS 5216 : Part I : 1982	Recommendations on Safety Procedures and Practices in Electrical Work.
IS 2071 : 1993	High voltage test techniques.
IEC-60540	Power cables with extruded insulation and their accessories and cords
EC 60060 : 1989	High Voltage Test Techniques
IEC-60502	Extruded solid dielectric insulated power cables for rated voltages from 1KV
IEC-60754 : 1991	Tests on gases evolved during combustion of electric cables

IEC-60183 : 1990	Guide to the Selection of High Voltage Cables.
IEC-60230 : 1996	Impulse tests on cables and their accessories.
IEC-60840 / IEC- 62067	Testing
IEC-60287 : 1995	Calculation of the continuous current rating of cables (100%load factor).
IEC-60304 : 1982	Standard colours for insulation for low-frequency cable and wires
IEC-60331 : 1970	Fire resisting characteristics of Electric cables.
IEC-60332 : 1992	Tests on electric cables under fire conditions.
BS-5468	Cross-linked polyethylene insulation of electric cables
IEC-60228 : 1978	Conductors of insulated cables
IEC-60332 : 1993	Test on electric cables under fire conditions
IEC-60066	Environmental Test
IEC-60117	Graphical Symbols
IEC-60270 : 2000	Partial Discharge Measurements
CSA-Z299.1-1978h	Quality Assurance Program Requirements
CSA-Z299.2-1979h	Quality Control Program Requirements
CSA-Z299.3-1979h	Quality Verification Program Requirements
CSA-Z299.4-1979h	Inspection Program Requirements
ASTMD-2863	Measuring the minimum oxygen concentration to support candle like combustion of plastics (oxygen index)

2.17.0 COMPLIANCE WITH SPECIFICATION & DEVIATION:

- 2.17.1 Normally the offer should be as per Technical Specification without any deviation. But any deviation felt necessary to improve performance, efficiency and utility of equipment must be mentioned with reasons duly supported by documentary evidence. Such deviations suggested may or may not be accepted by the purchaser. As a mark of technical conformance, all sheets of the specification shall be furnished by each bidder with the signature and company seal affixed thereon.

2.18.0 CONSTRUCTION OF 33KV XLPE CABLE :

- 2.18.1 EC H4 grade aluminium conductor of class 2 shall be used as per IS 8130/1984 and any latest amendments to it. The shape of conductor shall be compacted, stranded, and circular/ sector shaped, shielded with conductor screen of black extruded semi-conducting compound, XLPE insulation, shielded with insulation screen of black extruded semi-conducting compound, black semi-conducting tape and metallic screen of copper tape, Inner sheath extruded PVC type ST2, single layer of strip/round steel, round hard drawn aluminium wire armoured and the outer sheath shall consist of Extruded black HDPE (TypeST7) grade conforming generally to IS:7098 (Part II). Cables used earlier or repaired after damaged shall not be accepted.
- 2.18.2 The construction of cable shall generally conform to the description mentioned above. Bidder may offer necessary layers such as separation tape, binder tapes etc additionally as per their manufacturing practices for meeting required performance of the offered cable. The bidder shall enclose with the bid, drawing showing cross section of the cable
- 2.18.3 The cable outer sheath is to be protected against rodent and termite attack.
- 2.18.4 The cables shall be designed to withstand all mechanical, electrical and thermal stresses under steady state and transient operating conditions.
- 2.18.5 Progressive sequential marking of the length of cable in meters at every one meter shall be provided on the outer sheath of the cable.
- 2.18.6 The cables shall have outer sheath of a material with an Oxygen Index of not less than 29 and a Temperature index

of not less than 250°C.

- 2.18.7 Allowable tolerance on the overall diameter of the cables shall be as per relevant IS/ IEC.

2.19.0 COMPOSITIONS OF CABLES

2.19.1 CONDUCTOR

The conductor shall be of EC H4 grade aluminium. The compacted circular conductor shall consist of segments wound up and then compacted. For the cable sizes having cross section over 400 sq.mm, the segmental compacted circular conductor having minimum four (4) segments should be constructed for the supply under the scope of bid. When the conductor's cross-section is less than 400 sq.mm, the compacted circular is applied generally.

2.19.2 CONDUCTOR SCREEN

The conductor screen shall consist of extruded semi-conducting material.

2.19.3 INSULATION

The insulation material shall be extruded cross-linked polyethylene for 33kV. In order to ensure that the screen and insulation are intimately bonded together and free from all possibilities of voids between layers, the conductor screen, the insulation and the insulation screen should be extruded simultaneously in one process in single cross-head. The extrusion process should be carried out under strictly controlled atmospheric conditions. The thickness of the insulation layer shall be uniform. The cross-linking process by N2 gas should be preferred instead of the conventional cross-linking process by saturated steam.

2.19.4 INSULATION SCREEN

The insulation screen shall consist of extruded semi-conducting compound. Suitable bedding tapes shall be applied over the extruded semi-conducting screen.

2.19.5 MOISTURE BARRIER

The longitudinal water barrier shall be applied over insulation screen by a layer of non-woven synthetic tape with suitable water swellable absorbent.

2.19.6 METALLIC SCREEN:

The metallic screen shall be of copper wire as per IS. The metallic screen shall be designed to meet the requirement of the system short circuit rating of 31.5KA for 3 sec (for 33KV).

2.19.7 ARMOURING

- a. The armouring shall be of non-magnetic material.
- b. The armour wires shall be applied as closely as practicable the direction of lay of the armour shall be left hand. For double wires armoured cables, this requirement shall apply to the inner layer of wires.
- c. A binder tape may be applied on the armour.
- d. The joints in armour wires of strips shall be made by brazing and the surface irregularities shall be removed. A joint in any wire shall be at least 300 mm from the nearest joint in any other armour wire in the completed cable, Number of joint in a single wire to be limited.

2.19.8 OUTER SHEATH

The outer sheath shall consist of Extruded black HDPE (TypeST7) grade. The outer sheath shall be designed for protection against termite and rodent attack and shall be coated with graphite.

2.19.9 RATING

The bidder shall declare current rating of cable for maximum conductor temperature of 90 degree C under continuous operation. A complete set of calculation made in arriving at the current rating shall be furnished for laying condition and cable sheath bonding system adopted. Short circuit temperature shall be limited to 250 degree C.

2.20.0 CABLE DRUMS

- 2.20.1 Cables shall be supplied in steel drums of heavy construction of suitable size and packed conforming to IS 10418 or applicable internationally accepted standards.

- 2.20.2 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 stenciled on both sides of drum. A tag containing the same

information shall be attached to the leading end of the cable. A narrow and suitable accompanying wording shall be marked on one end of the reel indicating the direction in which it should be rolled.

- 2.20.3 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 hermetically sealed by means of water blocking compound followed by heat shrinkable caps totally coated inside with mastic so as to prevent to cable for moisture penetration during transit, storage and laying. Direction of rolling shall be marked on the drum.
- 2.20.4 The bidder shall consider supply of cable on returnable drums basis. Contractor shall take back all the cable drums from site after successful laying, testing and commissioning of cables. If any length of cable remains unused, the same shall be adjusted by AEGCL.

2.21.0 TECHNICAL PARTICULARS FOR 33 KV SINGLE CORE XLPE CABLE

Sl.No.	Particulars	Details
1	Description of Cable	ARMOURING: ARMoured CORE MATERIAL: ALUMINIUM INSULATION: XLPE NOMINAL AREA: 400 SQ.MM. NO.OF CORE: Single Core SHEATHING MATERIAL: EXTRUDED PVC, INNER & OUTER VOLTAGE GRADE: 33KV
2	Highest system voltage	36 KV
3	Voltage Grade	19/ 33KV
4	Earthing System	Effectively earthed
5	Frequency	50 Hz
6	Size of Cable	400 sqmm
	No. of Core	1C
7	Rated Power Frequency Withstand Voltage (1 min)	70 KV (rms)
8	Impulse withstand BIL (1.2/ 50/ micro Sec) Line to earth	±170 kVp
9	Rated short time withstand current	31.5 KA (rms) for 3 sec
10	Rated peak withstand current (1 sec)	78.75 kVp
11	No of phase per Ckt	3
12	Maxm.Conductor temp	90 degree C at maxm. continuous current
13	Maxm. Permissible short circuit Temperature	250 degree C for one second
14	End Sealing	H.S. Caps
15	CABLE DETAILS : CONDUCTORS	
i	Conductor material	EC (H4) GRADE Aluminium
ii	Conductor Shape	Compacted circular.
iii	Conductor Screen	Extruded, Cross-linked, semi conducting compound of suitable thickness. Semi conducting separator tapes with 50% overlap to be applied between conductor and conductor screen.
iv	Resistivity of the semiconducting screen	Maximum 1000 ohm-meter
16	INSULATION	
i	Insulation material	XLPE
ii	Insulation thickness	8.8 mm (Nominal thickness)
iii	specified insulation resistance at 90°C	1x10 ¹² ohm cm
iv	Insulation Screen: Type & Material	Freely strippable (with heat) type extruded non-metallic semi conducting compound followed by copper metallic tape with minimum 25 % overlapping.
16	Resistivity of the semiconducting compound	Max 500 Ohm-meter
17	Longitudinal water barrier Material	Layer of semiconducting tape with suitable water swellable absorbent with 50% overlap.
18	Overall sheath	Extruded black HDPE (TypeST7) with anti-termite and anti-rodent treatment.
19	Coating of outer sheath	A hard baked layer of graphite or semi conducting layer shall be applied over the outer sheath as outer electrode for testing the sheath.
	Armouring	Armoured
20	TESTS	
i	Type Test	All tests as per specifications IEC Standards.
ii	Routine Test	All tests as per specifications IEC Standards.
iii	Acceptance Test	All tests as per specifications IEC Standards.
iv	Whether test will be witnessed by purchaser or his representative	Yes. Acceptance test will be witnessed.
21	Bending Radius	The minimum bending radius of XLPE insulated cables as follows: Cable: Bending radius Single Core: 25xD (D – diameter of overall conductor)

