

ODISHA POWER TRANSMISSION CORPORATION LIMITED



ODISHA POWER SECTOR EMERGENCY ASSISTANCE PROJECT

(PACKAGE – I, LOT – 2)

**Technical Specification
For 132kV UG Cable**

**TECHNICAL SPECIFICATION FOR 132 kV XLPE (CROSS LINKED POLYETHYLENE)
INSULATED POWER CABLE:**

1.1 SCOPE

1.1.1 The scope under this section covers design, manufacturer, testing, packing, supply, delivery and laying of 132kV XLPE, insulated power cable including integrated testing and commissioning, technical support, supervision of maintenance, training of Employer's staff and documentation for a complete System necessary to deliver the requirements of this Specification.

1.2 STANDARDS:

Unless otherwise specified, the cables shall conform, in all respects, to IEC-60840 and IS:7098 (Part-III)/1993 with latest amendment or latest edition for cross linked polyethylene insulated PVC sheathed cable for working voltage of 132 kV.

The following standard specifications of latest version updated to as on date of opening of this bid document will govern supply, laying testing and commissioning of cables and their accessories that are being used in this Contract. In case of conflict between such codes and/ or standards and the specification, the specifications shall govern.

Sr. No	Title of Specification	Specification No.
1	Cross linked polyethylene insulated Thermoplastic sheathed cables	IEC: 60502-2 IEC: 60840, IEC: 62067
2	Conductors for insulated cables.	IEC : 60228
3	Test on cable over Sheath which have a special protective function and are applied by extrusion	IEC 60229
4	HDPE pipes	BIS 4984
5	Power cables with extruded insulation and their accessories for rated voltage above 30 kV and up to 150 kV- Test Methods & requirements	IEC 60840

Sr. No	Title of Specification	Specification No.
6	Power Cables with extruded insulation and their accessories for rated voltages above 150kV.	IEC: 62067
7	Impulse test on cables & their accessories.	IEC 60230
8	Cyclic and emergency rating of cable	IEC 60852-2
9	Common test methods for insulating and sheathing material of electrical cables.	IEC 60811
10	Electric test methods for Electric cables – Test methods for Partial Discharge measurements on lengths of extruded power cables.	IEC 60885

1.3 PRINCIPAL PARAMETERS:

- 1.3.1 132 KV (E) grade XLPE single core power cable conductor electrolytic grade copper of single length, with formation of stranded compacted circular conductor for size up to 800 Sqmm and segmental type for size above 800mm² as per IEC-60228, tapped with semi conducting tap, shielded with extruded semi-conducting layer, insulated with dry gas cured cross linked polyethylene (XLPE) insulation, insulation screened with extruded semi- conducting layer, insulated core copper-wire, screened lapped with a combination of semi- conducting water swell able and poly aluminium laminated followed by black extruded PE (Poly-ethylene) inner sheath. Corrugated Aluminium armoured and black HDPE ST7 with graphite coating or extruded conductive layer overall cable, confirming to IEC-standards for construction and also confirming to IS:7098 (Part-III)/1993 or any latest amendments thereof.
- 1.3.2 Outer sheathing should be designed to afford high degree of mechanical protection and should also be heat, oil chemicals and weather resistant.
- 1.3.3 The cable should be suitable for laying in covered trenches and/or underground for outdoor
- 1.3.4 The sheath/screen bonding system shall provide a continuous current path through the cable sheath and jointing kits and shall be bonded. The bonding ends shall be suitably earthed with/without SVL as per approved configuration/design. The sheath voltage under full load condition shall not exceed the voltage specified/allowed in relevant standard for safety of personal as well as satisfactory working of cable. Sheath shall be solidly grounded at suitable location with or without SVL. Bidder must indicate details of configuration proposed along with sufficiency calculation with the bid

so as to limit induced voltage of sheath within 65V.

1.3.5 CABLE PARAMETERS

Sr. No.	System Particulars	132kV
i)	Voltage Grade (Uo/U)	76/132
ii)	No. of Cores	Single
iii)	Size (mm ²)	630mm ² , 800mm ² ,1000mm ² , 1200 mm ²
iv)	Nominal system voltage KV	132
v)	Highest system voltage KV	145
vi)	System Frequency Hz	50
vii)	Variation in Frequency	+ 3%
viii)	Fault level individually for i) Conductor ii) Cu. Screen/Armour	31.5 KA for1sec 31.5 KA for 1sec
ix)	Maximum allowable temperature	
	a) Design continuous operation at rated full load current, the max, temp. of conductor shall not exceed. °C	90
	b) The conductor temperature after a short circuit for 1.0 sec shall not exceed. °C	250
x)	Basic insulation level (1.2/50 Micro Second Wave)	625 KVP
xi)	1-min. power frequency withstand voltage (rms)	275 KV
xii)	System earthing	Effectively earthed

1.4 OPERATION CHARACTERISTICS:

- One/Two Three-phase feeders, each consisting of 1 runs of 4 Single core cables, feed power at 132 kV
- In normal situation, each cable will have to be designed to carry a continuous current, to deliver a rated power of Transformers and its designed overload.
- The cable should be designed for a suitable current carrying capacity under normal situation, and which will cater for the above overload capabilities also, will be required.

1.5 GENERAL TECHNICAL REQUIREMENTS:

1.5.1 CONDUCTOR:

The cable conductor shall be made from electrolytic grade copper with formation as stranded compacted circular conductor for size upto 800 sqmm and segmental type as

per IEC-60228 for the size above 800mm². The conductor shall confirm to IS:8130/1984.

1.5.2 CONDUCTOR SCREEN:

A Conductor screen made of semiconducting compound shall be provided over the conductor, by extrusion. The extruded coat shall be continuous, with a constant mean depth, without bump, perfectly adhering to the insulation envelope. A semiconducting tape(s) shall be provided below the extruded semi-conducting conductor screen to prevent penetration of the compound into the underlying conductor. The conductor having a semi-conducting screen shall ensure perfectly smooth profile and avoid stress concentration. The conductor screen shall be extruded in the same operation as the insulation; the semi-conducting polymer shall be cross-linked. Minimum thickness of the conductor screen shall be 0.55 mm. The electric resistivity of the conductor screen shall not be more than 5000 Ω cm at 20°C and not more than 25000 Ω cm at the working rated temperature.

1.5.3 INSULATION:

The Insulation envelope shall be of cross-linked polyethylene (XLPE) insulation applied by extrusion should be suitable for 132kV system voltage. The nominal thickness of insulation shall not be less than 11 mm, subject to tolerances as per IEC 60840. The manufacturing process shall ensure that the Insulation shall be applied by extrusion and vulcanized using dry curing process to form a compact homogenous body free from micro voids and contaminants. The insulation compound shall be of high quality, heat, moisture, ozone and corona resistant. The insulation shall withstand mechanical and thermal stressed under steady state and transient operating conditions. The extrusion method should give very smooth interface between semi-conducting screen and insulation.

1.5.3.1 The voltage gradient in the rated working conditions shall be

- a) equal to or less than 6kV/mm at the level of internal semiconductor.
- b) Equal to or less than 3kV/mm at the level of external semiconductor

1.5.3.2 The mechanical characteristics shall be as follow:

- a) In delivery condition:
 - 1) minimal traction resistance : 12.5 Mpa
 - 2) minimal elongation before breaking : 200%
- b) After ageing of 240 h at 135°C:
 - 1. maximal variation of traction resistance : \square 25%
 - 2. maximal variation of elongation before breaking : \square 25%

1.5.3.3 The isolating envelope shall comply with the hot condition elongation test:

- a) temperature : (200)°C
- b) on load duration : 15 minutes
- c) mechanical constraint : 0.2 Mpa

- d) maximal elongation on load : 100%
- e) maximal elongation after cooling : 15%

1.5.4 INSULATION SCREEN:

To confine electrical field to the insulation, non-magnetic semi- conducting shield shall be put over the insulation. The insulation shield shall be extruded in the same operation as the conductor shield and the insulation by suitable extrusion process (triple extrusion). The XLPE insulation shield should be bonded type. Metallic screening shall be provided. The metallic screen shall be of copper wire having fault current capacity same as the conductor (31.5KA for 1-sec).

1.5.4 INNER SHEATH:

The inner sheath shall comprise of a combination of semi-conducting water swell able and ploy aluminium laminated tape. The tape shall be applied over the extruded insulation screening to block and prevent moisture propagation in a longitudinal direction. The sheath shall be suitable to withstand the site conditions and the desired temperature. It should be of adequate thickness, consistent quality and free from all defects. The sheath shall be extruded and of black P.E. (Poly-ethylene).

1.5.6 ARMOUR:

Metallic sheath shall be either of Corrugated Aluminum sheath or Corrugated Copper. The dimension of armoring shall be as per latest IS:3975/19988, IEC-60840. The armour shall be having fault current same as capacity conductor (31.5KA for 1 sec.)

In the case of metallic sheath of Corrugated Aluminum or Copper sheath the bidder shall submit the calculation of area of aluminium or copper sheath in this support.

1.5.6.1 BEDDING TAPE

The bedding shall be anti corrosive layer of Bitumen compound.

1.5.7 OUTER SHEATH:

The outer sheath shall be extruded red/yellow/blue colour or similar (as per phase). Suitable semi conducting layer coated on black HDPE ST7 with graphite coating or extruded conductive layer confirming to IEC: 60840, shall be applied over armoring with suitable additives to prevent attach by rodents and termites. The outer sheath should have embossing at every one meter for Supplier Name, manufacturer name, DMRC, Voltage grade etc.

5.7.1 The Mechanical Characteristics shall be as follow :

- c) - In delivery condition
 - 1) - minimal traction resistance : 12.5 Mpa
 - 2) - minimal elongation before breaking : 200%
- d) - After ageing of 240 h at 135°C:
 - 1) - traction resistance:
 - 2) - minimum value : 12.5MPa

- 3) - maximum variation : $\pm 25\%$
- 4) - elongation before breaking:
- 5) - minimum value : 200%
- 6) - maximum variation : 25%

5.7.2 The variation is the difference between the medium value obtained after ageing and the medium value without ageing, expressed in percentage of the last.

1.5.8 CONSTRUCTION:

1.5.8.1 All materials used in the manufacture of cable shall be new unused and of finest quality. All materials should comply with the applicable provision of the tests of the specification. IS, IEC, Indian Electricity Rules, Indian Electricity Act and any other applicable statutory provisions rules and regulations.

1.5.9 CURRENT RATING:

The cable will have current ratings and de-rating factors as per relevant standard IEC.

1.5.9.1 The one-second short circuit rating values each for conductor, screen & armour shall be furnished and shall be subject to the purchaser's approval.

1.5.9.2 The current ratings shall be based on maximum conductor temperature of 90 deg. C with ambient site condition specified for continuous operation at the rated current.

1.5.9.3 SIZE:

The different sizes of cable shall be 132 kV Single Core

- a) **630mm²**
- b) **800mm²**
- c) 1000mm²
- d) 1200mm²

1.5.10 OPERATION:

1.5.10.1 Cables shall be capable of satisfactory operation under a power supply system frequency variation of plus minus 3% voltage variation of plus, minus 10% and combined frequency voltage variation of 10% (absolute sum).

1.5.10.2 Cable shall be suitable for laying in ducts or buried under ground.

1.5.10.3 Cable shall have heat and moisture resistance properties. These shall be of type and design with proven record on transmission network service.

1.5.11 LENGTHS: The cable shall be supplied in standard drum lengths as

below: **Size of cable**

Standard Drum Length

a) Single Core, 630mm², 800mm²,

750 meters $\pm 5\%$ tolerance and

1000mm², 1200 mm²

$\pm 2\%$ overall tolerance in total quantity of cable.

1.5.11 IDENTIFICATION MARKING:

Identification of cables shall be provided externally at three meters' intervals to identify as under:-

- i) 'Name of Manufacture'
- ii) 'Year of manufacture'
- iii) 'Voltage grade' to be printed/embossed at the interval of one meter-length. The identification, by printing or embossing shall be done only on the outer sheath. Name of purchaser shall also be embossed.

1.6.0 TESTS

1.6.1 Type Tests

The equipment offered should be type tested. Type test report should not be more than seven years old, reckoned from the date of bid opening, in respect of the following tests,

carried out in accordance with ISS-7098/IEC-871, from Govt./Govt. approved test house, shall be submitted along with bid:

- i) Physical tests for insulation and outer sheath.
- ii) Bending test.
- iii) Di-electrical power factor test.
- iv) Heating cycle test followed by di-electrical power factor as a function of voltage and partial discharge test.
- v) Impulse withstand test.

The remaining type test report as per clause 3 of ISS-7098/ IEC-871/ IEC-60840 shall be submitted by the successful bidder within three months from the date of placement of order. These type test reports shall be from Govt./Govt. approved test house and shall not be more than five years old, reckoned from the date of placement of order. The failure to do so will be considered as a breach of contract.

1.6.2 ROUTINE TESTS AND ACCEPTANCE TESTS

All routine and acceptance tests shall be carried as per relevant ISS in the presence of Employer's representative

1.7 INSPECTION

The material shall be inspected and tested before dispatch by an authorised representative of the Owner in respect of quality. The inspecting officer shall also satisfy himself about the correctness of length of cables. In case the supplier is not in a position to get these tests carried out at his works, such tests may be got carried out by him at any Govt. recognized test agency at his own expense.

1.8 TEST CERTIFICATES

The supplier shall supply test certificates from a Govt. agency in respect of quality as per IS:7098(part-II) 1985 with latest amendments thereof for approval of the purchaser.

1.9 PACKING

The cable shall be supplied in non-returnable wooden drum as per IS:10418:1982 so constructed, as to enable the cable to be transported on each drum. The cable wound on such drum shall be one continuous length. The ends of cables shall be sealed by means of non-hygroscopic sealing material.

1.10 MARKING

The marking on the drum shall have the following information: -

- a) Reference to Indian Standard & cable code.
- b) Name of the manufacturer & trade name.
- c) Nominal cross section area of conductor for the cables.
- d) Number of core.
- e) Sequential No. at each meter.
- f) Type of the cable & voltage for which it is suitable.
- g) Length of cable on the drum.
- h) Approximate gross weight.
- i) Net weight of the cable.
- j) Drum identification number.
- k) P.O. No. and date.
- l) Consignee's name with designation.
- m) Year of manufacture.

1.11 DRAWINGS & INSTRUCTION MANUAL

The tenderer shall supply the following drawings with the tender: -

- i) Detailed drawing of the cable showing conductor, screening insulation, Armouring, outer sheath etc.
- ii) Detailed drawing showing jointing of cable and sealing of end boxes.

Copies of instruction manuals for testing, installation jointing operation and maintenance of cables shall also be submitted with the offer for reference of the purchaser.

1.12 TECHNICAL & GUARANTEED PARTICULARS:

The tenderer shall furnish guaranteed technical particulars as per the tender specification. Particulars, which are subject to guarantee, shall be clearly marked. Offer not containing this information will not be considered.

1.13 TERMINATION KITS AND STRAIGHT THROUGH JOINTS

The entire necessary Straight through joints and Sealing Ends for 132 kV shall be supplied and erected. The Straight through joints and Sealing Ends wherever required shall be Heat Shrink Type or equivalent, of reputed make with shear head type mechanical connectors or cold shrink type of proven technology & make.

1.14 ISO Accreditation

The cable shall be manufactured by a company having ISO accreditation for quality. The manufacturing process of XLPE cable shall consist of conductor screen, insulation & insulation screen shall be extruded in a single process.(triple extrusion) and cross linked by VCV Process (Vertical Continuous Vulcanization process) dry curing technology to ensure homogeneity and absence of micro voids. The cables shall be manufactured by "Dry Curing" Process. It is mandatory that bidder should submit Plant Installation Certificate for VCV Line and for Metallic sheath machineries indicating the year of installation and other details along with bid

The Employer may decide to visit the works of cable manufacturer to confirm the manufacturing process mentioned.

PART II

TECHNICAL SPECIFICATION FOR LAYING, TESTING AND COMMISSIONING OF 132kV XLPE UNDERGROUND POWER CABLE

SECTION-1 SPECIFICATION FOR LAYING OF CABLE

1.1 GENERAL

1.1.2 The Cable Laying works shall be executed according to the rules of the Art pertaining to professional grade and generally in compliance with International Standards and Indian Standards.

1.1.3 The EHV Cables between the Power Supply Authorities Substation and the DMRC RSS shall be laid in ground depending upon the site conditions of the selected route, any of the following paying conditions, may be adopted.

1.1.4 Cable Laying Cases

- Case 1 - Direct buried, with all cables laid in flat formation.
- Case 2 – Direct buried, with the cables (3) of each circuit laid in trefoil formation and side by side in one trench.
- Case 3 – Laid in underground duct.
- Case 4 – Laid in Trench less piping.
- Case 5 – Laid in abutment crossing
- Case 6 – Laid in Rail Track crossing
- Case 7 – Laid in Air, supported on piers/walls, for nallah-crossing

1.1.5 Details of Case 2 :

The trench for carrying the cables shall be at least 1.8m deep and 1.1m wide, which may vary as per site conditions with the approval of employer. Each of the 2 feeders shall consist of 3 single-core cables, and laid in trefoil formation. Cables shall be laid at a depth of 1.7m below the ground level and over a 100 mm bed of coarse sand. Trench is to be filled with sand upto a depth of 1100mm below the ground level. Warning concrete slabs of at least 50mm thickness shall then be laid above the sand. Trench shall then be filled with earth upto a depth of 300 mm below the ground level. A warning net shall then be laid above the earth filling (at 300 mm depth below the ground level). A warning tape shall also be laid appropriately with Purchaser's Name marked on it. The top space of 300 mm shall be suitably filled with compacted Boulder and Bitumen/Jelly and given a final finish matching the surroundings. The cables shall be tied through locking belts after 2 meters each for keeping the cables intact in case of trefoil formation. At locations, where there is change of level of laying, the cables shall be tied through locking belts after 1 meter each.

1.1.6 Details of Case 3

In specific locations, the Employer may require the cables to be laid in underground ducts. The underground ducts shall be laid where road construction or formation is under construction or where water logging stretch is expected or as per the specific site condition.

1.1.7 Details of Case 4 & 6

On all road/rail crossings and at other specific locations, cable laying shall be through trenchless drilling and the cables shall be passed through High Density Polyethylene (HDPE) Pipes or G.I. Pipes of appropriate diameter and thickness (Case-4). One spare HDPE pipe shall be laid for each feeder of 3 cables at the road/rail crossings.

1.1.8 Details of Case 5 & 7

On all abutment crossing or in air, supported on piers/walls, for Nallah crossing and at other specific locations, cable laying shall be on the galvanized steel structures which can withstand wind velocity of 160kmph, supported on piers and have sufficient structural strength. The minimum average weight of zinc coating should be 1000g/m² (RDSO). The cables should be well protected by providing MS sheet of thickness 8mm at least fastened with nuts and bolts & tag welded on all sides to be protected from any pilferages. The arrangement shall render cable absolutely safe from any natural calamity. The cable shall not be exposed or get affected due to stray fire caused in the vicinity. Indicative arrangement is shown in the drawing.

1.1.9 Spare Cables and Pipes

When cables are laid in pipes, in addition to the pipes carrying the cables, at least one spare pipe (minimum 200 mm dia), without cable shall also be provided. In the case cables laid in underground ducts (Case 3) and cables laid in Trenchless piping (Case 4), spare HDPE pipes, one for each circuit, shall be provided. In addition to pipes for power cables, 2 additional pipes, each of not less than 100 mm dia, shall be provided to carry control and monitoring cables, one operational and one spare (As indicated in the Interfacing Requirements, other cables such as pilot wire for pilot wire protection, if required, copper-core or optic fibre cables for control and monitoring, tele-communication etc, supplied by other Suppliers.

1.1.10 Cable protection at changeover location

The cable path, when changing from buried in ground to underground duct or trenchless piping shall be adequately protected by proper sealing in concrete or other suitable means of sufficient mechanical strength to avoid cable from suffering damage due to heat/fire/water ingress etc.

1.1.11 Pulling Chambers

Pulling chambers shall be provided, as necessary, along the route. Such pulling chambers shall be 4m long, 3m wide and at least 2.5m deep. The masonry structure should be of adequate strength with water proofing to avoid any accumulation of seepage of water inside. The edges of RCC covers and masonry shall be lined in GI angles to achieve a long service life.

1.1.12 Route Markers

The route shall be appropriately marked by suitable retro-reflective cable markers, at suitable intervals and positions of straight through joints shall be indicated by suitable boards.

2.0.0 CABLE ACCESSORIES AND BONDING

2.1.0 Straight Through Joints

2.1.1 The straight through Joints should be HEAT SHRINKABLE type or cold shrink type of proven technology and make, suitable for underground buried cables. The joint should comprise of stress control sleeves, insulating sleeves and co-extruded dual wall Tubing comprising of an insulating and semi-conducting layer. A mechanical connector with shear head bolts shall make the conductor connection.

2.1.2 The product should be type tested as per IEC /KEMA specifications

2.1.3 GENERAL SPECIFICATIONS

- a. The product offered should be proven and should be in use in India for a minimum period of 5 years for the same voltage class. List of past supplies in India to be furnished. Performance certificates to be submitted along with the offer.
- b. The product offered should have unlimited shelf life.
- c. Offers should be supported with type test certificates from test laboratories of repute, as per IEC/ KEMA specifications, failing which the offers shall be ignored.

2.1.4 General Specifications for Joints and Terminations for 132 kV XLPE Cables

The Terminations (Outdoor Sealing ends) and Straight Through Joints for 132 kV cables shall be of 'Heat-shrinkable, " type or cold shrink type of proven technology and make, suitable for 132 kV (E) grade or higher, Single core 400 sq mm or higher, XLPE Insulated, Aluminium sheathed cables. The Indoor termination for use in the GIS Substation.

2.2.0 Bonding

2.2.1 Suitable bonding methods viz., Single End, Both End and Cross Bonding shall be used.

2.2.2 Link boxes with & without SVL shall be used as required.

3.0.0 TESTING AND INSPECTION

7.1.0.1.1 TYPE-TESTS

7.1.0.2 General

All the equipment which are used for this work shall be of proven design and standards to achieve a very high level of reliability in service. An equipment is considered to be proven if it is in successful operation at least for a period of two years. Irrespective of the fact that the summary of type test reports was submitted for 132kV (E) or higher grade Single core, XLPE insulated, Copper conductor Aluminium Sheathed cable along with the bid, the Supplier shall furnish a summary of type test reports for all the equipment listed below except those equipment which are yet to be type tested being under development within three (3) months period from the date of signing the contract.

7.1.0.3 Heat Shrinkable type or cold shrink type of proven technology and make straight through joint suitable for 132 kV (E) grade Single Core 400 sq. mm or above size XLPE insulated cable with Aluminum or Copper sheath.

7.1.0.4 Heat Shrinkable type or cold shrink type of proven technology and make cable terminations (indoor & outdoor) suitable for 132 kV (E) grade

7.1.0.5 The cable and cable accessories intended to be used for this work shall be

(i) Type-tested within the last ten (10) years period prior to the date of bid opening. (ii) Proven in service for at least two (2) years as on the date of bid opening.

7.1.0.6 Submission of Performance Certificates

As a proof of satisfactory performance of following equipments during last two years from the bidder /JV partner /sub Supplier from whom Bidder intends to supply them.

7.1.0.7 Heat shrinkable " type or cold shrink type of proven technology and make straight through joint suitable for 132 kV (E) grade or above grade, Single Core 400 sq. mm or above size XLPE insulated cable with Aluminum sheath.

7.1.0.8 Heat shrinkable " type or cold shrink type of proven technology and make cable terminations (indoor & outdoor) suitable for 132 kV (E) grade

7.1.1 Type Test Results

Summary of type test results of the above mentioned equipment will be in the following format:

Sl. No.	Equipment	Manufactured By	Rating	Governing specification for type test	Name of type test	Month/ Year conducted	Testing Lab/Testing House/In House	Result/ Remark

7.1.1.1 If the type tests of any equipment being supplied for this work are not yet conducted by the Supplier then all the type tests as per the relevant IEC shall be conducted at his expense in the presence of employer's representative either at manufacturer's works having requisite facilities and approved by independent laboratory like KEEMA, Netherland or CESI Italy, or at KEEMA, Netherlands or CESI, Milano, Italy.

7.1.1.2 Details of 'Make of Cables/Accessories

The bidder shall submit to the employer the proposed "make" of all the above equipment in the bid form along with other details such as rating, quantity in use, place of installation number of years in satisfactory operation, summary of type test reports of required rating of 132kV or higher grade, Aluminum/copper conductor, XLPE insulated, Aluminum or Copper sheath cable along with the bid so as to decide the 'make' of the items. Based on the information thus furnished the employer shall decide the 'make' of the items to be used for the work. The plant & equipment being supplied against this bid shall conform to relevant IEC standards.

7.1.1.3 Rejection of Type Test Report

When the Employer rejects any specific type test report for a particular equipment stating the grounds for such rejection, the Supplier shall re-conduct the relevant type tests as per the specification in the presence of Employer's representatives before the item is supplied by him. Such type test shall be conducted by the Supplier at his own expense at the manufacturer's works approved by KEMA Netherland or CESI Italy in the presence of Employer's

representative.

7.1.1.4 Type Test Reports

The type test reports of the equipment shall be of the tests carried out either at the manufacturer's works having requisite facilities or at KEEMA, Netherlands, CESI, Milano, Italy during the last ten (10) years period as on the date of bid opening. If any type test report is older than 10 years, the type tests will have to be repeated at Supplier's cost. Employer shall waive some of these tests in case of equipment / sub assemblies where the manufacturer can establish to the satisfaction of employer that such tests have already been carried out earlier or where the equipment have been proved in service. In such a case, manufacturer shall submit complete test reports along with necessary certification.

7.2.0 ROUTINE TESTS

Routine tests shall comprise of visual inspection of the items and all the routine tests as per specification. All these tests shall be conducted in the presence of Employer's nominated representative at the manufacturer's works. Routine test shall be carried out as per specification ICE 60840 latest version.

7.2.1.1 General

The following tests shall be carried out on each manufactured length of cable:

- a) Partial discharge test (see 5.2.2);
- b) Voltage test (see 5.2.3);
- c) Electrical test on over sheath of the cable, if required (see 5.2.4).

7.2.1.2 The order in which these tests are carried out is at the discretion of the manufacturer. The main insulation of each prefabricated necessary shall undergo partial discharge (see 5.2.2) and voltage (see 5.2.3) tests according to either 1), 2) or 3) below:

- 1) On accessories installed on cable;
- 2) By using a host accessory into which a component of an accessory is substituted for test;
- 3) By using a simulated accessory rig in which the electrical stress environment of a main insulation component is reproduced.

7.2.1.3 In cases 2) and 3), the test voltage shall be selected to obtain electrical stresses at least the same as those on the component in a complete accessory when subjected to the test voltages specified in 5.2.2 and 5.2.3

7.2.1.4 NOTE: The main insulation of prefabricated accessories consists of the components that come in direct contact with the cable insulation and are necessary to control the electric stress distribution in the accessory. Examples are pre-moulded or pre-cast elastomer or filled epoxy resin insulating components that may be used singly or jointly to provide the necessary insulation or screening of accessories.

7.2.1.5 Partial discharge test

The partial discharge test shall be carried out in accordance with IEC 60885-3 for cables, except that the sensitivity as defined in IEC 60885-3 shall be 10pC or better. Testing of accessories follows the same principles, but the sensitivity shall be 5pC or better. The test voltage shall be raised gradually to and held at $1.75 U_0$ for 10 s and then slowly reduced to $1.5 U_0$ There shall

be no detectable discharge exceeding the declared sensitivity from the test object at 1.5 U₀.

7.2.1.6 Voltage test

The voltage test shall be made at ambient temperature using an alternating test voltage at power frequency. The test voltage shall be raised gradually to 2.5 U₀) and then be held for 30 min between the conductor and metallic screen/sheath. No breakdown of the insulation shall occur 60840 @ IEC: 2004 Electrical test on over sheath of the cable When the test is required by the particular contract, the cable over sheath shall be subjected to the electrical test specified in Clause 3 of IEC 60229.

7.3.0 Acceptance tests

7.3.1 General

Acceptance tests for the power cable & its accessories shall be carried out wherever the same is mentioned in the relevant specification governing the cable and its accessories. All the acceptance tests as mentioned in the governing specification to which the product is manufactured shall be conducted in the presence of Employer's nominated representative by the Supplier at their manufacturing works. The following tests shall be carried out on samples which, for the tests in terms b) and g), may be drum lengths of cable, taken to represent batches:

- a) Conductor examination (see 5.3.4);
- b) Measurement of electrical resistance of conductor and of metallic screen (see 5.3.5);
- c) Measurement of thickness of insulation and over sheath
- d) Measurement of thickness of metallic sheath
- e) Measurement of diameters, if required
- f) Hot set test for XLPE, EPR and HEPR insulations Measurement of capacitance
- Measurement of density of HDPE insulation
- g) Water penetration test, if applicable
- h) Tests on components of cables with a longitudinally applied metal foil

7.3.2 Frequency of tests

The sample tests in items a) to h) of 5.3.1 shall be carried out on one length from each batch (manufacturing series) of the same type and cross-section of cable, but shall be limited to not more than 10% of the number of lengths in any contract, rounded to the nearest whole number. The frequency of the tests in items l) and j) of 5.3.1 shall be in accordance with agreed quality control procedures. In the absence of such an agreement, one test shall be made for contracts with a cable length above 20 km.

7.3.3 Repetition of tests

If the sample from any length selected for the tests falls in any of the tests in 5.3.1, further samples shall be taken from two further lengths of the same batch and subjected to the same tests as those in which the original sample failed. If both additional samples pass the tests, the other cables in the batch from which they were taken shall be regarded as having complied with the requirements of this standard. If either fail, this batch of cables shall be regarded as having failed to comply.

7.3.4 Conductor examination

Compliance with the requirements of IEC 60228 for conductor construction, or the declared construction, shall be checked by inspection and measurement when practicable. Measurement of electrical resistance of conductor and metallic screen The cable length, or a sample thereof, shall be placed in the test room, which shall be maintained at a reasonably constant temperature for at least 12 h before the test. If there is a doubt that the conductor or metallic screen temperature is not the same as the room temperature, the resistance shall be measure after the cable has been in the test room for 24 h. Alternatively, the resistance can be measured on a sample of conductor or metallic screen, conditioned for at least 1 h in a temperature controlled liquid bath.

7.3.5 Additional Acceptance Tests

The following additional acceptance tests shall be carried out.

1. Additional acceptance tests (1 sample/offered lot) shall be carried out for Ovality & Eccentricity.
2. Tensile strength and Elongation on insulation and over sheath before and after ageing and Thermal Stability on outer sheath of power cable.
3. finish and length measurement shall be carried on one length of each size of offered lot of power cables.

7.3.6 Short Circuit Test :

Short Circuit test for Power Cables will be conducted by the Supplier on the cable at Manufacturer's works having requisite facilities approved by KEMA Netherlands or CESI Italy or at KEEMA, Netherlands or CESI Milano, Italy & shall be witnessed by the Employer's authorized representative.

7.3.7 TEST CERTIFICATES

Three copies of the test certificates of successful type tests if any carried out on cables and cable accessories shall be furnished to the Employer within fifteen days after completion of such type tests. Three copies of successful acceptance & routine tests carried out on cables and cable accessories and the certificate of inspection issued by the Employer's representative shall be furnished within 15 days, after the completion of tests by the Employer's representative.

7.3.8 RESPONSIBILITY OF SUPPLIER FOR DELIVERY/SUPPLY

(a) All defects detected as a result of testing / inspection shall be rectified by the manufacturer at his own expense and shall be documented and corrected prior to shipment. If in opinion of Employer, a repeat of the test is required after such rectification, this shall also be carried out at the expense of the Supplier.

(b) No cable / accessory shall be supplied until Employer has inspected the same to his satisfaction and accepted. However, such inspection and/or acceptance certificate shall not relieve the Supplier of his responsibility for furnishing the cables and cable accessories conforming to the requirements of the contract nor prejudice any claim, right or privilege which the Employer may have because of the use of defective or unsatisfactory items. Should the Employer waive the right to inspect any item, such waiver shall be obtained by the Supplier from the Employer in writing and such a waiver shall not relieve the Supplier in anyway from his obligation under the contract.

(c) Only after obtaining clearance from the Employer, the Supplier shall despatch the items to

site.

7.3.9 INSPECTION OF ERECTION WORK

All erection work will be subject to inspection by the Employer or his representative to ensure that the work is done in accordance with the specification and approved drawing.

7.3.10 INSPECTION AND TESTS OF COMPLETELY LAID CABLE

7.3.10.1 General

As soon as the work is completed and ready for inspection and testing, the Supplier shall advise the Employer in writing. Tests will be carried out by the Employer jointly with the Supplier. Testing equipments and staff required for the tests shall be provided by the Supplier free of charge. The Supplier shall take full responsibility for these tests interalia his other responsibilities. The Supplier shall notify the manufacturer of cable and cable accessories regarding likely date of pre-commissioning tests, one month in advance so that their representative may be available at site at the time of conducting the tests. It shall be Supplier's responsibility to ensure that the cable and it's accessories are commissioned as per laid down procedures.

7.3.11 Pre commissioning Tests for the facility as a whole The following site tests shall be conducted on a completed power cable installation as per specification IEC 60840 latest version.

(i) Visual Inspection and Continuity Check Visual inspection shall include check for satisfactory workmanship Continuity check shall be carried out on the cable to ensure that the cable is continuous.

(ii) DC voltage test of the over sheath The test shall be conducted as per Clause 15.1 of IEC 60840.

(iii) AC voltage test for the installation. The test shall be conducted as per Clause 15.2 of IEC 60840.

(iv) the insulation resistance of the cable shall be checked before & after the HV test on cable. The core resistance shall be measured and the value corrected in accordance with clause 5 of IEC 60228.

(v) The cable must be discharged on completion of DC High Voltage Test and the cable shall be kept earthed until it is put into service. The values obtained during these tests shall be in conformity with the values obtained during inspection of the materials at the manufacturer's works.

7.3.12 PROFORMA FOR TESTS

The Supplier shall submit the results of tests in quadruplicate in an approved proforma within 7 days from the date of completion of the tests but before actual commissioning of the cable. The proforma shall be developed by the Supplier and got approved from Employer within three (3) months from the effective date of the contract.