# SUPPLY & LAYING OF 220 kV 1000/1200 sqmm XLPE UNDERGROUND CABLE WITH ASSOCIATED ACCESSORIES

## VOLUME - II

(220 kV 1000/1200 sqmm XLPE U/G CABLE)

## TECHNICAL SPECIFICATION

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## TECHNICAL SPECIFICATION FOR 220 KV XLPE CABLE

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## TECHNICAL SPECIFICATION

1.0 SCOPE: This specification provides for the establishment of an underground cable transmission scheme on total turnkey basis which includes the design, manufacture, inspection and testing before dispatch, packing and delivery C.I.F/F.O.R. (destination) of 220 KV , 1000/1200 Sq.mm , Single Core , Stranded, Compacted and Segmented Electrolytic Grade Copper Conductor, XLPE Insulated, Corrugated Extruded Aluminum sheathed, Extruded HDPE outer sheathed cable and accessories under the supply portion and laying including obtaining permission for road cutting from various government and other agencies in HMDA/project area for execution of work, handling and installation of materials required in laying, terminating at the substations, site testing and commissioning under the erection portion.

1.1 Surveying of the proposed cable route including digging and closing of trial pits, preparation of requisite drawings and finalizing the cable route in consultation with the owner's representative.

NOTE: In the expected cable route, ground structure may dramatically change from one point to another, and in some places like Railway Crossing, Major Road Crossing, the local environment is especially bad which may lead to unexpected accelerated aging of insulation and would limit the life expectancy of the cable itself. The successful bidder has to execute works by taking all the necessary precautions so as to get a minimum of 274/ 290 MW Power flow in 220kV 1000/1200 Sq. mm cable. Even after considering all the derating factors for laying cable in those locations, the minimum continuous current shall be 800 Amps /850 Amps for 220KV 1000/1200 Sqmm XLPE Cables.

1.2 Testing and evaluation of the soil resistivity, soil thermal resistivity of the soil along the cable route at every 100 meter's, and based on the data, recommend the final system design.

b) Perform a through route soil thermal resistivity survey by in-situ testing along the entire cable route.
c) Conduct a detailed analysis of soils / strata encountered along the route for the thermal performance under specified cable loading.
d) Specify a suitable thermal backfill so that the soil T.R. does not exceed $150^0$C cm/watt, to encapsulate the cables to prevent thermal run away of cable.
e) Formulation of thermal backfill, quality control and supervision during backfill.
f) Obtaining Road cutting permission from various Government and any other permission from other utilities.
g) Supply & Laying of 220 KV,1000/1200 sqmm XLPE Single Circuit Underground Copper Cable with Associated Accessories including services for laying, jointing, terminations, site testing, commissioning the complete cable system**,** including Design, Supply, Fabrication, laying foundation, Erection of special type in line tower for mounting pole mounted end terminations and providing of end termination structures at substation end.

**1.3) Following accessories are included in the scope of supply along with 220kV XLPE cable**

(a) Pre-moulded Insulation / straight through joints along with associated accessories suitable for the above cable, including cross bonding arrangements with sheath voltage limiters, link boxes, maintenance free earthing scheme as described in this specification.

(b) Outdoor /pole mounted cable terminations (sealing ends) required at both ends.

(c) Adequate nuts and bolts as required.

(d) Consumables or Mandatory spares shall be useful at least for 5 years after the supply.

**1.4)** The scope also covers the following.

i. Route Survey and preparation of Cable route profile drawings with Latitude & Longitude details for every 50 Mtrs of cable route.
ii. Formation of trench for laying of one circuit (three single core cables) in horizontal formation in case of single circuit Cable line / laying of two circuits ( six single core cables) horizontal formation in case of Double Circuit Cable line .
iii. Required Sand for filling the Trench for cable bedding.
iv. Laying of cable in Horizontal formation
v. Supply and positioning/ laying of RCC slabs/ Warning Tapes over entire route.
vi. Refilling the trench with excavated earth.
vii. Foundation for end termination structures for mounting end termination.
viii. Erection of link boxes both with / without SVL.
ix. Services for Cable jointing and End terminations.
x. Provision like tents, Air Conditioners etc. at the time of jointing and terminations for maintaining proper environmental condition.
xi. Necessary earthing of the system.
xii. Site Testing and Commissioning.
xiii. Supply of Cable route markers and fixing them on one side of cable route at every 100 meters interval.

**Note: Above scope is as per present TGTRANSCO practice of UG cable directly buried in soil. However if required cable may also be laid in closed RCC trenches. As such continuous current rating for closed RCC trenches shall also be furnished and trench dimensions considered in calculation shall be furnished.**

1.5 It is not the intent to specify completely all the details required for the above cable system. However, the cable system shall be designed to carry possible maximum power in each circuit, induced voltage in the sheath shall not exceed 120 V for 220 kV cable systems under full load conditions duly taking into consideration length of cable route and adopting suitable cable sheath bonding system. Accessories shall conform in all respects to the high standard of engineering design and workmanship and shall be capable of performing in continuous commercial operation up to the suppliers guarantee. The cable system offered shall be complete with all the components necessary for its effective and trouble free operation and all components required shall be deemed to be within the scope of the bidder.

1.6 T&P required for laying, Jointing and termination shall be arranged by the bidder for carrying out installation, testing & commissioning.

T&P to be arranged by the bidder should include the following items.

Test Kits:

1) Tan delta & Capacitance Test Kit, 2) 10/15 kV DC Test Kit for outer sheath testing, 3) Mobile A/C with blower for use at jointing bay of size 10mX4mX2m, 4) 50 KVA Generator Set, 5) *Crimping Tool with Hydraulic Compressor with Die Sets suitable for 1000/1200 Sq. mm Cable Conductor, 6) Tarpaulin tent House of size 12m X 6m X 2m.* 7) fault locator for cable insulation Murre loop

Tools:

1) Compressor with required dies, 2) Hoist, 3) Lever Hoist, 4) Belt Sandor, 5) Ribbon Heater, 6) Heating Mat, 7) Vernier Calipers, 8) Torque Wrench, 9) Nylon Strings, 10) Electrical drier, 11) Electrical Drill, 12) Chain Hoist, 13) Ventilator Fan, 14)Hand operated hydraulic compressor, 15) Vacuum Cleaner, 16) Gear Puller, 17) Hydraulic Compressor fork type, 18) Cable straightening tool, 19) High Voltage Insulation Tester,

20) Capacitance bridge, 21) Earth resistance tester, 22) Clamp Tester, and all tools required for Cable joints & terminations

Note : The scope shall cover supply of all required equipment's, accessories, spares ,jointing kits, tools and plant, competent supervision , consumables and all other matching materials required (whether specifically mentioned or not) for complete installation, testing and commissioning of the system. Any items / equipment which are having shelf life shall be brought to site at the time of erection only. TGTRANSCO is not responsible for any such material becoming un-usable due to delay in execution of the project.

2.0 STANDARDS

The 220 kV XLPE UG Cable shall conform to the following Indian / International Standards, which shall mean latest revisions, amendments/changes adopted and published, unless otherwise specified herein before. International and Internationally recognized standards to which these standards generally correspond are also listed below:

**The standards mentioned above are available from :**

| **Reference** | **Abbreviation** | **Name and Address** |
|---|---|---|
| BS | British Standards, | British Standards Institution, 101, Pentonvile Road, N-19-ND UK |
| IEC/ CISPR | International Electro technical Commission | Bureau Central de la Commission, Electro Technique International,1 Rue de verembe, Geneva SWITZERLAND |
| BIS | Bureau of Indian Standards | Manak Bhavan,9, Bahadur Shah Zafar Marg, New Delhi-110 001, INDIA |
| ISO | International Organization for Standardization | Danish Board of Standardization Danish Standardising Sraat, Aurehoegvej-12, DK-2900, Heelprup, DENMARK |
| NEMA | National Electric Manufacture Associate | 115, East 44th Street, New York NY 10017 U.S.A |

The construction of the cable and tests shall generally conform to IS 7098 (Part-3) / IEC 62067 with exception to the specific requirements of this specification. The cables and the accessories shall conform to the latest editions and amendments of the standards listed hereunder wherever applicable.

IEC-60050 International Electro Technical vocabulary
IEC-60060 High Voltage Test Techniques.
IEC-62631-3-1 Dielectric and resistive properties of Solid Insulating Materials –Part-3-1

IEEE-48 Test procedures and requirements for AC cable terminations used on Shielded Cables having laminated insulation rated 2.5kV through 765 kV Or extruded insulation rated 2.5 kV through 500 kV.
IEC-60112 Method for determination of the comparative tracking indices of solid insulating materials under moist condition.
IEC-60183 Guidance for the selection of high voltage cables.
IEC-60216 Guide for the determination of thermal endurance properties of electrical insulating materials.
IEC-60228 Conductors of insulated cables. IEC-60228 - A (First supplement) Guide to the dimensional limits of circular conductors.
IEC-60229 Electric cables - Tests on extruded oversheaths with a special protective function
IEC-60230 Impulse test on cables and their accessories.
IEC-60243 Recommended method of tests for electrical strength of solid insulating materials.
IEC-6062631-2-1 Dielectric and Resistive Properties of Solid Insulating Materials-determination of permittivity, dielectric dissipation factor of electrical insulation materials at power, audio frequencies.
ICE-60270 HV test techniques- Partial Discharge measurements
IEC-60287 Calculation of continuous current rating of Cables, 100% load factor.
IEC-60540 Test methods for insulation and sheaths of electric cables and cords.
IEC-60811 Common test methods for insulating and sheathing materials of electric cables. (Applicable parts / sections of different editions)
IEC-60840 Applicable clauses only Power cable with extruded insulation for voltages above 30kV ($U_m$=36kV) up to 150 ($U_m$=170Kv). Test methods & requirements.
IEC-60885-2 Electrical test methods for electric cables, part-2: Partial discharges test.
IEC-60885-3 Electrical test methods for electric cables part-3 Test methods for partial discharge measurement on lengths of extruded power cables.
IEC-62067 Power cable with extruded insulation and their accessories for rated voltage above 150 kV – Test methods & requirements.
IEC-60949 Calculation of thermally permissible short circuit currents, taking into account non-adiabatic heating effects.
IS-3043 Code of practice for earthing
IS-7098(P-III) XLPE cable specification for working voltages from 66KV upto & incl 220KV.
IS-1885 Electro Technical vocabulary applicable parts.
IS-5216 Guide for safety procedures and practices in electrical works
IS-5831 PVC insulation and sheath of electric cables.
IS-8130 Conductors for insulated cables and flexible cords.
IS-10810 Method of test for cables: Applicable parts.
IEC-60859 Cable Connection for gas insulated metal enclosed switch gear for rated voltage of 72.5 KV and above.
Indian Electricity Act - 2003
Indian Electricity Rules

**NOTE: i) For the purpose of this specification all technical terms used hereinafter shall have the meaning as per IEC/IS specification.**

**2.1 CONFLICT OF STANDARDS:** Equipment conforming to other internationally accepted standards, which ensure equal or higher quality than the standards mentioned above, would also be acceptable. In case the Bidders who wish to offer material conforming to the other standards, salient points of difference between the standards adopted and the specific standards shall be clearly brought out in relevant schedule. Four copies of such standards with authentic English Translations shall be furnished along with the offer. In case of conflict **the order of precedence shall be (i) IS (ii) IEC (iii) Other standards**. In case of any difference between provisions of these standards and provisions of this specification, the provisions contained in this specification shall prevail. However such differences shall be brought to notice of order placing authority.

## 3.0 CLIMATIC CONDITIONS

| | | |
|---|---|---|
| i) | Location | Refer volume-I, NIT and Project Data sheet. |
| ii) | Max. ambient air temp. (deg. C) | 50 |
| iii) | Min ambient air temp. (deg. C) | 0 |
| iv) | Average daily ambient air temperature (deg. C) | 35 |
| v) | Ground temperature at a depth of 1500 mm (deg. C) | 30 |
| vi) | Maximum Relative humidity (%) | 74 |
| vii) | Average annual rainfall (mm) | 925 |
| viii) | Average rainy days | 90 days /year |
| ix) | Max. wind pressure (kg/sq.m.) | 200 |
| x) | Max. altitude above mean sea level (metres) | 1000 |
| xi) | Isoceraunic level (days/year) | 40 to 50 |
| xii) | Seismic level (horizontal acceleration). | 0.30g |
| xiii) | Soil thermal resistivity* | 120 to150 Deg.C- cm /Watt |
| xiv) | Pollution level | Very Heavy. Minimum total creepage distance as 31 mm per KV of Highest System Voltage. |

*Note: Bidder shall furnish the current rating of 1000/1200 Sq.mm cable at Thermal resistivity of soil at $120^0$C-Cm/watt and $150^0$C-Cm/watt. However the successful bidder has to measure the soil thermal resistivity along the cable route and the cable has to be designed suitably.

4.0 PRINCIPAL PARAMETERS:

The cable and accessories shall conform to the specific technical requirements given hereunder:

| Sl No | Item | Description |
|---|---|---|
| i) | Type of cable | XLPE (Cross Linked Polyethylene) Insulated Cable |
| ii) | No. of cores | Single |
| iii) | Conductor size | 1000/1200 Sqmm |
| iv) | Conductor material | Stranded, Compacted and Segmented (Milliken) electrolytic grade copper conductor |
| v) | System voltage (Nominal/Highest) | 220KV |
| vi) | Maximum fault current and its duration | 50KA for 1 sec |
| vii) | System frequency & variation | 50HZ +/- 5% |
| viii) | 1.2/50 micro sec. lightning Impulse withstand voltage | 1050 KV (Peak) |
| ix) | Power frequency withstand voltage for 30 minutes | 318KV (rms) |
| x) | Rated minimum continuous current for each circuit when laid in ground in flat formation/ Closed RCC Trenches with the climatic conditions mentioned at clause 3.0 above | 800/850 Amps after all derating factors for 1000/1200 Sqmm cable |
| x) | Power Flow Minimum (MW) | 274/290MW |
| xi) | **System Earthing** | Solidly Earthed |

**5.1 Design Considerations**

5.1.1 The cable shall be suitable for buried installation with uncontrolled back filling. The cable shall withstand all mechanical and thermal stresses, which are likely to occur during its normal steady state and transient operation conditions.

5.1.2 The metallic screen shall be designed to withstand earth fault current liable to occur in the system during conductor to ground fault as specified in clause 4.0(vi).

5.1.3 The thermal resistivity of the soil is not to exceed $150^o$C cm/watt.

5.1.4 The cable shall be designed to have a minimum useful life of not less than fifty years.

5.1.5 Each cable length shall be provided with a pulling socket pulling eye, which shall be fitted to pulling end. The pulling socket eye end shall be able to take the pulling tension of 2800 kgs., along with factor of safety of 1.25. The supplier shall confirm whether the cable can take this pulling load.

5.1.6 The outer sheath of the cable shall be given adequate chemical treatment in order to protect itself from rodent and termite attack.

5.1.7 The conductor shall be clean, uniform in size and shape, smooth and free from harmful effects.

**5.1.8 CURRENT RATING:**

The bidder shall furnish the continuous current ratings in ground, in air, in pipes, in closed RCC Trenches and in ducts at the maximum conductor temperature of $90^0$C with reference to the ambient site conditions on the guidelines of relevant latest IS/IEC. Any additional data, other than furnished under climatic conditions and operating conditions may be suitably assumed duly considering site conditions The ratings shall be for Horizontal for 220 KV single circuit/Double Circuit; when the sheaths are single point bonded and both ends bonded or cross bonded (without exceeding the stipulated induced voltage undue high circulating currents).

The current ratings shall be for single circuit in operation.
The bidder shall also furnish technical information on:
Derating factors for various types of installation conditions in trefoil and flat (viz., depth of laying, varying ground temperatures, cables in ducts / pipes / closed RCC Trenches, cable spacings, circuit spacings, varying soil thermal resistivities etc.) shall be furnished by the bidder for the following conditions:

Proximity to other 132/220 kV cables.
Variation of number of cables (max. 12 in number).
Variation in spacing.
Variation in loading of the cables (80% to 100%).
Variation in depth of water table.
Depth of laying cables in closed RCC trenches and cable ducts.
Depth of STB below and above laid cables.
Width of trench on either side of the cables in which STB will be put.
Variation in STB effective thermal resistivity.
Variation in soil thermal resistivity.

Laying of cables in long lengths of HDPE pipe– Variation due to size and thickness of pipe and open space available in pipe – BIDDER shall suggest methods to improve the ratings.

Short Time Current Loading:

The current loading permissible for a defined period of short time operation over the cyclic load as under:
Cyclic loading over a 24 hour period.

| | |
|---|---|
| 2100 to 0600 Hours | (9 Hours) 50% |
| 0600 to 0900 Hours | (3 Hours) 120% |
| 0900 to 1800 Hours | (9 Hours) 75% |
| 1800 to 2100 Hours | (3 Hours) 120% |

**<u>Furnish short time loading for the following conditions:</u>**

Only one cable circuit is live.
When cables are laid in Trefoil touching/ Flat formation.
Single point bonded.
Both end bonded.
Cross bonded.
The bidders should furnish GA drawing/other details with supporting calculations on charging current, capacitance, tan delta, inductance, losses, sheath voltages, sheath currents, surge impedance, sequence impedance and screen factors, detailed drawings etc., along with the bidding documents.

## 5.2 Construction details

### 5.2.1 Cable construction and material for 220 KV XLPE cables:

i) **Conductor:** Single core conductor shall consist of stranded, segmental (Milliken), compacted circular annealed copper wires confirming to IEC -60228 /IS -8130. The wires shall be made of high conductivity copper. The copper used for the conductor shall be highest purity. The nominal area of conductor shall be 1000/1200 sq mm. The minimum number of wires in conductor and DC resistance of conductor shall be as per IEC 60228. For 220kV 1000/1200 Sqmm cable may be constructed from 4,5, or 6 equal segments (Milliken)

The maximum conductor temperature shall not exceed $90^0$C during continuous operation at full rated current. The temperature after a short circuit for one second shall not exceed $250^0$C, with initial conductor temperature of $90^0$C.

The BIDDER shall indicate the maximum percentage overload current that the cable can carry and its duration when operating initially at a conductor temperature of $90^0$C and the permissible final conductor temperature after overload.

ii) **Conductor screening:** Conductor screening shall consist of an extruded layer of thermosetting black semi conducting compound which shall be firmly bonded to the outer surface of the conductor and should cover the whole surface of the conductor and suitable for the operating temperature of the cable and compatible with the insulating material. The nominal and minimal thickness of the conductor screen shall be 1.5 mm and 1.3 mm respectively. A non hygroscopic semiconducting tape shall be applied to the conductor under extruded layer to prevent penetration of compound into conductor interstices.

iii) **Insulation:** Insulation shall be cross-linked polyethylene (XLPE) and shall conform the IS 7098(P-III)/IEC 62067. XLPE shall of very high degree of purity and dry cured. This XLPE insulation shall be applied by extrusion and vulcanized to form a compact homogenous body free from micro voids and contaminants. The nominal and minimum thickness of the insulation between conductor screen and insulation screen shall be as per IS 7098 (P-3) i.e 27mm & 24.3 mm respectively for 220KV cable.

iv) **Non-metallic part of insulation screening:** The insulation screen shall consist of an extruded layer of thermosetting of semi-conducting compound extruded directly over the insulation and shall be continuous and cover the whole surface are of insulation. It should be firmly bonded to the insulation and suitable for operating temp. of the cable and compatible with the insulating material. **The conductor screening, insulation and insulation screening shall be extruded in one operation by single common head process to ensure homogeneity and elimination of voids.** The nominal and minimum thickness of insulation screen shall be 1.5mm & 1.3mm respectively.

v) **Water blocking tape (Longitudinal Water Barrier):** This shall be Semi-conducting synthetic non-woven tape with suitable swellable absorbent for longitudinal water sealing covering the whole surface area of the non-metallic part of insulation screening. This barrier shall restrict longitudinal water penetration under the metallic sheath. The Semiconducting Water Swellable tapes shall be of 2.0mm total thickness followed by semiconducting copper woven tape.

vi) **Copper Woven Tape:** A layer of semiconducting copper woven tape of 0.45mm to 0.55mm thickness shall be provided before metallic screen.

vii) **Metallic screen:** The Metallic screen shall consist of corrugated, Extruded/Seam Welded Aluminum Sheath. The Metallic sheath shall be so selected that aluminum sheath can carry specified fault current (50 kA for one second). The nominal & minimum thickness shall be 2.5 mm & 2.1mm respectively. Anticorrosive compound shall be applied over Aluminium Sheath.

viii) **Outer Jacket:** The outer jacket will consist of extruded, black, heavy duty compound conforming to the requirement of type ST-7 for PE/HDPE compound should be as per IS 7098(P-3)/IEC 62067.. The outer jacket shall be anti-rodent and anti-termite graphite coated extended semi conducting layer.The nominal and Minimum thickness of outer sheath shall be 5.0 mm & 4.2mm respectively.

Note: Thicknesses maintained above from clause No. 5.2.1 (ii to viii) are required values. If type test values are higher than above, type tested values shall be adopted in cable design / GTP.

5.2.2 **Cross bonding and earthing of metallic sheath.**

In order to eliminate the sheath circulating current losses and consequent rise in potential, the metallic sheath at cable joints shall be cross bonded and earthed. The sheath of the three cables at the terminations shall be connected together at every joint and solidly earthed through disconnecting link boxes. It shall be possible to test the insulation of sheath by opening the link. The sheaths shall be insulated from ground at the switchyard sealing termination. The cable sheath covering and sheath insulators provided at the cable terminations shall be capable of with standing (with an ample safety margin) sheath voltages arising from maximum momentary fault current of 50kA (rms) for 1 second for 220 KV. Cable covering protection units (CCPU) with surge diverters shall be provided between sheath and ground to protect the cable covering from surge voltages induced in the cable circuit. The sheath voltage under normal operating condition shall be less than 120 volts to ground for 220 kV in any section. (Calculations shall be furnished to substantiate this).

5.2.3 The charging current of the cable shall be as low as possible and shall be stated in the bid. The surge impedance of the cable shall be low so that the over voltage at the transformer terminals due to lightning surge remain well below its impulse level of 1050 kVp for 220 KV. Calculations for such over voltages shall be furnished along with the bid.

5.2.4 **Cable accessories**

The sealing ends shall conform to the latest international standards and shall be of thoroughly proven design. The internal electric stress in the sealing end shall be controlled by the stress cone arrangement preferably with semi-conductive bell mouth. The cable terminations shall be outdoor type. The outdoor type sealing ends shall be suitable for installation in polluted atmosphere referred to in clause 3.0 and shall be completely weather proof. Each outdoor-type sealing end shall be supplied complete with mounting plate insulators to insulate the sealing end from the supporting structures and to control the sheath current. If required, terminal connectors and bimetallic clamps shall also be supplied. Each sealing end shall be provided with consumption materials such as wiper and solvent for cleaning. The power cable leading to sealing end shall be provided with proper sunshield cover with flexible HDPE pipe.

**a) Pre-Moulded Straight through joint:** These joints shall be suitable for underground installation with uncontrollable backfill and for laying in areas likely to be flooded by water. These shall have adequate mechanical protection features. The surface shall be smooth and have no defects such as cracks, cuts and any other defects. The joints shall be copper/steel casing tube and coffin box type. The main insulation shall be a premoulded silicon rubber and of superior quality.

**b) Pre-Moulded Cross Bonding Joint:** The sheaths of first two minor sections from the feeding end (i.e. ~~a~~end termination) will have to be cross bonded at the joint bays and at every third joint the sheaths have to be directly earthed. End of every major section shall be of normal type of straight through joints and end of every minor section, which is to be cross-bonded, shall be of insulated type of joints. Phase transposition of cable shall be done during laying. The surface shall be smooth and have no defects such as cracks, cuts and any other defects. These joints shall be suitable for underground installation with uncontrollable backfill and for laying in areas likely to be flooded by water. These shall have adequate mechanical protection features. The joints shall be copper/steel casing tube and coffin box type. The main insulation shall be a premoulded silicon rubber and of superior quality.

**c) Outdoor Type Terminations**

Outdoor type terminations shall be of well proven design and shall be manufactured in accordance with relevant standards and manufacturer's special instructions.

The termination shall complete with all fittings and terminating materials. In addition, the termination shall be supplied with consumption materials such as wiper and solvent for cleaning, emery cloth for insulation surface finishing as well as metal foil, protection tapes for cable annealing and straightening cable as necessary.

The conductor shall be connected by means of a compression ferrule or other approved arrangement. It shall be able to carry the maximum current under all possible circumstances without causing overheating and ensure the firm connection under mechanical possibility exposed in service.

The main insulation of the sealing end shall be superior to the cable insulation in respect of electrical, thermal and mechanical characteristics under service and under short circuit conditions. The dielectric design of the termination shall be so optimized that the electric stress distribution along the stress relief cone and the cable surface shall be well controlled without causing harmfully high electrical stress.

The housing of the outdoor type termination shall be of porcelain/composite insulator having uniform quality and shall have sufficient strength against mechanical, electrical and thermal stresses. The color of the insulator shall be brown/grey. The insulator shall have sufficient creepage distance complying with the requirements of very heavy pollution level specified in IEC 815.

The termination shall be isolated from the supporting structure by means of porcelain supporting insulators.

**d) Pole/Tower Mounted Type Terminations**

Pole Mounted type terminations shall be of well proven design and shall be manufactured in accordance with relevant standards and manufacturer's special instructions.

The termination shall be complete with all fittings and terminating materials. In addition, the termination shall be supplied with consumption materials such as wiper and solvent for cleaning, emery cloth for insulation surface finishing as well as metal foil, protection tapes for cable annealing and straightening cable as necessary.

The conductor shall be connected by means of a compression ferrule or other approved arrangement. It shall be able to carry the maximum current under all possible circumstances without causing overheating and ensure the firm connection under mechanical possibility exposed in service.

The main insulation of the sealing end shall be of superior to the cable insulation in respect of electrical, thermal and mechanical characteristics under service and under short circuit conditions. The dielectric design of the termination shall be so optimized that the electric stress distribution along the between the stress relief cone and the cable surface shall be well controlled without causing harmfully high electrical stress.

The housing of the Pole Mounted type termination shall be of silicon insulator having uniform quality and shall have sufficient strength against mechanical, electrical and thermal stresses. The insulator shall have sufficient creepage distance complying with the requirements of very heavy pollution level specified in IEC 815.
"The termination shall be isolated from the supporting structure by means of Silicon supporting insulators".

**e) Link boxes:** Link boxes shall be made of stainless steel plate of sufficient mechanical strength (5mm Thick Minimum) and enclosed with links and CCPUs. The insulated type straight through joints shall be connected to cross link box by means of coaxial cable and through links and sheath voltage limiters (CCPU) to be connected to earth. Provision for sheath cross bonding shall be made in cross-link boxes. The insulating plate to mount the terminals inside link box shall be of epoxy resin. The link plate and earthing terminal shall be of copper. Underground type link boxes shall be of water proof design (IP 68) to withstand for permanent installation in pits with 1 m depth below the ground surface.
The normal type of straight through joints shall also be connected to link box by means of single core cable and through links. The connecting terminals and disconnecting link shall be of copper. Short Circuit rating of Link Box shall be 50KA/1sec.

The link boxes in between the route shall be of buried type and those at the termination shall be of structure-mounted type.

Following type test reports shall be submitted along with GTP's & Drawings of link boxes
DC Voltage withstand test, Lightening Impulse Voltage Withstand Test, Power Frequency Voltage Withstand Test, Measurement of IR & Contact resistance, Short Circuit Current Test, Degree of Protection (IP 68) & Internal Power Arc Test etc.

**f) Cable Cover Protection Units (CCPUs)**

In order to minimize transient over voltage on cable outer sheath, cable cover protection units (CCPUs) shall be installed at insulated joints at either cross bonded positions or unearthed ends of single point bonded sections. Under some circumstances, CCPUs may be installed across the insulation flange on a SF6 Gas Termination.

The CCPU shall be of the non-linear resistor type and shall be made of zinc oxide compound. The CCPU shall be capable of withstanding the voltages and currents under any operating conditions of the cable system. The Bidder shall examine such conditions and shall select the suitable rating of CCPU to be capable of limiting transient voltages below the acceptable levels of the cable outer sheath.

The CCPU shall be protected from moisture in a suitable case or encapsulation shall be enclosed in the water tight link boxes. Relevant Type Test Reports shall be furnished.

**5.2.5 Identification**

The external surface of the outer sheath shall be embossed with the following legend. “220 kV, 1000/1200 sq.mm XLPE, (Name of the supplier), (Year of Manufacture), TGTRANSCO property”. The embossed letters and numerical shall be raised and shall consist of upright block characters along two lines, approximately and shall be equally spaced around the circumference of the cable. The size of the characters shall be approximately 13mm. The gap between the end of the one set of embossed characters and the beginning of the next shall not exceed 1500mm.

Besides above, progressive sequential marking of length shall also be provided at every one meter, which shall be clear and legible and shall be contrast color.

***NOTE:***

1) Any items / equipment which are having shelf life shall be brought to site at the time of
erection only. TGTRANSCO is not responsible for any such material becoming un-usable due to delay in execution of the project.

2) **“The Guaranteed Technical Particulars for the equipment / material being supplied shall be provided with the bid as specified in the Technical Specification. The Bids without the Guaranteed Technical Particulars shall be treated as Non-Responsive.”**
3) **Consumables or mandatory spares shall have a minimum useful life of 5 years after supply.**

6.0
**TESTS**

**6.1 Definitions of Tests**

6.1.1 **Routine Tests** shall mean those tests, made by the manufacturer on each manufactured component (cable or accessories) to check that the component meets the specified requirements.

6.1.2 **Sample Tests / Acceptance Tests** shall mean those tests, made by the manufacturer on samples of cable or accessories taken from a complete cable /

accessories offered for pre-dispatch inspection, at a specified frequency, so as to verify the finished product meets the specified requirements.

6.1.3 **Type tests** shall mean those tests conducted on a type of cable system covered by the standards, before supplying it on a general commercial basis. Type tests are to be carried out to prove the process of manufacture and general conformity of the material to the specification.

The bidder shall furnish a copy of type test certificates for the cable and accessories and cable system offered as per the specification from any of the following laboratories on similar cable and accessories as offered for this tender. The bids without type test certificates are liable for rejection.

**a)** KEMA, Holland
**b)** EDF, France
**c)** Hydro-Quebec, Canada
**d)** CESI, Italy
**e)** CPRI, Bangalore
**f)** IPH Germany.

Or at any international accreditation laboratory.

6.1.4 **Tests during manufacture** shall mean those tests, which are to be carried out during the process of manufacture and end inspection by the Bidder to ensure the desired quality of the end product to be supplied by him.

6.1.5 **Tests after installation** shall mean tests made to demonstrate the integrity of the cable system as installed.

6.1.6 For all type and acceptance tests, the acceptance values shall be the values guaranteed by the Supplier in the Proforma for "Guaranteed Technical Particulars", furnished in this Specification or acceptance value specified in this specification, whichever is more stringent for that particular test.

6.1.7 **Pre-qualification test** shall mean those tests made before supplying a cable system on a general commercial basis a type of cable system covered by this standard, in order to demonstrate satisfactory long term performance of the complete cable system.

**6.2 Test Reports to be enclosed**:

**The bidder shall furnish two sets of type test reports and Pre-Qualification test reports as per qualification requirements for 220 KV, 1000/1200 sqmm or higher voltage XLPE Cable system.**

**The bidder shall furnish two sets of type test reports as per qualification requirements.**

**The tests must have been conducted on the 220 KV, 1000/1200 sqmm XLPE cables with pre-moulded/prefabricated joints for pre qualification test.**

**The Type tests shall be done as per relevant IEC.**

### 6.2.1 Type Tests on Cable

All the type tests shall be carried out to prove the general qualities and design of given complete cable system with pre-moulded joints

A) Following electrical type tests shall be conducted on the cable system (cable & accessories) in accordance with clause 12 of IEC 62067 and in accordance with sequence prescribed in clause 12.4.2 of IEC 62067.

i) Bending Test on the cable followed by visual inspection and installation of accessories and partial discharge at ambient temperature

ii) Tan Delta measurement

iii) Heating cycle voltage test

iv) Partial discharge test at ambient temperature and at high temperature ( This test shall be carried out after final cycle of item (iii) or alternatively after lightening impulse voltage test in item (v))

v) Impulse withstand test followed by power frequency voltage test

vi) Partial Discharge Tests if not previously carried out in item (iv) above

vii) Examination of cable system with cable and accessories on completion of above tests

B) Following Non Electrical Type Tests shall be carried out as per UEC 62067/ IS 7098(Part-3)

a) Tests on Cable Conductor- Conductor Examination as per 10.4 of IEC 62067, D.C Resistance at 20°C, annealing tests for copper

b) Tests on Insulation- Thickness of insulation, Tensile Strength and Elongation at Break (Before and After ageing), Tensile Strength and Elongation at Break after cable ageing, Shrinkage Tests, Hot Set Test, Void and Contaminant Test as per IS 7098 (P-3)

c) Tests on Metallic Sheath- Thickness of Corrugated Alumnium metallic sheath

d) Tests on Semi Conducting Layers- Dimensional Check, Resistivity Check for semiconducting layers

e) Tests on Outer Sheath – Dimensional Check, Tensile Strength and Elongation at Break (Before and After ageing), Tensile Strength and Elongation at Break after cable ageing, Pressure Test at High Temperature, Carbon Black Test, Shrinkage Test

f) Water Penetration Test

Above is indicative list only. All Tests necessary as per IEC 62067 & IS 7098(Part-3) shall be carried out.

### 6.2.2 Type tests on accessories

All the type tests shall be carried out to prove the general qualities and design of given types of cable accessories required under the bid. The type tests shall conform to the latest IEC.

**6.2.3 Type Tests on Cable system**

All the type tests shall be carried out to prove the general qualities and design of given complete cable system with pre-moulded joints.

**6.2.3 Pre-qualification test on cable system.**

In case of 220 kV,1000/1200 sqmm class XLPE cable system, the Pre-qualification test shall be carried out on the 220 kV cable system or higher voltage with pre-moulded/prefabricated joints. Type tests conducted for cable and accessories separately will be considered. Bidder shall furnish Pre-Qualification Test Carried Out on complete cable system as per clause 13.1 of IEC 62067. Offered Cable will not considered if PQ test certificate is not furnished.

6.2.5 The Bidder is required to carry out all the acceptance tests as per latest IEC successfully in the presence of Purchaser's representative before dispatch. All routine tests shall be performed at the factory in the presence of Purchaser's representative. All test reports shall be submitted and got approved by the purchaser before delivery of equipment".

**6.3 Routine tests, acceptance tests and special tests**

The cable and accessories shall be subject to all relevant routine, acceptance tests as described in IEC 62067, IS 7098(Part-3) & Approved Manufacturing Quality Assurance Plan. The detailed list of such tests and copies of reports of such tests conducted on similar material shall be furnished with the offer.
The indicative list of Acceptance tests is as follows

(i) Conductor Examination
(ii) Measurement of Diameters
(iii) Annealing Tests
(iv) Measurement of electrical resistance of conductor and metallic sheath
(v) Measurement of Thickness & Eccentricity of XLPE insulation
(vi) Measurement of Thickness of Metallic Sheath
(vii) Measurement of Thickness of Outer Sheath
(viii) Hot Set & Permanent Set Test on insulation
(ix) Measurement of Capacitance
(x) High Voltage Test on full drum Length
(xi) Partial Discharge Test on Full Drum Length
(xii) Sheath Voltage Test ( DC Voltage Test)
(xiii) Tan Delta Test
(xiv) Weight of Aluminum & Copper
(xv) Void and Contamination Test
(xvi) Impulse Voltage Test (One Sample Per PO and shall necessarily be conducted during first lot acceptance tests)
(xvii) Water Penetration Test (One Sample Per PO and shall necessarily be conducted during first lot acceptance tests)
(xviii) Complete /Partial UnWinding of cable drum(s) for visual inspection of manufactured cable if required as per decision of inspecting officer.
(xix) Any Other Test as per TGTRANSCO approved MQAP

Routine tests shall be performed at the factory by manufacturer on all manufactured components and relevant test reports shall be made available to the purchaser.

## 6.4 Tests during installation

The cable shall be meggered before jointing. After jointing, complete cable system shall be tested before commissioning. The cable core shall be tested for

a) Continuity
b) Absence of cross phasing
c) Insulation resistance to earth
d) 10 kV DC voltage test for 1 minute on the outer sheath

## 6.5 Additional tests

The purchaser reserves the right for carrying out any other tests of reasonable nature at the works of the supplier/Laboratory or at any other recognized laboratory/research institute in addition to the above mentioned type, acceptance and routine tests at the cost of the purchaser to ensure that the material complies with the intent of this specification.

## 6.6 Commissioning tests

All the Commissioning tests shall be carried out before commissioning of the complete cable system

a) DC Voltage test on outer sheath at 10 kV for 1 minute (as per clause 5 of IEC 60229) between metallic sheath/ screen and external conducting surface.
b) Conductor resistance of each completed circuit. Insulation resistance test, Capacitance Test
A.C. TESTING**:**
d) Cross Bonding effectiveness test,
e) Tan delta test.
f) The installation shall be tested with AC voltage at power frequency.

The installation shall be tested with AC voltage at power frequency voltage equal to 318kV for 30 min as per Table 4 of IEC 62067

Or

24 Hours AC testing, a voltage of Uo may be applied for 24 hours.

7.1 INSPECTION

7.2 The purchaser may carry out inspection at any stage of manufacture. The successful bidder shall grant free access to the purchaser's representative at a reasonable time when the work is in progress. Inspection and acceptance of any equipment under this specification by the purchaser shall not relieve the bidder of his obligation of furnishing equipment in accordance with the specification and shall not prevent subsequent rejection if the equipment is found to be defective. The supplier shall keep the purchaser informed in advance about the manufacturing program so that arrangement can be made for inspection. The purchaser reserves the right to insist for witnessing the acceptance / routine testing of the bought out items.

The supplier shall furnish latest calibration certificates of testing instruments/equipments to be used for testing of of the material covered in the purchase order to the inspecting officer of the purchaser. The testing instruments/meters/apparatus should be got calibrated by the supplier from NABL accredited Lab. The testing instruments should be duly sealed by the calibrating agency and mention thereof indicated in the calibration certificates.

7.3 No material shall be dispatched from its point of manufacture unless the material has been satisfactorily inspected and tested.

7.4 The supplier shall give 15 days (with in India) / 60 days (Other than India) advance intimation to enable the purchaser to depute his representative for witnessing types, acceptance and routine tests.

7.5 The purchaser reserves the right to insist for witnessing the acceptance/routine testing of the bought out items. All travel expenses for inspection including accommodation and local transportation required for inspection should be borne by the bidder.

8.0 **QUALITY ASSURANCE PLAN**

8.1 The bidder shall invariably furnish the following information along with his offer failing which the offer shall be liable for rejection. Information shall be separately given for individual type of equipment offered.

i. The Structure of organization

ii. The duties and responsibilities assigned to staff ensuring quality of work

iii. The system of purchasing, taking delivery and verification of materials

iv. The system for ensuring quality of workmanship

v. The quality assurance arrangements shall conform to the relevant requirement of ISO-9001 or ISO 9002 as applicable.

vi. Statement giving list of important raw materials, names of sub-suppliers for the raw materials, list of standards according to which the raw material are tested, list of tests normally carried out on raw material in the presence of suppliers representative, copies of test certificates.

vii. Information and copies of test certificates as on (i) above in respect of bought out terms.

viii. List of manufacturing facilities available

ix. Level of automation achieved and list of areas where manual processing exists.

x. List of areas in manufacturing process, where stage inspections are normally carried out for quality control and details of such tests and inspections.

xi. List of testing equipment available with the bidder for final testing of equipment specified and test plant limitation, if any vis-à-vis the type. Special acceptance and routine tests specified in the relevant standards. These limitations shall be very clearly brought out in "Schedule of Deviations" from the specified test requirements.

8.2 The Contractor shall within 30 days of placement of order, submit the following information to the purchaser.

i) List of the raw material as well as bought out accessories and the names of sub-suppliers selected from those furnished along with the offer.

ii) Type test certificates of the raw material and bought out accessories if required by the purchaser.

iii) Quality Assurance Plan (QAP) with holds points for purchaser's inspection. QAP and purchasers hold points shall be discussed between the purchaser and contractor before the QAP is finalized.

iv) The bidder should provide to the inspecting officer deputed by the purchaser the routine test certificates of brought out material/ raw material at the time of routine tests to enable the purchaser ensure that the quality assurance requirements have been followed by the bidder.

8.3 The Quality Assurance Program shall give a description of the Quality System and Quality Plans with the following details.

i) Quality System:

The Structure of the Organization

The duties and responsibilities assigned to staff ensuring quality of work. The system of purchasing, taking delivery of verification of materials.

The system of ensuring of quality workmanship. The system of control of documentation.

The system of retention of records.

The arrangement of contractor internal auditing.

(a) A list of Administrator and work procedures required to achieve contractor's quality requirements. These procedures shall be made readily available to the purchaser for inspection on request.

ii) Quality Plans:

An outline of the proposed work and program sequence. The structure of contractor's organizations for the contract. The duties and responsibilities ensuring quality of work

Hold and notification points.

Submission of engineering documents required by this specification. The Inspection of the materials and components on request.

Reference to contractor's work procedures appropriate to each activity. Inspection during fabrication/construction.

Final inspection and test.

## 9.0 DOCUMENTATION

9.1 All drawings shall conform to International Standards Organization (ISO) 'A' series of drawing sheet/Indian Standards Specification. All drawings shall be in ink and suitable for micro filming. All dimensions and data shall be in S.I units. Technical descriptions, data sheets, catalogues and other material submitted with the quotation must enable the engineers evaluate the proposal for its compliance with the specification. **Soft copy of the drawings and documents shall be enclosed.**

9.2 List of drawings and documents

The supplier shall furnish four sets of relevant, descriptive and illustratively published literature pamphlets and the following/particulars for preliminary study along with the bid.

i) General information and overall dimensional (sectional) drawing.
ii) Principal technical data
iii) Description of insulation and sheathing.
iv) Cable current Vs temperature characteristics
v) Drawings indicating phase transposition of cable during laying.
vi) Cable drum particulars and shipping dimensions
vii) Drawings of joints and cable terminations
viii) Reference lists of supply and installed cable and accessories including customer identification and year of installation.
ix) List of accessories included in the offer.
x) All relevant test reports as per Clause 6.0 and test facilities available with the supplier.
xi) Foundation drawing of the cable terminating structure.
xii) Civil Engineering details of jointing base with cross sectional elevation and plan.
xiii) Dimensioned cross sectional details and plan of cable trench/duct/road crossing /drain crossing showing the position of cable.
xiv) Dimensioned cross sectional drawing of the pipe electrode earthing along with bill of materials.
xv) Drawing showing the method of bonding of the cable screen/sheath and the earth connection to be furnished by successful bidder.
xvi) Drawing of RCC cable protection cover.
xvii) Calculation of induced voltages in the sheath and the recommended method of bonding
xviii) Any other relevant particulars.

i) The successful bidder shall prepare the route layout plan indicating the road crossing, crossing across drains, nallahs, railway line etc., and location of the straight through joints. All relevant and associated drawings.

9.3 The successful supplier shall, within 2 weeks of placement of order, submit four sets of final version of all the above drawings for purchaser's approval. The purchaser shall communicate comments/approval on the drawings to the supplier within reasonable period. The supplier shall, if necessary, modify the drawings and resubmit four copies of the modified drawings for purchaser's approval within two weeks from the date of comments. After receipt of purchaser's approval the supplier shall, within three weeks, submit twenty

(20) prints and two good quality reproducible of the approved drawings for owner's use. Further, the supplier shall also furnish the following calculations for the information of purchaser.

i) Current carrying capacity under laid condition.
ii) Sheath induced voltage under normal operating and fault condition.
iii) Guaranteed losses, namely conductor, sheath and dielectric losses at rated current.

9.4 The successful supplier shall also furnish twenty (20) copies of bound manuals and two soft copies (in CD) covering all relevant information and drawings pertaining to the cable and accessories including laying and commissioning.

9.5 The manufacturing of the cable and accessories shall be strictly in accordance with the approved drawings and no deviation shall be permitted without the written approval of the purchaser. All manufacturing work against this specification prior to the approval of drawings shall be at supplier's risk.

9.6 Approval of drawings/work by the owner shall not relieve the supplier of any of his responsibilities and liabilities for ensuring correctness and correct interpretation of the drawings for meeting the requirements of the latest revision of the applicable standards, rules and codes of practices. The cable and its accessories shall conform in all respects to high standards of engineering, design, workmanship and latest revision of relevant standards at the time of supply and purchaser shall have the power to reject any work or material which, in purchaser's judgment, is not in full accordance therewith.

9.7 Test Reports

i) Four copies of Type test reports shall be furnished. One copy will be returned duly certified by the purchaser to the supplier. Within two weeks thereafter and on receipt of the same, supplier shall commence with the commercial production of the concerned material.
ii) Four copies of special or acceptance test reports shall be furnished to the purchaser. One copy will be returned duly certified by the purchaser and only thereafter the material shall be dispatched.
iii) All Routine test reports shall be submitted to the purchaser.
iv) The supplier shall maintain all test reports of tests conducted during manufacture. These shall be produced for verification as and when requested for by the purchaser.

9.8 The bidder shall also prepare permanent records of all "as built" cable installations. The record shall include the following field data :

a) Actual route map of cable.
b) Location of the cable in relation to existing facilities, kerb line etc., and depth.
c) Detailed drawings and various types of crossings.
d) Position and types of all joints.
e) Accurate lengths from joint to joint and manufacturer's cable drum number.

The actual route map shall be prepared in survey sheets to the scale 1:5000. These survey sheets shall have to be procured by the bidder from Survey of India's sales office at Hyderabad or Urban Development Authority on payment. The plan should contain detailed measurements of the cable and joints and all permanent land marks and subsoil obstructions. Detailed measurement of depth shall also be shown in cross sectional views.

9.9 The successful bidder shall also furnish twenty (20) copies of bound manuals covering all relevant information and drawings pertaining to the cable and accessories including laying and commissioning along with a soft copy.

9.10 Before seeking approval of any other authority, the bidder shall obtain Approval of work / drawings for road crossing, culvert crossing and bridge crossing etc., by the TGTRANSCO Engineer. This shall not relieve the bidder of any of his responsibilities and liabilities for ensuring correctness and correct interpretation of the drawings for meeting the requirements of the latest revision of the applicable standards rules and codes of practices.

## 10.0 PACKING AND FORWARDING

10.1 Supplier shall indicate in the offer, the maximum standard length of power cable, which can be supplied on one drum. Purchaser desires minimum standard lengths of cable more than 500 meters for 220 kV, based on which the number of joints have been arrived at. The bidder should quote for the quantities given in Schedule of Requirements only. However the Purchaser desires to have 500-600 m cable lengths for 220 kV voltage class cables for laying.

10.2 The cut ends of the cable shall be sealed by means of non-hygroscopic sealing material so as to protect the cable from moisture and other atmospheric effects during transit and laying. The following information shall be marked on the drum.

a) Trade name/Trade mark
b) Name of the manufacturer
c) Nominal cross-sectional area of the conductor
d) Type of cable and voltage
e) Length of cable on the drum
f) Direction of rotation of drum (Arrow)
g) Gross weight of the drum
h) Consignee
i) Order No.
j) Tare weight of drum

10.3 The drum shall be of such construction as to ensure delivery of cable at site free from displacement and damage and shall be able to withstand all stresses during handling in transit and laying. The drum shall be suitable for wheel mounting.

10.4 Drums or parts of drums shall be made from ferrous metals and shall be treated with suitable rust preventive finish or coating to minimize rusting during transit or storage. The cable drums shall be fitted with outer metallic sheets for safety and for long storage and shall be fitted with a stand at the bottom for proper resting on ground.

10.5 Bolts, screws, nails etc., if used in the construction of drums shall be counter sunk so that the heads are below the surface of the flange.

10.6 Drum construction, cable placement on the drum and the installation of protective wrappings etc., shall be carefully coordinated to prevent damage to the cable during normal handling, ocean shipment and land transportation of the cable to site. The supplier shall also indicate the method of storage of cable drums at site in case the cables are to be stored for longer periods.

10.7 The cable accessories shall be packed suitably so as to withstand handling during transit. The supplier shall be responsible for any damage during transit due to improper and inadequate packing and handling. The easily damageable material shall be carefully packed and marked with appropriate caution symbols. The supplier without any extra cost shall supply any material found short inside the packing cases.

10.8 Each consignment of cable accessories shall also be accompanied by a detailed packing list containing the following information:

a) Name of the consignee
b) Details of consignment
c) Destination
d) Total weight of consignment
e) Handling and unpacking instructions
f) Bill of material indicating contents of each package.

The supplier shall ensure that, the packing list and bill of material are approved by the purchaser, before dispatch.

After cable laying the empty drums shall be handed over to construction stores / Erragadda. The spare cable and left over cable (if any along with drums) shall be delivered at construction stores / Erragadda.

## 11.0 SERVICES FOR ROUTE SURVEY, CABLE LAYING, CABLE JOINTING, END TERMINATION AND TESTING & COMMISSIONING.

### 11.1 SURVEY OF THE ROUTE:

The successful bidder is required to carryout the detailed survey of the route and submits detailed route map, schematic diagram, and lengths of cable and complete bill of materials for the project within 30 days after award of contract for approval of TSRANSCO. In the course of surveying by the bidder any conspicuous variations in the route and physical features to those indicated in the route maps must be brought to the notice of the TGTRANSCO. The TGTRANSCO if considered necessary shall make alternations to the route maps and communicate the same to the bidder in writing. All such alternations shall be carried out accordingly and after inspecting the surveyed route, TGTRANSCO shall give final approval for the revised route maps in writing. The successful bidder shall not commence the work until the final approval of the route map. The quantities of materials (such as cable, joints, link boxes, etc.) as per revised actual route map shall be supplied by the bidder at quoted unit rate.

### 11.2 WAY LEAVES AND STATUTORY NOTICES: (ROAD CUTTING CHARGES)

a) The successful bidder shall submit proposals for way leaves and right of way. The bidder is entirely responsible in getting permissions from the concerned Government Departments. The field officials of TGTRANSCO will assist to prepare required letters to apply for permissions. The cost payable to local authorities towards Road cutting charges / permissions is to be paid by the successful bidder as per contract.

b) No trench cutting shall be done until permission is given to the bidder by authorities concerned to proceed with trench cutting. The bidder shall arrange trench cutting and cable laying soon after permission in writing is communicated.

c) At times however, it may not be possible to arrange / get right of way for excavation and trench cutting at a particular place. At all such times, the bidder may shift his gangs to other areas. The rates quoted shall cover all such contingencies and no extra payments shall be claimed for such contingencies.

d) The bidder shall take all possible steps to see that the already existing cables, pipes and other public utility systems are not damaged while attending to trench cutting. However in case the bidder expects that in a given location it would not be possible to carry out the works without possible damages, he shall bring the matter to the notice of the engineer in-charge of the works and get his approval before proceeding with the works. The bidder shall bear the compensation for damages caused in all cases.

## 11.3 METHOD OF INSTALLATION

The supplier shall carryout the necessary calculations and design works at no cost to the purchaser to finalize the respective cable system based on the survey results. In designing the cable system for the specified cable route the following factors shall be considered. The suppler shall carryout the necessary design below but not limited to: -

11.3.1 Cable installation design such as configuration and spaces between phases and between circuits based on the calculation of current carrying capacity taking into account of mutual heating between phases and between circuits.

11.3.2 Bonding / earthing system taking into account of sheath induced voltages and the cable outer sheath protection in various conditions.

11.3.3 Cable supporting and fixing system taking into account of thermo mechanical behaviour of cables.

11.3.4 Design of special installation such as road crossing, river / culvert crossing, railway crossing on / along bridge and on Cable Bridge.

11.3.5 Design of various kinds of cable trays, supporting structure and cable bridges as required.

11.3.6 It is proposed to lay the cable circuits in trefoil/horizontal formation for 220 kV XLPE cable . (The bidder has to furnish complete details including trench drawing and details of formation of trench and any other required information and drawings etc in two sets.).

11.3.7 Installation of cable shall be done by the following methods.

i) Buried directly in the ground / laid in built up RCC trenches to achieve required cable current rating of 800/850 Amps.

ii) Laid in built up trenches, cable trays, and on supports at terminal substations.

iii) Pulled through conduits and ducts (in the crossings)
iv) Clamped bare on the walls, ceiling and structure ( at river /Nalla / Culvert crossing) as per the drawing which will be furnished to the successful supplier. Where specific cable layouts are not shown, the supplier shall route them as directed by the Engineer in charge of work.
v) Identification tags shall be provided at intervals of 100 mters to indicate the route of the cable and also at every joint.

11.3.8 The thermal resistivity of the soil is generally 150 deg.C. cm/watt. However, the successful bidder must satisfy himself regarding the actual soil resistivity along the proposed cable route before laying cable.

11.3.9 Cable length shall be provided with a pulling socket and a pulling eye which shall be fitted to pulling end. The pulling socket and the eye end shall be able to take the maximum pulling tension of 2800 Kgs along with a 1.25 factor of safety. Thebidder shall bring automatic power driven pulling winch of suitable capacity only. Cable joint bay as per approved drawings shall be prepared and as soon as the jointing is completed by cable supplier, the pit should be refilled by the successful bidder. After completing jointing the joint bay should be refilled. Link box pit as per approved drawings should be made for installation of link box and providing of earth pipe. The earthing set also to be supplied by bidder.

11.3.10 Over all, the successful bidder shall make a detailed survey of the cable route, by excavating the trial pits as warranted by the local conditions and prepare necessary drawings. All relevant data, required shall be properly recorded and preserved for future use and to decide on requirements of:

- Cable delivery length per drum
- Proposed cable sections
- Location of joint bay positions
- Type and quantity of joints required
- Final cable route plans
- Design of cable ducts/trench for road crossings drainage crossings, railway crossings etc.
- Identify locations for bonding.

The survey data on the cable route should also include recording of the information required for cable design, such as

- Type of soil along the cable route, soil resistivity
- Soil thermal resistivity, PH Value
- Sub soil water locations and other relevant information in designing the ducts and pipes for cable.

NOTE: The quantities executed will be paid at actuals.

**11.3.10 MINIMUM BENDING RADIUS**

The minimum safe bending radius for the XLPE cable may be taken as 20 D where ‘D’ is sheathed diameter of the cable. At joints and terminations, the cable should never be bent so that the radius of the bend is less than 26 times the diameter over the insulation. However, recommendations of the supplier regarding this may be indicated in the bid.

## 11.4 EXCAVATION OF CABLE TRENCH:

a) After the final survey of the cable route and after marking the route, excavation work has to be commenced in accordance with the approved route maps. Excavation is generally done by pick axes, crowbars and shovels. Excavation in very hard or rocky soil or in rock beds may be done by any alternative methods except blasting.

b) Excavation rates shall be quoted by the bidder for the following types of soil including dewatering of pits and shorting and shuttering wherever necessary. No quotation for extra rates for dewatering during excavation and shorting and shuttering will be entertained.

i) All soils other than hard rock.

**ii)** Hard rock: Hard rock will be required to be excavated by drilling and or any method other than blast. The cost of drilling and any other method shall be included in the quoted rates. In this case, the area around the location happens to be an inhabited area consequent to which blasting cannot be resorted to, the excavation may have to be by the process of drilling, wedging, hammering and splitting or by the process of heating and splitting by sudden cooling. The rate quoted shall take into consideration such contingencies also.

## 11.5 DEVIATIONS

Constructional details specified in this specification are for guidance of the bidder. Minor deviations from Specification if any proposed by the bidder will be considered on merit, provided that they do not affect competitive comparison of the proposal. The TGTRANSCO shall have the right to evaluate all such deviations in accordance with their judgments, if corresponding prices for complying with the intent of this specification are not furnished along with the bid. All such deviations therefore shall be specifically mentioned with justification.

## 11.6 FORMATION OF TRENCH:

**a)** The bottom of the trench should be carefully leveled and kept free from stones. But if gradients and changes of depth are unavoidable, they should be gradual. Where cables are laid directly in ground, they shall be laid on 100 mm. sand bed as per the drawings. The cables shall then be covered on top with sand, slabs and earth. Over this, protective RCC covers duly engraved with “TGTRANSCO “shall be placed on the cables and the trench shall be filled with soil and rammed well. The protective cable covers shall conform to and be laid as per the relevant practice and standards and the drawing shall be got approved. A suitable warning tape shall also be placed in the trench at an appropriate place. The details of tape shall be submitted for approval.

b) In addition, wherever indicated, side wall shall be constructed. Excavated earth shall be moved to a storage location and brought back for backfilling after the cable are laid. As the roads may be narrow in the city stalling of excavated earth in the road adjacent to trench is not permitted. Proper safety precautions shall be taken by erecting barricades and sign boards with radium paint adjacent to the trench. The extra earth after completing the laying and refilling of the trench shall be removed and foot paths or roadways cleared properly for easy traffic

movement. Cable route indicators shall be provided at an interval of 100Mts or wherever there is turn or deviation from the straight route and also at every joint. The indicator at the joints shall be distinct with the letter 'J' inscribed prominently. The bidder shall carry out this work as per approved drawings.

**11.7 DEPTH OF TRENCH:**

The minimum depth of laying any cable from ground surface to the top of cable should be 1.50 meter.

**11.8 WIDTH OF TRENCH:**

**For 220 KV:**

Width of the trench shall be suitably designed to be 1 meter with enough clearances to house one cable circuit in horizontal formation allowing for maximum possible current flow and minimum induced voltage in sheath.

**SIDES OF THE TRENCH:**

If there is any danger of trench collapsing, the sides should be well shored up with timbering and sheeting as the excavation proceeds and, in some cases, it may even be advisable to leave the supports in tact when backfilling the trench, rather than risk a possible collapse of adjacent structures merely for the sake of recovering timber. In all cases bricks on edges shall be placed along the sides of the trench.

**12.0 CABLE JOINT BAY:**

The bidder shall prepare cable joint bay pit as per the approved drawing by providing a RCC Chamber 9 m x 2 m x 1.8 m for 220 kV single circuit cable line The thickness of the bottom shall be 250 mm ( 100 mm PCC 150mm RCC) and walls shall be 250 mm RCC. After completion of the jointing works, the cable jointing bay should be refilled with sand and covered with RCC slabs of 250 mm thick. All the cable ends should be hydroscopically sealed.

Earthing of Joint Bay: Earthing scheme of joint bays shall consist of the following:

(i) Copper flat of cross section equivalent to the earthing cable (400 sq.mm) and run all around the joint bay, (ii) providing earth electrodes i.e. steel rods coated with copper as per international standards and treated with suitable earth enhancing compound to get an effective diameter of 100mm and (iii) welding the copper flat to the electrodes by exothermic welding. The earthing scheme drawing shall be got approved with all earth resistance calculations considering its effectiveness to discharge the fault currents

**12.1 RCC PIT FOR LINK BOX:**

The bidder shall provide RCC pit for accommodating the link box at each jointing bay as per approved drawings. The coaxial cables have to be laid from cable jointing bay to link box and earthing cable from link box to earth electrode. The bidder shall quote the rates by keeping in view all the above.

**12.2 SPACING BETWEEN CABLES**

Spacing between single core cables shall be 2 times the external diameter of cable (centre to centre) in order to reduce the effects of mutual heating and also to ensure that a fault occurring on one cable will not damage the adjacent

cable. Spacing width may be increased according to trench width if cable laid up in closed RCC trenches.

## 12.3 CABLE LAID IN A HORIZONTAL FORMATION

Cable shall be laid in horizontal formation and shall not be laid in more than one layer.

## 12.4 CLEARANCES

The desired minimum clearances are as follows.

| | | |
|---|---|---|
| Power cable to control cable | : | 0.2 mts. |
| Power cable to communication cable | : | 0.3 mts. |
| Power cable to gas/water main | : | 0.3 mts |
| Power cable to power cable clearances | : | 2 D (D is external diameter of cable) |
| Circuit to circuit clearance | : | 0.8 mts to 1.2 mts according to formation either trefoil/Horizontal |

### 12.4.1 SOIL THERMAL RESISTIVITY / SOIL RESISTIVITY:

The successful bidder shall investigate the soil characteristics along the cable route, at the required laying depths to evaluate the parameters, governing the cable design.

The thermal resistivity tests should be carried out at every 200 m intervals along the cable route and wherever required as per field requirement. At each location the thermal resistivity tests are taken at three different depths and two soil samples are taken for further laboratory analysis.

The laboratory analysis of the soil samples collected from the site should be conducted in detail, including soil identification, moisture content, density, organic content, critical moisture content of each soil type encountered along the route and arrive at the thermal resistivity values of the native soil.

These tests should be conducted by using reliable measuring instruments with fully automated thermal property analyzer and thermal probes, through reputed agencies, like GEOTHERM, CPRI, Technical Institutions & any other competent Firms. TGTRANSCO will depute its Engineer, to witness these tests.

The generally assumed value of the soil thermal resistivity may be taken as 1500C Cm/w.

The OWNER anticipates the presence of soil strata at a few locations along cable routes with a soil thermal resistivity of more than 150°C Cm/w.

However, the successful BIDDER shall be responsible to ensure that no derating of the cable will take place on account of variation in soil thermal characteristics. In consultation with the OWNER, the BIDDER shall analyze and indicate the appropriate backfill (STB) recommended. Bidder will have to design the trench optimally to take care of local site conditions. The maximum permissible soil thermal resistivity shall be limit to 150°C Cm/w in fully dried condition out of the locally available materials to achieve maximum current capacity for the cable section used. BIDDER shall ensure that no derating of the cable takes place on account of soil/backfill thermal characteristics and that proper backfill is used.

In conformity with the above requirement, the BIDDER shall determine and advise on the following:

- Optimum design of trench to take care of local hot spots and methods to improve effective Thermal resistivity value.
- The type of graded sand to be utilized by sieve analysis as one of the components of the STB backfill to obtain tight fit soil.
- The optimum Kaolinitic clay content in the soil to make it less porous and of high specific surface area for optimum moisture retentivity suitable for areas prone to moisture migration on account of low water table.
- The ratio of the weak mix of sand, cement and fly ash, cement and water (by volume/weight), the type of cement of adequate compression strength and mixing procedure of the three constituents to ensure the best thermal resistivity value of the STB in fully dried condition and to ensure low breaking strength of the STB for ease of breaking in case of fault repairs and laying of second circuit, if required.
- The ratio of the weak mix of sand, cement and fly ash, cement and water and other suitable material like Full bent etc., to be utilized in joint bays to facilitate breaking/removal of cement bound sand (weak mix) in future, if necessary.
- Compacting procedures indicating the method and type of compaction for obtaining high density, using vibration dampers, for granular soils and adequate moisture content for lubrication purposes of clay soils.
- The temperature rise above the ground temperature of 30°C corresponding to the area of the isotherm required to ensure no derating in the current carrying capacity of the cables. BIDDER shall ensure that no derating of the cable takes place on account of soil thermal characteristics and that proper backfill is used to ensure maximum/optimum current carrying capacity from the cable used. The suggested stabilized thermal backfill i.e., STB is of the following composition (cement 2.5% by weight, fly ash 11% by weight and graded sand 86.5% by weight). BIDDER should advise on the use of any other locally available binder and the amount to be used with sand and cement to give a soil thermal resistivity of less than 1500 cm/w in fully dried condition of the STB. Bidder shall be responsible for ensuring the best “effective” thermal resistivity.

Subsequent to completion of backfilling, in-situ measurements of soil thermal resistivity, dry cured density, void ratio, moisture and clay contents of the soil shall be carried out by the BIDDER along the cable routes at regular intervals mutually agreeable to the BIDDERand PURCHAER, using his own instruments as a quality check on the backfill employed and method of back-filling and detailed report shall be submitted by BIDDER.

However, the successful bidder shall carry out the required investigation and tests to evaluate and determine the soil resistivity and soil thermal resistivity along the cable route, at cable laying depth, to the satisfaction of the owner.

12.4.2 THERMAL BACKFILLS:

For the purpose of price evaluation, the bidders shall quote the unit rate (Rs./meter-cube) for providing the thermal backfill of stable T.R. Value of 150°C Cm/w. The necessary technical data on the bidders proposal for stabilized thermal backfill shall be furnished along with the bid.

The successful bidder shall design, specify supply formulate, test and lay a suitable backfill, only if the owner desires and with the prior approval of the owner, if found

necessary after the receipt of the route survey report for thermal characteristics of the soil.

**12.5 ROAD CROSSINGS**

Whenever cable crosses the roadways or carriage ways it is preferable to cross on skew to reduce the angle of bend as the cable enters and leaves the road crossings. While crossing the roads, cable should be taken through HDPE(thickness 10mm) pipes. Only one single core cable should be taken through each pipe and the size of this pipe shall not be less than twice the diameter of the cable. The ends of the pipes shall be sealed properly to avoid rainwater seeping into the pipe. Bell mouths shall be provided. HDPE pipes shall be ISI approved.

**12.6 CABLE OVER BRIDGES**

At places where the cable is to be routed over culverts and long bridges ladder type cable trays suitable for withstanding atmospheric conditions, may be used. Cable is to be clamped on the trays and adequate sun shield covers are to be provided on these trays. The sun shield covers shall be fabricated out of 16 gauge MS sheet. Before work can proceed across the bridges, it is necessary to obtain consent from the concerned authorities.

Drawings shall be submitted showing the proposed position of the cable and the method of laying. In cases where the cable is laid on the provided troughs on the bridges, the troughs should be filled up with shock absorbing materials such as sand. When laying the cable on long bridges, the longitudinal expansions caused by temperature differences shall be taken into consideration and suitable cable loops should be provided at the piers of the bridges.

12.7 **RAILWAY CROSSING**

For crossing railway tracks, the cable should be laid in reinforced spun concrete at such depths as may be specified by the railway authorities but not less than 1 meter measured from the bottom of sleepers to the top of the pipe. Or the railway crossing can be made through HDD method by placing HDPE pipes (10 mm thick) of diameter twice the cable diameter and then drawing the cables through them. This shall be done after obtaining permission from railway authorities.

12.7.1 **PROTECTION OF OTHER UTILITY SERVICES**

a) As the trenching work proceeds and existing facilities of other authorities are exposed, adequate steps shall be taken to protect such facilities, and it is advisable to obtain the approval of the concerned authorities for the method of support adopted so as to avoid possible claims for damages subsequently. The utility services likely to be encountered underground are power and telephone cables, drainage and drinking water pipe lines

etc. The usual method of giving temporary support is by means of brick piers, or lashings from pieces of timber or bars placed at frequent intervals across the trench from which the services may be slung while the work is in progress. Before reinstating such facilities the soil shall be well rammed under them so that they are well kedded and according to circumstances, permanent brick or concrete support may have to be built under them. When the proposed cable route lies along side high wall, specifically if there are retaining walls or bride abutments, the trench should be kept as far away from the wall as possible so as to prevent the excavation affecting the stability of the wall. It is better if an alternative route can be found. In order to avoid damages to the existing utilities encountered in the cable route i.e water pipe lines ,gas pipelines , different cables and sewerage lines etc if necessary they should be shifted to facilitate laying of

XLPE cables. Charges for such supplementary works depending on the field conditions will be reimbursed by TGTRANSCO at rates arrived out of mutual agreement.

a) Accidental damage to any facility shall be reported with the least delay to the owning authorities under intimation to the TGTRANSCO by the engineer in charge of the work either personally or telephonically. Such reports shall be later confirmed in writing. If the bidder is not responsible for the damage, the fact shall be clearly stated at the time the report is made. The bidder is liable to pay for all the damages caused by his workmen. He should also repair and make good any damage caused to the existing public or private roads or paths. In case of public or private road or paths, he shall back fill the trench up o 15 cm. above the ground level.

b) **PREVENTION OF DAMAGES DUE TO SHARP EDGE**

After any cable has been laid and until the whole of the cables to be laid in the trench have been covered with their protective covers, no sharp metal tools such as spades, crowbars or fencing pins shall be used in the trench or placed in such a position that they may fall into the trench. Pullers used during the laying of the cable shall not have sharp projecting parts liable to damage the cable.

## 12.8 JOINTING OF CABLE

a) Jointing of cable shall be in accordance with the relevant standards and manufacturer's special instructions.

b) Cable seals shall be examined to ascertain whether they are intact and also that cable ends are not damaged. If the seals are found broken or sheath punctured, the cable ends shall not be jointed until the same are examined and tested by the Purchaser's Officers. Before jointing is commenced insulation resistance of both sections of the cable to be jointed shall be checked by 1000 V megger.

## 12.9 CABLE TERMINATIONS

a) Cable terminations for outdoor shall be done in accordance with the relevant standards and manufacturer's special instructions.

b) Supplier shall supply complete cable terminating tools and accessories.

## 12.10 EARTHING METAL SHEATH

a) Metal sheath of the cable shall be bonded to the earthing system as per relevant standards and manufacturer's recommendations.

b) All metal pipes or conduits in which the cables have been installed should be efficiently bonded and earthed. Earthing and bonding should be done in accordance with IS 3043 code of practice for earthing. The bidder has to supply complete earthing materials required.

c) The bidder is responsible for Complete earthing system for the required short circuit current as specified in GTP except at substation end.

The cable installation, jointing and termination shall generally conform to manufacturer's recommendation and Indian Electricity Rules or CEA's regulations under section 53 of the Electricity Act 2003, as may be applicable.

**12.11 CLAMPING ARRANGEMENT**

The clamps necessary for the horizontal and cantilever type supports have to be supplied by the bidder. Clamps necessitated in case of trefoil formation shall be supplied and fixed at regular intervals. The clamps shall be fabricated out of 75x8 mm MS flat. The bidder shall also supply bolts and nuts required for fixing the clamps.

12.12 **DANGER BOARDS**

The bidder shall provide danger boards indicating high voltage at all the cable terminations.

**13.0 SUPPORTING STRUCTURES FOR CABLE TERMINATION**

Three structures at both the termination ends or special design tower at line side for erecting online termination structure of the cable shall be formed by bidder, including the required foundations as per approved drawings. Earthing is required to be provided by bidder for the three terminations separately at both the locations. Cable is to be run through HDPE **(**thickness 10mm**)** conduit pipe up to 1 meter above the ground level at each termination location. The support structures for cable terminations at both ends are in the scope of bidder and the supporting structure for LAs at line side is in the scope of bidder. The Gantry at Sub-Station side is not in the scope of this specification.

**14. CO-OPERATION WITH OTHERS**

The supplier shall post a competent Engineer for supervision along with competent assistants to assist supervision Engineer at site who shall be stationed at site and shall be responsible for the cable laying, Jointing and end terminations including site testing and commissioning and handing over to the purchaser

The supplier’s supervising Engineer shall co-operate with Purchaser’s officers, and other service departments during the contract period of all matters of common interest and shall ensure that all works are carried out without obstructing works executed by others. The supplier’s supervising Engineer shall ensure all necessary safety precautions required to prevent damage to any equipment, for which supplier is responsible. Attention of the supplier is drawn to the fact that some of the works have to be carried out adjacent to the existing installations which are electrically live. Great care shall, therefore, be taken to ensure that no interference or damage is caused to the working personnel. It will be the responsibility of the suppliers supervising Engineer to ensure that suitable safety measures are taken.

## 15 LINES AND GRADES

All the works shall be performed to the lines, grades and elevations indicated on the drawings. The bidder shall be responsible to locate and layout the works. Basic horizontal and vertical control points will be established and marked by the Engineer at site at suitable points these points shall be used as datum for the works under the contract. The bidder shall inform the Engineer well in advance of the times and places at which he wishes to do work, in the area allotted to him, so that suitable datum points may be established and checked by the Engineer to enable the bidder to proceed with his works. Any work done without being properly located may be removed and/or dismantled by the Engineer at bidder's expense.

## 16 BILL OF QUANTITIES

16.1 The Bill of Quantities shall be read in conjunction with the instructions to Bidders, General and Special Conditions of Contract, Technical Specifications and Drawings.

16.2 The quantities given in the Bill of Quantities are estimated and provisional, and are given to provide a common basis for bidding. The basis of payment will be the actual quantities of work ordered and carried out, as measured by the Contractor and verified by the Employer and valued at the rates and prices tendered in the priced Bill of Quantities, where applicable and otherwise at such rates and prices of the Employer may fix within the terms of the Contract.

16.2.1 The rates and prices tendered in the priced Bill of Quantities shall, except in so far as it is otherwise provided under the Contract, include all constructional plant, labour, supervision, materials, erection maintenance, insurance, profit, taxes and duties, together with all general risks, liabilities and obligations set out or implied in the contract. The whole cost of complying with the provisions of the Contract shall be included in the items provided in the priced Bill of Quantities, and where no items are provided the cost shall be deemed to be distributed among the rates and prices entered for the related items of work.

16.2.2 General directions and descriptions of work and materials are not necessarily repeated nor summarized in the Bill of Quantities. Reference to the relevant sections of the contract documentation shall be made before entering prices against each item in the price Bill of Quantities.

16.2.3 The method of measurement of completed work of payment shall be in accordance with relevant I.S.S. Codes.

16.2.4 Rock is defined as all materials which, in the option of the Purchaser require blasting or the use of metal wedges and sledge hammers, or, the use of compressed air, drilling for its removal, and which cannot be extracted by ripping with a tractor at least with 150 brake H.P. with a single rear mounted heavy duty ripper.

# TECHNICAL DATA SHEETS

## 1.0 GUARANTEED TECHNICAL PARTICULARS FOR 220KV XLPE CABLE & ACCESSORIES

### 1.1 GUARANTEED TECHNICAL PARTICULARS FOR 220KV, 2500 Sq.mm XLPE INSULATED POWER CABLE

| Sl. No. | Description | Requirements | Particulars |
|---|---|---|---|
| 1 | Name and Country of manufacture | | |
| 2 | Manufacturer's type designation | | |
| 3 | Rated voltage | | |
| a) | Nominal : kV | 220 | |
| b) | Highest : kV | 245 | |
| 4 | Suitable for earthed or unearthed system | | |
| 5 | Permissible voltage and frequency variation for satisfactory operation | | |
| a) | Voltage (Volts) | 245 | |
| b) | Frequency (Hz) | 50 ± 5% | |
| 6 | Continuous current carrying capacity as below for the conditions (a), (b) & (c) | | |
| | - One Circuit operation : A | | |
| | - Two Circuit operation : A | | |
| | - Spacing between phases : mm | | |
| | - Spacing between Circuits : mm | | |
| | Temperature rise of 10% overload current : °C | | |
| a) | At the maximum conductor temperature of 90 deg C, directly buries at 1.5m depth, ground temperature of 30 deg C, soil thermal resistivity of 150 deg C- Cm/watt | 800/850 Amps (Min) under Two Circuit Operation | One Ckt Operation:<br>Two Ckt Operation:<br>Spacing between Ph:<br>Spacing between Ckts:<br>Temp Rise 10% OL Current: |
| b) | At the Maximum conductor temperature of 90° C, laid in closed RCC Trenches, ambient air temperature of 50° C : | 800/850 Amps (Min) under Two Circuit Operation | One Ckt Operation:<br>Two Ckt Operation:<br>Spacing between Ph:<br>Spacing between Ckts:<br>Temp Rise 10% OL Current:<br>Trench Dimensions: |
| b) | At the Maximum conductor temperature of 90° C, laid in free air, ambient air temperature of 50° C : | | One Ckt Operation:<br>Two Ckt Operation:<br>Spacing between Ph:<br>Spacing between Ckts:<br>Temp Rise 10% OL Current: |
| 7 (i) | Rating factors applicable to the current in cl.No.6 (a) & (b) i) two circuits operation for the following variations/ conditions of installation. | | |

| | | | |
|---|---|---|---|
| a) | Variation in ground temperature from 25°C to 50°C in steps of 5°C for cables laid directly in ground & in trenches. | | |
| b) | Variation in Ambient Temperature from 25°C to 55°C in steps of 5°C | | |
| c) | Variation in soil thermal resistivity from 120-150 Deg C-cm/W. | | |
| d) | Group rating factor for different spacing (center to center) of cables installed in flat formation laid directly in ground. | | |
| e) | Group rating factor for different spacing (center to center) of cables Laid in closed RCC Trenches | | |
| 8 | Short circuit capacity: | | |
| a) | Short circuit current kA (rms) | Min. 50 | |
| b) | Duration of short circuit (sec) | Min. 1.0 | |
| c) | Permissible conductor temperature for the short circuit duty with conductor temperature as 90°C before inception of short circuit. | Max. 250 | |
| 9 | Dielectric loss angle at normal frequency and rated voltage | | |
| 10 | Conductor | | |
| a) | Material | | |
| b) | Nominal cross sectional area ($mm^2$) | 1000/1200 | |
| c) | Number and nominal diameter of stands (No. / mm) | | |
| d) | Nominal diameter (mm) | | |
| e) | Maximum D.C resistance of conductor for at 20°C. (Ω/Km) | | |
| f) | Maximum A.C resistance of conductor for at 90°C. (Ω/Km) | | |
| 11 | Impedances at 50Hz | | |
| a) | Positive & Negative sequence = Ω/Km | | |
| b) | Zero sequence = Ω/Km | | |
| 12 | Electro-static Capacitance at 50Hz (μF/km) | | |
| 13 | Maximum charging current at the rated voltage (A/Km) | | |
| 14 | Conductor screening : | | |
| a) | Material | | |
| b) | Extruded/wrapped or both | | |
| c) | Nominal Thickness (mm) | 1.5 (Nom)<br>1.3 (Min) | |
| 15 | Insulation | | |
| a) | Material of insulation | | |
| b) | Extrusion and curing system | | |
| c) | Dry or steam curing | | |

| | | | |
|---|---|---|---|
| d) | Extruder Thickness of insulation | | |
| 1) | Nominal Thickness (mm) | 27.0 | |
| 2) | Minimum Thickness (mm) | 24.3 | |
| e) | Variation in thickness as per IEC 60840 clause 10.6.2 | | |
| f) | Insulation resistance at 90 °C (Ω.m), 20 °C (Ω.m) | | |
| g) | Maximum dielectric stress at the rated voltage (kV/mm) | | |
| i) | At the conductor screen (kV / mm) | | |
| ii) | Mean (KV / mm) | | |
| iii) | At the insulation screen (kV / mm) | | |
| 16 | Insulation screen : | | |
| a) | Material | | |
| b) | Extruded / wrapped or both | | |
| c) | Thickness (mm) | 1.5 (Nom)<br>1.3 (Min) | |
| 17 | Bedding | 2.0 ( Water Swellable Tape) +0.55 ( Copper Woven Tape) | |
| a) | Material | | |
| b) | Nominal Thickness (mm) | | |
| 18 | Metallic Sheath | | |
| a) | Type of material | | |
| b) | Nominal Thickness (mm) | 2.5 | |
| c) | Minimum thickness at any point (mm) | 2.1 | |
| d) | Nominal outer diameter (mm) | | |
| e) | Whether the sheath is to be earthed at both termination? (Yes / No) | | |
| f) | Sheath induced voltage corresponding at the rated current (V / km) | | |
| g) | Sheath current corresponding to the rated current (A) | | |
| h) | Screen loss corresponding to the rated current (W/km) | | |
| i) | Sheath Voltage corresponding to the symmetrical short circuit current (kV / km) | | |
| 19 | Short circuit capacity of metallic sheath: | | |
| a) | short circuit current (kA) | Min. 50 | |
| b) | Duration of short circuit (sec) | | |
| c) | Permissible sheath temperature for the short circuit duly with conductor temperature as 90°C before inception of short circuit | Min. 1.0 | |
| 20 | Outer sheath | HDPE | |

| | | | |
|---|---|---|---|
| a) | Anti-corrosion layer | | |
| i) | Material | | |
| ii) | Nominal thickness (mm) | 5.0 | |
| iii) | Minimum thickness at any point (mm) | 4.2 | |
| b) | Anti-termite layer | | |
| i) | Material | | |
| ii) | Nominal Thickness (mm) | | |
| c) | Whether both layer are extruded in one process? (Yes / No) | Yes | |
| 21 | Overall diameter of completed cable (mm) | | |
| 22 | Unit weight of completed cable (kg/m) | | |
| | Unit weight of Copper content (kg/m) | | |
| | Unit weight of Aluminium content (kg/m) | | |
| 23 | Minimum installation radius of the cable (mm) | | |
| 24 | Permissible pulling tension when pulled with a eye (kg) | | |
| 25 | Cable Drums: | | |
| a) | Dimensions (Flange diameter) | | |
| b) | Barrel diameter | | |
| c) | Gross weight (kg) | | |
| d) | Standard shipping length (m) | | |
| e) | Maximum shipping length (m) | | |
| 26 | | | |
| a) | Maximum dielectric loss of 3-phase cables laid in ground at the rated voltage, freaquency and the maximum conductor conductor temperature (kW/km) | | |
| b) | Total losses of 3 phase cables at rated voltage and rated frequency with the rated current the condition with the rated current (Kw/Km) | | |
| 27 | Attenuation to carrier signal operating over a frequency range of 50-200 kHz | | |
| 28 | Phase to ground characteristic impedance at 50-200 kHz | | |
| 29 | Maximum shelf life | | |
| b) | Cable (year) | | |
| c) | Termination (year) | | |
| d) | Straight joints (year) | | |
| 30 | Power frequency withstand volage (kV) | 318 | |
| 31 | Lightning impulse withstand voltage (kVp) | 1050 | |
| 32 | Maximum partial discharge magnitude at 1.7 $U_0$ (pC) | | |

1.2) SCHEDULE OF GUARANTEED TECHNICAL PARTICULARS FOR 220KV 1000/1200Sqmm End Terminations

Outdoor type cable end termination (sealing end)/Plugin Type for GIS modules

| | | | |
|---|---|---|---|
| 1. | Manufacturer's Name | : | |
| 2. | Country of Manufacture | : | |
| 3. | Class and Type | : | |
| 4. | No. of years the design is in commercial use | : | |
| 5. | Rated Voltage Kv | : | |
| 6. | Rated Continuous Current Amps | : | |
| 7. | Size of sealing end termination | : | |
| 8. | Total Creepage Distance (mm) | : | |
| 9. | Maximum Conductor size, Cu (Sq.mm) | : | |
| 10. | Details of Terminal Connector | : | |
| 11. | Power Frequency Voltage 1 Min Dry withstand | : | |
| | : Test kV. Rms | | |
| 12 | Power Frequency Voltage Wet withstand | : | |
| | Voltage kV | | |
| | Time : Sec. | | |
| | KV | | |
| 13. | Power Frequency Voltage Dry withstand | : | |
| | Voltage kV. Rms | | |
| 14. | Flashover voltage | : | |
| | Dry KV rms | | |
| | Wet KV rms | | |
| 15 | Radio Interference Voltage (R.I.V) Test (Micro Volts) | : | |
| 16. | Partial Discharge (corona) extinction Test | : | |
| | a) Extinction Voltage kV rms | | |
| | b) Minimum Detector Sensitivity PC | | |
| 17. | Impulse Voltage Lightning Voltage Dry withstand kV (Crest) | : | |
| 18. | Direct Voltage 15 Min Dry withstand kV | : | |
| 19. | Description of Materials used in the terminations with electrical & mechanical Particulars | : | |
| 20. | Mounting Structure Details for termination | : | |
| 21. | Electrical & Mechanical Particulars of | : | |
| | a) Heat Shrinkable Tubing | : | |
| | b) Heat Shrinkable Moulded Parts | : | |
| | c) Heat Shrinkable adhesives / sealents | : | |
| 22. | Type Tested to [Standard (s)] | : | |
| 23 | Other Details (Material of Insulator, Colour of Insulator, Weight etc) | : | |
| | | | |
| | | | |
| | Please Enclose complete Technical literature | : | |

1.3) 220KV 1000/1200 Sqmm Normal Straight Joint (Earthing Type) And Straight Joint Insulated / Cross Bonding Joint

| | | | |
|---|---|---|---|
| 1. | Manufacturer's Name | : | |
| 2. | Country of Manufacture | : | |
| 3. | Type (Design) of Joint | : | |
| 4. | No. of years the design is in commercial use | : | |
| 5. | Rated Voltage kV | : | |
| 6. | Rated Current Amps | : | |
| 7. | Suitable for cable conductor Sq.mm | : | |
| 8. | Connector, Type, Material | : | |
| 9. | Partial discharge test 245 kV PC | : | |
| 10. | A.C. Withstand Voltage kV | : | |
| 11. | Impulse withstand voltage +ve & -ve 10 times kV | : | |
| 12. | Load Cycling 90degC + 5 degC (No. of Cycles) | : | |
| 13. | Load Cycling as above under water at kV (No. of Cycles) | : | |
| 14. | D.C. Withstand kV Hrs | : | |
| 15. | D.C. Withstand Voltage 15 Min | : | |
| 16. | Conductor thermal short circuit 250degC for 1 sec | : | |
| 17. | Shield thermal short circuit 250degC for 1 sec | : | |
| 18. | Type Tested to standard (S) | : | |
| 19. | Maximum conductor temperature in joint at rated current. | : | |
| 20 | Additional Information (Type of Compound filling into coffin box coffin box material, weight of completed joint etc | : | |

1.4) 220KV Cable Covering Protection Units / Surge Voltage Limiters:

| | | | |
|---|---|---|---|
| 1. | Manufacturer's Name | : | |
| 2. | Country of Manufacture | : | |
| 3. | Type of material | : | |
| 4. | Dimensions / Weight mm/kg | : | |
| 5. | Rated Voltage kV | : | |
| 6. | Characteristics | : | |
| 7. | Nominal discharge current KA | : | |
| 8. | Power frequency withstand voltage KV | : | |
| 9. | Power frequency spark over voltage kV | : | |
| 10. | Reseal voltage | : | |
| 11. | Pressure relief class | : | |
| 12. | Impulse high current short duration discharge (Amps) | : | |
| 13. | Additional Requirements | : | |

3.0) Link box details :

| Sl.No. | Technical Particulars | |
|---|---|---|
| 1.<br>a) | Details of<br>Link Box Material | |
| b) | Type of Application | |
| c) | Drawings | |
| d) | Accessibility | |
| e) | Suitability | |
| f) | At Circuit end | |
| g) | Option | |
| h) | Special arrangement | |
| i) | Accessories | |
| 2. | Cross-bonding link box (CBB Concentric bonding leads of suitable size to suit 3 nos. of Co-axial cable entries to CBB | |
| 3. | Sheath Bonding Cables | |
| 4. | Cross Bonding of Cable Sheath | |
| 5. | No. of Joints | |
| 6. | Sheath standing voltage to earth for rated cable current | |
| 7. | Sheath standing voltage to earth when an external 13-symmetrical through fault | |
| 8. | Transposition of cables | |
| 9. | Temperature Transducers | |
| 10. | Numerical Distance Scheme optional Item | |
| 11. | Installation of Thermo-Couples | |
| 12. | Remote transmission of monitored temperature | |

4.0) List of consumables to be supplied by the vendor

| Sl.No. | Description | Quantity |
|---|---|---|
| | | |

5.0) Schedule of instruction manuals/catalogues/calculations/certificated etc.

| Sl.No. | Description | Quantity |
|---|---|---|
| 1. | Description of extrusion, curing and cooling processes | |
| 2. | Transport, storage and handling practices for cables and accessories | |
| 3. | Electrical characteristics (conductor resistance, capacitance, electrical stress etc.) of the cables | |
| 4. | Characteristics of sheath voltage limiters and surge arresters | |
| 5. | Manning schedule for one set of three straight through joints and one set of three sealing ends | |
| 6. | Design calculations – wherever called for against respective clause of specification and GTP | |
| 7 | Type test certificates issued by a recognized institution | |

NOTE : Not exhaustive. Bidders may furnish additional documents as required.

## 6.0) SCHEDULE OF DRAWINGS/GRAPHS

The bidder shall furnish the following drawings along with the graph.

| Sl.No. | Description | |
|---|---|---|
| 1 | Cross section and dimensional drawings of the cable with weight | |
| 2 | Detailed drawings of the straight through joint. | |
| 3 | Detailed drawings of the direct earthing link boxes.<br>a) Weather proof type<br>b) Structure mounted type | |
| 4 | Detailed drawings of sheath earthing link boxes weather proof type | |
| 5 | Detailed drawing of the cable earthing arrangement | |
| 6 | Detailed drawing of the cable protection unit (S.V.L) | |
| 7 | Outline dimensional and assembly drawings of cable sealing end. | |
| 8 | Outline dimensional and assembly drawings of<br>a) Normal straight joint | |
| 9 | Detailed drawings of cable termination supporting structure and foundation. | |
| 10 | Schematic drawings of cables installation<br>a) Cable screen earthed at both ends.<br>b) Installation of cables in trench(direct buried)<br>c) Installation of cables in pipe/ducts<br>d) Installation of cables in RCC through/over open drains<br>e) Plan and cross sectional drawings of cable jointing bay in detail. | |
| 11 | Detailed drawing of RCC cable protection Covers. | |
| 12 | Detailed drawing of cable reel/drum. | |
| 13 | Characteristics of cable temperature Vs current | |
| 14 | Characteristics of cable and sealing end-power factor Vs temperature. | |
| 15 | Characteristics of cable and sealing end-power factor Vs voltage. | |
| 16 | Characteristics of cable and sealing end-partial discharge magnitude or Vs temperature. | |
| 17 | Characteristics of cable covering protection unit (S.V.L) | |
| 18 | Foundation drawing of<br>a) Cable end termination structure<br>b) Special link box mounting structure | |
| 19 | Arrangement of joint chamber with dimensions | |
| 20 | Arrangement of terminal structure for outdoor sealing end with civil designs with earthing arrangement cable | |
| 21 | Cross section of sheath bonding cable | |
| 22 | Drawing of straight rollers and angle rollers | |
| 23 | Trefoil clamp | |

## Technical Specifications of HDPE Duct pipe, RCC Chambers & Associated works for laying in UG-XLPE power cable trench:

**Name of the Work: HDPE Duct & Associated works in UG-XLPE power cable trench:**

**Technical Specifications:**

1. The HDPE pipe shall conform to the following standards and the specifications described in the following section.

i. IS:4984 - Specifications for HDPE Pipe

ii. IS :2530 - Test method for polyethelene moulding materials and compounds

iii. IS: 14151 (part1) - Polyethelene pipes for sprinkler irrigation systems (part-1 pipes)

iv. IS: 9938 - Recommended colours for PVC insulation for LP wires and cables.

v. Tec-Spec No. - HDPE pipe for use as duct for optical fibre cable. (G/CDS-08/01/Dec-99)

vi. IS: 7328 - HDPE material for moulding and extrusion

vii. ASTM D 1693 -Test method for environmental stress cracking of polyethelene plastic

viii. IS:12235 (Para9) - Method of test for unplasticized PVC pipe for portable water supplies, impact strength at Zero Degree Centigrade

ix. ASTMD 1505 - Test method for density.

x. ASTMD 3895 - Method for oxidation induction test.

ii) **HDPE duct pipe:**

iii)

| Sl. No. | Parameter | Specific Value | Specification |
|---|---|---|---|
| | Dimensions of the pipe | | |
| | Size: OD/ID | 40/33 mm+0.4mm | BSNL/DOT |
| | Wall thickness | 3.5 mm+/-0.2mm | -Do- |
| | Appearance | Inside & outside surface shall be smooth | |
| | Colour | Green/Orange/Blue with matching lines | |
| | Melt flox Index | 0.2 to 1.1grms per 10 min at | IS: 2530:1963 |

| | | | |
|---|---|---|---|
| | | 190 and 5kg load | |
| | Density | 940 to 958 kg/m3 at 27°C | |
| | Reversion test | 3% Max | IS:4984-1995 |
| | E.S.C.R (Environment Stress Crack Resistance) | Samples shall not crack and split | ASTM:D-1693 |
| | IPCRT(Internal Pressure Creep Rupture Test) | Duct shall not show swelling ,leakage for 48hrs, 80°C | Is:4984-1995 |
| | Crush Resistance test | Deflection not greater than 10% with load on 50kg: deflection not greater than 2% after recovery of 5 minutes | |
| | Tensile strength | 20N/mm2(Min) | IS14151(part-1) |
| | Temperature Resistance & Range of product use | -20°C to +60°C | |
| | Impact Resistance | No crack and split shall be observed while dumping 10 Kg weight from 1.5 mt drop height with tup of the weight has 50,8mm dia radius edge | |
| | Coefficient of friction | Internal surface of the duct shall have less than 0.06 | |
| | Standard Length of Pipe | 1000 mtrs (+100) | |
| | Max outer dia of the OFC cable that can be installed by blowing technique in the HDPE pipe | 16 mm | |
| | Elongation shall be | >600% | |

**3. Plastic (Duct) Coupler:**

Size: 40 mm dia

The coupler shall be used to join two HDPE pipes. High pressure rated 10 bar air tight coupling for HDPE duct which reduces blowing resistance and allows for greater lengths of OF cable.

**4. Duct Cap :**

Size: 40mm dia

These shall made of rubber used for sealing the duct ends before dispatch and during transportation and laying to prevent dirt, dust, water or any other particulars from entering the duct.

**5. Cable sealing plug (Simple Plug):**

Size: 40 mm

Duct Inner Diametre: 33 mm (+0.2mm)

Cable outer diameter: 14 to 16 mm

Simple plug with split bush assembly for sealing around cable in duct installations. Simple installation around in place cables, seals the duct from moisture, dust and dist going inside the duct in man holes.

**6. RCC Route Markers**

The HDPE duct shall be clearly marked at intervals of 0.2 Km with the RCC route markers of dimensions 900x300x60mm with the following information on the markers.

- TGTRANSCO OFC with Logo
- Year of commissioning
- Running length marking

**7. Tests shall be carried on finished HDPE pipe:**

c) Reversion test
d) E.S.C.R (Environment Stress Crack Resistance)
e) IPCRT(Internal Pressure Creep Rupture Test)
f) Crush Resistance test
g) Tensile strength

**8. Type Tests:**

The HDPE pipes and accessories offered to be supplied should have been type tested either as per the requirement specified in the section 1&2 of relevant TEC specifications including latest amendments. The Bidder shall submit along with their bid the earlier carried out type test reports and the TEC certificates for the offered HDPE pipe & accessories.

**9. Factory Acceptance Test:**

The tests mentioned in sec -7 shall be carried out as factory acceptance for the HDPE pipe and accessories. The air pressure tests of plastic couplers shall be carried out at least for two joints of HDPE pipe.

The HDPE Duct shall be entirely suitable for laying Optical Fibre Approach Cable (OFAC) of 48F through HDPE pipe in the XLPE cable trenches. The HDPE Duct pipe shall have additive to prevent rodent attack.

The HDPE Duct& Accessories shall also meet the following requirements:

i. Fire retardant and no acid gas evolution.

ii. Resistance to ultra-violet deterioration.

iii. Anti-moisture penetration.

**10. SUPPLY: HDPE PIPE DRUMS:**

THE HDPE PIPE SHALL BE SUPPLIED IN NON-RETURNABLE STRONG WOODEN (OR ALTERNATIVELY STEEL) DRUMS PROVIDED WITH LAGGING OF ADEQUATE STRENGTH, CONSTRUCTED TO PROTECT THE CABLE

AGAINST ANY DAMAGE AND DISPLACEMENT DURING TRANSIT, STORAGE AND SUBSEQUENT HANDLING AND STRINGING OPERATIONS IN THE FIELD. THE BIDDER SHALL LIST THE INFORMATION CONCERNING THE FOLLOWING: WEIGHT, DIMENSIONS, MATERIAL AND STANDARDS APPLIED.

THE DUCT ENDS SHALL BE PROPERLY SEALED AND SECURED IN TRANSPORT AND HANDLING.

**ONLY ONE LENGTH OF 1000 METERS** HDPE PIPE SHALL BE WOUND ON EACH DRUM. EACH DRUM SHALL BE ACCOMPANIED BY THE FOLLOWING INFORMATION.

a. MANUFACTURER'S NAME AND ADDRESS
b. TYPE OF THE CABLE
c. GROSS WEIGHT OF THE HDPE PIPE AND DRUM
d. NET WEIGHT OF THE CABLE
e. LENGTH OF THE CABLE
f. DRUM AND LOT NUMBER
g. NAME AND ADDRESS OF THE CONSIGNEE
h. MONTH AND YEAR OF MANUFACTURE
i. ROTATION OF DRUM

**11. Installation of HDPE duct pipe: (Excavation of trench for UG-XLPE power cable is in the scope of XLPE cable laying Contractor. )**

**Installation of HDPE duct and associated works shall be carried out strictly in coordination with the XLPE cable works as this HDPE duct pipe shall be laid in parallel with XLPE cable laying and the trench shall be back filled only after laying of both XLPE cable and HDPE duct pipe.**

Specifications for HDPE pipe and accessories have been provided in sec 2 to 6 shall be laid in parallel with XLPE cable and its bedding by making the surface smooth and providing 80mm stone free sand bedding. After laying the pipe additional sand shall be added to increase the height sand layer to a total of 200mm and hence positioning the HDPE duct in the middle of the sand layer.

(21) LINE UP OF TRENCH SHALL BE SUCH THAT HDPE DUCT WILL BE LAID IN STRAIGHT LINE, BOTH LATERALLY AS WELL AS VERTICALLY EXCEPT AT LOCATIONS WHERE IT HAS TO NECESSARILY TAKE A BEND BECAUSE OF CHANGE IN ALIGNMENT OR GRADIENT OF TRENCH.

(22) WHERE THE BERM HAS BURROWED PITS OR FORESTATION, OR WHEN CABLE IS TO BE LAID ALONG CULVERTS/BRIDGES OR CROSS-STREAMS, TRENCH MAY BE MADE CLOSER TO ROAD EDGE, OR IN SOME CASES, OVER EMBANKMENT OR SHOULDER OF THE ROAD.

ix) DUCTS WILL BE LAID IN A FLAT BOTTOM TRENCH, FREE FROM STONES, AND SHARP EDGED DEBRIS.

x) THE DUCT WOULD BE PLACED IN TRENCH AS STRAIGHT AS POSSIBLE. HOWEVER, AT BENDS HORIZONTAL AND VERTICAL MINIMUM BENDING RADIUS FOR DUCT OF 1300 MM WOULD BE MAINTAINED.

xi) DUCTS WILL BE LAID PREFERABLY USING SPECIALLY DESIGNED DISPENSERS.

xii) DUCTS SHALL BE FREE FROM TWIST AND COLLAPSED PORTIONS. ANY SUCH PORTION WILL BE RECTIFIED BEFORE BACKFILLING BY USING COUPLERS.

xiii) ENDS OF DUCTS WILL ALWAYS BE CLOSED WITH END PLUGS TO AVOID INGRESS OF MUD, WATER OR DUST.

xiv) PRIOR TO ALIGNING THE DUCTS FOR JOINTING, EACH LENGTH OF THE HDPE DUCT WILL BE THOROUGHLY CLEANED TO REMOVE ALL SAND, DUST OR ANY OTHER DEBRIS THAT MAY CLOG, DISTURB OR DAMAGE THE OPTICAL FIBER CABLE WHEN IT IS PULLED OR BLOWN AT A LATER STAGE.

xv) THE DUCTS WILL BE JOINED WITH COUPLERS USING DUCT CUTTER & OTHER TOOLS AND WILL BE TIGHTENED AND SECURED PROPERLY.

xvi) THE DUCT JOINT WILL BE PRACTICALLY AIRTIGHT TO ENSURE SMOOTH CABLE BLOWING USING CABLE BLOWING MACHINES.

xvii) GL AND / OR RCC PIPES WILL BE USED AS ADDITIONAL PROTECTION FOR THE HDPE DUCTS AT RAIL / ROAD CROSSINGS, BUILT-UP AREA/CITY LIMITS, ON CULVERTS AND BRIDGES, AS REQUIRED.

xviii) CHAMBERING OR CONCRETING AROUND RCC/ GL PIPES AS ADDITIONAL PROTECTION ON BRIDGES, CULVERTS AND ALSO ON STRETCHES WHEREVER DEPTH OF EXCAVATION IS LESS THAN SPECIFIED WILL BE DONE.

xix) The supply & Laying of the HDPE pipe & associated accessories is the contractor's responsibility.

**BACK FILLING: (BACK filling & Reinstatement work of excavated trench is in the scope of XLPE power cable laying contractor.)**

v) **Reinstatement**: Reinstatement of excavated trench will be done with proper compaction

vi) **THE TRENCH SHALL BE BACK FILLED ONLY AFTER LAYING BOTH XLPE POWER CABLE AND HDPE DUCT.**

xx) THE TRENCH SHALL BE CLOSED AFTER INITIALLY FILLED WITH SIEVED SOIL OR SAND IN ROCKY TERRAIN FOR ABOUT 10 CM WHICH WILL ACT AS A CUSHION / PADDING AND THEN DUCT IS PLACED GENTLY OVER IT.

xxi) AFTER THAT ANOTHER LAYER OF 10 CM OF FINE SIEVED SOIL OR SAND IS POURED AND THEN ENTIRE TRENCH IS BACKFILLED WITH EXCAVATED MATERIAL.

xxii) UNDER NORMAL SOIL CONDITIONS DUCT IS DIRECTLY LAID IN TRENCH AND BACKFILLED. ADEQUATE DRY COMPACTION WILL BE DONE BEFORE CROWNING.

vii) **CROWNING**

xxiii) WHEN BACKFILLING HAS BEEN DONE UP TO GROUND LEVEL A HUMP OF SOIL IS MADE TO CATER FOR SOIL SETTLEMENT.
xxiv) ENTIRE EXCAVATED SOIL WILL BE USED FOR BACK FILLING.
xxv) CROWNING WILL BE CONFINED TO WIDTH OF TRENCH ONLY.

**Duct Integrity Test**

After backfilling ducts shall be tested for integrity. Two types of tests are conducted, viz., (Air Tightness Test and Kink-free Shape test).

g) **AIR TIGHTNESS TEST** THIS SHALL BE DONE BY PRESSURIZING 2 KM OF DUCT STRETCHES AT A TIME, BY CLOSING ONE END OF DUCT AND PASSING COMPRESSED AIR AT 5-6KG/CM2 FROM THE OTHER END. WHEN THE PRESSURE REACHES ABOUT 5KG/CM2, THE INLET OF THE DUCT IS CLOSED. FALL IN PRESSURE SHOULD NOT BE MORE THAN 50% IN 1(ONE) HOUR.
h) **KINK-FREE SHAPE TEST** TO CHECK THAT DUCT HAS NOT COLLAPSED OR KINKED A WOODEN CYLINDRICAL PIECE (SHUTTLE) OF SIZE 150 MM LONG AND 0.75 X D MM IN DIAMETER, (WHERE 'D' IS INNER DIAMETER OF DUCT), IS BLOWN INTO THE DUCT WITH FAR END FITTED WITH FLEXIBLE WIRE GRIP/STOCKING. THE WOODEN SHUTTLE SHOULD PASS THROUGH DUCT AT FAR END WITH OUT ANY OBSTRUCTION AND WITHIN APPROXIMATELY 10 MINUTES OR LESS.

a RCC ROUTE MARKERS SHALL BE PROVIDED AND INSTALLED TO MARK THE
LOCATION AND ROUTE OF BURIED OFC/ XLPE POWER CABLES.

**12. RCC JOINT CHAMBERS (MANHOLES):**

**SPECIFICATIONS: THE PRE CAST CYLINDRICAL RCC JOINT CHAMBERS SHALL MEET THE FOLLOWING REQUIREMENTS:**

a) SIZE: 1200MM(BOTTOM DIA) / 950 MM (UPPER DIA) X760MMX50MM ( DIA X HEIGHT X THICKNESS)
b) UPPER COVER: PRE CAST RCC 50MM THICKNESS AND DIAMETER PLATE SUITABLE FOR MANHOLE COVERING
c) BASE PLATE OF MANHOLE: PRE CAST RCC 80MM THICKNESS AND 950 MM DIAMETER PLATE

**13.CONSTRUCTION OF MANHOLES**:

- RCC CHAMBER MARKERS AND ROAD CROSSING MARKERS SHOULD BE PROVIDED
- THE RCC JOINT CHAMBERS (MANHOLES) SHALL BE PROVIDED TO HOUSE JOINT BOX AND OPTICAL FIBRE CABLE SERVICE LOOPS.
- THE LOCATION FOR THE JOINT BOXES SHALL BE FOR EVERY **500 METERS** OF THE SECTION IN THE REROUTE AND ADDITIONAL

CHAMBERS MAY BE PROVIDED AT ROAD CROSSINGS AND TURNINGS ETC.

- THE COVER SHALL INCLUDE TWO PERMANENTLY FIXED IRON HOOKS OF SUFFICIENT SIZE FOR REOPENING PURPOSE.
- MINIMUM 3MM THICKNESS GI STRIP RINGS SHALL BE USED INSIDE & OUTSIDE OF THE TOP EDGE OF THE MANHOLE CYLINDER TO AVOID DIRECT CONCRETE CONTACT BETWEEN MANHOLE CYLINDER AND TOP COVER AND AS WELL AS PROTECTION OF THE CONCRETE EDGE.
- THE BOTTOM OF THE MANHOLE SHALL BE AT THE DEPTH EQUAL TO THE DEPTH OF DUCT (TRENCH).
- THE MANHOLE SHALL BE ABLE TO WITH STAND A LIVE LOAD OF 20 TON VEHICLES AND 30% IMPACT OF THE MOVING VEHICLE.
- THE MANHOLES SHALL INCLUDE SUFFICIENT NO OF SUITABLE ENTRIES FOR INSTALLING HDPE PIPE ENTRIES AND EXITS.
- THE MANHOLES SHALL HAVE TWO HOLES IN EACH FOUR PERPENDICULAR DIRECTION TO HDPE PIPE ENTRIES AND EXITS.
- FIXTURES FOR PLACING CABLE AND SPLICED JOINT BOX IN THE MANHOLE SHALL BE PROVIDED.
- THE JOINT BOX SHALL BE MOUNTED VERTICALLY ON THE WALL OF THE MANHOLE.
- ALL HDPE PIPE ENDS SHALL BE PROPERLY SEALED WITH DUCT CAPS OR SIMPLE PLUGS.
- THE CHAMBERS SHALL BE FILLED WITH SAND

**14. MAINTENANCE:**

MAINTENANCE OF THE HDPE PIPES SHALL BE CARRIED OUT ONLY IN FAULT CONDITIONS OR FOR SPECIAL NEEDS. TO FACILITATE HDPE PIPES MAINTENANCE AFTER LAYING, THE FOLLOWING SHALL BE PROVIDED:

THE EXACT ROUTE DESCRIPTIONS, LOCATION OF JOINT CHAMBERS SHALL BE PROVIDED, BOTH TO Headquarters' office (Chief Engineer / SLDC/ Vidyut Soudha, TGTRANSCO, Hyderabad) and to THE TERMINAL sub-stations.

The Bidder shall provide/arrange any additional tools and test equipment (common and specialized) with recommended quantities necessary to install, operate and maintain all equipment to be supplied in this procurement/contract. This shall not be included/considered in the contract or evaluation of the bid.

15. The telecom works for HDPE supply and installation shall be done under the supervision of concerned telecom engineer. The HDPE duct and chamber shall be check measured by concerned Division Engineer telecom before commencing the new XLPE duct.