



GUJARAT ENERGY TRANSMISSION CORPORATION LTD.

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TECHNICAL SPECIFICATION FOR
SUPPLY, LAYING AND COMMISSIONING
OF
220kV 1Cx1200 sq. mm Cu -XLPE POWER
CABLE FOR
TRANSMISSION LINES
&
SUB-STATIONS

GETCO/ENGG/TECH. SPECI. –POWER CABLE 220 kV Cu/
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TECHNICAL SPECIFICATION FOR 220 KV XLPE CABLE

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TECHNICAL SPECIFICATION

1.1 SCOPE :

1.1.1 The scope includes design, engineering, supply, laying, testing & successful erection, testing & commissioning of 220 kV underground cable system on turnkey basis for intended projects as per tender schedule/Annexure.

1.1.2 The scope includes manufacturing, testing, packing, supply of 127/220 kV 1core 1200 sq. mm. Miliken Copper conductor XLPE insulated power cable, supply of all necessary accessories required for successful erection & satisfactory operation, supply of galvanized lattice cable end termination support structure including civil works, laying of cable and erection, testing & commissioning of the cable system for intended projects. On tower side, the scope includes necessary arrangement required for cable laying/dressing in trefoil formation up to cross arm including ladder/necessary clamping arrangement etc.

1.1.3 Supply of accessories includes

- a) Supply and Erection with best engineering practices pre-moulded straight through joints/Shield break joints along with associated accessories suitable for the above cable, including sheath bonding arrangements with supply of earth continuity cable, sheath bonding cable, sheath voltage limiters, link boxes, earthing sets (maintenance free) etc. as described in this specification.
- b) Supply and Erection with best engineering practices outdoor cable terminations required at both ends with supply & erection of galvanized lattice cable end termination support structure at Sub-Station end (including all ancillary works incl. civil works).

1.1.4 The scope also includes

- a) Preparation of trench by normal excavation / trenchless digging for laying of two circuits of cable in trefoil formation with non-metallic clamps.
- b) Required sand for bedding.
- c) Laying of cable in trefoil formation.
- d) Supply and positioning/laying of RCC slabs, Warning tape, Cable route & Joint markers etc. for each circuit.

e) Refilling the trench.

1.1.5 The bidder shall visit/survey the route before submitting the offer. The scope also includes route survey and preparation of cable route.

1.1.6 It is not 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 and induced voltage in the sheath shall not exceed 65 V, 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. T&P (Tools & Plant) required for laying, Jointing and termination shall be arranged by the bidder by certified jointers. The job is on turnkey basis.

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

2.0 STANDARDS

2.1 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:

Sl No.	Indian Standards	Title	International Standards
1.	IS:7098 Part-3	Specification for XLPE insulated PVC sheathed cables up to 220 kV	BS-5468
2.	IS:1255	Code of practice for laying of power cables	
3.	IS-3043	Code of practice for earthing	
4.	IS-5216	Guide for safety procedure and practices	

		in Electrical works	
5.	IS-8130	Conductors of Insulated Cables	IEC-60228.
6.		Power cables with extruded insulation & their accessories for rated voltages above 150 kV and up to 500 kV – Test methods and requirement	IEC-62067
7.		Guide to the dimensional limits of circular Conductors	IEC-60228A
8.		Tests on cable over sheath, Power cables, Insulators	IEC-60229, IEC-60840, IEC-60230
9.		Power Cables with extruded insulation and their accessories	IEC 502-2
10.		Calculation of continuous current rating of cables	IEC-60287
11.		Indian Electricity Rules -1956	
12.		Tests on cable over sheath which have a special protective function and are applied by extrusion	IEC-60229

The above standards are for guidance and shall be suitably extended for service voltage of 220 kV wherever applicable.

- 2.2 **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) IEC (ii) IS (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 and decision of the owner shall be final and binding to the bidder.

3.0 CLIMATIC CONDITIONS

i)	Location	
ii)	Max. ambient temp. (deg. C)	50
iii)	Min ambient temp. (deg.C)	4
iv)	Maximum daily average ambient air temperature (deg. C)	40
v)	Maximum Relative humidity (%)	95
vi)	Average number of the thunder storm days per annum	15
vii)	Average annual rainfall (mm)	150
viii)	Average rainy days	90 days / year
ix)	Max. wind pressure (kg/sq.m.)	150
x)	Max. altitude above mean seal	1000

	level (meters)	
xi)	Max. soil temp.at cable depth (deg. C)	30 to 40
xii)	Soil thermal resistivity	150 Deg. C- cm / Watt at depth of 2.0 Mtr.

4.0 PRINCIPAL PARAMETERS:

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

Sl No.	Item	Description
i)	Types of cable	127/220 kV XLPE
ii)	No. of cores	Single
iii)	Conductor size	1200 sq. mm compacted Miliken
iv)	Conductor material	Copper
v)	System voltage (Nominal / Highest)	220 kV / 245 kV
vi)	Metallic screen minimum fault current and its duration	40 kA for 1 sec.
vii)	System frequency & variation	50 Hz +/- 5%
viii)	1.2/50 micro sec. lightning Impulse withstand voltage	1050 kV (Peak)
ix)	1min. Wet Power frequency withstand voltage test	460 kV (rms)
x)	Rated continuous current In ground with the climatic conditions mentioned at clause 3.0 above	min. 780 Amps for S/C trefoil laying at 2.0 mtr. Depth
xi)	Maximum allowable temp. for Cable and accessories	
	a) During continuous operation in air at rated full load current the maximum temperature of the conductor shall not exceed	90°C
	b) The conductor temp. after rated short circuit as per Sl. No. 6 above	250°C
xii)	System earthing	Solidly earthed

5.0 GENERAL TECHNICAL REQUIREMENT

5.1 Design Considerations

- 5.1.1 The cable shall be suitable for buried installation with uncontrolled back filling and laying in the area likely to be flooded by water. 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 Cables shall be capable of satisfactory operation under a power supply system frequency variation of $\pm 5\%$, voltage variation of $\pm 10\%$ and combined frequency voltage variation shall be $+10\%$ & -15% .
- 5.1.3 Cable shall be suitable for operating under variable loading conditions varying from light load to continuous operation under full load.
- 5.1.4 The metallic part of insulation 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(6).
- 5.1.5 The thermal Resistivity of the soil is generally $150^\circ\text{C-cm / watt}$.
- 5.1.6 The cable system shall be designed to have a minimum useful life of not less than fifty years.
- 5.1.7 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 a reasonable factor of safety. The supplier shall confirm whether the cable can take this pulling load or not with supporting documents.
- 5.1.8 The outer sheath of the cable shall be given adequate chemical treatment in order to protect itself from rodent and termite attack.
- 5.1.9 The conductor shall be clean, uniform in size and shape, smooth and free from harmful effects.
- 5.1.10 The supplier shall supply the design calculations and associated details along with the offer in order to establish the specified minimum continuous current rating and short time current rating of the cable.

5.2 Construction details

5.2.1 Cable construction and material for 127/220 kV XLPE cables:

- 5.2.1.1 i) Conductor:** Single core conductor shall consist of stranded, segmental compacted circular (Miliken) plain annealed copper wires confirming to IEC-60228 / IS-8130. The wires shall be made of high conductivity copper and shall be stranded and compacted. The copper used for the conductor shall be highest purity. The nominal area of conductor shall not less than 1200 sq. mm. The minimum number of wires in conductor and DC resistance of conductor shall be as per IEC 60228 / IS 8130. Nos of Copper wires shall be specified in GTP.
- ii) Conductor screening:** Conductor shall be wrapped with one layer of non hygroscopic semiconducting tape compatible with continuous & emergency operating temperature of conductor. 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/tape 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 Minimum thickness of the conductor screen should be 0.8 mm.

- iii) **Insulation:** Insulation shall be cross-linked polyethylene (XLPE) and shall confirm the latest IEC / IS and of very high degree of purity and radiant cured (dry curing and dry cooling process). This XLPE insulation shall be applied by extrusion and vulcanized to form a compact homogenous body free from micro voids and contaminants. The nominal thickness of the insulation between conductor screen and insulation screen should be 27 mm nominal & 24.3 mm minimum. The eccentricity of insulation shall not be more than 10%.
- iv) **Non-metallic part of insulation screening:** The insulation screen shall consist of an extruded layer of thermosetting semi-conducting compound extruded directly over the insulation and shall be continuous and cover the whole surface area 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 screen, insulation and insulation screen shall be extruded in one operation by single common head process to ensure homogeneity and elimination of voids.** The Minimum-thickness of insulation screen should be 0.8 mm.
- v) **Water blocking tape (Longitudinal Water Barrier):** This shall be layer of Semi-conducting synthetic non-woven/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 nominal thickness of water blocking tape shall be as per latest relevant IEC / IS. One layer of copper woven semi-conducting tape shall be applied. Suitable layers of tape shall be provided to achieve minimum thickness of 1.0 mm.
- vi) **Metallic part of Insulation screening (Radial Moisture barrier):** This shall consist of corrugated Aluminium metallic sheath and shall be capable to carry fault current of 40 kA 1 sec. and also to perform as radial water barrier as well as strength member and shall be applied by suitable method. Extrusion application is preferred. However, seam welding of high quality is also acceptable. A suitable anti-corrosive treatment should be given to outer surface of Aluminium sheath. It should be of adequate thickness as per IEC, consistent quality and free from all defects. For seam welded sheath, the welding shall be of high quality & ensure minimum strength as that of Aluminum with no porosity. Necessary fillers and water swellable non-woven binder tape shall be used above metallic sheath to ensure overall round shape of cable.

Nominal cross sectional area of Aluminum corrugation sheath shall not be less than 570 sq. mm with minimum thickness of Aluminum corrugation sheath shall be 2.0 mm

- ix) **Outer Jacket:** The outer jacket shall consist of extruded, black, heavy duty HDPE compound type ST7 conforming to the requirement as per latest relevant IEC. The thickness of the outer jacket should be minimum 3.3 mm. The outer jacket shall be anti-rodent and anti-termite treated. Extruded semi conducting layer shall be provided over HDPE outer sheath.

CURRENT RATING: The cable will have current ratings and derating factors as per relevant IEC standard. The continuous current ratings shall be based on maximum conductor temperature of 90 °C with ambient temperature 40 °C, ground temperature 30 °C and soil thermal Resistivity 150 °C cm/watt for continuous operation depth of laying 2.0 mtr with 800 mm spacing between two circuits. The detailed calculation in support shall be submitted as per IEC. The bidder shall also submit details for safe permissible overload capacity of cable system in terms of ampere and duration.

The detailed calculation for three / one - second short circuit current rating values each for conductor and sheath shall be furnished. For calculating short circuit rating of metallic sheath, initial temperature shall not be considered less than 80 °C, whereas maximum temperature shall be considered not more than 160 °C in compliance with outer sheath.

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 if required. It shall be possible to test the insulation of sheath by opening the link. The sheaths shall be insulated from ground at the termination. The cable sheath covering and sheath insulators provided at the cable terminations shall be capable of withstanding (with an ample safety margin) sheath voltages arising from maximum momentary fault current of 40 kA (rms) 1 second. 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 not more than 65 volts to ground in any section. Detailed calculations shall be furnished to substantiate this. The earth continuity cable of 1.1 kV 1Cx300 sq. mm Copper conductor XLPE insulated HDPE ST-7 outer sheathed cable shall be laid and connected to earthpits along the route/ends to maintain earthpits at same potential.

- 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. Calculations for such over voltages shall be furnished along with the bid. The supplier in the offer shall also indicate suggested parameters for lightning arresters for use at the terminals.

5.2.4. **Cable accessories**

The sealing ends shall conform to the latest international standards, fully Type Tested and shall be of thoroughly proven design. The internal electric stress in the sealing end shall be controlled by the stress con 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 supported with wooden/PP blocks.

- a) **Pre-Moulded Straight through/Shield break 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. For mechanical protection the joint shall be covered by copper casing additionally. The surface shall be smooth and have no defects such as cracks, cuts and any other defects.

b) **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 be capable of withstanding loads/forces acting upon due to termination on tower cross arms.

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 well proven 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. It shall be compliant to short circuit capacity of conductor.

The main insulation of the sealing end shall be of prefabricated type that shall be comparable or 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 able surface shall be well controlled without causing harmfully high electrical stress.

The housing of the outdoor type termination shall be composite insulator with Track & Erosion resistant, Hydrophobic silicon rubber weather sheds having profile in line with requirements of IEC:815 having uniform quality and shall have sufficient strength against mechanical, electrical and thermal stresses. The color of the silicon insulator shall be grey. The insulator shall have creepage distance of 31 mm/kV with reference to highest system voltage.

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

- c) **Link boxes:** Link boxes shall be made of stainless steel plate of sufficient mechanical strength and enclose links and CCPUs. The insulated type straight through joints shall be connected to cross link box by means of 6.6 kV single core 300 sq. mm copper conductor XLPE insulated PVC outer sheathed cable and through links and surge arrestors (CCPU) to be connected to earth. Provision for transposition of sheath and screen by 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.

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

5.2.5

Identification

The external surface of the outer sheath shall be embossed with the following legend. "220 kV, 1200 sq. mm, XLPE, 2XA2Y (Name of the supplier), (Year of Manufacture), property of GETCO", GETCO may ask any Specific detail to be embossed shall be conveyed during approval of GTP stage. 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 150mm.

Besides above, progressive sequential marking of length shall also be provided at every one meter by laser printing, 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. GETCO 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."**

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 **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. These tests shall be carried out from any one of the reputed National / International Test Laboratories (accredited by laboratory accreditation body of the country).
The Type test reports shall not be older than 7 years and shall be valid till validity of offer.

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 performa 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 demonstrate satisfactory long term performance of the complete cable system.

6.2 Test Reports to be enclosed.

The tests must have been conducted on the cables & Accessories as per IEC 62067.

6.2.1 **Type Tests on Cable System**

Those bidders who have submitted type test reports as per IEC 62067 2011 clause no. 12.2: "Range of type approval" are considered for evaluation of Bid.

Successful bidder has to conduct, following type tests on the complete cable of offered size offered construction from NABL accredited laboratory as per IEC-62067 / IS:7098(P-3) with latest / amended / up to date IS/IEC & submit valid type test report.

The bidder has to submit the all type test reports as stated hereunder for the offered item along with the technical bid. The type test reports from NABL accredited/Government Laboratory/ International Test Laboratories (accredited by laboratory accreditation body of the country) shall not be older than Ten years. Type test reports shall be valid as on the last date of submission of bid.

Following type tests shall be conducted on the complete cable as per IEC-62067 / IS:7098(P-3) with latest amendment.

- a) Tests on conductor:
 - i) Annealing test
 - ii) D.C. Resistance test

- b) Physical test on insulation:
 - i) Test for thickness and dimensions of insulation
 - ii) Tensile strength and elongation at break
 - iii) Thermal ageing in air oven
 - iv) Hot set test
 - v) Shrinkage test
 - c) Resistivity test for semi-conduction layers
 - d) Thickness of metallic sheath
 - e) Physical tests for outer sheath:
 - 1) Measurement of thickness
 - 2) PE sheath
 - i) Tensile strength
 - ii) Elongation at break before and after ageing
 - iii) Hot-deformation
 - iv) Carbon black content
 - v) Shrinkage Test
 - f)
 - i) Thermal ageing on complete cable sample
 - ii) Tensile strength and elongation at break for insulation and outer sheath
 - iii) Resistivity test for semi-conducting layer
 - g) Bending test followed by P.D. test
 - h) Dielectric power factor and capacitance measurement at ambient temperature
 - i) Dielectric power factor measurement at elevated temperature
 - j) Load cycle test (Heating cycle voltage test) followed by P.D. test
 - k) Impulse withstand test followed by HV test
- Note: Prior to conducting the above type tests check on insulation thickness of the cable shall be carried out on a representative piece of cable length as per IEC-62067.

Important Note:

In case of non-submission / partial submission or type test reports of which validity is over, the bidder shall submit pending type test report/s from NABL accredited/Government Laboratory, in the event of an order, before commencement of supply without affecting delivery schedule, at no any extra cost to GETCO. Confirmation for above shall be invariably submitted along with technical bid. Furthermore, purchaser reserve right to select the sample from Manuf. Works & recommend the NABL lab to carry

out type tests in case of non-submission/ partial submission or type test reports of which validity is over. Successful bidder has to offer call/intimate to GETCO for selection of cable sample before sending cable sample at type testing laboratory.

6.2.2. **Type tests on accessories**

All the type tests as per IEC 62067 shall be carried out on offered kit to prove the general qualities and design of given types of cable accessories. The type shall conform to the latest IEC 62067

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

The Pre-qualification test shall be carried out on given cable system. The Pre-qualification test shall conform to the latest IEC 62067. The bidders who are conducting PQ test shall be considered subject to the condition that the bidder shall submit an undertaking they will submit the successful test reports for the above before award of contract. PQ test reports must be required for qualifying in bid.

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

The cable and accessories shall be subjects to all relevant routine, acceptance (as listed below) and special tests as described in IEC 62067 / IS:7098 P3 or any other relevant standards. The detailed list of such tests and copies of reports of such tests conducted on similar material shall be furnished with the offer. The Bidder is required to carry out all the acceptance tests as described in Specification according to IEC 62067 / IS:7098 P3 successfully in the presence of Purchaser's representative before dispatch. All special and routine tests shall be performed at the factory.

All test reports shall be submitted and got approved from the purchaser before delivery of material.

Sample shall be selected from offered lot, for not less than 10% (Ten percent) of nos. of cable drums, for conducting acceptance tests after considering the next highest whole numbers

List of acceptance tests

- a) Conductor resistance test with number of strands
- b) Conductor Weight Kg/meter (for reference Only)
- c) Test for dimensions of insulation – Thickness, % Eccentricity & Ovality
- d) Thickness measurement of insulation screen & conductor screen.
- e) Hot set test for insulation

- f) Void and contaminants test
- g) DC Resistance Metallic sheath at 20°C (at final inspection)
- h) Test for thickness of Aluminium sheath – Area of Aluminum sheath with all parameters Dt, Dg, h & P (to perform as stage Inspection before outer sheathing)
- i) Tensile strength & % Elongation at break of Al sheath
- j) Sheath Integrity Test for metallic sheath (Refer Annexure - A) (to perform as stage Inspection before outer sheathing)
- k) Mechanical strength of welded sheath (Refer Annexure - A) (to perform as stage Inspection before outer sheathing)
- l) Test for thickness of outer sheath
- m) Partial discharge test
- n) High voltage test (2.5U₀ for 30 min. on full drum)
- o) Measurement of capacitance
- p) 25 kV DC withstand test on outer sheath of cable.
- q) Complete cable Weight KG/meter (for reference Only), measurement of stage wise overall dia of cable.
- r) Verification of sequential marking as per GTP
- s) High voltage test (3U₀ for 4Hrs. on sample) or Lightning impulse test on 1 sample of offered lot.
- t) Insulation resistance test at room temperature & elevated temperature
- u) Verification of Drum length, Drum dimensions, end sealing, Packing & Marking on Drum

Note that tests mentioned at (h), (i), (j) & (k) above shall be offered & performed in presence of GETCO inspector as stage inspection on 100% cable drums for seam weld metallic sheath & 25% cable drums for seamless/extruded metallic sheath, after metallic sheath operation completion & before doing outer sheathing or any associated activity like bitumen layer etc. The same shall be included in Manufacturing Quality Plan to be submitted by bidder. However, note that GETCO reserves right for reduction of sampling plan or waiver of the stage inspection tests.

Tests to be performed on finished cable, under sr. no. (a) to (g) & (l) to (t) shall be performed on 10 % of offered drums.

Tests under sr. no.(u) to be performed on minimum 5 % of offered lot.

For cable accessories following tests shall be carried out on 10 % of offered lot as Acceptance Test. (Test through VC for overseas suppliers is acceptable)

1. Visual & Dimension verifications
2. Verification of kit content
3. HV & PD test on prefabricated stress con on 1 sample of offered lot for inspection

In case of overseas suppliers, Acceptance Tests shall be arranged in Indian NABL / Govt. approved Lab. OR any other lab.

approved by purchaser. All necessary arrangements & cost shall be borne by the bidder.

The bidder will not be paid for quantity used for Acceptance Testing.

6.4 Tests during installation

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

- a) Continuity
- b) Absence of cross phasing
- c) Insulation resistance to earth

6.5 Tests after installation

Following tests shall be carried out as per IEC - 62067 on the complete installation after completion of cable laying, jointing and providing all necessary accessories.

- a) Insulation resistance test
- b) DC/AC testing in accordance with IEC-62067
- c) Site tests on non-metallic sheaths in accordance with IEC-229.
- d) Test for detection and sealing of pinholes.

The supplier shall also indicate any additional special test at site recommended by them to ensure satisfactory operation.

Note: Site Testing shall include tests before and during Installation, tests on the complete installation during and after completion of cable laying, cable jointing and completion of end terminations. Supplier shall carry complete testing and commissioning equipment.

6.6 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.

6.7 Commissioning tests

All the Commissioning tests shall be carried out before commissioning of the complete cable system. The type tests shall conform to the latest IEC 62067.

7 INSPECTION

- 7.1 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.
- 7.2 No material shall be dispatched from its point of manufacture unless the material has been satisfactorily inspected and tested.
- 7.3 The supplier shall give 15 days (within India) / 45 days (Other than India) advance intimation to enable the purchaser to depute his representative for witnessing types, acceptance and routine tests.

8.0 QUALITY ASSURANCE PLAN

- 8.1 The bidder shall invariably furnish the following information along with this 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 supplier representative, copies of test certificates.

- vii. Information and copies of test certificates as on (i) above in respect of bought out items.
- 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 successful bidder shall within commencement period 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 alongwith 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 successful bidder shall submit the routine test certificates of bough out accessories and central excise passes for raw material at the time of routine testing if required by the purchaser and ensure that the quality assurance requirements of specification are followed by the sub-contractor.

8.3 The bidder have to submit detailed Field Quality Plan (FQP) for successful erection & commissioning of the cable system along with the bid, indicating role & responsibility of staff/supervisors. The FQP shall include pre-erection activity, during erection, care required from cable & public safety aspects, care during jointing/termination & all relevant activities for erection work.

9.0 DOCUMENTATION

9.1 All drawings shall conform to International Organization for Standardization (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 specification.

9.2 List of drawings and documents

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

- i) General information and overall dimensional (sectional) drawing.
- ii) Principal technical data with support calculation.
- iii) Description of insulation and sheathing.
- iv) Cable current Vs temperature characteristics
- v) Drawings indicating phase/sheath 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) QAP for supply items
- xii) Field Quality Plan for erection part
- xi) Any other relevant particulars.

9.3 The successful supplier shall, within commencement period of placement of order, submit two 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 two copies of the modified drawings for purchaser's approval. 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.
- iv) Sheath voltage limiting scheme
- v) **AREA OF CORRUGATED ALUMINIUM SHEATH**
 Area of Corrugated Aluminium Sheath

$$\text{Area} = \pi/4 (D_t^2 - D_g^2) * f$$
 where D_t = Diameter over trough in mm

$$D_g = \text{Diameter over gap below Aluminium Sheath in mm}$$

$$f = \text{Corrugation factor} = \frac{1}{\cos \{ \tan^{-1}(2h/p) \}}$$

$$h = \text{Height of Corrugation}$$

$$p = \text{Pitch of Corrugation}$$

- 9.4 The successful supplier shall also furnish two copies of bound manuals and 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. All manufacturing work against this specification prior to the approval of drawing 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 herewith.
- 9.7 Test Reports
- i) Two copies of Type test reports shall be furnished to the owner before commercial production of the concerned material.
 - ii) Four copies of special or acceptance test reports shall be furnished to the purchaser. Material shall be dispatched only after receipt of clearance certificate from purchaser.
 - iii) All records of routine test reports shall be maintained by the supplier at his works for periodic inspection by 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 Successful 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, etc., and depth.

- c) Detailed drawing 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.
- f) The successful bidder have to prepare & submit final (as built) route with precise lat-long.
- g) Approval of Sheath voltage limiting scheme as per Format attached.
- h) Method of construction of cable

The actual route map shall be prepared in sheets to the scale 1:500. 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.

The successful bidder has to prepare Auto CAD drawing of Method of construction (MOC) as per GETCO requirement & get approval before execution of work, in case of non-availability of MOC drawing.

9.9 The successful bidder shall also furnish three copies of bound manuals covering all relevant information and drawings pertaining to the cable and accessories including laying and commissioning.

9.10 Approval of drawings / work to be obtained for road crossing, culvert crossing, bridge crossing, etc. shall be in the scope of successful Bidder.

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 shall be such that joint can be avoided. The drawing can be referred with GETCO by the Bidder in order to finalize the single length of cable.

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 made from ferrous metals shall be treated with suitable rust preventive finish or coating to minimize rusting during transit or storage.
- 10.6 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.
- 10.7 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.
- 10.8 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.
- 10.9 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.

11.0 LAYING, JOINTING AND INSTALLATION (GENERAL):

- 11.1 The successful Bidder shall arrange for the services of fully qualified and competent supervising Engineer / Engineers and necessary minimum number of certified jointers, semi-skilled labors, as he deems it absolutely necessary

- 11.2 The successful Bidder shall furnish all necessary information, including drawings, manuals and instructions related to both cable laying and jointing practice.
- 11.3 The associated civil works, which are necessary for laying / installation / termination of power cable, though not specifically mentioned, shall be in the scope of successful Bidder
- 11.4 Successful Bidder has to arrange at his own cost for first-aid, fire protection, electricity and water requirement at site. He shall also arrange for GETCO sign board, caution board, safety & security personnel etc. on cable route
- 11.5 No idling charges or cost over run for the entire project shall be entertained.
- 11.6 Successful Bidder shall arrange space for working office, workshop & store / yard for storing requisite materials like kits, cables etc.
- 11.7 The successful bidder has to open site store at substation site or at place near by the substation site and ensure for safe custody of all the stored materials at his own cost.
- 11.8 The successful bidder shall have total responsibility for the entire materials stored, loose, semi assembled and/or erected by him at site in his custody. The successful bidder shall make suitable security arrangements at his own cost to ensure the protection of all materials, equipment and works from theft, fire, pilferage and any other damages and loss. It shall be the responsibility of the contractor to arrange for security till the works are finally taken over by the GETCO.

12.0 LAYING OF POWER CABLE:

- 12.1 The 220 kV (E) XLPE cable shall be installed underground and normally buried directly in the ground complying with relevant IEC / IS: 1255 / CIGRE recommendations & their amendments.
- 12.2 Three single core cables shall be laid in trefoil formation for one circuit. For two or more circuits (trefoils) in one trench, minimum spacing between the trefoils shall be 800mm. Precast RCC slab shall be used to separate each trefoil.
- 12.3 The power cable shall be laid generally at a depth of 2000 mm but can vary, if obstacles like power cable of other rating / telephone cable / water pipe line / drain etc, come in the route of installation. In such case minimum depth of 1750 mm shall be maintained from nearest road level. Separate approval for each case from EIC is required for variation in depth from 2000 mm.
- 12.4 The cables shall be completely surrounded by a layer of a low thermal resistivity (selected sand) sand about 250 mm over & below of the cable

- surface throughout width of the cable trench at no extra cost. River sand shall be allowed for surrounding layer.
- 12.5 The extra protection of pre-cast flat RCC slab with proportion of 1:2:4 (M-150) minimum shall be provided about 250 mm over the power cables for entire route of the cable. The slab shall be given curing time required to attain minimum strength.
 - 12.6 For two or more circuits (trefoils) in one trench the contractor is required to put partition of pre cast flat concrete slab as above.
 - 12.7 Contractor shall supply & fix the non-magnetic material trefoil clamps on cables at regular interval of not more than 05 meters to maintain perfect trefoil. The clamp shall be having rubber lining at inner surface in contact with cable.
 - 12.8 Where road crossing comes in way of laying power cable and open excavation is possible, the power cable shall be laid through HDPE pipes 1 number per phase and NP-4 RCC Hume pipes 1 number per trefoil. The required length of Hume pipe and HDPE pipes shall be arranged by the successful Bidder at no extra cost.
 - 12.9 Where road crossing comes in way of laying power cable and open excavation is not possible, than cable shall be laid through minimum 6 kg class HDPE pipes 1 number per trefoil by horizontal drilling/boring under road by automated drilling machine. Individual Cable shall be laid in Min 250 mm. OD diameter PVC/HDPE pipe per phase and the trefoil shall be covered by min. 630 mm dia OD , 6 kg. class HDPE pipe 1 number per trefoil. The required length of HDPE pipe and PVC pipes shall be arranged by the successful Bidder at no extra cost.
 - 12.10 For crossing of utilities like water line, drainage lines, telephone lines, gas lines etc, sufficient care shall be taken & protection shall be made available so that other utilities do not damage the cable mechanically and / or electrically or do not effect the performance of the cable.
 - 12.11 Railway Crossing if comes in way of cable route, the same shall be carried out in compliance with Railway specifications/requirement without extra cost to GETCO.
 - 12.12 Joint chamber with brick masonry & PCC shall be prepared & covered with RCC slabs.
 - 12.13 Normally, the back filling shall consist of the materials earlier excavated, however, bigger stones or piece of rock should be removed and if required new soil has to be provided and used for back filling with

no extra cost. Back filling shall be done only after permission received from EIC after due verification. After back filling and ramming, watering on route of cable trench to be done for proper settling of earth. Successful bidder shall visit route and attend cavity, sinking of earth if any.

12.14 The minimum bending radius of the cable shall be in accordance with the cable manufacturer recommendation.

12.15 For the public safety, board with stand having red color marking “CAUTION – 220 KV CABLE LAYING WORK IN PROGRESS” “STAY AWAY – DEEP EXCAVATION” in English as well as Gujarati shall be put. In addition red cotton flags shall be kept wherever necessary. Caution barricade ribbon shall be provided for continuous route of trench right from start of excavation work till back filling completion.

12.15 IDENTIFICATION, MARKING AND WARNING:

a) The identification marker shall be of adequate size fabricated from 3 mm thick, 25 mm x 25 mm aluminium strip. The marker shall be embossed with letter as stated below:

“GETCO – 220 KV ____ LINE ” and “Phase R or Y or B” – as the case may be.

The marker shall be tightened by nylon thread along with each cable at interval of 3 meters in such a way that it does not damage / penetrate the outer sheath of cable because of the dead weight of back filled materials OR soil.

b) A pre-warning PVC yellow tape with size 152 mm (width) x 100 microns thick (HDDPE) / LLDPE shall also be laid as per following clause of the specification. The warning tape shall also contain the **"WARNING"** printed in black letters as under **(In English as well as Gujarati):**

"CAUTION: 220000 VOLTS GETCO CABLE"

c) A pre-warning tape as per above clause shall be laid below ground level in the earth about 400 / 550 mm deep along the route of cable per circuit and in jointing bays.

d) The cable route and joint marker is to be made from RCC blocks duly engraved and painted with permanent non washable color, on both the side as under:

“GETCO 220 kV CABLE LINE” “GETCO 220 KV CABLE LINE – JOINT” as the case may be.

- e) The minimum size of RCC blocks shall be ~~600 x 300 x 50~~ 800x 500x100 – mm. It shall be at least embedded in ground up to 300 mm depth. The exposed portions shall be painted with non-washable paints. The interval should be maximum 20 meters between two markers. It should be put nearer at bends, curves, both sides of road/railway/nala crossing, etc. of cable route for easier identification of route.

13.0 JOINTS AND END TERMINATION :

- 13.1 Joints and end terminations shall be made using pre-approved and pre inspected kits only by certified jointers of respective manufacturers.
- 13.2 The kits shall be opened in presence of EIC only and material shall be verified as per packing list. Credentials of jointer shall be submitted to EIC for verification.
- 13.3 For preparation of joint and end terminations, required scaffolding and fully covered temporary shed/tent shall be made to maintain high degree of cleanliness, controlled humidity level and temperature as per the recommendations of kit manufacturer. It will be the total responsibility of successful bidder for better performance of cable system. The jointing and end termination work shall be made strictly as per recommendations of kit manufacturer and no bypassing shall be made.
- 13.4 The successful bidder has to prepare joint pit using bricks and lean concreted at base as per approved drawing by GETCO.

14 GENERAL PARTICULARS:

- a) The bidder is required to impart training in view of manufacture, assembly, erection, operation and maintenance for offered item, at his works, to the person/s identified by GETCO, in the event of an order, free of cost. The cost of logistics will be bear by GETCO.
- b) Please note that the evaluation will be carried out on the strength of content of bid only. No further correspondence will be made.
- c) The bidder shall bring out all the technical deviation/s only at the specified annexure.
- d) The bidder should indicate manufacturing capacity by submitting latest updated certificate of a Chartered Engineer (CE).

ANNEXURE – A

1. Sheath Integrity Test for Metallic sheath:

This test shall be offered & performed in presence of GETCO inspector as stage inspection on cable drums after metallic sheath operation completion & before doing outer sheathing or any associated activity like bitumen layer etc. Intention of this test is to ensure no crack, porosity, blow holes or poor welding is left with metallic sheath to ensure its function of radial water barrier. This test is applicable for both types, seam welded / seam less (extruded) metallic sheath.

The cable (core + metallic sheath) shall be sealed on one side with appropriate arrangement to arrest any leakage from test accessory joints & to be provided with pressure gauge & valve to work as outlet only. The other side of cable shall be sealed with appropriate arrangement to arrest any leakage from test accessory joints & to be provided with pressure gauge & valve to be connected with inlet for dry air or nitrogen gas. Keeping outlet valve closed the inlet valve shall be opened slowly & suitably to allow inlet of dry air or nitrogen gas. Pressure of minimum 1 bar shall be achieved (indicated in both pressure gauges) & maintained for 1/2 hr. period without any drop. The pressure shall not drop.

In case of pressure drop observed in any drum of cable, that drum shall be considered as non-compliance of requirement & shall not be included for further activity. The cable shall be properly sealed & signed by GETCO inspector at both ends. Any corrective action in cable shall be done with prior intimation & confirmation of GETCO only.

2. Mechanical strength of welded sheath:

This test shall be offered & performed in presence of GETCO inspector as stage inspection on cable drums after metallic sheath operation completion & before doing outer sheathing or any associated activity like bitumen layer etc. Intention of this test is to ensure high quality welding. This test is applicable for seam welded metallic sheath only.

Ring of metallic sheath shall be cut & shall be straightened. The strip shall be cut in two pieces, sample one to include welding line & sample two without welding line. Sample two (without welding line) shall be subjected for tensile strength test & the value achieved shall be considered as reference. Now sample one shall be subjected for tensile strength test & the value achieved shall be not less than 90% of sample two (or reference value).

ANNEXURE -B

The bidder must fill up all the point of GTP for offered item/s. Instead of indicating “refer drawing, or as per IS/IEC”, the exact value/s must be filled in.

TECHNICAL DATA SHEETS FOR 220 KV XLPE CABLES

1.0 GUARANTEED TECHNICAL PARTICULARS FOR 220 KV, 1200sq.mm. XLPE INSULATED POWER CABLE AND ACCESSORIES

Sl No	Description	
1.	Name and address of works country of manufacture	
2.	Specifications & Standards	
3.	Manufacture's type designation	
4.	Rated voltage a) Nominal : kV b) Highest : kV	220 245
5.	1 min wet power frequency withstand voltage (kV) rms.	460
6.	Lightning impulse withstand voltage (kVp)	1050
7.	Suitable for earthed or unearthed system	
8.	Permissible voltage and frequency variation for satisfactory operation a) Voltage (Volts) b) Frequency (Hz)	
9.	Conductor :- a) Material b) Nominal cross sectional area (mm ²) c) Construction c) Number and nominal diameter of strands (No. / mm) d) Nominal diameter (mm) as a whole e) Maximum D.C. resistance of conductor for at 20°C (/Km) f) Maximum A.C. resistance of conductor for at 90°C. (/Km) h) Conductor weight (Kg/mtr)	
10.	Conductor screening: a) Material b) Extruded / wrapped or both c) Minimum Thickness (mm)	0.8 mm
11.	Insulation: - a) Material of insulation (XLPE) b) Extrusion and curing system (VCV/MDCV) c) Type of curing (Dry) d) Extruder (Triple common)	

	e) Thickness of insulation 1) Nominal Thickness (mm) 2) Minimum Thickness (mm) f) Maximum eccentricity g) Insulation resistance at room temperature & elevated temperature h) 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)	27 mm. nom. 24.3 mm. min.
12.	Insulation screen : a) Material b) Extruded / wrapped or both c) Minimum Thickness (mm)	0.8 mm
13.	Bedding a) Material b) Nominal Thickness (mm)	
14.	Metallic Sheath a) Type of material b) Nominal thickness (mm) c) Minimum thickness at any point (mm) d) Nominal outer diameter (mm) f) Sheath induced voltage corresponding to 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) j) Nominal Cross sectional area (570 sq. mm min.) a) Diameter over trough (Dt) b) Diameter over gap (Dg) c) Height of corrugation (h) d) pitch of corrugation (P) k) DC Resistance of Al. sheath at 20°C (Ohm/Km) l) Tensile strength N/Sq. mm , % Elongation	2.0 mm
15.	Anti-corrosion layer I. Material II. Nominal thickness (mm) III. Minimum thickness at any point (mm)	
16.	Outer sheath I. Material II. Nominal thickness (mm) III. Minimum thickness at any point (mm)	3.0 mm

17.	a) At the maximum conductor temperature of 90°C, directly buried at 2 m depth, ground temperature of 30°C, soil thermal receptivity of 150°C - Cm / watt, laid in Trefoil / Flat formation (1D spacing) i) Continuous current carrying capacity - One Circuit Operation : A - Two Circuits Operation: A - Spacing between phases : mm - Spacing between circuits : mm ii) Permissible safe overload - % overload / Ampere - Period - Conductor temperature b) At the Maximum conductor temperature of 90°C, laid in free air, ambient air temperature of 40°C : A	
18.	Rating factors applicable to the current in cl. No. 6 (a) (i) two circuits operation for the following variations / conditions of installation.	
19.	a) Variation in ground temperature from 25°C to 50°C in steps of 5°C.	
20.	b) Group rating factor for different spacing (center to center) of cables installed in trefoil formation.	
21.	c) Group rating factor for different spacing (center to center) of cables installed in flat formation.	
22.	Maximum charging current at the rated voltage (A/Km)	
23.	Dielectric loss angle at normal frequency and rated voltage	
24.	Impedances at 50 Hz 1. Positive & Negative Sequence = /Km 2. Zero sequence = /Km	
25.	Electro - static Capacitance at 50 Hz (F/km)	
26.	Short circuit capacity of conductor a) Short Circuit current kA (rms) b) Duration of short circuit (sec) c) Permissible conductor temperature for the short circuit duty with conductor temperature as 90°C before inception of short circuit	
27.	Short circuit capacity of metallic sheath:- a) Short circuit current (kA) b) Duration of short circuit (s) c) Permissible sheath temperature for the	Min. 40 kA Min. 1 sec.

	short circuit duty with conductor temperature as 90°C before inception of short circuit.	
28.	Overall diameter of completed cable (mm) with tolerance	
29.	Unit weight of completed cable (kg/m)	
30.	Minimum installation radius of the cable (mm)	
31.	Permissible pulling tension when pulled with a eye (kg)	
32.	a) Maximum dielectric loss of 3-phase cables laid in ground at the rated voltage, frequency and the maximum conductor temperature (kW/km) b) Total losses of 3 phase cables at the condition with the rated current (kw/km)	
33.	Cable drums: a) Dimensions b) Barrel diameter c) Gross weight (kg) d) Standard shipping length (m) c) Maximum shipping length (m)	
34.	Maximum cable length that can be manufactured and transported at site (Shall be as per sheath voltage limiting scheme to be got approved from GETCO)	
35.	Cable Identification Marking on outer sheath by embosing- Every three meter, "220 kV, 1200 sq. mm, XLPE, 2XA2Y (Name of the supplier), (Year of Manufacture), property of GETCO". Sequential length marking at every one meter by laser printing.	
36.	Outdoor type terminations a) Name and address of works country of manufacture b) Model no. c) Type of main insulation d) Material of the insulator e) Creepage distance (mm) f) Color of the insulator g) Weight of completed termination (kg) h) Whether cable termination is supplied complete with all accessories (yes / no) i) Mounting detail	
37.	Straight joint/ Shield break joint a) Name and address of works country of manufacture	

	b) Model no. c) Type of main insulation d) Material of insulation flange f) Weight of competed joint i) Without protection box and compound ii) With protection box and compound g) Type & Material of protection box	
38.	Outdoor Termination & Straight through joint a) Rated continuous current b) Rated Voltage (kV) c) HSV (kV) d) 1 min wet power frequency withstand voltage (kV) e) Lightning impulse withstand voltage (kVp) f) Maximum dielectric stress at the rated voltage (kV/mm) offered kit can withstand w.r.t cable data (as per type test value) a) At the conductor screen (kV/mm) b) At interfacing points/insulator screen (kV/mm)	
39.	Shelf life of Outdoor Termination & Straight through joint	
40.	Precautions required for storage of Outdoor Termination & Straight through joint	
41.	Flexibility / reopen ability, if any	
42.	Connector detail	
43.	Maximum partial discharge magnitude at the specified test voltage (pC) for cable system	

SEAL OF THE FIRM.**SIGNATURE OF THE BIDDER.**
Name:
Designation:
Date:

NOTE: THE BIDDER MAY USE SEPARATE SHEET FOR FILLING UP ABOVE FORMAT FOR GIVING MORE DETAILS.

**GUARENTEED TECHNICAL PARTICULARS
FOR
6.6 kV SHEATH CONNECTION / 1.1 kV EARTH CONTINUITY CABLE**

SR NO	DESCRIPTION	
1.	Manufacturer's name & works	
2. a.	Voltage grade	
3.	Reference Standard	
4.	Conductor 1) Materials 2) Nominal cross sectional area (sq.mm) (nos. of wires & dia of each conductor) 3) Flexibility class 4) Form of conductor 5) Max. DC resistance of conductor at 20°C(ohm/km)	COPPER
5.	Insulation 1) Materials 2) Nominal & Minimum thickness (mm)	
6.	Outer sheath 1) Material- HDPE ST7 (for 1.1 kV ECC) PVC (for 6.6 kV SCC) 2) Nominal & Minimum thickness(mm)	
7.	Approximate overall diameter of cable (mm)	
8	(a) Short circuit current carrying capacity for 1 second duration (KA)	
9	Embossing on outer sheath	

SR NO	DESCRIPTION	
	The external surface of the outer sheath shall be embossed with the following legend. "6.6 kV or 1.1 kV , XXX sq. mm, XLPE “ cable coding” (Name of the supplier), (Year of Manufacture), property of GETCO" & Sequential length marking on every one meter.	

SEAL OF THE FIRM.**SIGNATURE OF THE BIDDER.**

Name:

Designation:

Date:

NOTE: THE BIDDER MAY USE SEPARATE SHEET FOR FILLING UP ABOVE FORMAT FOR GIVING MORE DETAILS.

Format for Sheath Voltage Limiting Scheme

Project: Underground S/C (3+0)/(2+1) Cable Laying for XYZ line							
Name of contractor							
Ref: AT No. " CE(Project)/SE/V/220KV Cable-ARC/CCCC/ Dt: 07/09/2020"/ Estimate no.							
Size of Cable: "220Kv 1C x 1200Sq.mm XLPE Cable" type " XXX "							
Total Route Length: XXXX Meters Approx.							
Location	Drum Length in Meters	Cummulative Length in Meters	Description of Termination	Description of Joint : As given below	Description of Link Boxes: as given below	Sheath Voltage (In Volts)	Remarks : for reference
Terminal 1			Outdoor Termination	N.A	Sheath connected through Earth Link box Without SVL	0	
Joint 1 (J 1)			N.A	Normal Straight Through Joint			
Joint 2 (J 2)			N.A	Straight Through Joint With sheath cross Bonding of Sheath	Sheath connected through Earth Link box With SVL.		Minor section-1,2
Joint 3 (J 3)			N.A	Straight Through Joint With Mid Point Bonding of Sheath	Sheath connected through Earth Link box Without SVL.		End of major sect.-1. Original position of sheath w.r.t conductor achieved.
Joint 4(J4)			N.A				
Joint 5(J5)			N.A				
Joint 6(J6)			N.A				
Joint 7(J7)			N.A				
Terminal 2			Outdoor Termination	NA			
NOTES							
1	LENGTH OF EACH MINOR SECTIONS OF PARTICULAR MAJOR SECTION MUST BE IDENTICAL.						
2	IN SPARE CORE, SHEATH WOULD BE IN SINGLE PHASE LINK BOX AND SHALL BE CONNECTED TO POSITION OF REPLACING PHASE. SPARE CORE SHALL BE USED FOR SHORT PERIOD EMERGENCY USE ONLY.						
3	TO PERFORM CROSS BONDING AT JOINT, SUTIALE KIT SHALL BE USED						
4	Mid-point joint shall be convertible to Cross bonding joint in case of future requirement through required modification in link box, without replacing existing joint.						
Stamp & sign of contractor							

Seal of the Contractor**Signature & Seal of cable manufacturer.**

Name:

Designation:

