

Erection & Maintenance of overhead HT, LT line & T/C structure with dismantling of pole, transformer centre & laying of Underground Cable MVCC work & Other related works under DISS & Other Scheme for Sarthana sub division or any sub division under Surat Rural Division.

TECHNICAL SPECIFICATIONS:

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- 1.0 11/22 kV XLPE Cable Jointing Kit & laying of cables
- 2.0 Earthing
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- 5.0 List of Approved Makes of Equipments and Accessories
- 6.0 Drawings

GENERAL INFORMATION (TECHNICAL):

1.0. SCOPE:

This chapter covers the requirements for the selection, installation and jointing of power cables for low, medium and high voltage applications up to and including 33KV. For details not covered in these Specifications, IS: 1255-1983 shall be referred to. All references to BIS-Specifications and codes are for codes with amendments issued up to date i.e. till the date of call of tender.

1.1. CODES, STANDARDS & REGULATIONS

The design, manufacture, erection, cable laying and testing of the equipments and material to be supplied shall comply with latest revisions of relevant Indian Standards or equivalent IEC standards. In addition, the Indian Electricity Rules, Electricity Act 2003, Statutory requirements of Central Govt., GERC and State Government of Gujarat(applicable codes), shall also be complied with. Any complications arising out of it will be set right by the bidder without any implication to DGVCL. The bidder shall submit his offer as per information given in submission of tender.

Drawings, Data and Documents

The bidder shall furnish following documents/ information along with offer in spiral bound volumes. General description of equipment offered specifying the important features, make, technical parameters, materials of construction etc. To enable DGVCL to have proper understanding of the material offered and its operation.

The drawings and documents shall be furnished to DGVCL by the successful bidder for approval of DGVCL, within the period stipulated in the draft contract/mutually agreed terms at the time of placement of order, the bidder shall submit a list of all such drawings and documents he proposes to submit. The list will be approved by DGVCL and may be modified, if necessary. Each drawing /document in the list shall be identified with a serial number, description and scheduled date of submission. This should be submitted in a spiral bound volumes.

1.2. FOR REFERENCE

- OEM's Complete and comprehensive instruction manuals with drawings for operation and maintenance of the equipments supplied by the bidder.
- Preventive maintenance schedule for each equipment.
- Procedure for shutdown and HT equipment.
- Safety procedures for safe operation of equipment and complete system.
- Test procedure for site tests.

1.3. AS- BUILT DRAWINGS

On completion of installation, testing and commissioning, the bidder shall in Corporate visions/ modification if any, in the reproducible and submit 'as built' drawing for DGVCL's record in spiral bound volumes and soft copy. The drawings shall be in AutoCAD DXF format.

1.4. TEST AND INSPECTION FOR INDIVIDUAL ITEM

Routine test/ Acceptance tests shall be carried out on all equipment at manufacture's works/ ERDA as per appropriate IS/IEC. The bidder shall make reasonable facilities, at his cost for inspection and testing of the equipment/material by DGVCL's Officials. No equipment/item shall be dispatched to site without provisional certificates of acceptance issued by DGVCL. Inspection and test shall be carried out at the place of manufacture as well as on receipt of the equipment at site if required. Inspection and tests do not relieve the bidder of his contractual obligations regarding performance of the

equipment at site/in actual use.

The bidder shall submit the brief summary of all type test certificates for similar equipment supplied by him elsewhere and the actual type test certificates as and when asked. In case type test certificates for similar equipment is not available, the same shall be conducted in the presence of DGVCL's Authorized representative if DGVCL so desires, without any financial implications to the DGVCL. The type test report shall not be older than 5 year from the date of tender opening (Technical bid opening). The supplier of the equipment shall ensure that the equipment available at his works for routine test/type test/acceptance test are duly calibrated and necessary certificate shall be made available to the inspecting officer of DGVCL.

As far as possible, the supplier of equipment shall give a minimum of 15 days notice of readiness of material and give the inspection call accordingly. If on arrival of inspecting officer at the works, the material is not found to be ready, the concerned supplier of equipment shall be liable for additional expenditure DGVCL may incur on account of retention or re-deputation of the inspecting officer.

The officer deputed for inspecting for particular lot of material according to intimation from you may also like to check Quality Control Plan and for that purpose he may demand the Test Reports of raw material being procured.

1.5. FUNCTIONAL AND COMPOSITE TESTING

Following test shall be conducted on equipment after completion of erection in the presence of Engineer-in-charge from point of view of completeness in the presence of DGVCL's Authorized Representative.

- Visual inspection of total system.
- Checking of continuity of power and LT/HT cables.
- Checking of nameplate data of complete system.
- Verification and measurement of earthing resistance.
- Checking of cable terminations and laying, dressing etc. in the equipment kiosk.
- Checking of safe accessibility of components.
- All the equipments and materials shall be passed through checks and test as per approved Field Quality Plan.
- The insulation resistance test shall be carried out
- HV installation above 11/22 KV- by 2500V Megger
- Power circuit of voltage up to 22KV.

1.6. BAR CHARTS

The Bidder shall furnish along with the bid, the bar charts in Project and project schedule indicating starting and completion dates of each activity, such as preparation & approval of drawings, manufacturing/supply/ delivery, civil works, Cable laying erection, testing, pre commissioning and commissioning etc. so that quarter wise completion activities suffice the purpose for releasing the connections.

1.7 GENERAL

Identification labels shall be provided on all equipments as per client's approval. All labels shall be engraved on plastic (white letters with black background) and all text shall be in English language.

Any exclusion /deviation from specification shall be clearly spelt out and listed at one place only and bidder shall substantiate the same with appropriate reasons. In the absence of clearly spelt out and mutually agreed deviation, it shall be considered that the bidder has undertaken to comply with the technical specification totally, in letter and spirit. It will be responsibility of the successful bidder to obtain necessary approval of statutory authority as per rules of Govt. of Gujarat before energizing/ charging the equipment/system. However bidder shall be extended all assistance by the DGVCL in regard to application for the same. For installation work at site, the bidder shall be fully responsible for arranging

the supply of required tools and tackles, welding sets, cable crimping tools, labours, scaffolding, ladders, etc.

The power connection will be provided by DGVCL at one point only at the prevailing tariff, from where the bidder has to arrange for temporary connection and further distribution of supply at his own cost. The installation of energy meter, cut out, switches etc. for construction power shall be as per prevailing norms of DGVCL. The test report and other requirement to release the connection shall be as per prevailing rules of DGVCL. On completion of the installation but before energizing the system, all installation shall be physically checked and properly tested. These checks and tests shall be conducted by the bidder under the supervision of Engineer In-charge and bidder shall furnish the final status and test results shall be made good by the bidder free of cost within contract completion period.

All clamps, brackets, bolts, nuts, screws, markers, ferrules, lugs and glands and other hardware necessary for erection work, shall include in the scope of work and shall be arranged by the bidder.

2.0 INSPECTION AND TESTING OF EQUIPMENT

Manufacturing Progress reviews, inspection & testing of equipment covered under the technical specification shall be carried out by the DGVCL's Authorized Representative at the manufacturer's works/premises prior to dispatch, to ensure that their quality & workmanship are in conformity with the contract specifications and approved drawings.

2.0.1 INSPECTION OF WORK

DGVCL shall assign the work of supervision and inspection to third party for work of contractor's workmanship and quality on 24 x 7 hours basis. The periodical inspection reports shall be accessed and any defects or poor quality of workmanship has to be got rectified by the contractor invariably within stipulated time limit. DGVCL reserves the right of stop payment on non response of consumer on this issue.

2.0.2 ELECTRICAL INSPECTOR APPROVAL FOR CHARGING OF CABLE

It is responsibility of bidder to get the approval of charging cable from Electrical Inspector concerned, after due payment of inspection fees and submission of drawing and required documents to Electrical Inspector by bidder

3.0 RESPONSIBILITY FOR INSPECTION

Any inspection by the DGVCL's Authorized Representative does not relieve the Bidder from his responsibility of quality assurance and quality control functions.

As such, any approval which the Inspecting Engineer of the DGVCL may have given in respect of equipment and other particulars and the work or workmanship involved in the contract (whether with or without test carried out) shall not bind the DGVCL to accept the plant & equipment, should it on further tests at site be found not comply, with the requirements of the contract. If required, audit wing of DGVCL Inspection

Department shall also be entrusted with inspection of particular item/equipment received at site. The bidder is to meet the inspection & testing requirements for the equipment coming under the statutory regulations e.g. weights & measures, safety, IE rules, etc. and submit calibration certificates and documents from appropriate authority to the DGVCL Inspecting Engineer for the same, on demand.

4.0 METHOD OF GIVING INSPECTION CALLS

Inspection calls shall be given by the Bidder to Addl. Chief Engineer (Proc.) DGVCL, Surat in accordance with mutually agreed program with 15 days' clear time for all equipments. Four sets of relevant test certificates and inspection report of the Bidder/ Sub-bidder after satisfactory completion of internal inspection and test shall be submitted along with acceptance/routine test certificate of the tests witnessed by DGVCL Inspector. The DGVCL reserves the right to visit at any stage of manufacture at plant and ask for additional inspection & tests if it is found necessary after completion of detailed design &

engineering and approval of drawings. The DGVCL or his duly authorized representative shall on giving written instructions to the bidder, setting out any grounds of objection which he may have in respect of the work, be at liberty to reject all or any part of plant/equipment or workmanship which are not in conformity with the contract provisions.

5.0 BIDDER'S RESPONSIBILITY

The Bidder shall provide all reasonable facilities to the Inspecting Engineer of the DGVCL to the Bidder's or their sub-bidder's premises at any time during contract period, to facilitate him to carryout inspection & testing of equipment during manufacture of equipment. The Bidder shall delegate a representative/coordinator to deal with DGVCL on all inspection matters.

The Bidder shall comply with instructions of the DGVCL's Inspecting Engineer fully. The Bidder shall ensure that the equipment and materials once rejected by the Inspecting Engineer are not reused in the manufacturing of the equipment and materials. Where parts rejected by the Inspecting Engineer have been rectified as per agreed procedures laid down in advance, such parts shall be segregated for separate inspection and approval, before being used in the work.

6.0 INSPECTION WAIVER

For certain standard bought-out items and the products of reputed firms where the DGVCL has earlier experience on the quality of their products, the DGVCL may consider allowing of inspection waiver for such items. The Addl. Chief Engineer (Proc.) DGVCL, Surat shall issue approval of inspection waiver certificate after scrutiny of bidder's internal inspection report, test certificates and other documents. However, it is not binding upon DGVCL to give waiver on bidder's request. DGVCL may weigh the important issues like quantity of material, cost of material, importance of material, distance of travel & time of travel required to inspect before deciding the waiver of the inspection.

7.0 AUDIT INSPECTION

From the lots inspected by the DGVCL, the Inspector of DGVCL may pick up samples from the lots supplied at stores of contractor at random for quality check only. The samples picked up will be tested for acceptance test / type test or as decided by DGVCL at Government/ NABL approved laboratory or ERDA laboratory at DGVCL RSO, in presence of representatives of contractor and DGVCL as per relevant ISS/BIS/ DGVCL specifications. The test results will be binding on the suppliers and DGVCL, in general will not allow re-sampling. If the material fails in any of the acceptance tests carried out, the full lot of materials will be considered as rejected, and if replacement is not possible due to consumption of the materials then in that case for whole of the rejected lot, DGVCL will deduct maximum up to 30% (Thirty) of the contractual order cost of that item. If the same are not utilized / consumed, then DGVCL may ask for replacement at sole discretion of DGVCL or may accept with maximum deduction up to 30% (Thirty) of the contractual order cost of that item, and all these will be binding on the contractor.

In case if the materials does not confirm to specifications or fails at Government approved laboratory or other laboratory decided by DGVCL for testing and if subsequent testing are to be carried out (which will solely at DGVCL discretion), then all Testing fees, expenses of the inspector and other expenses incurred by DGVCL will be to contractor's account. The decision in this regard for acceptance as above of DGVCL shall be final and this will be binding on the contractor.

8.0 OTHER CONDITIONS

Any clarification / amendment necessary, in any or more clauses incorporated in the present A/T, you will have to make a detailed reference to the DGVCL latest within ten days from the receipt of A/T. If you fail to do so, no request for any clarification / amendment shall be considered thereafter. Please also note that all the points which need

clarification / amendment should be brought out at once. No piecemeal clarification/amendment will be entertained.

9.0 PRE INSPECTION AND VERIFICATION OF SITE BY BIDDERS (PRE BID SURVEY):

Bidder, if desire, may visit and inspect proposed work site of respective circle. Prospecting bidder may contact our Executive Engineer (O&M) Circle/division/Sdn with prior appointment and confirmation.

10.0 STORAGE AND HANDLING

10.1 Storage

- (i) The cable drums shall be stored on a well-drained, hard surface, so that the Drums do not sink in the ground causing rot and damage to the cable drums. Paved Surface is preferred, particularly for long term storage.
- (ii) The drums shall always be stored on their flanges, and not on their flat sides.
- (iii) Both ends of the cables especially of PILCA cables should be properly sealed to prevent ingress/ absorption of moisture by the insulation during storage.
- (iv) Protection from rain and sun is preferable for long term storage for all types of cables. There should also ventilation between cable drums.
- (v) During storage, periodical rolling of drums once in, say, 3 months through 90 degrees shall be done, in the case of paper insulated cables. Rolling shall be done in the direction of the arrow marked on the drum.
- (vi) Damaged battens of drums etc. should be replaced as may be necessary.

10.2 Handling

- (i) When the cable drums have to be moved over short distances, they should be rolled in the direction of the arrow marked on the drum.
- (ii) For manual transportation over long distances, the drum should be mounted on cable drum wheels, strong enough to carry the weight of the drum and pulled by means of ropes. Alternatively, they may be mounted on a trailer or on a suitable mechanical transport.
- (iii) For loading into and unloading from vehicles, a crane or a suitable lifting tackle should be used. Small sized cable drums can also be rolled down carefully on a suitable ramp or rails, for unloading, provided no damage is likely to be caused to the cable or to the drum.

10.3 Charging of Cable

It is mandatory for the bidder to test the Main and Spare cable for continuous 72 Hrs at maximum loading condition.

1.0: 11/22 KV XLPE Cable Jointing Kit & Laying of Cables

SPECIAL INSTRUCTIONS TO BIDDER

Please read following instructions carefully before submitting your bid.

1. All the drawings, i.e. elevation, side view, plan, cross sectional view etc., in AutoCAD format and manuals in PDF format, for all items including installation (civil work) shall be submitted. Also the hard copies as per specification shall be submitted.
2. The bidder shall submit Quality Assurance Plan for manufacturing process and Field Quality Plan with the technical bid.
3. 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.
5. All the points other than GTP, which are asked to confirm in technical specifications must be submitted separately with the bid.
6. 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 DGVCL, in the event of an order, free of cost. The cost of logistics will be bear by DGVCL.
7. Please note that the evaluation will be carried out on the strength of content of bid only. No further correspondence will be made.
8. The bidder shall bring out all the technical deviation/s only at the specified annexure.

QUALIFYING REQUIREMENT DATA

The details are to be submitted in following format,

Sr. No	ITEMS SUPPLIED TO	ORDER REFERENCE No. & DATE	ITEMS	QUANTITY	ORDER FULLY EXECUTED. YES/NO	STATUS, IF ORDER UNDER EXECUTION	REMARK

- 5) Equipment offered shall have Type Test Certificates from Govt approved/accredited laboratory (accredited based on ISO/IEC Guide 25 / 17025 or EN 45001 by the National accreditation body of the country where laboratory is located), as per IEC / IS / technical specification. All the required type tests should not be older than 5 (five) years from the date of opening of technical bid.

TECHNICAL SPECIFICATION FOR 11/22 KV XLPE POWER CABLE TERMINATION KIT

SECTION -I

1.11 Termination:

The 11/22 kV cable termination/joints shall be done by skilled and experienced jointers duly approved by the Engineer in charge. Termination including supply of jointing kit is included in the contractor's scope unless specified otherwise.

Termination kits shall be suitable for termination of the cables to indoor switchgear or to weather proof cable end box of an outdoor mounted transformer an outdoor type for termination at poles. The terminating kits shall preferably be as of the following types. Heat shrink type of approved make of DGVCL as mentioned in approved make list in section 5.0(Technical specification) using factory molded silicone rubber insulators. For outdoor installations weather shields, shielding ends and any other accessories required should form part of the kit. Straight through jointing kits shall be suitable for underground installation with uncontrolled backfill and possibility of flooding by water. The jointing kit shall be preferably of PUSH ON/Heat shrink type of approved make of DGVCL as mentioned in approved make list in section 5.0(Technical specification)

Fixing of end termination & straight through joints.

1.
 - (i) Contractor should clarify the make of cable end termination and straight through joint. The heat & shrink type end termination & straight through joints shall be utilized for the job.
 - (ii) Dual wall molded type should be available in straight through joint.
 - (iii) After completing work of cable laying end termination straight through joints, following test shall be carried out jointly by engineer in charge of DGVCL and contractor.
 - (iv) Insulation resistance test before & after with 5 KV insulation tester. (A) Hypo test
 - (v) Contractor has to furnish Guaranteed Technical Parameters (GTP) type test certificate of various tests conducted at any Govt./ NABL approved laboratory for the joints they intend to supply for this job. The test certificate should not be prior to 5 years from the date of tender. The contractor shall have to submit the same with technical bid and failure in which technical bid will be disqualified & the price bid of that party will not be opened.
 - (vi) One competent skilled supervisor shall have to co-ordinate the site authority and he has to do all communication with engineer in charge of DGVCL.
 - (vii) It is essential to have suppliers certificate of training for cable jointing of cable jointer.
 - (viii) Jointer has to ensure safety while making joints so that other nearby cables will not be damaged.
 - (ix) **Before using Termination Kit & Jointing Kit should be got verified at circle level. The bidder has to get verification certificate from S.E. (O&M) for the works to be carried out in their jurisdiction.**
 - (x) **Bidder shall offer guarantee for all part of Termination Kit & Jointing Kit for a period of 2 Years from the date of charging the Termination Kit. In the event of failure of Kit due to manufacturing defect during guarantee period, bidder shall have to replace it at no extra cost within 24 hrs on intimation.**
 - (xi) **The bidder shall get each end termination kits & straight through joint kit verified before utilization of the same from the concern D.E. of s/dn office matching with original invoice submitted & sample approved by concern circle level and M.O.M. of verification to that effect shall be submitted while submitting the bills.**
- 2 The Bidder shall have to supply cable end joint / straight joint kit as per IS 13573-1992 with latest amendment No. 2, 1998 IEEE 48-1990 and shall be Class -1, ESI-09-13 performance specification for high voltage cable accessories.
- 3 The work of lying of cable along the road / road crossing to be carried out by Horizontal Drilling Machine / Auger boring machine enclosed in HDPE Pipe only.

CLASS OF TERMINATION:

The XLPE 11/22 KV Link Line shall be class 1 termination as per appropriate ISI code nos. i.e. IEEE-48-1990.

APPLICABLE STANDARDS:

IS 13573-1992 with latest amendment – Latest amendment No. 2, 1998. IEEE 48-1990. The termination shall be Class 1. ESI-09-13 performance specification for high voltage

cable accessories. The cable accessories being supplied in the form of kit which has different components to be assembled at site.

MATERIALS:

The term 11 KV / 22 KV XLPE Cable refers to extruded or Molded Polymeric. Polymeric material which are cross linked by gamma radiation to develop elastic memory and supplied in an expanded or otherwise deformed size and shape. Bidders should submit the proof that the tubes are cross linked by gamma radiations. However chemically cross linked, crotch seal and lug seals are permitted.

For straight joints, the insulation over the ferrules should be reinsulated by dual wall tubing. This should have an inner insulating layer vulcanized to an outer semi-conducting layer. This is required to ensure reconnection of cable insulation screen of the core from one end of the joint to the other. The dual wall tubing ensures that there is no entrapment of air pockets between the insulating and semi-conducting layers.

FOR JOINTS:

11 KV / 22 KV XLPE underground flexible polymeric tubing, preferably black colored pre coated with adhesive shall be provided for sealing the exposed metallic sheaths and sheath/earth connections.

PROVISION OF ADDITIONAL CREEPAGE INDOOR / OUTDOOR TERMINATIONS:

Single piece, 11/22 KV XLPE underground cable, weather sheds having non-tracking, erosion and weather resistant properties shall be supplied with the kits for application over non-tracking tubing. The quantity of sheds to be supplied shall depend on voltage grade and indoor/outdoor application and shall be indicated along with offer. Each shed shall give an additional creepage length of at least 100mm.

INSULATION AND SCREEN REINSTATEMENT FOR JOINTS:

The reinstatement of insulation shall be by means of heat shrinkable, flexible, polymeric tubing made from a discharge resistant polymer, preferably colored red. The tubing after complete recovery shall have a minimum wall thickness to ensure provisions of adequate insulation in step.

EARTH & SCREEN CONTINUITY FOR TERMINATION & JOINTS:

Screen continuity by using tinned copper mesh and earth continuity by using tinned copper braids of appropriate size shall be provided for transfer of screen/earth in straight through joints. In termination, tinned copper braids of appropriate size or equivalent current carrying capacity of cable conductor along with copper lugs of appropriate size shall be provided for continuity of screen to armour to the earth.

LUGS & FERRULES:

The requisite number and type of aluminum/ copper lugs/ferrules shall be provided for termination/joints. The Lugs and ferrules for XLPE cables shall be crimping type suitable for compacted circular conductor having two nos. of holes.

TECHNICAL SPECIFICATION

FOR Laying, testing & Commissioning of 11 KV underground cable (Cable to be supplied by DGVCL and jointing kits to be supplied by the Contractor) in Surat, Valsad & Bharuch Circles under jurisdiction of DGVCL.

1.11.1 Tests:

Before energizing the insulation resistance of every circuit shall be measured from phase to phase and from phase to ground with 2.5/5 kV Megger both before and after backfilling.

D.C High voltage 18 kV for 11 KV & as per IS for 22KV test shall be conducted after installation on the following and test results to be recorded as per DGVCL format in presence of Engineer in charge.

a)

Type tests are to be carried out at manufacturer's works for quality approval of termination/jointing kits. Following tests confirming to the latest IS 13573 and or IEC 502.2, 466 and VDE 0278 and C 81 specifications. The report of last three years type tests result shall be submitted for approval of the Kits. Terminations shall be kept open so that switchgears, transformers etc are not subjected to test voltage.

Tests for termination/jointing kits:

Indoor & Joint IS 13573
1) Conductor Resistance Test
2) Impact Test
3) AC High Voltage Test (Dry)
4) Partial Discharge Test
5) Impulse with stand test
6) AC Voltage life test with cyclic current loading
7) Partial Discharge Test
8) AC Voltage life test with cyclic current loading
9) Thermal Short circuit test
10) AC Voltage life test with cyclic current loading
11) Conductor Resistance Test
12) Impulse with stand test

13) D.C.High Voltage test

Out Door IS 13573

1) Conductor Resistance Test

2) AC High Voltage Test (Dry)

3) Wet Power frequency test

4) Partial Discharge Test

5) Impulse with stand test

6) AC Voltage life test with cyclic current loading

7) Partial Discharge Test

8) AC Voltage life test with cyclic current loading

9) Thermal Short circuit test

10) AC Voltage life test with cyclic current loading
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11) Water Tightness Test for Out door

12) Conductor Resistance Test

13) Impulse with stand test

14) D.C.High Voltage test

Indoor as per VDE 0278

1) Partial Discharge Test

2) Partial Discharge Test

3) Conductor Resistance Test

4) Partial Discharge Test

5) AC High Voltage Test (Dry)

6) Tan Delta as a Function of Voltage & Capacitance.
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7) Tan Delta as a Function of temperature

8) Impulse with stand test

9) AC Voltage life test with cyclic current loading

10) Partial Discharge Test
11) Tan Delta as a Function of Voltage & Capacitance.
12) AC Voltage life test with cyclic current loading
13) Thermal Short circuit test
14) AC Voltage life test with cyclic current loading
15) Partial Discharge Test
16) Conductor Resistance Test
17) Impulse with stand test
18) D.C.High Voltage test

Outdoor Termination VDE 0278
1) Partial Discharge Test
2) Partial Discharge Test
3) Conductor Resistance Test
4) Impact Test
5) Wet power frequency AC High Voltage Test
6) Partial Discharge Test
7) Tan Delta as a Function of Voltage & Capacitance.
8) Tan Delta as a Function of temperature
9) Impulse with stand test
10) AC Voltage life test with cyclic current loading
11) Partial Discharge Test
12) Tan Delta as a Function of Voltage & Capacitance.
13) AC Voltage life test with cyclic current loading
14) Short circuit test

15) AC Voltage life test with cyclic current loading
16) Conductor Resistance Test
17) Impulse with stand test
18) D.C.High Voltage test
19) Dynamic short circuit
20) Impulse with stand test
21) D.C.High Voltage test

As per C - 81

1) Impact Test
2) Insulation Resistance Test
3) A.C High Voltage Test
4) Insulation Resistance Test
5) Heat shock Test
Test after Heat shock Test
6) Insulation Resistance Test
7) A.C High Voltage Test
8) Insulation Resistance Test
9) Electric Heat cycle Test
Evaluation after Electrical heat cycle Test
10) Insulation Resistance Test
11) A.C High Voltage Test
12) Insulation Resistance Test
After Sheath Damage Test
13) Electric Heat cycle Test
Evaluation after Electrical heat cycle Test & sheath damage
14) Insulation Resistance Test
15) A.C High Voltage Test
16) Insulation Resistance Test
17) Examination Of Joint

1.12 TECHNICAL AND GUARANTEED PARTICULARS:
The bidder shall furnish all Guaranteed Technical Particulars, as called for, in Appendix - I of this Specification. Particulars, which are subject to guarantee, shall be clearly identified. Offer not containing these informations will not be considered for acceptance.

1.13 PERFORMANCE CERTIFICATE:

Bidders shall also submit performance reports for the specified size of cables supplied to other State Electricity Boards / reputed firms, with the clear indication of the period since when the cables performed satisfactory service.

1.14 LEGIBLE SUBMISSION:
Only required relevant, legible documents shall be submitted to avoid delay due to back reference.

GUARANTEED TECHNICAL PARTICULARS
HEAT SHRINK OUT DOOR TERMINATION ON 11KV (E) XLPE CABLE

Sr. No	Particulars	Unit	Guaranteed values.
1.0	MANUFACTURER		
2.0	APPLICABLE STANDARDS		As per IS:13573
3.0	GUARANTEED PARTICULARS		
3.1	For the nominal(phase to phase) System voltages Maximum system voltage	KV	11KV
3.2	A.C. withstand voltage Dry (ph/ground) Time duration	KV Mins	12KV 35 KV 1 Min
	A.C. withstand voltage Wet(ph/groun d) Time duration	KV Mins	28 KV 1 Min
3.3	Partial Discharge at 2 Vo	pC	<5pC

3.4	Impulse withstand,1.2/50/Us	kV	75KV
3.5	Load cycle Test a)Each Cycle-Heating Duration Temperature Cooling Duration b)Number of Cycles c)Continuous phase to ground Voltage Withstand	Hrs 0C Hrs. kV	5 100 3 117 2.5U ₀
3.6	Leak Tightness		9 Cycles.

3.7	Thermal Withstand Short circuit current 1Sec.	ka	As per IS:13573
3.8	Dynamic short circuit Withstand	Ka peak	2.55 x Is As per IS:13573
3.9	DC Voltage	kV	48Kv for 30Mins.
4.0	KIT PARTICULARS		
4.1	Material of the tubing/molded parts		Polyolefin
4.2	Method of stress control		High permittivity Material.
4.3	Method of environmental seal		H.S. Anti-tracking Tubes.
4.4	Allowable Kit storage Temperature	0C	Normal Ambient Temperature.
4.5	Shelf life of H.S components	Years	More then 5 Years.
5.0	Cable Termination Instruction Manuals	Yes/No	Yes

GUARANTEED TECHNICAL PARTICULARS
HEAT SHRINK STRAIGHT THROUGH JOINT ON 11KV (E) XLPE CABLE

Sr. No.	Particulars	Unit	Guaranteed values.
1.0	MANUFACTURER		
2.0	APPLICABLE STANDARDS		As per IS:13573
3.0	GUARANTEED PARTICULARS For the nominal(phase to phase) System voltages Maximum system voltage	KV	11KV
3.1	A.C. withstand voltage Dry (ph/ground) Time duration	KV Mins	35 KV 1 Min.
	A.C. withstand voltage Wet(ph/ground) Time duration	KV Mins	28 KV 1 Min.
3.2	Partial Discharge at 2 U ₀	pC	<5pC
3.3	Impulse withstand,1.2/50/Us	kV	75KV
3.4	Load cycle Test a)Each Cycle-Heating Duration Temperature Cooling Duration b)Number of Cycles c)Continuous phase to ground Voltage Withstand	Hrs OC Hrs. kV	5 100 3 63 2.5U ₀
	Water tightness test	KV	60Nos.at 2.5 U ₀ . as per above cycles.

3.5	Thermal Withstand Short circuit current 1Sec.	ka	As per IS:13573
3.6	Dynamic short circuit Withstand	Ka peak	2.55 x Is As per IS:13573
3.7	DC Voltage	kV	48kv for 30Mins
4.0	KIT PARTICULARS		
4.1	Material of the tubing/molded parts		Polyolefin.
4.2	Method of stress control		High permittivity Material.
4.3	Method of environmental seal		H.S. Black Insulating Tubes.
4.4	List of items included in the Kit a)For Terminations b)Allowable kit storage temperature c)Kit shelf life	Yes/No 0C Years	Yes Normal Ambient Temperature More then 5 Years
5.0	Cable Termination Instruction Manuals	Yes/No	Yes

GUARANTEED TECHNICAL PARTICULARS
HEAT SHRINK OUT DOOR TERMINATION ON 22KV (E) XLPE CABLE

Sr. No	Particulars	Unit	Guaranteed values.
1.0	MANUFACTURER		
2.0	APPLICABLE STANDARDS		As per IS:13573
3.0	GUARANTEED PARTICULARS		
3.1	For the nominal(phase to phase) System voltages Maximum system voltage	KV	22 KV
3.2	A.C. withstand voltage Dry (ph/ground) Time duration	kV KV Mins	24 KV 55 KV 1 Min
	A.C. withstand voltage Wet(ph/groun d) Time duration	KV Mins	50 KV 1 Min
3.3	Partial Discharge at 2 Vo	pC	<5pC
3.4	Impulse withstand,1.2/50/Us	kV	125KV
3.5	Load cycle Test a)Each Cycle-Heating Duration Temperature Cooling Duration b)Number of Cycles c)Continuous phase to ground Voltage Withstand	Hrs OC Hrs. kV	5 100 3 117 2.5Uo
3.6	Leak Tightness		9 Cycles.

3.7	Thermal Withstand Short circuit current 1Sec.	ka	As per IS:13573
3.8	Dynamic short circuit Withstand	Ka peak	2.55 x Is As per IS:13573
3.9	DC Voltage	kV	96 Kv for 30Mins.
4.0	KIT PARTICULARS		
4.1	Material of the tubing/molded parts		Polyolefin
4.2	Method of stress control		High permittivity Material.
4.3	Method of environmental seal		H.S. Anti-tracking Tubes.
4.4	Allowable Kit storage Temperature	0C	Normal Ambient Temperature.
4.5	Shelf life of H.S components	Years	More then 5 Years.
5.0	Cable Termination Instruction Manuals	Yes/No	Yes

GUARANTEED TECHNICAL PARTICULARS
HEAT SHRINK STRAIGHT THROUGH JOINT ON 22KV (E) XLPE CABLE

Sr. No.	Particulars	Unit	Guaranteed values.
1.0	MANUFACTURER		
2.0	APPLICABLE STANDARDS		As per IS:13573
3.0	GUARANTEED PARTICULARS For the nominal(phase to phase) System voltages Maximum system voltage	KV	22 KV
3.1	A.C. withstand voltage Dry (ph/ground) Time duration	KV Mins	55 KV 1 Min.
	A.C. withstand voltage Wet(ph/ground) Time duration	KV Mins	55 KV 1 Min.
3.2	Partial Discharge at 2 U ₀	pC	<5pC
3.3	Impulse withstand,1.2/50/Us	kV	125KV
3.4	Load cycle Test a)Each Cycle-Heating Duration Temperature Cooling Duration b)Number of Cycles c)Continuous phase to ground Voltage Withstand	Hrs OC Hrs. kV	5 100 3 63 2.5U ₀
	Water tightness test	KV	60Nos.at 2.5 U ₀ . as per above cycles.

3.5	Thermal Withstand Short circuit current 1Sec.	ka	As per IS:13573
3.6	Dynamic short circuit Withstand	Ka peak	2.55 x Is As per IS:13573
3.7	DC Voltage	kV	48Kv for 30Mins
4.0	KIT PARTICULARS		
4.1	Material of the tubing/molded parts		Polyolefin.
4.2	Method of stress control		High permittivity Material.
4.3	Method of environmental seal		H.S. Black Insulating Tubes.
4.4	List of items included in the Kit a)For Terminations b)Allowable kit storage temperature c)Kit shelf life	Yes/No OC Years	Yes Normal Ambient Temperature More then 5 Years
5.0	Cable Termination Instruction Manuals	Yes/No	Yes

Signature of the Bidder:

Name:

Designation:

Date:

Authorized common rubber

Stamp / seal of the bidder:

2.0 Earthing

1.0 INSTALLATION SPECIFICATION FOR

EARTHING: GENERAL:

All the non-current metal parts of electrical installation (RMU, MSP/FSP, Cables terminals) shall be earthed properly. All metal conduits, trucking, cable sheaths, switchgear, distribution fuse boards, lighting fittings & fixtures and all other parts made of metal shall be bonded together and connected by means of specified earthing system. All earthing will be conformed to Indian Standard Specifications **IS: 3043 – 1987**. The bidder shall measure the resistivity of various places in the proposed sub stations and design suitable earthing system and get it approved from DGVCL.

EARTHING

CONDUCTORS:

All earthing conductors shall be of high conductivity G.I./Aluminum/copper and shall be protected against mechanical injury or corrosion.

CONNECTION OF EARTHING CONDUCTORS:

- (i) Main earthing conductors shall be taken from the earth connections at the main switchboards to an earth electrode with which the connection is to be made. Sub- main earthing conductors shall run from the main switchboard to the sub- distribution boards. Final distribution boards earthing conductors shall run from sub- distribution boards.
- (ii) Circuit earthing conductor shall run from the exposed metal of equipment and shall be connected to any point on the main earthing conductor or its distribution boards or to an earth leakage circuit breaker. Metal conduits, cable sheathing and armouring shall be earthed at the ends adjacent to switchboards at which they originate or otherwise at the commencement of the run by an earthing conductor in effective electrical contact with cable sheathing. Where equipment is connected by flexible cord, all exposed metal parts of the equipment shall be earthed by means of an earthing conductor enclosed with the current carrying conductors within the flexible cord. Switches, accessories, lighting fitting etc. which are rigidly secured in effective electrical contact with a run of metallic conduit shall not be considered as a part of earthing conductor for earthing purposes, even though the run of metallic conduit is earthed.
- (iii) All metal clad switches and other equipment carrying single phase current shall be connected to earth by a single connection. All metal clad switches, carrying medium voltages and high voltage shall be connected with earth by two separate and distinct connections. The earthing conductors inside the building, wherever exposed, shall be properly protected from mechanical injury by running the same in GI pipe of adequate size.
- (iv) Earthing conductors, outside the building, shall be laid as per IS motioned above below the finished ground level.

PROTECTION FROM CORROSION:

Connections between copper and galvanized equipment shall be made on vertical face and protected with paint and grease. Galvanized fixing clamps shall be used for fixing earth conductors. When there is evidence that the soil is aggressive to copper, buried earthing conductors shall be protected by suitable serving and sheathing.

PIPE ELECTRODE EARTHING:

Earthing electrode shall consist of a GI pipe (class B of approved make), not less than 80 mm dia. and 3 meters long. GI pipe electrode shall be cut tapered at the bottom and provided with holes of 12 mm dia. drilled at 75 mm interval up to 2.5 meters length from bottom. The electrode shall be buried vertically in the ground as far as practicable below permanent moisture level, but in any case not less than 3 mtr. below ground level. The electrode shall be in one piece and no joints shall be allowed in the electrode. Wherever possible, earth electrodes shall be located close to water tap, water drain or a down take pipe. Earth electrode shall not be located in proximity to a metal fence. It shall be kept clear of the building foundations and in no case; it shall be nearer than 2 meters from the outer face of the wall.

The pipe earth electrode shall be kept vertically and surrounded with 300mm alternate thick layer of charcoal dust and salt mixture up to a height of 2.5 meters from the bottom. At the top of the electrode a G.I. threaded cap shall be provided for watering the earth. The main earth conductors shall be connected to the electrode just below the G.I. cap, with proper terminal lugs and check nuts. The G.I. cap over the GI pipe and earth connection shall be housed in a masonry chamber, approximately 300 mm length x 300 mm wide and 350 mm deep. The masonry chamber shall be provided with a cement concrete inspection cover resting over a C.C. frame, embedded in masonry. The pipe type earthing drawing for 11/22 kv cable laying work is attached.

EARTH RESISTANCE:

The earth resistivity result of the soil where the earthing stations are located shall be submitted to the engineer-in-charge before the earthing work starts. If the earth resistance is too high and multiple electrode earthing does not give adequate low resistance to earth, the soil resistivity immediately surrounding the earth electrodes shall be reduced by adding sodium chloride, calcium chloride, sodium carbonate, copper sulphate, salt and soft coke or charcoal in suitable proportions as required.

RESISTANCE TO EARTH:

The resistance of each earth system shall not exceed 2 ohm in the case of M.V. system and

1.0 ohm in the case of E.H.V. system.

The separate earthing shall be provided for incoming and outgoing cable

3.0 Cable Trench

CABLETRENCH:

TECHNICAL SPECIFICATION FOR 11/22 KV XLPE UNDERGROUND CABLE.

This specification lays down the material properties. Performance requirement of 11/22 KV XLPE Cable termination and jointing system for use on electrical systems operating at voltage 11/22KV (i.e. voltage at which the cable termination kit is meant for).

3.2 Route

Before the cable laying work is undertaken, the route of the cable shall be decided by the Engineer-in-Charge considering the following.

(i) While the shortest practicable route should be preferred, the cable route shall generally follow fixed developments such as roads, foot paths etc. with proper offsets so that future maintenance, identification etc. are rendered easy. Cross country run merely to shorten the route length shall not be adopted.

(ii) Cable route shall be planned away from drains and near the property, especially in the case of LV/MV cables, subject to any special local requirements that may have to be necessarily complied with.

(iii) As far as possible, the alignment of the cable route shall be decided after taking into consideration the present and likely future requirements of other services including cables enroute, possibility of widening of roads/lanes etc.

(iv) Corrosive soils, ground surrounding sewage effluent etc. shall be avoided for the routes.

(v) Route of cables of different voltages.

(a) Whenever cables are laid along well demarcated or established roads, the LV/MV cables shall be laid farther from the kerb line than HV cables.

(b) Cables of different voltages, and also power and control cables shall be kept in different trenches with adequate separation. Where available space is restricted such that this requirement cannot be met, LV/MV cables shall be laid above HV cables.

(c) Where cables cross one another, the cable of higher voltage shall be laid at a lower level than the cable of lower voltage.

3.3 Proximity to communication cables

Power and communication cables shall as far as possible cross each other at right angles. The horizontal and vertical clearances between them shall not be less than 60cm.

3.4 Railway crossing

Cables under railway tracks shall be laid in spun reinforced concrete, or cast iron or steel pipes at such depths as may be specified by the railway authorities, but not less than 1m, measured from the bottom of the sleepers to the top of the pipe. Inside railway station limits, pipes shall be laid upto the point of the railway station limits, pipes shall be laid upto a minimum distance of 3m from the centre of the nearest track on either side.

3.5 Way Leave

Way leave for the cable route shall be obtained as necessary, from the appropriate authorities, such as, Municipal authorities, Department of telecommunication, Gas Works, Railways, Civil Aviation authorities, Owners of properties etc. In case of private property, Section 12/51 of the Indian Electricity Act shall be complied with.

3.6 Methods of laying

The cables shall be laid direct in ground, pipe, closed or open ducts, cable trays or on surface of wall etc. The method(s) of laying required shall be specified in the tender schedule of work.

3.7 Laying direct in ground

3.7.1 General

This method shall be adopted where the cable route is through open ground, along roads/lanes, etc. and where no frequent excavations are likely to be encountered and where re-excavation is easily possible without affecting other services.

3.7.2 EXCAVATION OF TRENCH

The Contractor shall have to dig the trench for 1200 mm depth and 400 mm width (for single cable) & 600 mm width (for double cable) as per instruction of Engineer-in-charge. For 600 mm width, trench length will be considered as one & half (1½) times the length for 400 mm width and payment shall be made accordingly.as per DGVCL Drawing

3.7.3 Laying of cable in trench

LAYING OF XLPE CABLE IN TRENCH AND REFILLING OF TRENCH:

In cable trench each sand layer shall be prepared for 100 mm thick & 11 kV / 22 kV XLPE Cable of size up to 185/240 mm². to be laid on sand layer covering the cable with 150 mm Inner diameter x 25 mm thick and 1.0 meter long RCC half round muffs (to be supplied by contractor) and refilling the same, as per Instruction of Engineer-in-charge.

ERECTING XLPE CABLE ON D.P. STRUCTURE

The XLPE cable shall be erected on DP structure in such a manner that cable should be 8 meters above ground level in 110mm O.D. and 6.11 kg/Cm² ,Class-4, Green color with thickness of 8.5 mm confirms to the specification for HDPE pipes as per IS 4984 - 1987 (3rd revision) (110mm dia, 3000 mm in length) and HDPE should be erected 300 mm below ground level and 2700 mm above ground level.

I. The XLPE cable should be clamped on DP structure with proper polymer clits. The material shall be supplied by contractor.

EARTHING OF CABLES ON D P STRUCTURE

Pipe type earthing should be provided & fixed from 80 mm dia class-B GI pipe with pit to be filled with salt & coke and construction of chamber as per drawing attached and cable. All materials including joining of cable with earth pit pipe by providing 25mm width G.I. strip will be supplied by bidder.

The drawing is attached.

(ii) Testing before laying

All the time of issue of cables for laying, the cables shall be tested for continuity and insulation resistance

(iii) The cable drum shall be properly mounted on jacks, or on a cable wheel at a suitable location, making sure that the spindle, jack etc. are strong enough to carry the weight of the drum without failure, and that the spindle is horizontal in the bearings so as to prevent the drum creeping to one side while rotating.

(iv) The cable shall be pulled over on rollers in the trench steadily and uniformly without

jerks and strain. The entire cable length shall as far as possible be laid off in one stretch

(v) After the cable has been so uncoiled, it shall be lifted slightly over the rollers beginning from one end and by helpers standing about 10m apart and drawn straight. The cable shall then be lifted off the rollers and laid in a reasonably straight line.

(vi) Testing before covering

The cables shall be tested for continuity of cores and insulation resistance and the cable length shall be measured, before closing the trench.

(vii) Extra loop cable

(a) At the time of original installation, approximately 3m of surplus cable shall be left on each terminal end of the cable and on each side of the underground joints. The surplus cable shall be left in the form of a loop. Where there are long runs of cables such loose cable may be left at suitable intervals as specified by the Engineer-in-Charge.

(b) Where it may not be practically possible to provide separation between cables when forming loops of a number of cables as in the case of cables emanating from a substation, measurement shall be made only to the extent of actual volume of excavation, sand filling etc. and paid for accordingly.

(ix) Mechanical protection over the covering

(a) Mechanical protection to cables shall be laid over the covering as below to provide warning to future excavators of the presence of the cable and also to protect the cable against accidental mechanical damage by pick-axe blows etc.

(b) Covering the cable with 150 mm inner dia, 25 mm thick 1.0 meter long RCC half round muffs & refilling same as per instruction of EIC. (Necessary material to be supplied by bidder)

3.9. Back filling

(i) The trenches shall be then back-filled with excavated earth, free from stones or other sharp ended debris and shall be rammed and watered, if necessary in successive layers

(iii) The temporary re-statements of roadways should be inspected at regular intervals, particularly during wet weather and settlements should be made good by further filling as may be required.

(iv) After the subsidence has ceased, trenches cut through roadways or other paved areas shall be restored to the same density and materials as the surrounding area and –re-paved in accordance with the relevant building specifications to the satisfaction of the Engineer-in-Charge.

(v) Where road beams or lawns have been cut out of necessity, or kerb stones displaced, the same shall be repaired and made good, except for turfing /asphalting, to the satisfaction of the Engineer-in-Charge and all the surplus earth or rock shall be removed to places as specified.

3.10 CHARGING OF CABLE:

It is mandatory for the bidder to test the Main and Spare cable for continuous 72 Hrs at maximum loading condition.

3.11 JOINTING

3.11.1 Joints pits

- (i) Joint pits shall be of sufficient dimensions as to allow easy and comfortable working. The sides of the pit shall be well protected from loose earth falling into it. It shall also be covered by a tarpaulin to prevent dust and other foreign matter being blown on the exposed joints and jointing materials.
- (ii) Sufficient ventilation shall be provided during jointing operation in order to disperse fumes given out by fluxing.

3.11.2 Safety precaution

- (i) A caution board indicating "CAUTION – CABLE JOINTING WORK IN PROGRESS" shall be displayed to warn the public and traffic where necessary.
- (ii) Before jointing is commenced, all safety precautions like isolation, discharging, earthing, display of caution board on the controlling switchgear etc. shall be taken to ensure that the cable would not be inadvertently charged from live supply. Metallic armour and external metallic bonding shall be connected to earth. Where "Permit to work" system is in vogue, safety procedures prescribed shall be complied with.

3.11.3 Jointing materials

- (i) Jointing materials and accessories like conductor ferrules, solder, flux, insulating and protective **tapes**, filling compound, jointing boxes, heat shrinking joint kit etc. of right quality and correct sizes, conforming to relevant Indian Standards, wherever they exist, shall be used.
- (ii) The design of the joint box and the composition of the filling compound shall be such as to provide an effective sealing against entry of moisture in addition to affording proper electrical characteristic to joints.
- (iii) The heat shrinkable straight joint of approved make is to be used. The storage as well as jointing instructions of the manufacturer of such materials shall be strictly followed.

3.11.4 Joiner

Jointing work shall be carried out by a licensed/ experienced (where there is no licensing system for joiners) cable joiner.

3.11.5 Cable work with joints

- (i) About 3m long surplus cable shall be left on each side of joints .
- (ii) Insulation resistance of cables to be jointed shall be tested.. Unless the insulation resistance values are satisfactory, jointing shall not be done.
- (iii) Cores of the cables must be properly identified before jointing.
- (iv) Where cable is to be jointed with the existing cable, the sequence should be so arranged as to avoid crossing of cores while jointing.
- (v) Whenever the aluminium conductor is exposed to outside atmosphere, a highly tenacious oxide film is formed which makes the soldering of aluminium conductor difficult. This oxide film should be removed by using appropriate type of flux.
- (vi) The clamps for the armour shall be clean and tight.

3.9.6 Jointing procedure

While it would be necessary to follow strictly the instructions for jointing furnished by the manufacturers of cables and joint kits.

3.12 TESTING

3.12.1 Testing before laying

All cables, before laying, shall be tested with a 2500/5000V megger for 11 KV/22 KV cables .. The cable cores shall be tested for continuity, absence of cross phasing, insulation resistance from conductors to earth / armour and between conductors.

3.12.2 Testing after laying

(ii) The cable is to be tested for one minute with 2500/5000 V megger for 11KV/22 KV cables.

4.0 HDPE PIPE

Bidder has to submit the type test reports/certificates of HDPE pipes from NABL approved laboratory or CIPET and same should be of size: 110mm O.D. and 6.11KG/Cm² (0.6 Mpa), thickness of 8.5 mm for class 4 green color confirms to the specification for HDPE pipes as per IS 4984 - 1987 (3rd revision) for laying of 11/22KV XLPE cable of size up to 185mm² size on the erected DP structure for the mechanical protection of cable by inserting the cable inside HDPE pipe. The HDPE pipe shall be erected in such a way that 300mm shall be below the ground level and the rest 2700 mm shall be supported on the DP Structure Fixing with polymer clits.

The sample of HDPE pipe shall be getting approved at concern (circle level prior to commence supply of HDPE pipe. The testing certificate & type test certificate of HDPE pipe shall be submitted at the time of passing of bills.

The lot wise inspection of sample randomly selected from the lot of HDPE pipe is to be carried out at NABL approved testing LAB/CIPET prior to supply of HDPE pipe and then work for HDPE vertical laying/HDD work is to be executed.

HDPE Pipe of 110mm O.D. and 6.11kg/Cm² (0.6 Mpa), thickness of 8.5 mm confirms to the specification for HDPE pipes as per IS 4984 - 1987 (3rd revision) for laying of underground 11/22KV XLPE cable

5.0 LIST OF APPROVED MAKES OF EQUIPMENTS AND ACCESSORIES FOR PROPOSED TURNKEY PROJECT

Sr. No.	Particulars	Makes /Suppliers
1	Termination & Jointing Kit	Rychame, Bensons, Densons , M-seal (3M)
2	G.I. Pipes	Tisco, Sail, Damodar, Zenith & Shivdurg