

BHARAT HEAVY ELECTRICALS LIMITED
TRANSMISSION BUSINESS ENGINEERING MANAGEMENT
NOIDA

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TYPE OF DOC.	TECHNICAL SPECIFICATION	NAME	MM	DKM	AG
TITLE 220Kv & 132kv EHV XLPE CABLE & ACCESSORIES		SIGN	<i>[Signature]</i>	<i>[Signature]</i>	3/2/19
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		GROUP	TBEM		
		WO No.	88005		
CUSTOMER	UPPTCL				

PROJECT	400/220/132 KV GIS s/s at Rasra, Ballia
TENDER NO./ NOA NO.	

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Remarks: Bidder to note that data and details of Guaranteed Technical Particulars shall not be reviewed during Technical Evaluation/ Review, hence compliance of Guaranteed Technical Particulars in line with Technical Specification shall be bidder's responsibility.

Rev	Date	Altered	Checked	Approved
	24/06/19	<i>[Signature]</i>		
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Section 1: Scope, Project specific technical requirements & Bill of Quantities

1.1 SCOPE

This technical specification covers the requirements of design, manufacture, inspection and testing at manufacturer's works, proper packing and delivery to project site, installation, testing and commissioning of EHV XLPE Cable & Cable Jointing/ Termination Accessories for working voltage of 220kV & 132kV complete in all respect for efficient & trouble free operation mentioned under this specification.

Cable required for connecting (refer SLD)

- indoor 220kV GIS to 220kV Line (outdoor)
- indoor 132kV GIS to 132kV Line (outdoor)
- indoor 132kV GIS to 220/132kV ICT

Cables shall be laid in trenches on racks in trefoil formation.

Hence, the electrical scope of work under this specification shall include but not be limited to basic and detailed engineering and design, as required, manufacturing, inspection and testing at manufacturer's work, supply with proper packing, transportation to site, installation, testing and commissioning, commissioning spares, special tools and tackles as defined in equipment Bill of Quantity, datasheet, drawings, standard specifications, standards, etc. attached or referred with technical specification.

Oil type cable termination kits/ sealing ends are also acceptable for outdoor termination of 220kV & 132kV cable in accordance with standard IEC 62067/ IEC 61462/ IEC 60840 as applicable.

In general, scope entails following,

1. Supply activities includes design requirements as per section 2, manufacturing, quality assurance & control, assembly, inspection and testing at manufacturer's work, supply with proper packing, transportation to site.
2. Service activities includes installation, termination, providing & fixing structure, clamping on structure/ rack/ trays, testing, commissioning, final documentation etc.

This section covers the specific technical requirements of EHV XLPE Cable & Cable Jointing/ Termination Accessories for working voltage of 220/132 kV. This constitutes minimum technical parameters for the above item as specified by the BHEL/UPPTCL. The offered EHV XLPE Cable & Cable Jointing/ Termination Accessories for working voltage of 220/132 kV shall also comply with the Section-3 (Project Details and General technical requirements for all equipment under the Project) of this specification.

The specification comprises of following sections:

- Section-1 : Scope, Project specific technical requirements & Bill of Quantities
- Section-2 : Equipment Specification under scope of supplies.
- Section-3 : Project Details and General technical requirements (For all equipment

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- Section-4 : under the Project).
Annexures
Annexure-A (Schedule of Technical Deviations)
Annexure-B (Compliance Certificate)
Annexure-C (Guaranteed Technical Particulars)
Annexure-D (Technical Checklist)

The following order of priority shall be followed. In case of conflict between requirements specified in various referred documents/ standard/ specification/ datasheet and statutory requirements, the most stringent one shall be followed. BHEL/UPPTCL concurrence shall, however, be obtained before taking a final decision in such matters.

1. Statutory Regulations

In particular, the latest version of the following statutory regulations, as applicable, shall be followed for system,
o Indian Electricity Act
o CEA regulations

2. Section-1
3. Section-2
4. Section-3
5. Section-4
6. Codes & standards

Bidder shall furnish list of conflicts/ ambiguities/ deviations, if any, along with their technical offer and also furnish the basis that is considered for submitting technical offer. BHEL/UPPTCL will resolve listed conflicts prior to award. In case of ambiguity, bidder shall inform BHEL/UPPTCL of their interpretation. In case bidder fails to convey the same prior to award, the Owner's decision on interpretation shall be considered final and binding if need arises during the execution. No additional cost or extra time on account of conflicts/ ambiguities/ deviations shall be admissible.

In general, no deviation from the requirements specified in various clauses of this specification shall be allowed and hence, a certificate to this effect shall have to be furnished along with the offer (Annexure-B), however bidder may furnish list of conflicts/ ambiguities/ deviations (Annexure-A), if any. Any conflicts/ ambiguities/ deviations mentioned elsewhere in technical offer shall not be reviewed.

The equipment is required for the following project:

Name of the Customer/ UPPTCL	:	UTTAR PRADESH TRANSMISSION CORPORATION LTD. (UPPTCL)
Name of Main Contractor	:	Bharat Heavy Electricals Limited
Name of the Project	:	CONSTRUCTION OF 400kV GIS SUBSTATION, UPPTCL, RASRA, BALLIA

The complete scope shall be as per commercial terms and conditions enclosed separately with the notice inviting tender/ enquiry.

1.2 SPECIFIC TECHNICAL REQUIREMENTS

Specific technical requirements **EHV XLPE Cable & Cable Jointing/ Termination Accessories for working voltage of 220kV & 132 kV** shall be as per **section 2**.

Notes:

- (i) *Vendor shall furnish calculations of cable for following,
 - (a) Screen/ sheath voltage under full load condition,
 - (b) Screen/ sheath voltage during an external three phase symmetrical through-fault.
- (ii) Vendor shall furnish calculations for screen/ sheath voltage/ current and the recommended method for metallic screen bonding, i.e. single point/ cross bonding.

1.3 OTHER GENERAL REQUIREMENTS

Other general requirements EHV XLPE Cable & Cable Jointing/ Termination Accessories for working voltage of 220/132 kV shall be as follows,

(i) Schedule:

- (a) Supplier will submit detailed bar chart indicating all the milestones from engineering till manufacturing/ testing, dispatch to site, installation, testing and commissioning.
- (b) Bidder to submit list of consumables with shelf life of less than two years. It shall be supplied before erection after clearance from BHEL/UPPTCL.

(ii) Store:

Store shall be provided by BHEL. Bidder to provide their requirement of space in open and closed store during tender stage only. Bidder to provide their standard recommendations for precautions to be taken during unloading and storage etc.

(iii) Office facilities & accommodation for bidder's staff along with conveyance, transportation of all special tools & plants, testing kits etc. shall be in bidder's scope, however, unloading, storage, watch and ward and installation under bidder's supervision shall be in BHEL's scope.

(iv) Calculations

Bidder will submit short circuit current calculation, continuous current rating calculation and sheath standing voltage calculation of the 220/132 kV cable in line with proposed laying conditions and customer requirements. Any other detailed calculations, if required/ envisaged during detailed engineering stage shall also be in bidder's scope.

(v) Earthing

Earthing of EHV cable rack/tray with suitable size of flat shall be in BHEL scope. However, earthing of cable system including earthing cable shall be in bidder's scope. Earth grid connection shall not be available at all points, hence bidder to keep provision of rod/ pipe electrode etc.

(vi) Construction supply

For construction purpose, the necessary power supply at site shall be provided by BHEL at one point only, however supply requirements for testing etc. shall be arranged by bidder only.

(vii) Installation

(a) The cables shall be laid in cable racks in cable trench/ pipe rack assembly, as per requirement at site. The cable racks in cable trench/ pipe rack assembly shall be supplied and fixed by BHEL based on detailed input design and drawing provided by bidder. These details shall be furnished during tender stage only.

(b) Provision of site supervisor and skilled technician, qualified jointer etc. along with tools & tackles, testing instruments/ kits etc. shall be deemed to be included in bidder's scope.

(c) The required drilling, fabrication and minor civil works required for fixing clamp in cable racks in cable trench/ pipe rack assembly shall be in bidder's scope.

(d) Termination:

-Tools & tackles, testing instruments/kits required for carrying out termination/ jointing works shall be bidder's scope.

-For terminations at GIS end identified as customer use, datasheet has been enclosed as Annexure-Datasheet of 220kV XLPE Cable, 1200sqmm & Annexure-Datasheet of 132kV XLPE Cable, 630sqmm.

(e) Any cable or accessories damaged during installation, testing & commissioning shall be made good/ repaired/ replaced by bidder to the satisfaction of BHEL/UPPTCL.

(f) Bidder to note that different bays may be commissioned at different point of time, and hence bidder shall be required to deploy the resources multiple times.

(viii) Site test

Bidder shall depute its qualified testing & commissioning engineer including supply of all testing instruments/ kits (DC test for outer sheath and HV test) bidder's scope. Bidder shall submit complete methodology for conduction of site tests for further approval of BHEL/UPPTCL.

(ix) Bidder shall submit list of consumables with shelf life of less than two years and same shall be dispatched just before the erection and only after specific clearance from BHEL/UPPTCL.

(x) Any special tools and tackles required to complete the cable laying, termination and ETC shall be included in the offer. BHEL shall arrange general tools and tackles for laying of cables only.

(xi) In addition to this, packing of cables & its accessories shall be suitable for long term storage i.e. minimum 6 months, if required.

(xii) The bidder must fill up all the details required for offered item/s. Instead of indicating "refer drawing, or as per IS/IEC", the exact value/s must be filled in.

List of special tools and testing equipment which will be brought for installation and commissioning of the cable system by contractor (on returnable basis) shall be enclosed with bid.

1.4 BILL OF QUANTITIES

Quantities for supply and services for EHV XLPE Cable & Cable Jointing/ Termination Accessories for working voltage of 220/132 kV shall be as per Annexure-BOQ/220kV; Annexure-BOQ/132kV

However, any item/ service not appearing herein but required for completeness of the work is deemed to be included in bidder's scope.

Notes:

(i) Cable Length

The exact length shall also be decided by supplier either after visiting site & making precise measurements at contract stage or by inferring details from layout drawings. Manufacturing lengths and drum length shall be determined as per details provided by bidder and approved by BHEL/UPPTCL.

(a) The Payment of cables length for supply shall be as per approved quantities by BHEL/UPPTCL.

(b) The Payment of cables length installation will be as per actual measurement at site which shall also include cable terminations.

(c) The exact length may vary by -30% to +30% at contract stage based on actual measurement at site and calculations submitted by the bidder. Individual quantity of other items may vary to any extent and may get deleted during contract/ execution stage.

1.5 Drawings Enclosed

Sl. No.	BHEL Drg. No.	Drawing Title
1.	TB-3-404-510-001	SINGLE LINE DIAGRAM OF 400kV GIS UPPTCL
2.	TB-0-404-316-002	Overall General Arrangement Drawing of Switchyard for 400/UPPTCL KV GIS
3.	TB-0-404-316-005	Conceptual drg of 220 kV GIS Building
4.	TB-0-404-316-006	Conceptual drg of 132 kV GIS Building
5.	Sketch-1	Trench section drg

1.6 TECHNICAL REQUIREMENT OF EQUIPMENT

As per Annexure-1.

1.7 QUALITY PLAN

The successful bidder shall submit the Quality Plan for BHEL/UPPTCL approval. In case bidder has reference Quality plan agreed with BHEL/UPPTCL, same can be submitted for specific project after award of contract for BHEL/UPPTCL approval. There shall be no commercial implication to BHEL on account of Quality Plan approval.

All materials shall be procured, manufactured, inspected and tested by bidder/vendor/ sub-vendor as per approved quality plan. The bidder/vendor shall perform all tests necessary to ensure that the material and workmanship conform to the relevant standards and comply with the requirements of the specification. Charges for all these tests for all the equipment & components shall be deemed to be included in the bid price.

1.8 INSPECTION, TESTING & ACCEPTANCE

- (i) After completion of manufacture of cables and prior to despatch, the cables shall be subjected to type tests and special tests, as applicable, routine tests, acceptance

tests, optional test on cables and accessories in accordance with the applicable IEC /IS and the material shall be offered for final inspection by BHEL/UPPTCL in accordance with approved quality assurance plan. The test reports for all cables shall be got approved before despatch of the cables. For Further details, bidder to refer section-2.

- (ii) The bidder/ vendor shall carry out the works in accordance with sound quality management principles which shall include such as controls which are necessary to ensure full compliance to all requirements of the specification & applicable international standards. These quality management requirements shall apply to all activities during design, procurement, manufacturing, inspection, testing, packaging, shipping, inland transportation, storage, site erection & commissioning.
- (iii) Bidder shall also furnish factory acceptance testing procedures for BHEL/UPPTCL approval. The equipment manufacturer shall carry out these tests at site only

1.9 FIELD TESTING & COMMISSIONING

- (i) Field testing and commissioning of 220/132kV cable & its accessories shall be done by Bidder/OEM only.
- (ii) Bidder shall also submit site acceptance testing (SAT) procedures and get them approved from BHEL/UPPTCL before carrying out the site testing at site.
- (iii) Bidder shall coordinate with manufacturers of other equipment wherever required and shall freely and readily supply all technical information for this purpose as and when called for.

1.10 MAKES OF ITEMS/ SPARES

- (i) Bidder can offer equipment/ components of makes other than specified in the tender during order execution. The alternate makes of equipment/ components will be evaluated post order, based on the satisfactory track record and test certificates to be furnished by the Bidder. In case the alternate makes are not found acceptable, equipment/ components shall be strictly as per vendor list in section 2.

1.11 PACKING AND DISPATCH

- (i) Cables shall be despatched in non-returnable steel drums of suitable barrel diameter, securely battened, with the take-off end fully protected against mechanical damage.
- (ii) The following information shall be marked on the drum:
 - (a) Reference to IS: 7098 (Part-3)
 - (b) Manufacturer's name, trade mark/ brand name
 - (c) Type of cable and voltage grade
 - (d) Number of cores
 - (e) Nominal Conductor cross-section area and material
 - (f) Type of insulation

-
- (g) Cable code
 - (h) Cable drum number
 - (i) Length of cable in each drum
 - (j) Direction of rotation of the drum (by means of an arrow)
 - (k) Gross weight
 - (l) Year and country of manufacture
 - (m) Location of the cable outer end by an arrow
 - (n) Section of cable route for which the cable is intended.
 - (o) The details indicated in (h), (i), (j), (m) and (n) shall be painted on both sides of the drum.

- (iii) Cables shall be supplied in drum lengths of 500-600 meters for cables up to 220/132KV unless otherwise specified. However exact drum lengths shall be finalised during order execution. Due consideration shall be given to the route length & proposed screen bonding scheme to finalise drum lengths. A tolerance of +3% shall be permissible for each drum. However overall tolerance on each size of cable shall be limited to +2%.

Each cable end shall be hermetically sealed by means of PVC/ Rubber/ non hygroscopic sealing compound cups so as to protect the cable from outside moisture & ingress of water during transit, storage and laying. At top cable end, pulling eye shall be provided.

(iv) Markings and Indications

The cables shall be identified throughout the length of the cable for the following:

- a. The name or trade mark of the manufacturer
- b. The conductor cross-section and conductor material
- c. The insulation material
- d. The voltage grade
- e. The year of manufacture
- f. The reference to identify the cable-manufacturing batch
- g. Cable Code
- h. Reference to specification.

The marks can be printed, embossed or engraved on the outer sheath. The interval between the end of one inscription and the beginning of the next one shall not exceed one meter.

Sequential length mark shall be provided at each metre along with the above markings.

The packing shall be suitable for safe transport from manufacturer's works and for storage up to 6 months at site.

1.12 REPLACEMENT OF DEFECTIVE PARTS/ EQUIPMENTS/WORKS & RECTIFICATION OF DEFECTS

In case any defect is discovered during installation, testing and commissioning of equipment at site, the Bidder at his own cost shall rectify the defect/ replace the equipment or material promptly as to achieve the commissioning schedule.

In case any defect is discovered at site after taking over of the Substation by the Purchaser in the materials supplied or works done by Bidder, the Bidder at his own cost shall rectify the defect/ replace the equipment or material promptly as soon as informed by the Purchaser.

1.13 MISTAKES IN DRAWINGS

The Bidder shall be responsible for and shall pay for any alterations of the work due to any discrepancies, errors and omission in the drawings or other particulars supplied by him, whether such drawings or particulars have been approved by the Engineer or not, provided that if such discrepancies, errors or omissions are due to inaccurate information or particulars furnished to the Bidder by the Engineer, any alterations in the work necessitated by reason of such inaccurate information or particulars shall be paid for by the Purchaser.

Notes for Installation of cables

1. Cable installation shall be carried out generally as per applicable standard/manufacturer guidelines. Cable shall be on angles in cable trench. Typical sectional drawing for 220 KV/132kV cable trench section enclosed.
2. Cable drums shall be unloaded, handled and stored in an approved manner on hard and well drained surface so that they may not sink. In no case shall the drum be stored flat i.e. with flange horizontal. Rolling of drums shall be avoided as far as possible. For unreeling the cable, the drum shall be mounted on suitable jacks or on cable wheels and shall be rolled slowly so that cable comes out from over the drum and not from below. All possible care shall be taken during unreeling and laying to avoid damage due to twist, kink or sharp bends. Cable ends shall be kept sealed by heat shrinkable PVC caps to prevent damage and ingress of moisture.
3. While laying cable, ground rollers shall be used at every 2 meter interval to avoid cable touching ground. The cables shall be pushed over the rollers by a gang of people positioned in between the rollers. Cables shall not be pulled from the end without having intermediate pushing arrangement. Pulling tension shall not exceed the values recommended by cable Manufacturer. Cable ends shall be kept sealed by heat shrinkable PVC caps to prevent damage and ingress of moisture. Selection of cable drums for each run shall be so planned so as to avoid straight through joints.
4. Cable splices will not be allowed except where called for by the drawings or is unavoidable and permitted by the Project Manager. Care should be taken while laying the cables so as to avoid damage to cables.
5. Bending radii for cables shall be as per manufacturer's recommendations. Manufacturer's instructions shall be strictly adhere to and necessary conducting medium for checking healthiness of outersheath shall be applied.
6. Where cables cross roads/rail tracks underground, the cables shall be laid in HDPE pipes embedded in PCC in ground with a minimum cover of 1 metre. HDPE pipe shall also be provided where cables cross existing HT/LT cable trenches. The HDPE pipes and accessories shall be supplied, laid and encased in PCC by the employer.
7. Ends of HDPE pipes shall be sealed properly after laying of cable.
8. In each cable run, extra length shall be kept at suitable point to enable two straight joints to be made, should the cable develop fault at a later stage.
9. Bidder shall carry out the bonding of screen at the both ends of terminal using the insulated conductor of required size with earth mat.
10. The bidder shall ensure that the cables and accessories supplied by him are installed in a neat workman-like manner such that it is levelled, properly aligned and well oriented. The tolerance shall be as established in the bidder's drawing and/or as stipulated by the Employer.
11. The cable termination work shall be carried out by an experienced cable jointer who shall have adequate experience in jointing and termination of 220kV or higher grade XLPE cables. The successful bidder shall submit, sufficiently in advance, the biodata of the cable jointer giving the details of his qualification and experience for employer's approval.

Annexure-1

TECHNICAL REQUIREMENT OF EQUIPMENT for UPPTCL Ballia s/s

(A). OPERATIONAL EXPERIENCE

(A.1). 220 kV Grade XLPE Power Cables

The cable shall be from the manufacturer who must have designed, manufactured, type tested as per relevant IEC/IS or equivalent standard and supplied in a single contract at least 1(one) km of single core, 220kV or higher grade XLPE insulated cable which must be in operation for at least 3 (three) years in tropical climate as on the as on the date of bid opening i.e. 17.04.2018.

Performance certificate from end user shall be submitted.

(A.2). 132 kV Grade XLPE Power Cables

The cable shall be from the manufacturer who must have designed, manufactured, type tested as per relevant IEC/IS or equivalent standard and supplied in a single contract at least 1 (one) km of single core, 132kV or higher grade XLPE insulated cable which must be in operation for at least 3 (three) years in tropical climate as on as on the date of bid opening i.e.17.04.2018.

Performance certificate from end user shall be submitted.

(B). TESTING FACILITIES

The manufacturer must have all necessary facilities at their works for carrying out such routine and acceptance tests as prescribed in the relevant IEC/IS and any other routine and acceptance test as specified in the specification.

Documentary evidence of existence of such facilities shall be submitted.

M. Chhapal

31/3/11

M. Chhapal

Sl. No.	Description of Items	Long Description	Unit	Qty.
2A	MAIN SUPPLY ITEMS			
	EHV CABLE			
2A1	127/220kV Single Core, 1200 sqmm size, Cu conductor cable	Cable shall be complete in all respect and comprising of following but not limited to, 1. The cable construction shall as per technical specification. 2. The exact length shall also be decided by bidder either after visiting site & making precise measurements at contract stage or on basis of layout drawings. Manufacturing lengths and drum length shall be determined with consultation & approval with BHEL/UPPTCL. 3. Bidder shall furnish calculations of cable for following during tendering stage only, (a) Screen/ sheath voltage under full load condition, (b) Screen/ sheath voltage during an external three phase symmetrical through-fault. 4. Bidder shall furnish calculations for screen/ sheath voltage/ current and the recommended method for metallic screen bonding. 5. Any other item/(s) required to complete the supply in all respect but not limited to above shall be in bidder's scope.	Meter	2500
	CABLE ACCESSORIES			
2A2	Indoor Termination Kit for GIS end suitable for 127/220kV, 1200 sqmm size	Termination kit shall be complete in all respect and comprising of following but not limited to, 1. The cable end terminating kits shall be outdoor type as per technical specification. 2. The terminating kits shall complying with relevant standards. 3. Any other item/(s) such as weather shields/ sealing ends, lugs/ connector, hardware and other accessories required to complete the supply in all respect but not limited to above shall be in bidder's scope.	Set	12
2A3	Outdoor Termination Kit for Cable Sealing end suitable for 127/220kV, 1200 sqmm size	Termination kit shall be complete in all respect and comprising of following but not limited to, 1. The cable end terminating kits shall be indoor type as per technical specification. 2. The terminating kits shall complying with IEC 62271-209. 3. Any other item/(s) such as weather shields/ sealing ends, lugs/ connector, hardware and other accessories required to complete the supply in all respect but not limited to above shall be in bidder's scope.	Set	12
2A4	Straight Through Joint suitable for 127/220kV, 1200 sqmm size	Straight through jointing kit shall be complete in all respect and comprising of following but not limited to, 1. The jointing kits shall as per technical specification and relevant standards. 3. Any other item/(s) and other accessories required to complete the supply in all respect but not limited to above shall be in bidder's scope.	Set	3
2B	OTHER CABLE ACCESSORIES			
2B1	1nox3 phase link box without SVL(sheath voltage limiter) suitable/ compatible for cable system	1.Vendor shall furnish calculations for screen/ sheath voltage/ current and the recommended method for metallic screen bonding. 2. Any other item/(s) such as mounting structure and other accessories required to complete the supply in all respect but not limited to above shall be in bidder's scope.	Set	4
2B2	3nox1 phase link box with SVL(sheath voltage limiter) suitable/ compatible for cable system	1.Vendor shall recommend the Voltage rating of Sheath Voltage Limiter (SVL). 2.Vendor shall furnish calculations for screen/ sheath voltage/ current and the recommended method for metallic screen bonding. 3. Any other item/(s) such as mounting structure and other accessories required to complete the supply in all respect but not limited to above shall be in bidder's scope.	Set	4
2B3	Metallic screen bonding cable along with accessories suitable/ compatible for cable system	1. Any other item/(s) lugs/ connectors and other accessories required to complete the supply in all respect but not limited to above shall be in bidder's scope.	Set	4
2B4	Earth continuity conductor cable along with accessories suitable/ compatible for cable system	1. Any other item/(s) lugs/ connectors and other accessories required to complete the supply in all respect but not limited to above shall be in bidder's scope.	Set	4
2B5	Trefoil clamps, non-magnetic suitable/ compatible for cable system	1. Trefoil clamps shall be fixed at the distance of 1.0 meters on circuit cables. 2. Any other item/(s) such as mounting/ fixing hardware and other accessories required to complete the supply in all respect but not limited to above shall be in bidder's scope.	Lot	1
2B6	Single clamps, non-magnetic suitable/ compatible for cable system	1. Single clamps shall be fixed at the distance of 1.0 meters on both end of individual cable. 2. Any other item/(s) such as mounting/ fixing hardware and other accessories required to complete the supply in all respect but not limited to above shall be in bidder's scope.	Lot	1

Sl. No.	Description of Items	Long Description	Unit	Qty.
2B7	Cable support structure for GIS end suitable/ compatible for cable system	Supply of all structural materials including hardware for GIS end required to complete the work in all respect shall be in bidder's scope.	Set	4
2B8	Consumables with limited shelf life suitable/ compatible for cable system	Supply of all consumables required to complete the work in all respect shall be in bidder's scope. (1lot=complete requirement for package)	Lot	1
2B9	Miscellaneous Items including cable route marker, electrode etc required for cable system	Supply of all miscellaneous items including cable sealing end, cable route marker, rod/ pipe electrode shall be in bidder's scope. (1lot=complete requirement for package)	Lot	1
2B10	Any other item(s) not mentioned above, but required for completion of the supply	Supply of any other item (s) not mentioned above, but required for completion of the supply in all the respect shall be in bidder's scope and bidder shall provide the details for the same during tendering stage only. (1lot=complete requirement for package)	Lot	1
2B11	General / Special tools and tackles	Bidder shall provide the details of general/ special tools, to be provided on non-returnable basis. (1lot=complete requirement for package)	Lot	1
2C SERVICES				
EHV CABLE				
2C1	Site survey for route and length finalization	The exact length shall also be decided by bidder either after visiting site, making precise measurements at contract stage or on basis of layout drawings. Manufacturing lengths and drum length shall be determined with consultation & approval with BHEL/UPPTCL. 1. The payment of cables length for supply shall be as per approved quantities after survey. 2. The Payment of cables length for installation shall be as per actual measurement at site which shall also include cable terminations. 3. The length may vary by -20% to +20% at contract stage based on actual measurement at site and calculations submitted by the bidder. (1lot=complete requirement for package)	Lot	1
2C2	Installation of Cable in trefoil form/ single form on support structure/ cable rack assembly / pipe rack assembly	Installation of EHV cable shall be completed in all respect and comprising of following but not limited to, 1. Laying of cables in trefoil form with proper dressing by fixing trefoil clamps and/ or single form as required on support structure using trefoil/ single clamps on cable trays of cable trench/ rack assembly/ other structure assembly. 2. Fixing of cable support structure for support of cable/ termination including fixing arrangements. 3. Fixing of cable route marker, cable tag, phase marker etc. 3. Arrangement of special tools & tackles for smooth laying & installation 4. Any other service/(s) required to complete the work in all respect but not limited to above shall be in bidder's scope.	Meter	2500
2C3	Field Testing and commissioning of cable alongwith accessories	1. Field testing & commissioning of EHV cable along with accessories such end termination, straight through joints, if required shall be carried out in phase manner and hence simultaneous commissioning is not envisaged. 2. Field testing & commissioning shall be done as per approved SAT (site acceptance test), which shall be submitted by bidder and shall be approved by BHEL/UPPTCL. 3. Field testing & commissioning shall be carried out by skilled & experienced testing engineer. Test instruments along with valid calibration certificates for testing & commissioning shall be brought at site by bidder. 4. Any other service/(s) required to complete the testing & commissioning in all respect shall be in bidder's scope.	Set	4
2C4	Termination of Cable Termination Kit for GIS end	Termination of kit shall be completed in all respect and comprising of following but not limited to, 1. Termination of kit suitable/ compatible for EHV cable for GIS end in all respect. 2. Fixing of structure for support of termination including other fixing arrangements. 3. Termination of EHV cables shall be done by skilled and experienced jointer duly approved by Engineer-in charge. 4. Any other service/(s) required to complete the work in all respect but not limited to above shall be in bidder's scope.	Set	12
2C5	Termination of Cable Termination Kit for CS (Cable Sealing) end	Termination of kit shall be completed in all respect and comprising of following but not limited to, 1. Termination of kit suitable/ compatible for EHV cable for Cable Sealing End in all respect. 2. Fixing of clamps on structure for support of termination including other fixing arrangements. 3. Termination of EHV cables shall be done by skilled and experienced jointer duly approved by Engineer-in charge. 4. Any other service/(s) required to complete the work in all respect but not limited to above shall be in bidder's scope.	Set	12

Sl. No.	Description of Items	Long Description	Unit	Qty.
2C6	Termination of Straight Through Joint	Joining through kit shall be completed in all respect and comprising of following but not limited to, 1. Joining through kit suitable/ compatible for EHV cable in all respect. 2. Joining of EHV cables shall be done by skilled and experienced jointer duly approved by Engineer-in charge. 3. Any other service/(s) required to complete the work in all respect but not limited to above shall be in bidder's scope.	Set	3
2D	SERVICES - OTHER CABLE ACCESSORIES			
2D1	Installation of Link Box without SVL (Sheath Voltage Limiter) along with its accessories and earthing etc.	Installation of link box without SVL(sheath voltage limiter) at GIS end shall be completed in all respect and comprising of following but not limited to, 1. Installation of link box without SVL(sheath voltage limiter) at GIS end along with installation of metallic screen bonding/ earthing cable along with accessories. 2. Installation of rod electrode/ pipe electrode for earthing shall also be in bidder's scope, if required. 3. Any other supervisory service/(s) required to complete the work in all respect but not limited to above shall be in bidder's scope.	Set	4
2D2	Installation of Link Box with SVL (Sheath Voltage Limiter) along with its accessories and earthing etc.	Installation of link box with SVL(sheath voltage limiter) at GIS end shall be completed in all respect and comprising of following but not limited to, 1. Installation of link box with SVL(sheath voltage limiter) at cable sealing end along with installation of metallic screen bonding/ earthing cable along with accessories. 2. Installation of rod electrode/ pipe electrode for earthing shall also be in bidder's scope, if required. 3. Any other supervisory service/(s) required to complete the work in all respect but not limited to above shall be in bidder's scope.	Set	4
2D3	Fixing of support structure for GIS end	Structural works required to support and fix the end terminations including supply of mounting hardware, fixing hardware, grouting and other civil works required to complete the work shall be in bidder's scope.	Set	4
2D4	Any other service (s) not mentioned above, but required for completion of the service	Any other service(s) not mentioned above, but required for completion of the work in all the respect shall be in bidder's scope and bidder shall provide the details for the same during tendering stage only. (1lot=complete requirement for package)	Lot	1
2E	SERVICES-TRAINING			
2E1	Training - Training during installation	Services - Training during erection/ installation at site (1 lot=6 UPPTCL/BHEL Engineers at site for 1 day).	Lot	1
2E2	Training - Training during testing and commissioning	Services - Training during testing & commissioning at site (1 lot=4 UPPTCL/BHEL Engineers at site for 1 day).	Lot	1

Sl. No.	Description of Items	Long Description	Unit	Qty.
1A	MAIN SUPPLY ITEMS			
	EHV CABLE			
1A1	76/132kV Single Core, 630 sqmm size, Cu conductor cable	Cable shall be complete in all respect and comprising of following but not limited to, 1. The cable construction shall as per technical specification. 2. The exact length shall also be decided by bidder either after visiting site & making precise measurements at contract stage or on basis of layout drawings. Manufacturing lengths and drum length shall be determined with consultation & approval with BHEL/UPPTCL. 3. Bidder shall furnish calculations of cable for following during tendering stage only, (a) Screen/ sheath voltage under full load condition, (b) Screen/ sheath voltage during an external three phase symmetrical through-fault. 4. Bidder shall furnish calculations for screen/ sheath voltage/ current and the recommended method for metallic screen bonding. 5. Any other item/(s) required to complete the supply in all respect but not limited to above shall be in bidder's scope.	Meter	2300
	CABLE ACCESSORIES			
1A2	Outdoor Termination Kit for GIS end suitable for 76/132kV, 630 sqmm size	Termination kit shall be complete in all respect and comprising of following but not limited to, 1. The cable end terminating kits shall be outdoor type as per technical specification. 2. The terminating kits shall complying with relevant standards. 3. Any other item/(s) such as weather shields/ sealing ends, lugs/ connector, hardware and other accessories required to complete the supply in all respect but not limited to above shall be in bidder's scope.	Set	21
1A3	Indoor Termination Kit for Cable Sealing end suitable for 76/132kV, 630 sqmm size	Termination kit shall be complete in all respect and comprising of following but not limited to, 1. The cable end terminating kits shall be indoor type as per technical specification. 2. The terminating kits shall complying with IEC 62271-209. 3. Any other item/(s) such as weather shields/ sealing ends, lugs/ connector, hardware and other accessories required to complete the supply in all respect but not limited to above shall be in bidder's scope.	Set	21
1A4	Straight Through Joint suitable for 76/132kV, 630 sqmm size	Straight through jointing kit shall be complete in all respect and comprising of following but not limited to, 1. The jointing kits shall as per technical specification and relevant standards. 3. Any other item/(s) and other accessories required to complete the supply in all respect but not limited to above shall be in bidder's scope.	Set	3
1B	OTHER CABLE ACCESSORIES			
1B1	1nox3 phase link box without SVL(sheath voltage limiter) suitable/ compatible for cable system	1.Vendor shall furnish calculations for screen/ sheath voltage/ current and the recommended method for metallic screen bonding. 2. Any other item/(s) such as mounting structure and other accessories required to complete the supply in all respect but not limited to above shall be in bidder's scope.	Set	7
1B2	3nox1 phase link box with SVL(sheath voltage limiter suitable/ compatible for cable system	1.Vendor shall recommend the Voltage rating of Sheath Voltage Limiter (SVL). 2.Vendor shall furnish calculations for screen/ sheath voltage/ current and the recommended method for metallic screen bonding. 3. Any other item/(s) such as mounting structure and other accessories required to complete the supply in all respect but not limited to above shall be in bidder's scope.	Set	7
1B3	Metallic screen bonding cable along with accessories suitable/ compatible for cable system	1. Any other item/(s) lugs/ connectors and other accessories required to complete the supply in all respect but not limited to above shall be in bidder's scope.	Set	7
1B4	Earth continuity conductor cable along with accessories suitable/ compatible for cable system	1. Any other item/(s) lugs/ connectors and other accessories required to complete the supply in all respect but not limited to above shall be in bidder's scope.	Set	7
1B5	Trefoil clamps, non-magnetic suitable/ compatible for cable system	1. Trefoil clamps shall be fixed at the distance of 1.0 meters on circuit cables. 2. Any other item/(s) such as mounting/ fixing hardware and other accessories required to complete the supply in all respect but not limited to above shall be in bidder's scope.	Lot	1
1B6	Single clamps, non-magnetic suitable/ compatible for for cable system	1. Single clamps shall be fixed at the distance of 1.0 meters on both end of individual cable. 2. Any other item/(s) such as mounting/ fixing hardware and other accessories required to complete the supply in all respect but not limited to above shall be in bidder's scope.	Lot	1
1B7	Cable support structure for GIS end suitable/ compatible for for cable system	Supply of all structural materials including hardware for GIS end required to complete the work in all respect shall be in bidder's scope.	Set	7
1B8	Consumables with limited shelf life suitable/ compatible for for cable system	Supply of all consumables required to complete the work in all respect shall be in bidder's scope. (1lot=complete requirement for package)	Lot	1
1B9	Miscellaneous Items including cable route marker, electrode etc required for cable system	Supply of all miscellaneous items including cable sealing end, cable route marker, rod/ pipe electrode shall be in bidder's scope. (1lot=complete requirement for package)	Lot	1
1B10	Any other item(s) not mentioned above, but required for completion of the supply	Supply of any other item (s) not mentioned above, but required for completion of the supply in all the respect shall be in bidder's scope and bidder shall provide the details for the same during tendering stage only. (1lot=complete requirement for package)	Lot	1
1B11	General / Special tools and tackles	Bidder shall provide the details of general/ special tools, to be provided on non-returnable basis. (1lot=complete requirement for package)	Lot	1
1C	SERVICES			

Sl. No.	Description of Items	Long Description	Unit	Qty.
EHV CABLE				
1C1	Site survey for route and length finalization	The exact length shall also be decided by bidder either after visiting site, making precise measurements at contract stage or on basis of layout drawings. Manufacturing lengths and drum length shall be determined with consultation & approval with BHEL/UPPTCL. 1. The payment of cables length for supply shall be as per approved quantities after survey. 2. The Payment of cables length for installation shall be as per actual measurement at site which shall also include cable terminations. 3. The length may vary by -20% to +20% at contract stage based on actual measurement at site and calculations submitted by the bidder. (1lot=complete requirement for package)	Lot	1
1C2	Installation of Cable in trefoil form/ single form on support structure/ cable rack assembly / pipe rack assembly	Installation of EHV cable shall be completed in all respect and comprising of following but not limited to, 1. Laying of cables in trefoil form with proper dressing by fixing trefoil clamps and/ or single form as required on support structure using trefoil/ single clamps on cable trays of cable trench/ rack assembly/ other structure assembly. 2. Fixing of cable support structure for support of cable/ termination including fixing arrangements. 3. Fixing of cable route marker, cable tag, phase marker etc. 3. Arrangement of special tools & tackles for smooth laying & installation 4. Any other service(s) required to complete the work in all respect but not limited to above shall be in bidder's scope.	Meter	2300
1C3	Field Testing and commissioning of cable alongwith accessories	1. Field testing & commissioning of EHV cable along with accessories such end termination, straight through joints, if required shall be carried out in phase manner and hence simultaneous commissioning is not envisaged. 2. Field testing & commissioning shall be done as per approved SAT (site acceptance test), which shall be submitted by bidder and shall be approved by BHEL/UPPTCL. 3. Field testing & commissioning shall be carried out by skilled & experienced testing engineer. Test instruments along with valid calibration certificates for testing & commissioning shall be brought at site by bidder. 4. Any other service(s) required to complete the testing & commissioning in all respect shall be in bidder's scope.	Set	7
1C4	Termination of Cable Termination Kit for GIS end	Termination of kit shall be completed in all respect and comprising of following but not limited to, 1. Termination of kit suitable/ compatible for EHV cable for GIS end in all respect. 2. Fixing of structure for support of termination including other fixing arrangements. 3. Termination of EHV cables shall be done by skilled and experienced jointer duly approved by Engineer-in charge. 4. Any other service(s) required to complete the work in all respect but not limited to above shall be in bidder's scope.	Set	21
1C5	Termination of Cable Termination Kit for CS (Cable Sealing) end	Termination of kit shall be completed in all respect and comprising of following but not limited to, 1. Termination of kit suitable/ compatible for EHV cable for Cable Sealing End in all respect. 2. Fixing of clamps on structure for support of termination including other fixing arrangements. 3. Termination of EHV cables shall be done by skilled and experienced jointer duly approved by Engineer-in charge. 4. Any other service(s) required to complete the work in all respect but not limited to above shall be in bidder's scope.	Set	21
1C6	Termination of Straight Through Joint	Jointing through kit shall be completed in all respect and comprising of following but not limited to, 1. Jointing through kit suitable/ compatible for EHV cable in all respect. 2. Jointing of EHV cables shall be done by skilled and experienced jointer duly approved by Engineer-in charge. 3. Any other service(s) required to complete the work in all respect but not limited to above shall be in bidder's scope.	Set	3
1D SERVICES - Other Cable Accessories				
1D1	Installation of Link Box without SVL (Sheath Voltage Limiter) along with its accessories and earthing etc.	Installation of link box without SVL(sheath voltage limiter) at GIS end shall be completed in all respect and comprising of following but not limited to, 1. Installation of link box without SVL(sheath voltage limiter) at GIS end along with installation of metallic screen bonding/ earthing cable along with accessories. 2. Installation of rod electrode/ pipe electrode for earthing shall also be in bidder's scope, if required. 3. Any other supervisory service(s) required to complete the work in all respect but not limited to above shall be in bidder's scope.	Set	7

Sl. No.	Description of Items	Long Description	Unit	Qty.
1D2	Installation of Link Box with SVL (Sheath Voltage Limiter) along with its accessories and earthing etc.	Installation of link box with SVL(sheath voltage limiter) at GIS end shall be completed in all respect and comprising of following but not limited to, 1.Installation of link box with SVL(sheath voltage limiter) at cable sealinmg end along with installation of metallic screen bonding/ earthing cable along with accessories. 2. Installtion of rod electrode/ pipe electrode for earthing shall also be in bidder's scope, if required. 3. Any other supervisory service/(s) required to complete the work in all respect but not limited to above shall be in bidder's scope.	Set	7
1D3	Fixing of support structure for GIS end	Structural works required to support and fix the end terminations including supply of mounting hardware, fixing hardware, grouting and other civil works required to complete the work shall be in bidder's scope.	Set	7
1D4	Any other service (s) not mentioned above, but required for completion of the service	Any other service(s) not mentioned above, but required for completion of the work in all the respect shall be in bidder's scope and bidder shall provide the details for the same during tendering stage only. (1lot=complete requirement for package)	Lot	1
1E	SERVICES-TRAINING			
1E1	Training - Training during installation	Services - Training during erection/ installation at site (1 lot=6 UPPTCL/BHEL Engineers at site for 1 day).	Lot	1
1E2	Training - Training during testing and commissioning	Services - Training during testing & commissioning at site (1 lot=4 UPPTCL/BHEL Engineers at site for 1 day).	Lot	1

PROJECT : 400/220/132kV GIS s/s at Rasra , Ballia

CUSTOMER: UTTAR PRADESH TRANSMISSION CORPORATION LTD. (UPPTCL)

Technical Specification of 220KV & 132KV EHV CABLE

TB-404-316-001

Section-2: EQUIPMENT SPECIFICATION

REV.00

SECTION 2

Equipment specification

- UPPTCL SPECIFICATION FOR 220KV XLPE CABLES – (16 PAGES)
- UPPTCL SPECIFICATION FOR 220KV XLPE CABLES TERMINATIONS AND JOINTING KITS – (18 PAGES)
- UPPTCL SPECIFICATION FOR 132KV XLPE CABLES - (18 PAGES)
- UPPTCL SPECIFICATION FOR 220KV XLPE CABLES TERMINATIONS AND JOINTING KITS- (17 PAGES)
- UPPTCL SPECIFICATION FOR INSTALLATION OF CABLE – (8 PAGES)

Project: 400/2220/132 kV GIS s/s for UPPTCL Rasra, Ballia

PI no. 342280499, 342280498

Amendment to technical specification TB-404-316-002 (220 & 132 kV EHV Cable & accessories)		
Sl No	Reference clause	Amendment
	Section 2	Extract from specification
1	Section- IV (A) Technical specifications for 220 kv XLPE Cable	6.0 MANUFACTURING PROCESS 6.1 XLPE cable should be processed in a modern triple head extrusion manufacturing line. XLPE Vulcanisation system (VCV) or horizontal MDCV will be used to ...
2	Section- IV (A) Technical specifications for 220 kv XLPE Cable	clause no 4.1 The cable shall be made of stranded, compacted circular conductor, electrolytic grade copper,
3	SECTION - IV (A) Technical specifications for 132 kv XLPE CABLES	clause no 4.1 The cable shall be made of stranded, compacted and segmented electrolytic grade copper, tapped with semi conducting tape.

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SECTION 2

SECTION – IV (A) **220 kV XLPE CABLES**

INDEX

S.No.	Description
1.	Scope
2.	Standards
3.	Climatic Conditions and Laying Conditions
4.	Design & Technical Details
5.	Material and Cable Construction
6.	Manufacturing Process
7.	Quality Assurance
8.	Testing
9.	Testing Facilities and Tests Certificates
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11.	Marking on Outer Sheath
12.	Sealing and Drumming
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15.	Guaranteed Technical Particulars
16.	Absolute Guarantees
Annexure – 1	Desired Technical Particulars of XLPE Cable

TECHNICAL SPECIFICATION FOR 220 kV XLPE CABLE

1.0 SCOPE

- 1.1 Scope includes manufacture, testing before dispatch and delivery FOR destination of 220 kV, 1200 sq. mm., single core, circular stranded, copper conductor XLPE power cable conforming to the IEC 62067 / IS 7098 (Part - III),

2.0 STANDARDS

- 2.1 Unless otherwise stated hereafter, rating, characteristics, test and procedures etc. concerning the 220 kV XLPE cable shall be preferably as per IS, IEC standards given below and shall be in compliance with the latest edition or revisions thereof and meeting the constructional details and testing requirement as stipulated in foregoing also.

IEC-60228	Conductor for insulated cable.
IEC-60229	Tests on cable over sheaths.
IEC-60230	Impulse tests on cables and their accessories.
IEC-60270	Partial discharge measurements.
IEC-60287-1-1	Calculation of continuous current carrying capacity.
IEC-60502	Power Cables with extruded insulation and their accessories.
IEC-60067	Tests for Power cables with extruded insulation for rated voltage above 150 kV upto 500 kV.
BIS: 7098 (Part-3)	XLPE Cable specification for working voltages from 66 kV upto and including 220 kV.
IEEE:48	Tests procedures and requirements for high voltage cable terminations.

- 2.2 The 220 kV XLPE cable may conform to any other authorities' standards, which ensures an equal or better quality than the standard mentioned above. The equivalence of IS or IEC be mentioned/ indicated by bidder (wherever only one of them are mentioned in the specification) to ensure that the required technical parameters/ tests as per specifications are complied. The bidder must specifically indicate the standards to which the cable conforms and indicate all deviations (if any) from the preferred IS/ IEC codes that affect performance and rating.
- 2.3 Compliance of the 220 kV XLPE cable manufactured with the provisions of this specification does not relieve him of the responsibility of furnishing 220 kV XLPE cable and accessories of proper design, electrically and mechanically suited to meet the operating guarantees at the specified service conditions.

- 2.4 If there are, in the opinion of the bidder, any conflicts between these codes and this specification, these contradictions shall be brought to the attention of the purchaser.

3.0 CLIMATIC CONDITIONS AND LAYING CONDITIONS

The XLPE Power cable shall be suitable for continuous and satisfactory operation under following conditions:-

3.1 Climatic Conditions :

i)	Design maximum ambient Air Temperature	50°C
ii)	Maximum average ambient temperature in 24 hours period in shade	40°C
iii)	Min. ambient air temperature in shade	0°C
iv)	Maximum temperature attainable by an object exposed to sun.	55°C
v)	Maximum relative humidity	100%
vi)	Minimum relative humidity	10%
vii)	Average number of thunder storm days per annum	50
viii)	Average number of rainy days per annum	100
ix)	Average annual rainfall	1200 mm
x)	Number of months of tropical monsoons conditions	4 Months
xi)	Maximum wind pressure	195 Kg/sq.m
xii)	Altitude not exceeding	1000 M
xiii)	Seismic Level	0.3 g

3.2 Conditions of Laying

- i) Laid directly in ground/ metaled road.
- ii) Installed outdoor in free air in vertical position.
- iii) Drawn into underground ducts/ trenches below mataled road.
- iv) Laid directly in open trench in GIS/ AIS Grid sub station.

3.3 Condition of installation of XLPE cable

i)	Ground Temp.	35°C
ii)	Maximum conductor temp.	90°C
iii)	Air temperature	50°C
iv)	Depth of burial	1.5 m. approx
v)	Formation	3 Ckts. Each in trefoil
vi)	Bonding of metallic sheath	Both End
vii)	Number of 3 phase circuits	Transformers and Line Bays

4.0 DESIGN & TECHNICAL DETAILS

- 4.1 1200 sq.mm. Single Core XLPE cable suitable for 220 kV nominal system shall have construction as under.

The cable shall be made of stranded, compacted circular conductor, electrolytic grade copper, taped with semi conducting tape. Conductor screening shall be with extruded semi conducting thermosetting compound layer. The cable shall be insulated with completely dry cured XLPE insulation (of 245 kV highest system voltage). Insulation screening for non-metallic part shall be with extruded semi-conducting thermosetting compound layer. Taping with semi conducting water swellable tape shall be provided for longitudinal water sealing. Screening for metallic part shall be with corrugated Aluminum or Lead Alloy 'E' sheathed in combination with bedding of semi-conducting tape(s) followed by annealed copper wires screen and taped with open helix copper tape binder, If required followed by suitable non-metallic tape binder and overall extruded black, PE or PVC sheath with outer conductive coating. Power cable shall conform to the IS 7098 (Part-III)/ IEC-62067 and foregoing paras of this specification.

- 4.2 The covering shall be watertight, electrically insulated, rodent proof and vermin proof.
- 4.3 The offered XLPE cable for 220 kV earthed system shall meet the technical particulars indicated in Annexure-I.
- 4.4 The XLPE Cable shall be suitable or use where combined ambient temperature and temperature rise due to load result in conductor temperature not exceeding 90°C under normal operation and 250°C under short circuit conditions.
- 4.5 Offered XLPE cable end termination as well as jointing kits shall be of rated short circuits current of 40 kV for duration of 1 second.
- 4.6 220 kV XLPE cable shall be designed to withstand the mechanical, electrical and thermal stresses under the steady state transient/ fault conditions and shall be suitable for proposed method of installation.
- 4.7 The cable shall be suitable for underground buried installation with uncontrolled back film and some of areas to be flooded by water in rainy season.
- 4.8 The sheath/ screen bonding system shall provide a continuous current path through the cable sheath and jointing kits and shall be bonded. The bonding ends shall be suitably earthed with/ without SVL as per the approved configuration/ design.
- 4.9 The sheath voltage under full load conditions shall not exceed the voltage specified/ allowed in relevant standards for safety of personal as well satisfactory working of cable. Sheath shall be solidly grounded at suitable location (middle as well as at terminals substations) with/ without SVL. Bidder must indicate details of configuration proposed along with sufficiency calculation with the bid so as to limit induced voltage of sheath within 65 V.

- 4.10 The charging current of the cable shall be as low as possible.
- 4.11 The XLPE cable shall be capable of withstanding the normal stress associated with transportation, erection, reeling and unreeling operation without getting deformed.
- 4.12 The XLPE cable shall be used on system voltage of 220 kV for 3-phase AC earthed system. The cables shall be suitable for continuous operation at a power frequency voltage 10% higher than system voltage.
- 4.13 Cables will be protected from over voltage caused by lightning strikes switching surges by means of station type lightning arrestors located at terminal point/ substations. The terminal substation yard equipment and all overhead 220 kV transmission lines will be shielded against direct lightning strokes by overhead ground wires.
- 4.14 Repaired cables shall not be acceptable.

5.0 MATERIAL AND CABLE CONSTRUCTION

5.1 Conductor

- 5.1.1 The stranded, very well compacted, round conductor shall be made of annealed plain copper wires complying to the requirements of flexibility class-2 of IEC-60228/ IS 8130. The conductor shall have high compactness and smooth surface finish.
- 5.1.2 The minimum number of wires in conductor and D.C. resistance shall be as per table-II of IEC-60228/ IS 8130. The grade and quality of the copper used for the conductor shall be as per IEC/ IS standard but shall not be less than the International Annealed Copper Standard (IACS) of 100% conductivity with purity of the order of 99.9%.
- 5.1.3 The nominal area of conductor shall be 1200 sq.mm.

5.2 Conductor Screen

- 5.2.1 The conductor screen consisting of semi conducting compound layer conforming IEC, shall be provided over the conductor by extrusion which will not only eliminate the risk of electric discharge at the interface between conductor and insulation but will also present a very smooth protrusion free interface with the insulation to eliminate any localized stress concentration. The screen shall be firmly bonded to XLPE insulation.
- 5.2.2 The minimum thickness of extruded conductor screen shall be 1.0 mm. The outer surface of the conductor screen shall be circular and free from irregularities. A non-hygroscopic semi-conducting tape, if required, shall be applied to the conductor under extruded layer to prevent penetration of compound in to the conductor interstices.

5.3 Insulation

- 5.3.1 The insulation composed of a special super clean grade layer of cross linked polyethylene (XLPE) shall comply with the requirement of IS-7098 (Part-3)/ IEC 62067. The insulation shall be applied by extrusion over the conductor screen and

vulcanized using dry curing process to form a compact homogeneous body free from micro voids and contaminants.

5.3.2 The eccentricity of insulation should not be more than 10%.

5.4 Insulation Screening

5.4.1 The insulation screening shall consist of two parts, namely, non-metallic and metallic.

5.4.2 Non-Metallic Part (Extrusion)

5.4.2.1 A non-metallic insulation screen of semi-conducting compound similar to conductor screen (clause 5.2) for similar purpose shall be applied directly over the insulation core by extrusion and shall be continuous and cover whole surface area of insulation. It shall be firmly bonded to the insulation.

5.4.2.2 The minimum thickness of extruded insulation screen layer shall be 0.8 mm, the ovality of the core shall be not more than 5%.

5.4.3 Non-Metallic Part (Taped)-Logitudinal Water Barrier

5.4.3.1 Under-sheath, water barrier shall consist of a synthetic semi-conducting moisture swellable layer (non woven synthetic tape with suitable water swellable absorbent tape with suitable overlap) covering the whole surface area of the insulation screen. The barrier shall restrict longitudinal water penetration under the metallic sheath. The nominal thickness of water swellable tape shall be 0.3 mm.

5.4.3.2 The semi conducting compound and the semi conducting tape shall compatible with the insulating material and suitable for the operating temperature of the cable.

5.4.4 Metallic Part-Radial Water Barrier

The metallic sheath of corrugated Aluminum sheath or Lead alloy E shall be provided over the non-metallic part of the insulation screening. Metallic sheath, together with copper screen (if required) shall be able to withstand short circuit current of 40 kA for duration of one second. The details of metallic sheath are as under:

5.4.4.1 Lead Alloy E Sheath

- i) The lead alloy sheath shall have composition as per IS: 692. The lead alloy 'E' sheath shall be extruded using a continuous screw press and shall be free from all extrusion defects. The nominal thickness of lead alloy E sheath shall be as per IEC-60502-2/ IS: 7098 (Part-3).
- ii) The bedding over the Metallic sheath shall be of semiconducting tape(s).
- iii) Copper wire screen of annealed plain copper wires with gap shall be helically applied over the Radial Water Barrier lead alloy metallic sheath.
- iv) The diameter of copper wire in the screen shall not be less than 0.8 mm. The perpendicular gap between two adjacent wire shall not be more than 4.0 mm.

- v) An open helix copper tape binder shall be applied over the copper wire screen. The nominal thickness of the tape shall not be less than 0.1 mm. The minimum thickness shall not fall below the nominal value by more than 10%. Suitable non-metallic binder tape may also be applied over the copper screen to prevent the penetration of the outer sheath in to the screen.

5.4.4.2 Corrugated Aluminum Sheath

- i) When the corrugated aluminum sheath is used, it shall be applied by extrusion/ seam-weld and passing through a corrugating head. The corrugating head contains rotating dies to form the valleys between the ribs like sine wave and produce to correct diameter of sheath to fit over the insulation. The sheath shall be free from pinholes flaws and other imperfections.
- ii) Anti-corrosive compound shall be applied over the aluminum sheath.

5.5 Outer Sheath

5.5.1 The outer sheath shall consist of an extruded layer of black, PE or PVC type ST-2 as per IEC-62067/ IS-7098 (Part-3).

5.5.2 The nominal thickness of outer sheath shall not be less than the value calculated as per the recommendation of IEC 60502-2/ IS-7098 (Part-3). The outer sheath shall be of sufficient hardness to discourage termite and rodent attack.

5.5.3 Outer Conductive Coating/ Layer

The outer conductive layer shall be of Graphite coating applied at works. This conductive layer/ coating must facilitate testing of the non-metallic outer sheath. This test is important to ensure the physical integrity of the cable from time to time be it at the factory, after transportation, directly after laying upon completion of the installation, or periodically thereafter.

6.0 MANUFACTURING PROCESS

- 6.1 XLPE cable should be processed in a modern triple head extrusion manufacturing line. XLPE extrusion and curing through Vertical Catenary Vulcanisation system (VCV) or horizontal MDCV will be used to ensure circularity and concentricity of the extruded layers around the conductor.
- 6.2 The conductor screen, insulation and insulation screen shall be extruded in one simultaneous triple extrusion process (Clause 14.2.1 of IS: 7098-3) through common triple crosshead. The extruders and triple crosshead shall be designed to prevent stagnation of materials to eliminate hot spots and ensure smoothness of the conductor screen and screen surfaces. Insulation thickness should be controlled on-line using X-ray monitoring system.
- 6.3 The cross linking, curing and cooling shall be carried out in one operation and shall be a dry curing process under high pressure to eliminate the formation of voids in the insulation and contaminations in the dielectric.

- 6.4 Process conditions such as curing and cooling temperature, production speed etc. shall be closely monitored during manufacture to ensure a good degree of cross-linking through the whole insulation.
- 6.5 The manufacturing process shall be desired to eliminate irregularities like protrusions, voids and contamination etc. to ensure the long-term reliability of the cable.
- 6.6 Loading of the extruder in the manufacturing plant shall be performed entirely closed and dust proof. The entire line of processing should be controlled from a computerized central control console. Contamination shall be avoided by use of a fully enclosed material handling system. To avoid contamination XLPE Granules must be transported using gravitational material feeding system.

7.0 QUALITY ASSURANCE

- 7.1 Raw materials used for manufacture of cable shall be of highest quality and material received by manufacturer should be checked/ tested to ensure that it meets manufacturer's material specification. The materials shall be clean and packed in moisture and dust proof packing.
- 7.2 As the quality control of EHV XLPE cables while manufacturing is very critical so expert supervision is required for raw material testing, in process checks and also for final testing. A specially trained quality assurance team should be in place for maintenance of the quality at an optimum level at the plant. Complete details of manufacturing process along with details of automatic manufacturing plant, list of officers/ staff to supervise the manufacturing and other details desired as per specification shall be furnished by bidder in the bid.
- 7.3 Quality assurance plan indicating test/ checks of raw material, process of manufacturer and final inspection with customer hold point shall be submitted to the purchaser for approval.

8.0 TESTING

8.1 GENERAL

- 8.1.1 This schedule gives tests to be carried out on 220 kV, single core XLPE type cables and associated accessories being supplied under these specifications. The schedule of tests to be followed shall be generally as per IS-7098 (Part-3)/ IEC 62067 "Extruded Solid Dielectric Insulated Power Cables for rated voltage from 150 kV up to 500 kV."
- 8.1.2 Cost of all type tests shall be indicated with unit prices in price schedule and the same shall be considered for price bid evaluation/ loadings. Sample tests, routine tests shall be included in quoted prices of cable. Type test (as envisaged by UPPTCL) to be performed on a sample from any lot of cable manufactured will be witnessed by representative of UPPTCL. The sample tests, routine tests will be witnessed by UPPTCL engineers before dispatch.

8.1.3 The facilities available for site tests shall be clearly and implicitly brought out in the tender. The site tests shall be carried out during and after laying/ installation by the supplier.

8.1.4 This test schedule can be modified at the discretion of the purchaser to omit or to include additional tests. Power frequency test shall be carried out at a frequency of 50 Hz.

8.2 TESTS:

8.2.1 The tests shall be carried out in accordance with IS-7098 (Part-3)/ IEC: 62067.

8.3 ROUTINE TESTS

The manufactured cable shall be subjected to test as prescribed in the different IS/ IECs for routine, acceptance and type test any other test mandatory under relevant IS/IEC.

8.4 SPECIAL TESTS

The following tests shall be carried out as special tests:-

- a) Conductor examination as per clause 10.4 of IEC-62067.
- b) Check on dimensions as per clause 10.6, 10.7 & 10.8 of IEC 62067 regarding the:
 - i) Measurement of thickness of insulation.
 - ii) Measurement of thickness of metallic sheath.
 - iii) Measurement of thickness of outer PE/PVC sheath.
 - iv) Measurement of external diameter.
- c) Lightning Impulse test as per clause 10.12 of IEC 62067.
- d) Hot set test for XLPE insulation as per clause 10.9 of IEC 62067.
- e) Bending test as per clause 12.4.4 of IEC 62067 to "demonstrate manufacture's specification in this regard."
- f) Measurement of tan delta and Partial discharge.

8.5 TYPE TEST (s)

The electrical test shall be carried out on cable system (cable & accessories) in accordance with clause 12 of IEC 62067 and in accordance with the sequence prescribed in clause 12.3 of IEC 62067/ IS 7098 (Part-3) with relevant clauses. Test shall be carried out in the following sequence:

- a) Bending test on the cable followed by installation of accessories and a partial discharge test at ambient temperature.
- b) Tan delta measurement.
- c) Heating cycle voltage test

d) Partial discharge tests

- At ambient temperature, and
- At high temperature.

(This test shall be carried out after the final cycle of item (c) above or alternatively, after the lightning impulse voltage test in item (f) below:

- e) Lightning impulse voltage test followed by a power frequency voltage test.
- f) Partial discharge tests, if not previously carried out in item (d) above.
- g) Tests of outer protection for buried joints.

Note : 1) These tests may be applied to a joint which has passed test in item (c) hearing cycle voltage test, or to a separate joint which has passed at least three thermal cycles.

2) If the cable and joint are not be subjected to wet conditions in service (i.e. not directly buried in earth or not intermittently or continuously immersed in water) these tests may be omitted.

- i) Examination of the cable system with cable and accessories shall be carried out after completion of the tests above.

8.6 NON-ELECTRICAL TYPE TESTS

- i) All non-electrical type tests shall be performed in accordance with the provisions laid in clause 12.5 of IEC 62067/ IS-7098 (Part-3) with relevant clauses.
- ii) The cost of the type test for all accessories shall be furnished separately. This shall be considered for evaluation. However, the purchaser reserves the right to waive off any of the type tests.
- iii) Insulation resistance after laying each cable length shall withstand a voltage of 10 kV DC between each reinforcement and external conducting surface and for one minute as per clause no. 14.1 of IEC-62067. In addition, the serving insulation resistance shall be measured and checked with the values obtained in the routine factory test.
- iv) On completion of the cable laying and jointing work the complete installation shall be tested as per clause 14.1 and 14.2 of IEC-62067. The testing kit required for the tests shall be arranged by the tenderer.

9.0 TESTING FACILITIES AND TESTS CERTIFICATES

- 9.1 The XLPE Cables should meet the requirement of all tests including special tests as specified in clause 8 above. The bidder shall furnish latest complete tests certificates for all type tests (not older than five years as on the date of Bid opening) prescribed in clause 8 for the offered size or higher size(s) of similar voltage class offered from any NABL accredited testing laboratory.

- 9.2 The bidder must have all testing facilities available at their works for testing the material as per clause 8 above. Detailed list of testing equipment along with relevant tests must be furnished with the tender other wise offers is likely to be ignored.

10.0 INSPECTION & TRAINING AT MANUFACTURER'S WORKS

- 10.1 The 220 kV XLPE cable should be manufactured and tested while manufacturing as per approved quality assurance plan and foregoing specification. Supplier shall intimate the programme of manufacturing of the XLPE cable in advance.

The inspection during manufacturing shall be carried out by the UPPTCL engineers at various stages of manufacture. The successful bidder shall grant free access to the purchaser's representative at a reasonable time when the work is in progress.

- 10.2 Inspection and acceptance of any equipment/ material under this specification by the purchaser shall not relieve the supplier of his obligation of furnishing equipment in accordance with the specification and shall not prevent subsequent rejection if the equipment/ material is found to be defective.
- 10.3 The supplier shall present the latest Calibration Certificate(s) of testing instruments/ equipments to be used for the testing of the material covered in the purchase order to the authorized inspecting officer/ inspecting agency of the purchaser. The testing instruments/ meters/ apparatus etc. should be got calibrated by the supplier from time to time from independent test laboratory/ house having valid accreditation from National Accreditation Board for Testing and Calibrating Laboratories for the testing equipments/ original manufacturer having credibility to NABL/ NPL or equivalent.
- 10.4 The calibration certificate(s) should not in any case be older than one year at the time of presenting the same to the inspecting officer/ inspecting agency of the purchaser. The testing instruments/ equipments should be duly sealed by the Calibrating Agency and mention thereof shall be indicated in the calibration certificate(s).
- 10.5 The purchaser reserves the right to insist for witnessing the sample/ routine tests of the bought out raw material/ items used in manufacturing of cables.

11.0 MARKING ON OUTER SHEATH

- 11.1 The following particulars shall be marked on cable outer sheath:
- i) Manufacturer's name/ or trade name
 - ii) Voltage grade viz. 127/220 kV.
 - iii) Cable size (no. of core x conductor cross section)
 - iv) Year of manufacture.
 - v) Purchaser's name i.e. UPPTCL
- 11.2 The spacing between one set of marking and the beginning of the next on the legend shall not exceed 150 mm.

- 11.3 Besides above, progressive sequential marking of length shall also be provided at every one meter, which shall be clear and legible sequential length working by embossing in same colour as that of outer sheath is permitted.

12.0 SEALING AND DRUMMING

- 12.1 Immediately after the works tests, both ends of every length of cable shall be sealed by means of heat shrinkable end caps.
- 12.2 Cables shall be wound on metallic drums. All the drums shall be arranged to take a round spindle and be legged with strong closely fitting wooden battens so as to prevent damage in the cable. Each drum shall bear an identification number permanently stenciled or branded on the outside of the flange.
- 12.3 Cable reels shall be of rugged construction, with a drum diameter of ample dimensions to accommodate the single conductor. Manufacturer shall be responsible for any damage to the cables during transit. Changes in the shape of cable during transit shall not result in deformation in metallic drum. A detail of steel drum/ reel is to be furnished by bidder in their bid.
- 12.4 The cable drum/ reel shall carry the following information clearly marked on flange of the drum.
- a) Manufacturer's name, Brand or Trade mark.
 - b) Conductor of cable
 - c) Type of cable and voltage grade.
 - d) Size of cable.
 - e) Length of cable on the drum.
 - f) Direction of rotation of drum (by means of an arrow).
 - g) Net weight.
 - h) Gross weight.
 - i) Year of manufacture.
 - j) Confirming to IEC/IS No.
 - k) Purchase Order details.
 - l) Name of Purchaser.
 - m) Name of Consignee.

13.0 STANDARD LENGTH AND QUANTITY TOLERANCE

- 13.1 Standard length of cable per drum shall be of 500-600 M. Longer drum length shall be preferred. The bidder shall indicate offered Standard length of cable per drum. A tolerance of $\pm 3\%$ will be permissible on standard drum length. The ordered quantity of the cable(s) can be supplied with quantity tolerance of $(\pm) 2\%$. Exact drum length shall be decided after route survey after award of contract.

14.0 DETAILS OF PAST EXPERIENCE

- 14.1 The details of past orders executed by the bidder shall be indicated in the relevant schedule.

15.0 GUARANTEED TECHNICAL PARTICULARS

- 15.1 The bidder shall furnish guaranteed technical particulars of cable in the relevant schedule enclosed.

16.0 ABSOLUTE GUARANTEES

- 16.1 All the commissioning tests and performance tests shall be treated as absolute guarantee and in the event of failure in any of such test(s) the bidder shall take steps to rectify/ replace/ modify the defective components(s)/ assemblies at his cost. The equipment after such rectification repair shall be re-tested at bidder cost at site.
- 16.2 The satisfactory of materials supplied shall be guaranteed for a period of 12 months from the date of commissioning of 220 kV complete cable system. Any defects noticed during the above should be rectified immediately by the Contractor free of cost and they shall be guaranteed for 12 months from the date of re-commissioning of such equipments. For cable joints and sealing end joints additional performance shall be as per specification.

17.0 FUNCTIONAL GUARANTEES, LIQUIDATED DAMAGES FOR NON - PERFORMANCE

- ✓ 17.1 The bidder shall indicate values of total losses (kW) per 1000 meter of cable in the relevant schedule of guarantees. *C.T.P*

- 17.2 Differential Price Factors for Evaluation and Liquidated Damages.

The factors and the respective Indian Rupees value per unit of differential loss for the purpose of calculation of differential price for the bid evaluation as specified shall be as stipulated below:

The factors and the respective Indian Rupees value per unit of differential loss over and above the guaranteed for the purpose of calculation of liquidated damages for non-performances shall be as stipulated below:

S. No.	Item	Value in Indian Rupees per kilowatt per 1000 mtr. cable length
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1.	220 kV XLPE Cable	Rs. 1,34,000.00
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- ✓ 17.3 The cable system under no circumstances shall be accepted if the measured losses are more than +15 % of the guaranteed losses at rated voltage quoted by the bidders.

DESIRED TECHNICAL PARTICULARS OF XLPE CABLE

S.NO.	PARTICULARS	TECHNICAL DETAILS
	Cable	Single Core, Copper Conductor XLPE cable.
1.	Applicable Standard	Conforming to IEC 60502 – 2 and IEC 60840: 2004-04 or IS 7098 (Part - 3) amended up to date.
2.	System voltage & frequency	220 ± 10% kV, 50Hz ± 3%
3.	Rated & Highest System Voltage	245 kV
4.	Suitable for earthed system	Yes
5.	CONDUCTOR	
(i)	Material	Annealed Plain Copper wires Conforming to IEC 60228/ IS 8130
(ii)	Nominal cross-sectional area	1200 Sq. mm
(iii)	Construction of conductor / flexibility class	Class -2, IEC 228/ IS: 8130
(iv)	Shape and formation	Circular, stranded & very well compacted
(v)	Approx. overall diameter of conductor	To be indicated
6.	CONDUCTOR SCREENING	
(i)	Material & Type	Extruded, semi conducting compound layer
(ii)	Grade	As per IEC/ IS
(iii)	Thickness	1.0 mm
7.	INSULATION	
(i)	Material	Cross linked polyethylene (XLPE)
(ii)	Special Super clean grade	As per IEC 6207/ IS 7098 (Part-3)
	Normal thickness of insulation	
8.	INSULATION SCREENING	
A.	Non-metallic part (extruded)	
(i)	Material	Extruded semi conducting compound layer
(ii)	Grade	As per IEC/ IS 7098 (Part-3)
(iii)	Min. Thickness	0.8 mm
B	Non-metallic part (taped) longitudinal water barrier over insulation screen	
(i)	Material	Synthetic Non-woven semi conducting Water swell-able tape
(ii)	Min thickness	As per standard
C	METALLIC SHEATH	
(i)	Material	Corrugated Aluminium/ Lead alloy “E” sheath IS 692
(ii)	Min. Thickness(mm)	Conforming to IEC 60502-2/ IS 7098 (Part-3) Table 6A/6B

(iii)	Short Circuit Current Withstand (Metallic sheath, together with copper screen (if required))	40 kA for one second
(D)	Bedding over lead sheath	Semi conducting tape(s)
(E)	CONCENTRIC COPPER WIRE SCREEN (IF REQUIRED)	
(i)	Material and type	Annealed plain copper wires applied helically with gap followed by open helix of copper tape binder.
(ii)	Min. area (sq. mm.)	This and lead alloy E sheath shall meet earth fault current of 40 kA for a duration of 1 second.
9.	OUTER SHEATH	
(i)	Material	Extruded Layer of Black PE or PVC type ST-2 as per IEC 62067/ IS 7098 (Part-3)
(ii)	Min. thickness of outer sheath	As per standard
10.	Conducting layer over outer sheath	Graphite coating
11.	Approx. weight overall diameter of cable (mm)	To be indicated
12.	Approx. weight per meter of cable (kg/m)	To be indicated
13.	Recommended minimum installation radius.	To be indicated
14.	Maximum D.C. Resistance of conductor at 90°C in ohm/km	As per standard
15.	Minimum continuous current rating for each circuit when laid in ground in trefoil formation and other condition given in specification.	650 Amps. after all de-rated factors.
16.	Maximum allowable temperature for cable and accessories.	
(i)	At rated full load and at site conditions.	90° C
(ii)	The conductor temperature after a short circuit for one second shall not exceed (with conductor temperature at start of short circuit as 90°C).	250°C
17.	Basic impulse insulation level (1.2 / 50 micro second wave)	650 kV
18.	Power frequency withstand voltage	As per standard
19.	Symmetrical Short circuit rating for one second duration for lead sheath and copper screened combined	40 kA for 1 sec.
20.	Drum Length	500-600 mtr. / As per requirement.
21.	Expected cable life.	35 years.

SECTION – IV (B)
245 kV XLPE CABLE
TERMINATIONS AND JOINTING KITS

INDEX

S.No.	Description
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3.	System Configuration
4.	General Details of Cable Kits
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**TECHNICAL SPECIFICATION FOR 245kV CABLE
TERMINATION AND JOINTING KITS FOR 1 x 1200 SQ. MM.
XLPE CABLE**

1.0 SCOPE

- 1.1 The scope includes supply, testing at manufacturer's works before dispatch and delivery of Internationally reputed make of following types of cable sealing ends, (end terminals/ pot heads) and straight through joints conforming to relevant IEC, unless otherwise stipulated in the Section GTR and all other accessories as well as consumables etc. suitable for XLPE cable (Section-IV A). These kits and accessories shall be integral part of 245kV cable system.
- I. 245kV rated, plug in type, indoor cable sealing ends conforming to IEC 62027 suitable for terminating 245kV highest voltage XLPE cables for interconnection with 220kV Gas Insulated Switchgear of proposed 220kV substation along with clamping arrangements of cable for 220kV Transformers and Line Bays.
- II. 245kV rated, Outdoor cable sealing ends conforming to IEC 62067 for terminating the 245kV highest voltage XLPE cables for outdoor termination to 220kV Transformers along with all the necessary supporting structure, fitting & mountings for 220kV Transformers and Line Bays.
- 1.2 Single phase Earth Link boxes with all associated accessories (for the connection of the cable sheath of 220kV rated XLPE cable) suitable for both end bonding arrangement of the complete cabling system.
- 1.3 Cable Fault Location Equipment (optional item) and one set of special tools and equipment for handling, assembly, installation, erection and dismantling of the 220kV XLPE cables and auxiliary equipment.
- List of special tools and testing equipments which will be brought for installation and commissioning of the cable system by contractor (on returnable basis) shall be enclosed with bid.
- 1.4 All the testing devices and instruments etc. including HV Generator required for final acceptance, testing and commissioning shall be responsibility of the contractor and no separate cost/ rental is payable. The testing devices etc. shall be taken back by the contractor after successful testing & commissioning. The testing instruments and devices indicated/ mentioned in price schedule may be ordered by UPPTCL, if required (to be assessed based on finalization of maintenance contract/ requirements) and the payment shall be made based on unit prices specified in the contract. List of special tools and equipment required for testing of power cable shall be enclosed with bid.
- 1.5 It is not the intent to specify completely herein, all details of design and construction of the equipment/ system and accessories required. However, the

cable system and its installation shall be complete with all accessories, conform in all respects, to high standard of engineering, design and workmanship and be capable of performing the continuous commercial operation up to guarantee in a manner acceptable to UPPTCL,

2.0 STANDARDS

Unless otherwise stated hereinafter, rating, characteristics, test and procedures etc. concerning the 220kV XLPE cable accessories shall preferably be as per IEC standards wherever existing and shall be in compliance with the latest editions or revisions thereof. Although a few preferred IEC standards are mentioned below but the list is not exhaustive and may be improved.

IEC: 62067	Tests for power cables with extruded insulation for rated voltage above 150 kV upto 500 kV.
IEC: TS 60859	Cable connection for Gas insulated metal enclosed switchgear for rated voltages of 72.5 kV and above.
IEC: 62271-203	Gas-insulated metal enclosed switchgear for rated voltages of 72.5 kV and above.
IEC: 60228	Conductor for insulated cable
IEC: 60229	Tests on cable over sheaths
IEC: 60230	Impulse tests on cables and their accessories
IEC: 60270	Partial discharge measurements
IEC: 60287	Calculation of continuous current carrying capacity
IEC: 60502	Power Cables with extruded insulation and their accessories.
BIS: 7098 (Part-3)	XLPE cable specification for working voltages from 66 kV up to and including 220 kV.
IEEE 48- 1990	IEEE Standard Test, Procedure & requirement for high voltage alternating current cable terminations.

3.0 SYSTEM CONFIGURATION

- 3.1 The 220kV systems will be solidly grounded. Cables will be protected from over voltages caused by lightning strikes or switching surges by means of station type lightning arrestors located at terminal point/ substations. The terminal substation yard equipment and all overhead 220kV transmission lines will be shielded against direct lightning strokes by overhead ground wires.

4.0 GENERAL DETAILS OF CABLE KITS

- 4.1 All the cable sealing end/ end termination kits, rated for 245 kV shall be of pre-molded type from one of internationally reputed manufacturer of proven design which has already been extensively used and fully type tested.
- 4.2 The offered kits shall be easy in handling, simple to install without much skill with minimum tools at site.

- 4.3 All cable sealing end shall be suitable for connecting single core XLPE Copper Conductor XLPE cables for a maximum continuous voltage of 245kV and core cross section of 1200 sq. mm. details in section-IVA.
- 4.4 The kits shall be suitable for storage without deterioration at a temperature up to 55°C.
- 4.5 The offered XLPE cable Termination kits for 220kV earthed system shall meet the technical particulars indicated in Annexure -1.
- 4.6 Field tests of sealing end terminals shall be made in conjunction with the 220kV cables after installation of the cables and terminals.

5.0 TYPE & MAKE OF CABLE KITS

5.1 SF6 SWITCHGEAR TYPE SEALING END

- 5.1.1 For the feeder bays having power cable connections, the suitable cable sealing end enclosures will be supplied by the GIS bidder but 220kV XLPE cables and cable sealing end terminators with cable cone will not be included in the GIS bidder's supply. Interface between GIS and power cable will be in accordance with IEC publication 60859.
- 5.1.2 The cable sealing end, conforming to IEC 62067 for termination of the Cables for maximum continuous voltage of 245kV at SF6 switchgear end will be supplied by the cable manufacturer. The contractor shall be responsible for the preparation of the cable insulation and conductors and correct termination of each cable to these sealing ends.
- 5.1.3 Bidders are requested to quote cable sealing end with design that helps reducing the works on the gas compartments. The cable sealing end shall be of plug in type that allows easy plugging and unplugging of high voltage power cable without the need of opening the GIS and related time consuming gas works.
- 5.1.4 Cable manufacturer shall furnish large scale general assembly drawings of the SF6 sealing ends, mounting flange details, size of terminal opening in the junction box, weight of terminal including accessories, physical shape and dimensions of all live part, recommended clearance from live parts to the inside surface to permit the SF6 switch gear manufacturer to design and supply junction boxes of adequate dimensions and construction to permit the installation and maintenance of the terminals without difficulty.
- 5.1.5 The stress cone made of silicone rubber shall inhibit possible mechanical stress and deformation of the cable insulation surface during operation and also shall be capable of accommodating minor radial and longitudinal movement without detriment to the dielectric stress in the insulation shield.
- 5.1.6 Manufacturer shall state the connector clearances required when the assembled cable DC proof test is undertaken for co-ordination with the SF6 switch gear design.

- 5.1.7 All supporting structures for the SF6 bus-duct connections between the XLPE cable sealing ends and the GIS shall be supplied by the GIS supplier. The supplier may specify connecting & supporting arrangements for approval of the purchaser.

5.2 OUTDOOR TYPE SEALING END

- 5.2.1 The cable sealing end, conforming to IEC-62067 of termination for maximum continuous voltage of 245kV cables at the outdoor yard shall be supplied by the cable manufacturer. The contractor shall be responsible for correct termination of each cable to sealing ends, installation of the cable sealing end and providing of terminal connectors for connecting to terminal conductor. The requisite interconnection between line end and sealing end is required to be designed (as per safety and statutory provision aspects) and executed (after approval of Purchaser) by successful bidder.
- 5.2.2 The silicone rubber/ composite bushing termination of rated capacity, suitable for outdoor installation in moderately polluted atmosphere shall be used. It should be resistant to UV exposure. The termination stress control shall be by means of stress cone.
- 5.2.3 The stress cone made of silicone rubber shall inhibit possible mechanical stress and deformation of the cable insulation surface during operation and also shall be capable of accommodating minor radial and longitudinal movement without detriment to the dielectric stress in the insulation shield.

5.3 MAKE OF CABLE KITS

All cable sealing ends shall be either of following reputed make:

- i) ABB Kabeldon AB, Sweden
- ii) Nexans Switzerland Ltd. (Formerly Alcatel Cable Switzerland Ltd.)
- iii) J Power System Corporation, Japan (Formerly Sumitomo Electric Industries, Japan)
- iv) SEFAG ixosil Ltd, Power Cable System, Switzerland.
- v) CCC GmbH Berlin.

As the Sub-station is new and to meet the requirement of next 35 years, so new technology is to be used/ adopted while manufacturing and latest technology kits are essential requirement. If any kit is not in a manufacturing range of any of above firms then equipment/ kits can be offered from other balance make but kits conforming to specification shall only be accepted.

6.0 ELECTRICAL CHARACTERISTICS OF CABLE KITS

- 6.1 The Cable Termination kits accessories shall be capable of carrying the specified rated current continuously without exceeding the specified temperature limitations.

- 6.2 The cable Termination kits accessories to be supplied against this specification shall be rated for 40 kA for 1 second.
- 6.3 The sheath voltage under full load conditions shall not exceed 65V specified/ allowed in relevant standards for safety of personal as well satisfactory working of cable. The sheath shall solidly grounded at the switch gear end & at the pot yard terminations.
- 6.4 The fault level withstand capacity of end termination kits should be strictly matching with the parameters of cables for which the kits are intended to be used.
- 6.5 After connecting the cable with terminal ends, the complete cable composite cable sheath screen bonding system shall provided a continuous current path through the cable sheath/ screen and shall be bonded and earthed at both ends.
- 6.6 The XLPE Cable Termination kits shall be suitable for use where combined ambient temperature and temperature rise due to load result in conductor temperature not exceeding 90°C under normal operation and 250°C under short circuit conditions.
- 6.7 220kV XLPE Cable Termination kits shall be designed to withstand the mechanical, electrical and thermal stresses under the steady state and transient/ fault conditions and shall be suitable for proposed method of installation.

7.0 DESIGN AND COMPONENTS FEATURES OF CABLE KITS

The following consideration shall be taken into account in the design of the product, material properties and components of cable kits.

- 7.1 The most important part of cable accessories is the stress grading device, the stress cone. The pre-molded cone shall be made of insulating and conducting silicone rubber molded together in the shape of geometric stress control unit. The synthetic insulating compound shall be used together with stress cone to improve the electrical properties inside the termination. The compound should swell the insulation of the cone and the cable to some extent so as to improve the electrical strength along with interface.
- 7.2 For XLPE cable, the critical part of the operation is making an electrical connection between the stress relief device and insulation screen. If any air pocket created, then discharge and break down can occur. As such connection method and material should be such that no risk of cable damage arises and that the jointer can check the result of his work at every stage. Thus the installation instruction should be easy to follow and should be well illustrative.
- 7.3 The design shall be such that when the cone is supplied, the diameter of hole in the cone shall be smaller than the diameter over cable insulation. After the cone is pushed on, the elasticity of silicon rubber should guarantee an active pressure on the cable insulation to ensure that no voids appear between the cone and the cable even after years of load cycling.

- 7.4 Every single stress cone & the stress grading device shall be tested electrically prior to delivery in presence of purchaser. Each stress cone shall be marked with an individual number and UPPTCL and a certificate containing detailed specification of test shall be included with every delivery.
- 7.5 The different accessories shall be type tested according to SEN, IEC-62067 and IEEE standards which include tests for impulse, AC load cycling and partial discharge. Before delivery every stress cone shall be installed on cable and carefully checked to establish that it is PF free in presence of purchasers representative(s).
- 7.6 Details of proper stress control, stress grading and non tracking arrangement in the termination details shall be elaborated in the offer. Detailed sectional view of assemblies shall be submitted along with the offer. The application of stress control system shall be safe, foolproof and independent of cable jointers skills. The stress control method should withstand expansion and contraction of cable during load cycling.
- 7.7 The cable end termination shall be designed in such a way so as give track resistant, erosion and weather resistance protection to the cable insulation. The outdoor end termination shall be totally sealed against ingress of moisture of environment.
- 7.8 All end outdoor terminations shall be provided with rain sheds/ creepage petticoats. The weather sheds shall be non-tracking weather resistant hydrophobic and have smooth surface to collect any water/ dirt etc. The design of rain skirts shall avoid any skirt to skirt conducting path under heavy rain condition.
- 7.9 For XLPE cables, the lugs should withstand short circuit of 250°C. For XLPE cables, the ferrule should be suitable for compacted conductor and should withstand thermal short circuit of 250°C.
- 7.10 Design features may be highlighted in bid and the mouldings of rubber components should be aimed to achieve a smooth finish on interior and exterior of the components.
- 7.11 The kits shall be provided with protection against rodent & termite attack.
- 7.12 The kits offered shall provided for total environment sealing of the cable crutch and at the lugs end. The details of which shall be offered along with the offer. Provision for effective screening over each core shall be made and bidder shall categorically confirm this aspect in their offer.
- 7.13 The materials and components of kits, not specifically stated in the specification, but which are essential for satisfactory operation of cable shall be deemed to be included without any extra cost.
- 7.14 The earthing arrangement shall form part of the terminations joints and shall be protected from erosion either by suitable tape or tube.

- 7.15 The word “UPPTCL” along with trade name of the manufacturer, month/ year of manufacture, size etc. shall be embossed/ engraved for the purpose of identification.
- 7.16 The adequate provisions for eliminating the chances of entrapment of air at steps formed by silicone screen shall be made.
- 7.17 The terminations joints shall be supplied in kit form. All insulation and sealing materials, consumable items, conductor fittings, earthing arrangements and lugs etc. should be provided. Requisite No. and size of lugs and ferrules depending upon the type of the cable shall be provided in the kit. Lugs and Ferrules shall be of crimping type and shall conform to the relevant standard applicable to XLPE cables.
- 8.0 LINK BOX FOR EARTHING & EARTHING CABLE WITH PVC INSULATION**
- 8.1 Bidder shall carry out the earthing of sheath/ screen in the both end bonding configuration. The successful bidder shall submit the complete sheath voltage calculation alongwith identification of bonding points. The Single Phase Link boxes with direct (through SVL, if required as per calculation/ study) grounding at cable termination ends at termination of cable ends. The bonding lead/ grounding cable of suitable sizes (as per sufficiency/ adequacy calculation submitted by successful bidder and approved by Purchaser shall be used for connecting cable sheath to earth.
- 9.0 SUPPORTING STRUCTURE AND ANGLE BRACKET SUPPORTS FOR CABLE**
- 9.1 Any support structures and cable clamps required to support the cable between the trays and the sealing end supports will be supplied and installed by the bidder.
- 9.2 Fabricated wall/ fabricated support mounted angle brackets along with Anchor bolts shall be provided by manufacturer of cable for supporting the SF6 Switchgear Type Sealing End for installation/ fixing at GIS at proposed 220kV GIS Substation to GIS supplier. The brackets which shall be constructed of galvanized steel structural sections will not be required to support the weight of SF 6 switch gear enclosure. The SF6 Switchgear enclosures shall be supplied by GIS substation supplier.
- 9.3 Fabricated structure of suitable height, to be approved by purchaser, shall be provided and installed by manufacturer of cable for supporting the Outdoor cable sealing end at 220kV Switchyard. The height of the structure shall be such that the terminal connection to receive the purchaser’s Twin ACSR conductor maintaining phase to phase and phase to earth and ground clearances. Exact height shall be intimated/ confirmed to the successful bidder while approval of drawings, The structures shall be of galvanized steel structural sections. Anchor bolts, washers etc will be supplied and installed by successful bidder of cable.

- 9.4 The supporting structure shall be suitable to withstand the wind pressure, seismic forces and the short circuit forces, etc and the design shall have with an adequate factor of safety as specified in I.E. Rules 1956.
- 9.5 The bidder shall furnish the design and fabrication drawings of these structures & foundation anchor bolts, and design calculations etc.
- 9.6 The bidder shall quote for unit prices for support structures for each single core cable to suit the end terminations supplied by him.

10.0 CABLE END TERMINALS (OUT DOOR TYPE) CONNECTORS

- 10.1 The terminal connector/ clamps shall be suitable for connection to Twin ACSR conductor at Transformer end. The terminal connector shall be of bimetallic type to connect the copper stud of the cable terminal end to the ACSR conductor.
- 10.2 The type and size of the conductor will be confirmed to the successful bidder.
- 10.3 The connector/ clamp shall be designed to overcome:
 - i) Galvanic Corrosion.
 - ii) Thermal Cycling.
- 10.4 The current carrying capacity of the connector/ clamps shall be greater than the maximum capacity of the power cable. The terminal clamp shall be free from burrs, voids, and blow holes.
- 10.5 The terminals clamps shall have passed tests for short circuit current capability and temperature rise.

11.0 EARTHING

- 11.1 Bidder shall carry out the earthing of sheath/ screen at both of termination ends of 245kV cable using insulation sheath bonding (earthing) cable of required size through Link box with/ without surge limiter at terminations.
- 11.2 Earthing shall be as per relevant standards and the details of the earthing arrangement offered for the cable accessories shall be submitted along with the offer.
- 11.3 The sheath/ screen shall bound in the earth station through disconnecting type link boxes.

12.0 TESTS

- 12.1 The testing of Cable termination for Gas Insulated Metal enclosed Switchgear, outdoor type sealing end kits for XLPE Cable shall be as per IEC: 62067. All the type tests, sample tests and routine tests shall be carried out on the cable kits (referred as accessories in IEC) as per Clause 8.2 (Tests), Section-IV A.

12.2 The above tests shall be carried out in presence of purchaser's representative as per relevant standard IEC: 62067 at bidder's cost and the sampling plan shall be 1% subject to minimum of one number.

12.3 The contractor shall make available to the UPPTCL Engineer a complete set of detailed data, required for inspection and Tests.

12.4 Details of Tests.

The bidder must specify the details of the type, sample and routine tests to be conducted on offered cable kits at their works along with the standards applicable in their offer.

12.5 Type tests on accessories (kits)

Type tests on accessories (kits) shall be conducted as per clause 14, Annexure-C of IEC 60840: 2004 at the manufacturer's works in the presence of UPPTCL Engineers.

12.6 Sample tests on accessories (kits)

Sample tests on accessories (kits) shall be conducted as per IEC 60840: 2004 and IEEE: 48. Some important tests are summarized for ready reference.

12.6.1 Tests on components

The characteristics of each component of kit shall be verified in accordance with the specifications of the accessories (kit) manufacturer, either through test reports from the sub supplier of a given component or through internal tests conducted at works of cable kit manufacturer.

The manufacturer of a given accessory (kit) shall provide a list of the tests to be performed on each component, indicating the frequency of each test. The components shall be inspected against their drawings. There shall be no deviations outside the declared tolerances.

12.6.2 Tests on complete accessory (Kit)

For accessories, where the main insulation cannot be routine tested (Clause 9.1 of IEC 60840: 2004), the following electrical tests shall be carried out by the manufacturer on a fully assembled accessory.

a) Partial discharge test (Clause 9.2 of IEC 60840: 2004)

b) Voltage test (Clause 9.3 of IEC 60840: 2004)

The sequence in which these tests shall be carried out shall be indicated in bid. These tests shall be performed on one accessory of each type.

12.7 Routine tests

Routine tests shall be conducted as per IEC 60840:2004. Some important test are summarized for ready reference.

The main insulation of each prefabricated accessory shall undergo following tests.

- a) Partial discharge test Clause 9.2 of IEC 60840: 2004
- b) Voltage tests Clause 9.3 of IEC 60840: 2004 according to either
1), 2) or 3) below
 - 1) on accessories installed on cable.
 - 2) by using a host accessory into which a component of an accessory is submitted for test.
 - 3) by using a stimulated accessory rig in which the electrical stress environment of a main insulation component is reproduced.

13.0 QUALITY ASSURANCE

- 13.1 Raw materials used for manufacture of cable shall be of highest quality and material received by manufacturer should be checked/ tested to ensure that it meets manufacturer's material specification. The materials shall be clean and packed in moisture and dust proof packing.
- 13.2 As the Quality control of EHV XLPE cables termination and accessories while manufacturing is very critical so expert supervision is required for raw material testing, in process checks and also for final testing. A specially trained quality assurance team should be in place for maintenance of the quality at an optimum level at the plant. Complete details of manufacturing process along with details of automatic manufacturing plant, list of officers/ staff to supervise the manufacturing and other details desired as per specification shall be furnished by bidder in the bid.
- 13.3 Quality assurance plan indicating test/ checks of raw material, process of manufacturer and final inspection with customer hold point shall be submitted to the purchaser for approval.

14.0 TEST CERTIFICATES

The latest complete type test certificates (conducted during last 5 years from date of tender along with attested drawing) in duplicate for all type of terminations of offered design/ material conducted at Inter National reputed test house conforming to IEC: 62067 must be enclosed with the offer. The offer without type tests results shall be ignored.

15.0 INSPECTION AT MANUFACTURE'S WORKS

- 15.1 The 220kV XLPE cable termination or Gas Insulated Metal enclosed Switchgear, outdoor type sealing end and other accessories should be manufactured and tests while manufacturing as per approved Quality Assurance plan and foregoing specification. Supplier shall intimate the programme of manufacturing of the cable Termination kits and accessories in advance. The inspection during manufacturing shall be carried out by the UPPTCL engineers at various stages of manufacture. The successful bidder shall grant free access to the purchaser's representative at a reasonable time when the work is in progress.

- 15.2 Inspection and acceptance of any equipment/ material under this specification by the purchaser shall not relieve the supplier of his obligation of furnishing equipment in accordance with the specification and shall not prevent subsequent rejection if the equipment/ material is found to be defective.
- 15.3 The supplier shall present the latest Calibration Certificate(s) of testing instruments/ equipments to be used for the testing of the material covered in the Purchase Order to the authorized inspecting officer/ inspecting agency of the purchaser. The testing instruments/ meters/ apparatus etc should be got calibrated by the supplier from time to time from independent test laboratory/ house having valid accreditation from National Accreditation Board for testing and Calibrating Laboratories for the testing equipments/ original manufacturer having credibility to NABL/ NPL or equivalent.
- 15.4 The calibration certificate(s) should not in any case be older than one year at the time of presenting the same to the inspecting officer/ inspecting agency of the purchaser. The testing instruments/ equipments should be duly sealed by the Calibrating Agency and mention thereof shall be indicated in the calibration certificate(s).
- 15.5 The purchaser reserves the right to insist for witnessing the sample/ routine tests of the bought out raw material/ items used in manufacturing of cable end terminations.

16.0 FIRE RESISTANCE

The cable terminations shall be fire resistant. The components of kits shall have flame retardant property.

17.0 INTERCHANGEABILITY

The components of different number of the kits shall be inter-changeable in case the need arises.

18.0 COMPLETENESS OF CABLE KIT FOR EASY INSTALLATION

- 18.1 The bidder shall offer complete material and components for each kit so as to meet one termination complete in all respects. The bidder shall indicate the list of the material/ components with quantities of each or cable end termination.
- 18.2 An instruction manual in English, indicating the complete method/ proceedings adopted for installations of kits, preferably with more diagrams/ pictorial presentation shall be supplied with each kit. Various items, quantity thereof against each kit must be indicated in the instruction manual.
- 18.3 The detailed bill of material and installation instructions shall be provided with each kit for verification by purchaser's inspecting officer and at Purchaser's stores/ site.

18.4 All components shall be sealed separately and marked clearly for the purpose of identification of each component. All components shall be supplied in single package as a complete kit for one termination joints and shall bear manufacturer's name and cable size of kit size for which it can be used.

18.5 The Bidder shall also indicate shelf life and ideal life of kit contents.

19.0 GUARANTEED AND OTHER TECHNICAL PARTICULARS

19.1 The bidder shall furnish the guaranteed and other technical particulars of the kit offered by him in Annexure -1 attached with the specifications. The particulars which are subject to guarantee shall be clearly indicated. Without schedule of GTP, completely filled, the offer shall not be acceptable.

19.2 The bidder shall highlight the various technical aspects of the kits offered by him.

20.0 GUARANTEE

The cable termination shall bear guarantee for one year from the date of commissioning. Any defect noticed in the kit shall be attended by the bidder immediately on getting the complaints and if required shall be replaced and installed free of cost otherwise the same will be arranged at the supplier's risk and cost.

21.0 SPECIAL TOOLS & TACKLES

Complete outfit of tools, special tools, spanners and other lifting devices, instrument and appliance necessary for the complete assembly, erection at site, dismantling and maintenance of Power Cable including all accessories (kits) covered by the contract together with suitable racks for holding them shall be arranged by the contractor.

22.0 MANUALS AND LITERATURE ON CABLE AND CABLE KITS

The following documents should be furnished along with the bid:

- i) Dimensioned cross sectional details of the cable.
- ii) Current carrying capacities "with supporting calculated data" of the cable and de-rated factors.
- iii) Instructions Manual on cable laying installation, storage, handling, maintenance, fault finding, repairs, preventive maintenance etc.
- iv) Type, acceptance and routine test certificates on the cable as per relevant IS, IEC or other international standards.
- v) Type, acceptance and routine test certificate on the straight through joints.
- vi) OGA drawing of the cable end termination.
- vii) Dimensioned cross sectional details of cable end terminations with bill of materials.

- viii) Instructions Manual on the method and formation on cable jointing techniques of the cable end terminations.
- ix) Type, acceptance and routine test certificate on the cable end terminations.
- x) OAG drawing of the cable termination structure alongwith the bill of materials.
- xi) Literature on special Tools and Plant.
- xii) Literature on sheath bonding, maintenance of link boxes.
- xiii) Any other relevant literature/ manual.
- xiv) Drawing showing additional details as per clause 5.3.2.

23.0 TRAINING DURING ERECTION

While erection the bidder shall arrange demonstration of use of kits (ordered by purchaser) for giving the training to the 4 or more personnel of the UPPTCL for getting acquainted with the cable jointing method/ procedure.

Annexure-1

DESIRED TECHNICAL PARTICULARS OF XLPE CABLES KITS AND ACCESSORIES

A.	OUTDOOR CABLE END TERMINATION	
1.	Nominal System Voltage U	220 kV (rms)
2.	Rated/ Highest System Voltage Um	245 kV (rms)
3.	Rated frequency & No. of phase	50 Hz $\pm$ 3%, Three (3)
4.	Installation	Outdoor
5.	Name and address of manufacturer of end termination	
6.	Nomenclature of kit	To be indicated
7.	Type of kit	Pre-molded
8.	Suitable for Single Core Copper Conductor XLPE cable Conforming to IEC 62067/ IS 7098 (part-3) amended upto date and as per specification.	Yes
9.	Maximum conductor size	To be indicated
10.	Rated continuous current	Maximum current of the cable
11.	Applicable standard for testing	IEC 62067
12.	Maximum allowable Pd-level	As per IEC
13.	Type of Insulator	Silicone/ Composite
14.	Creepage distance	25 mm/KV
15.	Colour	Brown
16.	Maximum allowable temperature for cable and accessories i) At rated full load and at site condition ii) The conductor temperature after a short circuit for one second shall not exceed (with conductor temperature at start of short circuits as 90°C).	90°C 250°C
17.	Basic impulse insulation level (1.2/50 micro second wave)	1050 kV
18.	Power frequency withstand voltage	As per standard
19.	Symmetrical Short circuit rating	40 kA for 1 sec.
20.	Power frequency withstand voltage (a) Dry (kV rms.) (b) Wet (kV rms.)	To be indicated
21.	Flashover voltage: (a) Dry (kV rms.) (b) Wet (kV rms.)	To be indicated
22.	Stress relief cone made of	Silicone rubber
23.	Net dimensions of kit (Length x Breadth x Width and Weight)	To be indicated
24.	Craft sensitivity and reliability	To be indicated
25.	Time required for energisation after completing the joint (curing period)	To be indicated
26.	Special storage condition. If any, upto an ambient temperature of 50 degree C and period.	To be indicated
27.	Whether provision made for:	Yes

	a) Stress relief b) Track resistance c) Sealing	
28.	Whether any additional support is required for kit?	If so, give details
29.	Make, Type and Material of lugs provided with kits.	Details to be given by bidder.
30.	Class of Kits.	Details to be given by bidder
31.	Sectional Drawing Showing constructional details along with each item material, description enclosed.	Yes.
32.	Expected life of cable joint and cable.	35 years
33.	(a) Shelf life of the kit (years) (b) Design life of the kit (years)	To be indicated To be indicated
34.	Guarantee of kit.	Five (5) years from date of commissioning
35.	Details of terminal connector	
B. SF6 SWITCHGEAR TYPE CABLE END TERMINATION		
1.	Nominal System Voltage U	220 kV (rms.)
2.	Rated/ Highest System Voltage Um	245 kV (rms.)
3.	Rated frequency & No. of phase	50 Hz $\pm 3\%$, Three (3)
4.	Installation	Indoor/ Outdoor
5.	Name and address of manufacturer of end termination	
6.	Nomenclature of kit	To be indicated
7.	Type of kit	Premoulded, Plug in type
8.	Suitable for Single Core Copper Conductor XLPE cable Conforming to IEC 62067/ IS 7098 (Part-3) amended upto date and as per specification.	Yes
9.	Maximum conductor size	To be indicated
10.	Rated continuous current	Maximum current of the cable
11.	Applicable standard for testing	IEC 62067
12.	Maximum allowable Pd-level	As per IEC
13.	Type of Insulator	Silicone/ Composite
14.	Creepage distance	25 mm/KV
15.	Colour	Brown
16.	Maximum allowable temperature for cable and accessories (i) At rated full load and at site condition (ii) The conductor temperature after a short circuit for one second shall not exceed (with conductor temperature at start of short circuits as 90°C).	90°C 250°C
17.	Basic impulse insulation level (1.2 / 50 micro second wave)	1050 kV
18.	Power frequency withstand voltage	As per standard
19.	Symmetrical Short circuit rating	40 KA for 1 sec.
20.	Power frequency withstand voltage (a) Dry (kV rms.) (b) Wet (kV rms.)	To be indicated
21.	Flashover voltage: (a) Dry (kV rms.) (b) Wet (kV rms.)	To be indicated
22.	Stress relief cone made of	Silicon rubber
23.	Details of terminal connector	As applicable

24.	Net dimensions of kit (Length x Breadth x Width and Weight)	To be indicated
25.	Craft sensitivity and reliability	To be indicated
26.	Time required for energisation after completing the joint (curing period)	To be indicated
27.	Special storage condition. If any, upto an ambient temperature of 50°C and period.	To be indicated
28.	Whether provision made for: a) Stress relief b) Track resistance c) Sealing	Yes
29.	Whether any additional support is required for kit?	If so, give details.
30.	Make, Type and Material of lugs provided with kits.	Details to be given by bidder.
31.	Class of Kits.	Details to be given by bidder.
32.	Sectional Drawing Showing constructional details along with each item material, description enclosed.	Yes
33.	Expected life of Cable joint and cable.	30 years
34.	(a) Shelf life of the kit (years) (b) Design life of the kit (years)	To be indicated To be indicated
35.	Details of terminal connector	
36.	Guarantee of kit	Five (5) years from date of commissioning.
C.	LINK BOX FOR EARTHING CABLE WITH PVC INSULATION	
1.	Make	
2.	Type	
3.	Detailed dimension and internal arrangement of Single/ Three phase Link boxes with direct grounding	To be submitted
4.	Detailed dimension and internal arrangement of Three Phase Link boxes for cross bonding with SVL	To be submitted
5.	Earthing of sheath/ screen at cross bonding points and termination ends	Yes
6.	PVC insulated single core/ concentric/ coaxial cable to be used for sheath bonding (earthing) suitable for 40 kA for 1 second	Size, Type to be indicated
7.	Insulation of above a earthing cable -	To be indicated (3 kV / 6 kV)
8.	Voltage rise of the insulation sheath controlled within voltage	65 Volts.
9.	Surge voltage limiter	Required (3 kV / 6 kV)
D.	SUPPORTING STRUCTURE & ANGLE BRACKET SUPPORTS FOR CABLE	
1.	Detail drawing enclosed	Yes
2.	Overall height of structure	Shall be as per approved drawing.

SECTION – IV (A)
132 kV XLPE CABLE

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Annexure-1	Desired Technical Particulars of XLPE Cable

TECHNICAL SPECIFICATION FOR 132 kV XLPE CABLE

1.0 SCOPE

- 1.1 Scope includes manufacture, testing before dispatch and delivery FOR destination of 132 kV, 630 sq.mm, single core, circular stranded, copper conductor XLPE power cable conforming to the IEC 60502-2 for construction and IEC 60840-2004-04 for testing/ IS 7098 (Part-3) unless otherwise stipulated in this section.

2.0 STANDARDS

- 2.1 Unless otherwise stated hereinafter, rating, characteristics, test and procedures etc. concerning the 132 kV XLPE cable shall be preferably as per IEC/ BIS standards given below and shall be in compliance with the latest editions or revisions thereof and meeting the constructional details and testing requirement as stipulated in foregoing clauses also.

IEC – 60228	Conductor for insulated cable
IEC – 60229	Tests on cable over sheaths.
IEC – 60230	Impulse tests on cables and their accessories.
IEC – 60270	Partial discharge measurements.
IEC – 60287-1-1	Calculation of continuous current carrying capacity.
IEC – 60502	Power Cables with extruded insulation and their accessories.
IEC –60840-2004-04	Test for power cables with extruded insulation for rated voltage above 30 kV up to 150 kV.
BIS –7098 (Part - 3)	XLPE cable specification – for working voltages from 66 kV up to and including 220 kV
IEEE – 48	Test procedures and requirements for high voltage cable terminations.

- 2.2 The 132 kV XLPE cable may conform to any other authorities standards which ensure an equal or better quality than the standard mentioned above. The bidder must specifically indicate the standards to which the cable conforms and indicate all deviations (if any) from the preferred IEC codes that affect performance and rating.
- 2.3 Compliance of the 132 kV XLPE cable manufactured with the provisions of this specification does not relieve him of the responsibility of furnishing 132 kV XLPE cable and accessories of proper design, electrically and mechanically suited to meet the operating guarantees at the specified service conditions.
- 2.4 If there are, in the opinion of the bidder, any conflicts between these codes and this specification, these contradictions shall be brought to the attention of the purchaser.

3.0 CLIMATIC CONDITIONS AND LAYING CONDITIONS

The XLPE Power cable shall be suitable for continuous and satisfactory operation under following conditions.

3.1 Climate conditions

i)	Peak ambient temperature in shade	50 °C
ii)	Maximum average ambient temperature in 24 hours period in shade.	40 °C
iii)	Min. ambient air temperature in shade	0 °C
iv)	Maximum temperature attainable by an object exposed to sun	55 °C
v)	Maximum relative humidity	100 %
vi)	Minimum relative humidity	10%
vii)	Average number of thunder storm days per annum	50
viii)	Average number of rainy days per annum	100
ix)	Average annual rainfall	1200 mm
x)	Number of months of tropical Monsoon conditions	4 months
xi)	Maximum wind pressure	195 kg/sq.m
xii)	Altitude not exceeding	1000 M
xiii)	Seismic level	0.3 g

3.2 Conditions of laying:

- i) Laid directly in ground/ metaled road.
- ii) Installed outdoor in free air in vertical position.
- iii) Drawn into underground ducts/ trenches below metaled road.
- iv) Laid directly in open trench in GIS/ AIS Grid sub station.

3.3 Condition of installation of XLPE Cable

i)	Ground Temp.	35 °C
ii)	Maximum conductor temp.	90 °C
iii)	Air temperature	50 °C
iv)	Depth of burial	1.5 m approx.
v)	Formation	2 Ckts. each in trefoil
vi)	Bonding of metallic sheath	Both End
vii)	Number of 3 phase circuits	Incomer-I & Incomer-II
viii)	Thermal Resistivity of soil	150 °C cm/W or as per site conditions

4.0 DESIGN & TECHNICAL DETAILS

- 4.1 630 sq.mm. single core XLPE cable suitable for 132 kV nominal system shall have construction as under:

The cable shall be made of stranded, compacted and segmented electrolytic grade copper, tapped with semi conducting tape. Conductor screening shall be with extruded semi-conducting thermosetting compound layer. The cable shall be insulated with completely dry cured XLPE insulation (of 145 kV highest system voltage) , Insulation screening for non-metallic part shall be with extruded semi-conducting thermosetting compound layer. Taping with semi-conducting water swellable tape shall be provided for longitudinal water sealing. Screening for metallic part shall be with extruded corrugated Aluminum or Lead alloy 'E' sheathed in combination with bedding of semi-conducting tape(s). Armouring shall be with annealed copper wire screen and taped with open helix copper tape binder, if required followed by suitable non-metallic tape binder and overall extruded black PE or PVC sheath with outer conductive coating. Power cable shall conform to the IEC 60502-2 for construction and IEC-60840-2004-04 for testing/ IS 7098 (Part-3) and foregoing paras of this specification.

- 4.2 The protective covering of neoprene, polyethylene or other material of suitable composition, inert to lead or copper or aluminum, shall be applied over the cable sheath to provide effective protection against chemical and electrolytic corrosion. The covering shall be watertight, electrically insulated, rodent proof and vermin proof.
- 4.3 The offered XLPE cable for 132 kV earthed system shall meet the technical particulars indicated in Annexure –I
- 4.4 The XLPE cable shall be suitable for use where combined ambient temperature and temperature rise due to load result in conductor temperature not exceeding 90 °C under normal operation and 250 °C under short circuit conditions.
- 4.5 Offered XLPE cable end termination as well as jointing kits shall be of rated short circuit current of 40 kA for duration of 1 second.
- 4.6 132 kV XLPE cable shall be designed to withstand the mechanical, electrical and thermal stresses under the steady state and transient/ fault conditions and shall be suitable for proposed method of installation.
- 4.7 The cable shall be suitable for underground buried installation with uncontrolled back fill and some of areas to be flooded by water in rainy season.
- 4.8 The sheath/ screen bonding system shall provide a continuous current path through the cable sheath & jointing kits and shall be bonded. The bonding ends shall be suitably earthed with/ without SVL as per the approved configuration/ design.
- 4.9 The sheath voltage under full load conditions shall not exceed the voltage specified/ allowed in relevant standards for safety of personal as well satisfactory working of cable. Sheath shall be solidly grounded at suitable locations (middle as well as at terminals substations) with/ without SVL. Bidder must indicate details of configuration proposed along with sufficiency calculation with the bid so as to limit induced voltage of sheath within 65V.
- 4.10 The charging current of the cable shall be as low as possible.

- 4.11 The XLPE cable shall be capable of withstanding the normal stresses associated with transportation, erection, reeling and unreeling operations without getting deformed.
- 4.12 The XLPE cable shall be used on System Voltage of 132 kV for 3-phase AC earthed system. The cables shall be suitable for continuous operation at a power frequency voltage 10% higher than system voltage.
- 4.13 Cables will be protected from over voltages caused by lighting strikes or switching surges by means of station type lightning arrestors located at terminal substations. The terminal substation yard equipment and all overhead 132 kV transmission lines will be shielded against direct lighting strokes by overhead ground wires.
- 4.14 Repaired cables shall not be accepted.

5.0 MATERIAL AND CABLE CONSTRUCTION

5.1 Conductor

- 5.1.1 The stranded very well compacted, round conductor shall be made of annealed plain copper wires complying to the requirement of flexibility class-2 of IEC 60228/IS 8130. The conductor shall have high compactness and smooth surface finish.
- 5.1.2 The minimum number of wires in conductor and D.C. resistance shall be as per table - II of IEC- 60228/ IS 8130. The grade and quality of the copper used for the conductor shall be as per IEC/ IS standard but shall not be less than the International Annealed Copper Standard (IACS) of 100% with purity of the order of 99.99%.
- 5.1.3 The nominal area of conductor shall be 630 sq.mm.

5.2 Conductor Screen

- 5.2.1 The conductor screen consisting of semi conducting compound layer conforming IEC/ IS, shall be provided over the conductor by extrusion which will not only eliminate the risk of electric discharge at the interface between conductor and insulation but will also present a very smooth protrusion free interface with the insulation to eliminate any localized stress concentration. The conductor screen shall be continuous and cover whole surface of conductor. The screen shall be firmly bonded to XLPE insulation.
- 5.2.2 The minimum thickness of extruded conductor screen shall be 1.0 mm. The outer surface of the conductor screen shall be circular and free from irregularities. A non-hygroscopic semi-conducting tape, if required, shall be applied to the conductor under extruded layer to prevent penetration of compound into the conductor interstices.

5.3 Insulation

- 5.3.1 The Insulation composed of a special super clean grade layer of cross linked polyethylene (XLPE) shall comply with the requirement of IS 7902 (Part-3)/ Table-IV of IEC 60840 2004-04 read with clause 5.3.2 below. The insulation shall be applied by extrusion over the conductor screen and vulcanized using dry curing process to form a compact homogeneous body free from micro voids and contaminants.

5.3.2 The average thickness of insulation, in a void free manner and suitable for the continuous highest system voltage 145 kV shall be not less than the normal value of 18 mm as specified in table 5 of IS 7098 (Part-3), while the smallest of the measured values of thickness of insulation shall not fall below the nominal value (ti) by more than 0.1 ti.

5.3.3 The eccentricity of insulation should not be more than 10%.

5.4 Insulation Screening

5.4.1 The insulation screening shall consist of two parts, namely non-metallic and metallic.

5.4.2 Non-metallic part (extrusion)

5.4.2.1 A non-metallic insulation screen of semi conducting compound similar to conductor screen (clause 5.2) for similar purpose shall be applied directly over the insulation core by extrusion and shall be continuous and cover whole surface area of insulation. It shall be firmly bonded to the insulation.

5.4.2.2 The minimum thickness of extruded insulation screen layer shall be 0.8 mm. The ovality of the core shall be not more than 5%.

5.4.3 Non-metallic part (taped) - Longitudinal water barrier

5.4.3.1 Under sheath water barrier shall consist of a synthetic semi-conducting moisture swellable layer (non woven synthetic tape with suitable water swellable absorbent tape with suitable overlap) covering the whole surface area of the insulation screen. The barrier shall restrict longitudinal water penetration under the metallic sheath. The nominal thickness of water swellable tape shall be 0.3 mm.

5.4.3.2 The semi conducting compound and the semi conducting tape shall compatible with the insulating material and suitable for the operating temperature of the cable.

5.4.4 Metallic Part-Radial Water Barrier

The metallic sheath of extruded corrugated Aluminium sheath or lead alloy E shall be provided over the non-metallic part of the insulation screening. Metallic sheath together with copper screen (if required) shall be able to withstand short circuit current of 40 kA for duration of one second. The details of metallic sheaths are as under:

5.4.4.1 Lead alloy E Sheath

- i) The lead alloy sheath shall have composition as per IS: 692 The lead alloy E sheath shall be extruded using a continuous screw press and shall be free from all extrusion defects. The nominal thickness of lead alloy E sheath shall be as per IEC 60502-2/IS 7098 (Part-3).
- ii) The bedding over the Metallic sheath shall be of semi conducting tape(s).
- iii) Copper wire screen of annealed plain copper wires with gap shall be helically applied over the Radial Water Barrier lead alloy metallic sheath.

- iv) The diameter of copper wire in the screen shall not be less than 0.8 mm. The perpendicular gap between adjacent wires shall not be more than 4.0 mm.
- v) An open-helix copper tape shall be applied over the copper wire screen. The nominal thickness of the tape shall not be less than 0.1 mm. The minimum thickness shall not fall below the nominal value by more than 10%. Suitable non-metallic binder tape may also be applied over the copper screen to prevent the penetration of the outer sheath in to the screen.

5.4.4.2 Corrugated Aluminum Sheath

- i) When the corrugated sheath is used, it shall be applied by extrusion/ seam welded and then passing through a corrugating head. The corrugating head contains rotating dies to form the valleys between the ribs like sine wave and produce to correct diameter of diameter of sheath to fit over the insulation. The sheath shall be free from pinholes flaws and other imperfections. When the aluminum sheath is applied directly over the extruded semi-conducting layer or inner plastic bedding, suitable non-metallic tape(s) may be applied under the aluminum sheath to prevent heat transfer onto the plastic material during the manufacturing.
- ii) The nominal thickness of aluminum sheath shall be as per IEC 60502-2/ IS 7098 (Part-3) Table 6B.
- iii) The minimum thickness at any point shall not fall below the nominal by more than 10%.
- iv) Anti-corrosive compound shall be applied over the aluminum sheath.

5.5 Outer Sheath

5.5.1 The outer sheath shall consist of an extruded layer of black, PE or PVC type ST-2 as per IEC 60502-2.

5.5.2 The nominal thickness of outer sheath shall not be less than the value calculated as per the recommendation of IEC 60502/ IS 7098 (Part-3). The outer sheath shall be of sufficient hardness to discourage termite and rodent attack.

5.5.3 Outer conductive coating/ layer

The outer conductive layer shall be of Graphite coating applied at works. This conductive layer/coating must facilitate of the metallic outer sheath. This test is important to ensure the physical integrity of the cable from time to time be it at the factory, after transportation, directly after laying upon completion of the installation, or periodically thereafter.

6.0 MANUFACTURING PROCESS

6.1 XLPE cable should be processed in a modern triple head extrusion manufacturing line. XLPE extrusion and curing through Continuous Catenary Vulcanisation (CCV) or vertical Catenary Vulcanisation system (VCV) or horizontal MDCV will be used to ensure circularity and concentricity of the extruded layers around the conductor.

- 6.2 The Conductor screen, insulation and insulation screen shall be extruded in one simultaneous triple extrusion process (Clause No. 14.2.1 of IS 7098-3) through common triple cross head. The extruders and triple cross head shall be designed to prevent stagnation of materials in eliminate hot spots and ensure smoothness of the conductor screen and core screen surfaces.
- 6.3 The cross linking, curing and cooling shall be carried out in one operation and shall be a dry curing process under high pressure to eliminate the formation of voids in the insulation and contaminants in the dielectric.
- 6.4 Process conditions such as curing and cooling temperature, production speed etc. shall be closely monitored during manufacture to ensure a good degree of cross linking through the whole insulation.
- 6.5 The manufacturing process shall be desired to eliminate irregularities like protrusions, voids and contaminations etc. to ensure the long term reliability of the cable.
- 6.6 Loading of the extruder in the manufacturing plant shall be performed entirely closed and dust proof. The entire line of processing should be controlled from a computerized central control console. Contamination shall be avoided by use of a fully enclosed material handling system. The use of special means like pressurized air etc. for transport of granules shall, as far as practicable, be avoided.

7.0 QUALITY ASSURANCE

- 7.1 Raw materials used for manufacture of cable shall be of highest quality and material received by manufacturer should be checked/ tested to ensure that it meets manufacturer's material specification. The materials shall be clean and packed in moisture and dust proof packing.
- 7.2 As the quality control of EHV XLPE cables while manufacturing is very critical so expert supervision is required for raw material testing, in process checks and also for final testing. A specially trained quality assurance team should be in place for maintenance of the quality at an optimum level at the plant. Complete details of manufacturing process along with details of automatic manufacturing plant, list of officers/ staff to supervise the manufacturing and other details desired as per specification shall be furnished by bidder in the bid.
- 7.3 Quality assurance plan indicating test/ checks of raw material, process of manufacturer and final inspection with customer hold point shall be submitted to the purchaser for approval.

8.0 TESTING

- 8.1 All type sample and routine tests as per IEC 60840-2004-04 and IS 7098 (Part-3) given below shall be carried out. Cost of all type tests shall be indicated with unit prices in price schedule and the same shall be considered for repetitions, if required by the purchaser. Sample tests, routine tests shall be included in quoted prices of cable. Type test (as envisaged by UPPTCL) to be performed on a sample from any lot of cable manufactured will be witnessed by representative of UPPTCL. The sample tests, routine tests will be witnessed by UPPTCL engineers before dispatch.

8.2 Type Tests

- 8.2.1 The cable offered shall have type test certificates as specified in IEC-60840 third edition 2004-04 amended up to date at third party NABL accredited laboratory in last 5 years from the date of bid opening.

The following tests shall be included in the type tests along with other balance type tests given in IS: 7098 (Part-3) on cable and cable jointing kits.

8.2.2 Electrical type tests.

8.2.2.1 Test Voltage Values

Prior to the electrical type tests, the insulation thickness of the cable shall be measured by the method specified in 8.1 of IEC 60811-1-1 on a representative piece of the length to be issued for the tests, to check that the average thickness is not excessive compared with the nominal value.

If the average thickness of the insulation does not exceed the nominal value by more than 5%, the test voltages shall be the values specified in Table 4 of IEC 60840:2004 for the rated voltage of the cable.

If the average thickness of the insulation exceeds the nominal value by more than 5% but by not more than 15% the test voltage shall be adjusted to give an electrical stress at the conductor screen equal to that applying when the average thickness of the insulation is equal to the nominal value and the test voltages are the normal values specified for the rated voltage of the cable.

The cable length used for the electrical type tests shall not have an average thickness exceeding the normal value by more than 15%.

8.2.2.2 Tests and sequence of tests (IEC 60840: 2004-04)

The tests in items a) to h) shall be made in the following sequence:

	IEC 60840: 2004-04
a) Bending test on the cable followed by installation of the accessories and a partial discharge test at ambient temperature.	Clause No. 12.3.3. Clause No. 12.3.4.
b) Tan delta measurement Note: This test may be carried out on a different cable sample with special test terminations from that used for the remainder of the sequence of the tests.	
c) Heating cycle voltage test	Clause No.12.3.6.
d) Partial discharge tests - at ambient temperature, and - at high temperature.	Clause No.12.3.4.
e) Lightning impulse voltage test followed by a power	Clause No.12.3.7.

frequency voltage test.

- | | | |
|----|--|-------------------|
| f) | Partial discharge tests, if not previously carried out in item d) above. | As per IS/IEC |
| g) | Tests of outer protection for buried joints. | As per IS/IEC |
| h) | Examination of the cable system with cable and accessories on completion of the above tests. | Clause no. 12.3,8 |

The resistivity of the cable semi-conducting screens (clause 12.03.9 of IEC 60840-2004-04) shall be measured on a separate sample.

Test voltages shall be in accordance with the values given in the appropriate column of table – 4 of IEC 60840-2004-04.

8.2.3 Non electrical type tests on cable components and on completed cable.

The tests are as follows ;

- | | | |
|----|--|----------------|
| a) | Check of cable construction | Clause 12.4.1 |
| b) | Tests for determining the mechanical properties of insulation before and after ageing. | Clause 12.4.2 |
| c) | Test for determining the mechanical properties of over sheaths before and after ageing. | Clause 12.4.3 |
| d) | Ageing tests on pieces of complete cable to check compatibility of materials. | Clause 12.4.4 |
| e) | Pressure test at high temperature on over sheath. | Clause 12.4.6 |
| f) | Hot set test for XLPE insulations. | Clause 12.4.10 |
| g) | Measurement of density of HDPE insulation. | Clause 12.4.11 |
| h) | Measurement of carbon black content of black PE over sheaths. | Clause 12.4.12 |
| i) | Shrinkage test for PE, HDPE and XLPE insulations | Clause 12.4.13 |
| j) | Shrinkage test for PE over sheaths | Clause 12.4.14 |
| k) | Water penetration test. | Clause 12.4.18 |
| l) | Tests on components of cables with a longitudinally applied metal foil. | Clause 12.4.19 |
| m) | Other balance tests as per IS 7098-3, The list of such test alongwith sequence in which these tests will be conducted is to be given in the bid. | |

8.2.4 Following additional type test shall be carried out on outer sheath of XLPE insulated HT cable.

Chemical composition test for verifying lead sheath composition as per IS 403-1997.

8.2 SAMPLE TESTS ON CABLES

8.3.1 The following tests, along with other balance Special/ Acceptance tests given in IS-7098 (Part-3) shall be carried out on samples which, for tests in items (b) and (g) may be on drum lengths of cable to represent batches as per IEC-60840 third edition 2004-04 (amended upto date).

	IEC 60840-2004-04
a) Conductor examination.	Clause 10.4
b) Measurement of electrical resistance of conductor and of metallic screen.	Clause 10.5
c) Measurement of thickness of insulation and over sheath.	Clause 10.6
d) Measurement of thickness of metallic sheath	Clause 10.7
e) Measurement of diameter.	Clause 10.8
f) Hot set test for XLPE insulation.	Clause 10.9
g) Measurement of capacitance.	Clause 10.10
h) Measurement of density of HDPE insulation.	Clause 10.11
i) Water penetration test.	Clause 12.4.18
j) Test on component of cables with a longitudinally applied metal foil.	Clause 12.4.19
k) Annealing test.	As per IS/IEC
l) Void and contaminations test.	Clause 20.1 IS 7098-3
m) Partial discharge test (to be conducted on full drum length)	As per IS / IEC
n) High voltage test: The cable shall withstand any failure of AC power frequency voltage of 3 times rated voltage for 4 hours	Clause 20.17 of IS 7098-3

8.3.2 The above sample tests a) to h) shall be carried out on one length from each batch manufacturing series of the same type and cross section size of cable but shall be limited to not more than 10% of the number of lengths in any contract, rounded to nearest whole number.

8.3.3 The frequency of the tests in item i) and j) shall be one test.

8.4 Routine Tests on cable

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

	IEC 60840: 2004-04
a) Partial discharge test.	Clause 9.2
b) Voltage test.	Clause 9.3

- c) Electrical test on over sheath of cable. Clause 9.4
- d) Conductor resistance test.

The order in which these tests to carried out shall be indicated in the bid by bidder.

8.5 Test at site after installation

- 8.5.1 Pre-commissioning tests on site, which shall be performed by the successful bidder, shall include the following:
 - a) DC voltage test on outer sheath at 10 kV (DC) for one minute (as per clause 5 of IEC-60229) between metallic sheath/ screen and external conducting surface.
 - b) Conductor resistance of each complete circuit.
 - c) On completion of cable and jointing work, the complete installation shall be checked with a DC voltage of 3 U applied for 15 minutes.
 - d) AC test voltage for 24 hrs. with phase to earth voltage of the system (U_o) this is alternative to DC voltage test as per (d) above.

9.0 TESTING FACILITIES AND TESTS CERTIFICATES

- 9.1 The XLPE Cables should meet the requirement of all tests including special tests as specified in clause 8 above. The bidder shall furnish latest complete tests certificates for all type tests (not older than five years as on the date of Bid opening) prescribed in clause 8 for the offered size or higher size (s) of similar type of cable and voltage class offered from any NABL accredited testing laboratory.
- 9.2 The bidder must have all testing facilities available at their works for testing the material as per clause 8 above. Detailed list of testing equipment along with relevant tests must be furnished with the tender otherwise offer is likely to be ignored.

10.0 INSPECTION AT MANUFACTURER'S WORKS

- 10.1 The 132kV cable should be manufactured and tested while manufacturing as per approved Quality Assurance plan and foregoing specification. Supplier shall intimate the program of manufacturing of the XLPE cable in advance. The inspection during manufacturing shall be carried out by the UPPTCL engineers at various stages of manufacture. The successful bidder shall grant free access to the purchaser's representative at a reasonable time when the work is in progress.
- 10.2 Inspection and acceptance of any equipment/ material under this specification by the purchaser shall not relieve the supplier of his obligation of furnishing equipment in accordance with specification and shall not prevent subsequent rejection if the equipment material is found to be defective.
- 10.3 The supplier shall present the latest Calibration Certificate(s) of testing instruments/ equipments to be used for the testing of the material covered in the Purchase Order to the authorized inspecting officer/ inspecting agency of the purchaser. The testing instruments/ meters/ apparatus etc. should be got calibrated by the supplier from time

to time from independent test laboratory/ house having valid accreditation from National Accreditation Board for Testing and Calibrating Laboratories for the testing equipments/ original manufacturer having credibility to NABL/NPL or equivalent.

- 10.4 The calibration certificate (s) should not in any case be older than one year at the time of presenting the same to the inspecting officer/inspecting agency of the purchaser. The testing instruments/ equipments should be duly sealed by the Calibrating Agency and mention thereof shall be indicated in the calibration certificate(s).
- 10.5 The purchaser reserves the right to insist for witnessing the sample/ routine tests of the bought out raw material/ items used in manufacturing of cables.

11.0 MARKING ON OUTER SHEATH

- 11.1 The following particulars shall be marked on cable outer sheath:
 - a) Manufacturer's name/ or trade name
 - b) Voltage grade viz. 132 kV (nominal)
 - c) Cable size (no. of core x conductor cross section)
 - d) Year of manufacture.
 - e) Purchaser's name i.e. UPPTCL
- 11.2 The spacing between one set of marking and the beginning of the next on the legend shall not exceed 150 mm.
- 11.3 Besides above, progressive sequential marking of length shall also be provided at every one meter, which shall be clear and legible sequential length working by embossing in same colour as that of outer sheath is permitted.

12.0 SEALING AND DRUMMING

- 12.1 Immediately after the works tests, both ends of every length of cable shall be sealed by means of heat shrinkable end caps.
- 12.2 Cables shall be wound on metallic drums. All the drums shall be arranged to take a round spindle and be legged with strong closely fitting wooden battens so as to prevent damage in the cable. Each drum shall be bear an identification number permanently stenciled or branded on the outside of the flange.
- 12.3 Cables reels shall be of rugged construction, with a drum diameter of ample dimensions to accommodate the single conductor. Manufacturer shall be responsible for any damage to the cables during transit. Changes in the shape of the cable during transit shall not result in deformation in metallic drum. A detail of Steel Drum/ reel is to be furnished by bidder in their bid.
- 12.4 The cable drum/ reel shall carry the following information clearly marked on one flange of the drum.
 - a) Manufacturer's name, Brand or trade mark.
 - b) Conductor of cable.

- c) Type of cable and voltage grade.
- d) Size of cable.
- e) Length of cable on the drum.
- f) Direction of rotation of drum (by means of an arrow).
- g) Net weight
- h) Gross weight
- i) Year of manufacture.
- j) Confirming of IEC/IS No.
- k) Purchase Order details.
- l) Name of Purchaser.
- m) Name of Consignee.

13.0 STANDARD LENGTH AND QUANTITY TOLERANCE

- 13.1 Standard length of cable per drum shall be of 500-600 M. Longer drum length shall be preferred. The bidder shall indicate offered Standard length of cable per drum. A tolerance of $\pm 3\%$ will be permissible on standard drum length. The ordered quantity of the cable(s) can be supplied with quantity tolerance of $\pm 2\%$. Exact drum length shall be decided after route survey, after award of contract.

14.0 DETAILS OF PAST EXPERIENCE

- 14.1 The details of past orders executed by the bidder shall be indicated in the relevant schedule.

15.0 GUARANTEED TECHNICAL PARTICULARS

- 15.1 The bidder shall furnish guaranteed technical particulars of cable in the relevant schedule enclosed.

16.0 ABSOLUTE GUARANTEES

- 16.1 All the commissioning tests and performance tests shall be treated as absolute guarantee and in the event of failure in any of such test(s) the bidder shall take steps to rectify/ replace/ modify the defective components(s)/ assemblies at his cost. The equipment after such rectification repair shall be re-tested at bidder cost at site.
- 16.2 The satisfactory of materials supplied shall be guaranteed for a period of 12 months from the date of commissioning of 132 kV complete cable system. Any defects noticed during the above should be rectified immediately by the Contractor free of cost and they shall be guaranteed for 12 months from the date of re-commissioning of such equipments. For cable joints and sealing end joints additional performance shall be as per specification.

17.0 FUNCTIONAL GUARANTEES, LIQUIDATED DAMAGES FOR NON - PERFORMANCE

- 17.1 The bidder shall indicate values of total losses (kW) per 1000 meter of cable in the relevant schedule of guarantees.
- 17.2 Differential Price Factors for Evaluation and Liquidated Damages.

The factors and the respective Indian Rupees value per unit of differential loss for the purpose of calculation of differential price for the bid evaluation as specified shall be as stipulated below:

The factors and the respective Indian Rupees value per unit of differential loss over and above the guaranteed for the purpose of calculation of liquated damages for non-performances shall be as stipulated below:

S. No.	Item	Value in Indian Rupees per kilowatt per 1000 mtr. cable length
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1.	132 kV XLPE Cable	Rs. 1,34,000.00
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- 17.3 The cable system under no circumstances shall be accepted if the measured losses are more than +15 % of the guaranteed losses at rated voltage quoted by the bidders.

DESIRED TECHNICAL PARTICULARS OF XLPE CABLE

S.NO.	PARTICULARS	TECHNICAL DETAILS
	Cable	Single Core, Copper Conductor XLPE cable.
1.	Applicable Standard	Conforming to IEC 60502 – 2 and IEC 60840: 2004-04 or IS 7098 (Part - 3) amended up to date.
2.	System voltage & frequency	132 ± 10% kV, 50Hz ± 3%
3.	Rated & Highest System Voltage	145 kV
4.	Suitable for earthed system	Yes
5.	CONDUCTOR	
(i)	Material	Annealed Plain Copper wires Conforming to IEC 60228/ IS 8130
(ii)	Nominal cross-sectional area	630 Sq. mm
(iii)	Construction of conductor / flexibility class	Class -2, IEC 228/ IS: 8130
(iv)	Shape and formation	Circular, stranded & very well compacted
(v)	Approx. overall diameter of conductor	To be indicated
6.	CONDUCTOR SCREENING	
(i)	Material & Type	Extruded, semi conducting compound layer
(ii)	Grade	As per IEC/ IS
(iii)	Thickness	1.0 mm
7.	INSULATION	
(i)	Material	Cross linked polyethylene (XLPE)
(ii)	Special Super clean grade	Table – IV of IEC 60840: 2004-04 /IS 7098 (Part-3)
	Normal thickness of insulation	18 mm As per IS 7098 (Part-3)
8.	INSULATION SCREENING	
A.	Non-metallic part (extruded)	
(i)	Material	Extruded semi conducting compound layer
(ii)	Grade	As per IEC/ IS 7098 (Part-3)
(iii)	Min. Thickness	0.8 mm
B	Non-metallic part (taped) longitudinal water barrier over insulation screen	
(i)	Material	Synthetic Non-woven semi conducting Water swell-able tape
(ii)	Min thickness	As per standard
C	METALLIC SHEATH	
(i)	Material	Corrugated Aluminium/ Lead alloy “E” sheath IS 692
(ii)	Min. Thickness(mm)	Conforming to IEC 60502-2/ IS 7098 (Part-3) Table 6A/6B
(iii)	Short Circuit Current Withstand	40 kA for one second

	(Metallic sheath, together with copper screen (if required))	
(D)	Bedding over lead sheath	Semi conducting tape(s)
(E)	CONCENTRIC COPPER WIRE SCREEN (IF REQUIRED)	
(i)	Material and type	Annealed plain copper wires applied helically with gap followed by open helix of copper tape binder.
(ii)	Min. area (sq. mm.)	This and lead alloy E sheath shall meet earth fault current of 40 kA for a duration of 1 second.
9.	OUTER SHEATH	
(i)	Material	Extruded Layer of Black PE or PVC type ST-2 as per IEC 60840: 2004-04 / IS 7098 (Part-3)
(ii)	Min. thickness of outer sheath	3.8 mm
10.	Conducting layer over outer sheath	Graphite coating
11.	Approx. weight overall diameter of cable (mm)	To be indicated
12.	Approx. weight per meter of cable (kg/m)	To be indicated
13.	Recommended minimum installation radius.	To be indicated
14.	Maximum D.C. Resistance of conductor at 90°C in ohm/km	As per standard
15.	Minimum continuous current rating for each circuit when laid in ground in trefoil formation and other condition given in specification.	500 Amps. after all de-rated factors.
16.	Maximum allowable temperature for cable and accessories.	
(i)	At rated full load and at site conditions.	90° C
(ii)	The conductor temperature after a short circuit for one second shall not exceed (with conductor temperature at start of short circuit as 90°C).	250°C
17.	Basic impulse insulation level (1.2 / 50 micro second wave)	650 kV
18.	Power frequency withstand voltage	190 kV for 30 min.
19.	Symmetrical Short circuit rating for one second duration for lead sheath and copper screened combined	40 kA for 1 sec.
20.	Drum Length	500-600 mtr. / As per requirement.
21.	Expected cable life.	35 years.

SECTION – IV B
145 kV XLPE CABLE
TERMINATIONS

INDEX

S.No.	Description
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Annexure - 1	Desired Technical Particulars for Cable End Termination

TECHNICAL SPECIFICATION FOR 145 kV CABLE TERMINATION FOR 1 X 630 SQ. MM XLPE CABLE

1.0 SCOPE

- 1.1 The scope includes supply testing at manufacturer's works before dispatch and delivery of Internationally reputed make of following types of cable sealing ends, (end terminals/ pot heads) conforming to relevant IEC unless otherwise stipulated in the Section GTR and all other accessories as well as consumables etc. suitable for XLPE cable (Section-IVA). These kits and accessories shall be integral part of 145kV cable system.
- I. 145kV rated Plug-in type, indoor cable sealing ends conforming to IEC 60840-2004 for testing & as per IEC 62271-203 suitable for terminating 145kV highest voltage XLPE cables for interconnection with 145kV Gas Insulated Switchgear of proposed 220kV Substation along with clamping arrangements of cable for 132kV Incomers and Line Bays.
- II. 145kV rated Plug-in type Outdoor cable sealing ends conforming to IEC 60840-2004 for testing for terminating the 145kV highest voltage XLPE cables in outdoor yard of proposed 220kV Substation along with all the necessary supporting structure, fittings & mountings for 132kV Incomers and Line Bays.
- 1.2 Single Phase Earth Link boxes with all associated accessories (for the connection of the cable sheath of 132kV rated XLPE cable) suitable for both end bending arrangement of the complete cabling system.
- 1.3 It is not the intent to specify completely herein, all details of design and construction of the equipment/system and accessories required. However the cable system and its installation shall be complete with all accessories, conform in all respects, to high standard of engineering, design and workmanship and be capable of performing the continuous commercial operation up to guarantee in a manner acceptable to UPPTCL.

2.0 STANDARDS

Unless otherwise stated hereafter rating characteristics, test and procedures etc. concerning the 132kV XLPE cable accessories shall preferably be as per IEC standards wherever existing and shall be in compliance with the latest editions or revisions thereof. Although a few preferred IEC standards are mentioned below but the list is not exhaustive and may be improved.

IEC 60840: 2004-04	Test for power cables with extruded insulation for rated voltage above 30 kV up to 150 kV
IEC : TS 60859	Cable connection for Gas insulated metal enclosed switchgear for rated voltages of 72.5 kV and above.
IEC : 62271-203	Gas insulated metal enclosed switchgear for rated voltages of 72.5 kV and above.
IEC : 60228	Conductor for insulated cable

IEC : 60229	Tests on cable over sheaths
IEC : 60230	Impulse tests on cables and their accessories
IEC : 60270	Partial discharge measurements
IEC : 60287	Calculation of continuous current carrying capacity
IEC : 60502	Power Cables with extruded insulation and their accessories
BIS : 7098 (Part-3)	XLPE cable specification for working voltages from 66 kV up to and including 220 kV
IEEE : 48-1990	IEEE Standard Test, Procedure & requirement for high voltage alternating current cable terminations.

3.0 SYSTEM CONFIGURATION

- 3.1 The 145kV systems will be solidly grounded. Cables will be protected from over voltages caused by lightning strikes or switching surges by means of station type lightning arrestors termination near to live at 132kV Switchyard at proposed 220kV Substation. The yard equipment and incoming/ outgoing transmission line feeders will be shielded against direct lightning strokes by overhead ground wires. LA shall be provided on other end of cable i.e. 132kV Switchgear Incomers and Feeders.

4.0 GENERAL DETAILS OF CABLE KITS

- 4.1 All the Cable Sealing end/end termination kits rated for 145kV shall be of pre-molded type from one of internationally reputed manufacturer of proven design which has already been extensively used and full type tested.
- 4.2 The offered kits shall be easy in handling, simple to install without much skill with minimum tools at site.
- 4.3 All cable sealing end shall be suitable for connecting single core XLPE Copper Conductor XLPE cables for a maximum continuous voltage of 145 kV and core cross section of 630 sq mm details in section IVA.
- 4.4 The kits shall be suitable for storage without deterioration at a temperature up to 55°C and shall have unlimited shelf life. The kits of the identical type brand and rated voltage as offered in the bid shall have proven performance of at least two years in Indian or similar conditions.
- 4.5 The offered XLPE cable Termination for 132kV earthed system shall meet the technical particulars indicated in Annexure-I.
- 4.6 The cable termination shall be fully dry insulated for easy mounting and testing and it shall be free of maintenance.
- 4.7 Field tests of sealing end terminals shall be made in conjunction with the 132kV cables after installation of the cables and terminals.

5.0 TYPE & MAKE OF CABLE KITS

5.1 SF6 SWITCHGEAR TYPE SEALING END

- 5.1.1 For the feeder bays having power cable connections, the suitable cable sealing end enclosures will be supplied by the GIS Manufacturer but 132kV XLPE cables and cable sealing end terminators with cable cone will not be included in the GIS Manufacturer scope. Interface between GIS and power cable will be in accordance with IEC publication 60859.
- 5.1.2 The cable sealing end, conforming to IEC: 60840 – 2004 for testing, for termination of the Cables for maximum continuous voltage of 145kV at SF6 switchgear end will be supplied by the cable manufacturer. The contractor shall be responsible for the preparation of the cable insulation and conductors and correct termination of each cable to these sealing ends.
- 5.1.3 Bidders are requested to quote cable sealing end with design that helps reducing the works on the gas compartments. The cable sealing end shall be of plug in type that allows easy plugging and unplugging of high voltage power cable without the need of opening the GIS and related time consuming gas works.
- 5.1.4 Cable manufacturer shall furnish large scale general assembly drawings of the SF6 sealing ends, mounting flange details, size of terminal opening in the junction box, weight of terminal including accessories, physical shape and dimensions of all live part, recommended clearances from live parts to the inside surface to permit the SF6 switchgear manufacturer to design and supply junction boxes of adequate dimensions and construction to permit the installation and maintenance of the terminals without difficulty.
- 5.1.5 The stress cone made of silicone rubber shall inhibit possible mechanical stress and deformation of the cable insulation surface during operation and also shall be capable of accommodating minor radial and longitudinal movement without detriment to the dielectric stress in the insulation shield.
- 5.1.6 Manufacturer shall state the connector clearances required when the assembled cable DC proof test is undertaken for co-ordination with the SF6 switchgear design.
- 5.1.7 All supporting structures for the SF6 bus-duct connections between the XLPE cable sealing ends the GIS shall be supplied by the bidder. The supplier may specify connecting & supporting arrangements for approval of the purchaser.

5.2 OUTDOOR TYPE SEALING END

- 5.2.1 The Plug-in type cable sealing end, conforming to IEC 60840-2004-04 for testing of termination for maximum continuous voltage of 145kV cables at the outdoor yard shall be supplied by the cable manufacturer. The contractor shall be responsible for correct termination of each cable to sealing ends, installation of the cable sealing end and providing of terminal connectors for connecting to terminal conductor. The requisite interconnection between line end and sealing end is required to be designed (as per safety and statutory provision aspects) and executed (after approval of Purchaser) by successful bidder.
- 5.2.2 The silicone rubber/ composite bushing termination of rated capacity, suitable for outdoor installation in moderately polluted atmosphere shall be used. It should be resistant to UV exposure. The termination stress control shall be by means of stress cone.

- 5.2.3 The stress cone made of silicone rubber shall inhibit possible mechanical stress and deformation of the cable insulation surface during operation and also shall be capable of accommodating minor radial and longitudinal movement without detriment to the dielectric stress in the insulation shield.

5.3 MAKE OF CABLE KITS

All cable sealing ends shall be either of following reputed make:

- i) ABB Kabeldon AB, Sweden
- ii) Nexans Switzerland Ltd. (Formerly Alcatel Cable Switzerland Ltd)
- iii) J Power System Corporation, Japan (Formerly Sumitomo Electric Industries, Japan)
- iv) SEFAG ixosil Ltd, Power Cable System, Switzerland.
- v) CCC GmbH Berlin.

As the Sub-station is new and to meet the requirement of next 35 years, so new technology is to be used/ adopted while manufacturing and latest technology kits are essential requirement. If any kit is not in a manufacturing range of any of above firms then equipment/kits can be offered from other balance make but kits conforming to specification shall only be accepted.

6.0 ELECTRICAL CHARACTERISTICS OF CABLE KITS

- 6.1 The Cable Termination shall be capable of carrying the specified rated current continuously without exceeding the specified temperature limitations.
- 6.2 The cable Termination accessories to be supplied against this specification shall be rated for 40 kA for 1 second.
- 6.3 The sheath voltage under full load conditions shall not exceed 65 V specified/allowed in relevant standards for safety of personal as well satisfactory working of cable. The sheath shall solidly grounded at the switchgear end & at the pot yard terminations.
- 6.4 The fault level withstand capacity of end termination should be strictly matching with the parameters of cables for which the kits are intended to be used.
- 6.5 After connecting the cable with terminal ends, the complete cable composite cable sheath screen bonding system shall provide a continuous current path through the cable sheath/screen and shall be bonded and earthed at both ends.
- 6.6 The XLPE Cable Termination shall be suitable for use where combined ambient temperature rise due to load result in conductor temperature not exceeding 90°C under normal operation and 250°C under short circuit conditions.
- 6.7 132 kV XLPE cable Termination shall be designed to withstand the mechanical, electrical and thermal stresses under the steady state and transient/ fault conditions and shall be suitable for proposed method of installation.

7.0 DESIGN AND COMPONENTS FEATURES OF CABLE KITS

The following consideration shall be taken into account in the design of the product material properties and components of cable kits.

- 7.1 The most important part of cable accessories is the stress grading device, the stress cone. The pre-molded cone shall be made of insulating and conducting silicone rubber molded together in the shape of geometric stress control unit. The synthetic insulating compound shall be used together with stress cone to improve the electrical properties inside the termination. The compound should swell the insulation of the cone and the cable to some extent so as to improve the electrical strength along with interface.
- 7.2 For XLPE cable the critical part of the operation is making an electrical connection between the stress relief device and insulation screen. If any air pocket created, then discharge and break down can occur. As such connection method and material should be such that no risk of cable damage arises and that the jointer can check the result of his work at every stage. Thus the installation instruction should be easy to follow and should be well illustrative.
- 7.3 The design shall be such that when the cone is supplied the diameter of hole in the cone shall be smaller than the diameter over cable insulation. After the cone is pushed on the elasticity of silicone rubber should guarantee an active pressure on the cable insulation to ensure that no voids appear between the cone and the cable even after years of load cycling.
- 7.4 Every single stress cone & the stress grading device shall be tested electrically prior to delivery in presence of purchaser. Each stress cone shall be marked with an individual number and UPPTCL and a certificate containing detailed specification of test shall be included with every delivery.
- 7.5 The different accessories shall be type according to SEN, IEC-60840-2004-04 and IEEE standards which include test for impulse, AC load cycling and partial discharge. Before delivery every stress cone shall be installed on cable and carefully checked to establish that it is PF free in presence of purchaser's representative(s).
- 7.6 Details of proper stress control, stress grading and non tracking arrangement in the termination details shall be elaborated in the offer. Detailed sectional view of assemblies shall be submitted along with the offer. The application of stress control system shall be safe foolproof and independent of cable jointer's skills. The stress control method should withstand expansion and contraction of cable during load cycling.
- 7.7 The cable end termination shall be designed in such a way so as to give track resistant erosion & weather resistance protection to the cable insulation. The outdoor end termination shall be totally sealed against ingress of moisture of environment.
- 7.8 All end outdoor terminations shall be provided with rain sheds/ creepage petticoats. The weather sheds shall be non-tracking weather resistant hydrophobic and have smooth surface to collect any water/ dirt etc. The design of rain skirts shall avoid any skirt to skirt conducting path under heavy rain condition.
- 7.9 For XLPE cables the lugs should withstand thermal short circuit of 250°C. For XLPE cables the ferrule should be suitable for compacted conductor and should withstand thermal short circuit of 250°C.

- 7.10 Design features may be highlighted in bid and the mouldings of rubber components should be aimed to achieve a smooth finish on interior and exterior of the components.
- 7.11 The kits shall be provided with protection against rodent & termite attack.
- 7.12 The kits offered shall provide for total environment sealing of the cable crutch and at the lugs end. The details of which shall be offered along with the offer. Provision for effective screening over each core shall be made and bidder shall categorically confirm this aspect in their offer.
- 7.13 The materials and components of kits not specifically stated in the specification, but which are essential for satisfactory operation of cable shall be deemed to be included without any extra cost.
- 7.14 The earthing arrangement shall form part of the terminations joints and shall be protected from erosion by suitable tape or tube.
- 7.15 The word "UPPTCL" along with trade name of the manufacturer month/ year of manufacture, size etc, shall be embossed/ engraved for the purpose of identification.
- 7.16 The adequate provisions for eliminating the chances of entrapment of air at steps formed by silicone screen shall be made.
- 7.17 The terminations joints shall be supplied in kit form. All insulation and sealing materials, consumable items, conductor fittings, earthing arrangements and lugs etc. should be provided. Requisite. No. and size of lugs and ferrules depending upon the type of the cable shall be provided in the kit. Lugs and Ferrules shall be of crimping type and shall conform to the relevant standard applicable to XLPE cables.

8.0 LINK BOX FOR EARTHING & EARTHING CABLE WITH PVC INSULATION

- 8.1 Bidder shall carry out the earthing of sheath/screen in the both end bonding configuration. The successful bidder shall submit the complete sheath voltage calculation alongwith identification of bonding points. The Single Phase Link boxes with direct (through SVL if required as per calculation/study) grounding at cable termination ends at termination of cable ends. The bonding lead/grounding cable of suitable sizes (as per sufficiency/ adequacy calculation submitted by successful bidder and approved by the Purchaser shall be used for connecting cable sheath to earth.

9.0 SUPPORTING STRUCTURE & ANGLE BRACKET SUPPORTS FOR CABLE

- 9.1 Any support structures and cable clamps required to support the cables between the trays and the sealing end supports will be supplied and installed by the bidder.
- 9.2 Fabricated wall/ fabricated support mounted angle brackets along with Anchor bolts shall be provided by manufacturer of cable for supporting the SF6 Switchgear Type Sealing Ends for installation/ fixing at 132kV GIS to indoor GIS supplier. The brackets which shall be constructed of galvanized steel structural sections will not be required to support the weight of SF6 switchgear enclosure. The SF6 Switchgear enclosures shall be supplied by Indoor GIS supplier.

- 9.3 Fabricated structure of suitable height, to be approved by Purchaser, shall be provided and installed by manufacturer of cable for supporting the Outdoor cable sealing end at 132kV switchyard. The height of the structure shall be such that the terminal connection to receive the Purchaser's ACSR conductor, at a suitable height. Exact height shall be intimated/ confirmed to the successful bidder while approval of drawings. The structures shall be of galvanized steel structural sections. Anchor bolts, washers etc. will be supplied and installed by successful bidder of cable.
- 9.4 The supporting structure shall be suitable to withstand the wind pressure, seismic forces and the short circuit forces etc. and the design shall have with an adequate factor of safety as specified in I.E. rules 1956.
- 9.5 The bidder shall furnish the design and fabrication drawings of these structures & foundation anchor bolts and design calculations etc.
- 9.6 The bidder shall quote for unit prices for support structure for each single core cable to suit the end terminations supplied by him.

10.0 CABLE END TERMINALS (OUT DOOR TYPE) CONNECTORS

- 10.1 The terminal connector/clamps shall be suitable for connection to ACSR conductor at 132kV Switchyard end. The terminal connector shall be of bimetallic type to connect the copper stud of the cable terminal end to the ACSR conductor.
- 10.2 The type and size of the conductor will be confirmed to the successful bidder.
- 10.3 The connector/ clamps shall be designed to overcome.
- i) Galvanic Corrosion.
 - ii) Thermal Cycling.
- 10.4 The current carrying capacity of the connector/ clamps shall be greater than the maximum capacity of the power cable. The terminal clamp shall be free from burrs, voids, and blow holes.
- 10.5 The terminal clamps shall have passed tests for short circuit current capability and temperature rise.

11.0 EARTHING

- 11.1 Bidder shall carry out the earthing of sheath/ screen at both the termination ends of 145kV cable using insulation sheath bonding (earthing) cable of required size through Link box with/ without surge voltage limiter at terminations.
- 11.2 Earthing shall be as per relevant standards and the details of the earthing arrangement offered for the cable accessories shall be submitted along with the offer.
- 11.3 The sheath/screen shall bound in the earth station through disconnecting type link boxes.

12.0 TESTS

- 12.1 The testing of Cable termination for Gas Insulated Metal enclosed Switchgear outdoor type sealing end for XLPE Cable shall be as per IEC : 60840:2004-04 and IEEE: 48. All the type tests, sample tests and routine tests shall be verified/ carried out on the cable kits (referred as accessories in IEC) at their manufacturer's works.
- 12.2 The routine and acceptance tests shall be carried out in presence of purchaser's representative as per relevant standard IEC : 60840:2004-04 and IEEE: 48 at bidder's cost and the sampling plan shall be 1% subject to minimum of one number.
- 12.3 The contractor shall make available to the UPPTCL Engineer a complete set of detailed data required for inspection and tests.

12.4 Details of Tests

The bidder must specify the details of the type, sample and routine tests to be verified/conducted on offered cable kits at their works along with the standards applicable in their offer.

12.5 Type tests on accessories (kits)

Type tests on accessories (kits) shall be conducted as per clause 14, Annexure-C of IEC 60840: 2004 at the manufacturer's works in the presence of UPPTCL Engineers.

12.6 Sample tests on accessories (kits)

Sample tests on accessories (kits) shall be conducted as per IEC 60840: 2004 and IEEE: 48. Some important tests are summarized for ready reference.

12.6.1 Tests on components

The characteristics of each component of kit shall be verified in accordance with the specifications of the accessories (kit) manufacturer, either through test reports from the sub supplier of a given component or through internal tests conducted at works of cable kit manufacturer.

The manufacturer of a given accessory (kit) shall provide a list of the tests to be performed on each component, indicating the frequency of each test. The components shall be inspected against their drawings. There shall be no deviations outside the declared tolerances.

12.6.2 Tests on complete accessory (Kit)

For accessories, where the main insulation cannot be routine tested (Clause 9.1 of IEC 60840: 2004), the following electrical tests shall be carried out by the manufacturer on a fully assembled accessory.

- a) Partial discharge test (Clause 9.2 of IEC 60840: 2004)
- b) Voltage test (Clause 9.3 of IEC 60840: 2004)

The sequence in which these tests shall be carried out shall be indicated in bid. These tests shall be performed on one accessory of each type.

12.7 Routine tests

Routine tests shall be conducted as per IEC 60840: 2004. Some important test are summarized for ready reference.

The main insulation of each prefabricated accessory shall undergo following tests.

- a) Partial discharge test Clause 9.2 of IEC 60840: 2004
- b) Voltage tests Clause 9.3 of IEC 60840: 2004 according to either 1) ,2) or 3) below
 - 1) on accessories installed on cable.
 - 2) by using a host accessory into which a component of an accessory is submitted for test.
 - 3) by using a stimulated accessory rig in which the electrical stress environment of a main insulation component is reproduced.

13.0 QUALITY ASSUARANCE

- 13.1 Raw materials used for manufacture of cable shall be of highest quality and material received by manufacture should be checked/ tested to ensure that it meets manufacturer's material specification. The materials shall be clean and packed in moisture and dust proof packing.
- 13.2 As the Quality control of EHV, XLPE cables termination kits and accessories while manufacturing is very critical so expert supervision is required for raw material testing, in process checks and also for final testing. A specially trained quality assurance team should be in place for maintenance of the quality at an optimum level at the plant. Complete details of manufacturing process along with details of automatic manufacturing plant, list of officers/ staff to supervise the manufacturing and other details desired as per specification shall be furnished by bidder in the bid.
- 13.3 Quality assurance plan indicating test/checks of raw material, process of manufacturer and final inspection with customer hold point shall be submitted to the purchaser for approval.

14.0 TEST CERTIFICATES

The latest complete type test certificates (conducted during last 5 years from date of tender along with attested drawing) in duplicate for all types of terminations of offered design/ material conducted at Inter National reputed test house conforming to IEC 60840,1999 or 2004 must be enclosed with the offer. The offer without type test results shall be ignored.

15.0 INSPECTION AT MANUFACTURER'S WORKS

- 15.1 The 132kV XLPE cable termination for Gas Insulated Metal enclosed Switchgear, outdoor type sealing end and other accessories should be manufactured and tested while manufacturing as per approved Quality Assurance plan and foregoing specification. Supplier shall intimate the programme of manufacturing of the cable termination and accessories in advance. The inspection during manufacturing shall be carried out by the UPPTCL engineers at various stages of manufacture. The successful

bidder shall grant free access to the purchaser's representative at a reasonable time when the work is in progress.

- 15.2 Inspection and acceptance of any equipment/ material under this specification by the purchaser shall not relieve the supplier of his obligation of furnishing equipment in accordance with the specification and shall not prevent subsequent rejection if the equipment/ material is found to be defective.
- 15.3 The supplier shall present the latest Calibration Certificate(s) of testing instruments /equipments to be used for the testing of the material covered in the Purchase Order to the authorized inspecting officer/ inspecting agency of the purchaser. The testing instruments/ meters/ apparatus etc. should be got calibrated by the supplier from time to time from independent test laboratory/house having valid accreditation from National Accreditation Board for Testing and Calibrating Laboratories for the testing equipments/ original manufacturer having credibility to NABL / NPL or equivalent.
- 15.4 The calibration certificate(s) should not in any case be older than one year at the time of presenting the same to the inspecting officer/inspecting agency of the purchaser. The testing instruments/ equipments should be duly sealed by the Calibrating Agency and mention thereof shall be indicated in the calibration certificate(s).
- 15.5 The purchaser reserves the right to insist for witnessing the sample/ routine tests of the bought out raw material/ items used in manufacturing of cable end terminations.

16.0 FIRE RESISTANCE

The cable terminations shall be fire resistant. The components of kits shall have flame retardant property.

17.0 INTERCHANGEABILITY

The components of different number of the kits shall be inter-changeable in case the need arises.

18.0 COMPLETENESS OF CABLE KIT FOR EASY INSTALLATION

- 18.1 The bidder shall offer complete material and components for each kit so as to meet one termination complete in all respects. The bidder shall indicate the list of the material/components with quantities of each or cable end termination.
- 18.2 An instruction manual in English, indicating the complete method/ proceedings adopted for installations of kits, preferably with more diagrams/ pictorial presentation shall be supplied with each kit. Various items, quantity thereof against each kit must be indicated in the instruction manual.
- 18.3 The detailed bill of material and installation instructions shall be provided with each kit for verification by purchaser's inspecting officer and at Purchaser's stores / site.
- 18.4 All components shall be sealed separately and marked clearly for the purpose of identification of each component. All components shall be supplied in single package

as a complete kit for one termination joints and shall bear manufacturer's name & cable size of kit size for which it can be used.

18.5 The Bidder shall also indicate shelf life and ideal life of kit contents.

19.0 GUARANTEED AND OTHER TECHNICAL PARTICULARS

19.1 The bidder shall furnish the guaranteed & other technical particulars of the kit offered by him in Annexure-1 attached with the specifications. The particulars which are subject to guarantee shall be clearly indicated. Without schedule of GTP, completely filled, the offer shall not be acceptable.

19.2 The bidder shall highlight the various technical aspects of the kits offered by him.

20.0 GUARANTEE

The cable termination shall bear guarantee for one year from the date of commissioning. Any defect noticed in the kit shall be attended by the bidder immediately on getting the complaints and if required shall be replaced and installed free of cost otherwise the same will be arranged at the supplier's risk and cost.

21.0 SPECIAL TOOLS & TACKLES

Complete out fit of tools special tools, spanners and other lifting devices, instrument and appliance necessary for the complete assembly, erection at site, dismantling and maintenance of Power Cable including all accessories (kits) covered by the contract together with suitable racks for holding them shall be arranged by the contractor.

22.0 MANUALS AND LITERATURE ON CABLE & CABLE KITS

The following documents should be furnished along with the bid.

- i) Dimensioned cross sectional details of the cable.
- ii) Current carrying capacities "with supporting calculated data of the cable and de-rated factors."
- iii) Instructions Manual on cable laying installation, storage, handling maintenance fault finding repairs preventive maintenance etc.
- iv) Type acceptance and routine test certificates on the cable as per relevant IS TEC or other International standards.
- v) OGA drawing of the cable end termination.
- vi) Dimensioned cross sectional details of cable end terminations with bill of materials.
- vii) Instructions Manual on the method and formation on cable joining techniques of the cable end terminations.
- viii) Type acceptance and routine test certificate on the cable end terminations.
- ix) OGA drawing of the cable termination structure along with the bill of materials.
- x) Literature on special Tools & Plant.

- xi) Literature on sheath bonding maintenance of link boxes.
- xii) Any other relevant literature/manual.
- xiii) Drawing showing additional details as per clause 5.3.2.

23.0 TRAINING DURING ERECTION

While erection the bidder shall arrange demonstration of use of kits (ordered by purchaser) for giving the training to the 4 or more personal of the UPPTCL for getting acquainted with the cable jointing method/ procedure.

DESIRED TECHNICAL PARTICULARS OF XLPE CABLES KITS & ACCESSORIES

A.	OUTDOOR CABLE END TERMINATION	
1.	Nominal System Voltage U	132 kV (rms)
2.	Rated / Highest System Voltage Um	145 kV (rms)
3.	Rated frequency & No. of phase	50 Hz $\pm$ 3%, Three (3)
4.	Installation	Outdoor
5.	Name and address of manufacturer of end termination	
6.	Nomenclature of kit	To be indicated
7.	Type of Kit	Pre-molded, Plug in type
8.	Suitable for Single Core Copper Conductor XLPE cable Conforming to IEC 60502-2 and IEC 60840: 2004-04 / IS 7098 (part-3) amended upto date and as per specification.	Yes
9.	Maximum conductor size	To be indicated
10.	Rated continuous current	Maximum current of the cable
11.	Applicable standard for testing	IEC 60840:2004-04 & IEEE-48
12.	Maximum allowable Pd-level	As per IEC
13.	Type of Insulator	Silicone / Composite
14.	Creepage distance	25 mm/kV (Total 2900 mm)
15.	Colour	Brown
16.	Maximum allowable temperature for cable and accessories i) At rated full load and at site condition ii) The conductor temperature after a short circuit for one second shall not exceed (with conductor temperature at start of short circuits as 90° C).	90°C 250°C
17.	Basic impulse insulation level (1.2/50 micro second wave)	650 kV
18.	Power frequency withstand voltage	190 kV for 30 min
19.	Symmetrical Short circuit rating	40 kA for 1 sec.
20.	Power frequency withstand voltage (a) Dry (kV rms.) (b) Wet (kV rms.)	To be indicated
21.	Flashover voltage : (a) Dry (kV rms.) (b) Wet (kV rms.)	To be indicated
22.	Stress relief cone made of	Silicone rubber
23.	Net dimensions of kit (Length X Breadth X Width and Weight)	To be indicated
24.	Craft sensitivity and reliability	To be indicated
25.	Time required for energisation after completing the joint (curing period)	To be indicated
26.	Special storage condition, if any upto an ambient temperature of 50 degree C and period.	To be indicated
27.	Whether provision made for : a) Stress relief. b) Track resistance.	Yes

	c) Sealing	
28.	Whether any additional support is required for kit?	If so, give details
29.	Make, Type and Material of lugs provided with kits.	Details to be given by bidder.
30.	Class of Kits.	Details to be given by bidder
31.	Sectional Drawing Showing constructional details along with each item material, description enclosed.	Yes.
32.	Expected life of cable joint and cable.	35 years
33.	(a) Shelf life of the kit (years)	To be indicated
	(b) Design life of the kit (years)	To be indicated
34.	Guarantee of kit.	Five (5) years from date of commissioning
35.	Details of terminal connector	
B.	SF6 SWITCHGEAR TYPE CABLE END TERMINATION	
1.	Nominal System Voltage U	132 kV (rms.)
2.	Rated / Highest System Voltage Um	145 kV (rms.)
3.	Rated frequency & No. of phase	50 Hz $\pm$ 3%, Three (3)
4.	Installation	Indoor
5.	Name and address of manufacturer of end termination	
6.	Nomenclature of kit	To be indicated
7.	Type of kit	Pre moulded, Plug in type
8.	Suitable for Single Core Copper Conductor XLPE cable Conforming to IEC 60502-2 and IEC 60840: 2004-04 or IS 7098 (Part-3) amended upto date and as per specification.	Yes
9.	Maximum conductor size	To be indicated
10.	Rated continuous current	Maximum current of the cable
11.	Applicable standard for testing	IEC 60840: 2004-04 & IEEE- 48
12.	Maximum allowable Pd-level	As per IEC
13.	Type of Insulator	Silicone / Composite
14.	Creepage distance	25 mm/kV (Total > 2900 mm)
15.	Colour	Brown
16.	Maximum allowable temperature for cable and accessories (i) At rated full load and at site condition (ii) The conductor temperature after a short circuit for one second shall not exceed (with conductor temperature at start of short circuits as 90° C).	90° C 250° C
17.	Basic impulse insulation level (1.2 / 50 micro second wave)	650 kV
18.	Power frequency withstand voltage	190 kV for 30 min.
19.	Symmetrical Short circuit rating	40 kA for 1 Sec.
20.	Power frequency withstand voltage (a) Dry (kV rms.) (b) Wet (kV rms.)	To be indicated
21.	Flashover voltage: (a) Dry (kV rms.) (b) Wet (kV rms.)	To be indicated
22.	Stress relief cone made of	Silicon rubber
23.	Details of terminal connector	As applicable
24.	Net dimensions of kit (Length X Breadth X Width and Weight)	To be indicated

25.	Craft sensitivity and reliability	To be indicated
26.	Time required for energisation after completing the joint (curing period)	To be indicated
27.	Special storage condition. If any, upto an ambient temperature of 50°C and period.	To be indicated
28.	Whether provision made for : a) Stress relief b) Track resistance. c) Sealing	Yes
29.	Whether any additional support is required for kit?	If so, give details.
30.	Make, Type and Material of lugs provided with kits.	Details to be given by bidder.
31.	Class of Kits.	Details to be given by bidder.
32.	Sectional Drawing Showing constructional details along with each item material, description enclosed.	Yes
33.	Expected life of Cable joint and cable.	30 years
34.	(a) Shelf life of the kit (years) (b) Design life of the kit (years)	To be indicated To be indicated
35.	Details of terminal connector	
36.	Guarantee of kit	Five (5) year from date of commissioning.
C. LINK BOX ROR EARTHING CABLE WITH PVC INSULATION		
1.	Make	
2.	Type	
3.	Detailed dimension and internal arrangement of Single / Three phase Link boxes with direct grounding	To be submitted
4.	Detailed dimension and internal arrangement of Three Phase Link boxes for cross bonding with SVL	To be submitted
5.	Earthing of sheath / screen at cross bonding points and termination ends	Yes
6.	PVC insulated single core/concentric / coaxial cable to be used for sheath bonding (earthing) suitable for 40 kA for 1 second	Size, Type to be indicated
7.	Insulation of above earthing cable	To be indicated (3 kV / 6 kV)
8.	Voltage rise of the insulation sheath controlled within voltage	65 Volts.
9.	Surge voltage limiter	Required (3 kV / 6 kV)
D. SUPPORTING STRUCTURE & ANGLE BRACKET SUPPORTS FOR CABLE		
1.	Detail drawing enclosed	Yes
2.	Overall height of structure	Shall be as per approved drawing.

SECTION-3

PROJECT DETAILS & GENERAL SPECIFICATION

SITE INFORMATION

	Particular	Details
a)	Owner	UPPTCL
b)	Customer	UPPTCL
c)	Project Title	400/220/132 kV GIS at Rasra, Ballia
d)	Location	Uttar Pradesh
e)	Transport Facilities	Nearest rail head - Ballia
SITE CONDITIONS		
a)	Max. ambient air temp.	50°C
b)	Min. ambient air temp.	0°C
c)	Max. design ambient emp.	50°C
d)	Design reference temp.	50°C
e)	Average Humidity	Max. 100%
f)	Special corrosion conditions	No
g)	Solar Radiation	
h)	Atmospheric UV radiation	High
i)	Altitude above sea level	Less than 1000meter
j)	Pollution Severity	High Pollution level
k)	Seismic Zone	As per the seismic zone defined in the relevant BIS / IEC-62271-300 but not less than 0.3g horizontal
WIND DATA		
	Wind load	195kg/sqm
	Average No. of thunderstorm days per annum	As per IS

1. GENERAL

This Chapter covers Technical Requirements and requirements of auxiliary items.

- 1.1 Equipments furnished shall be complete in every respect with all mountings, fittings, fixtures and standard accessories specified &/or normally provided with such equipment and/ or needed for erection, completion and safe operation of the equipment as required by applicable codes though they may not have been specifically detailed in the Technical Specifications.

Materials and components not specifically stated in the specification but which are necessary for commissioning and satisfactory operation of the substation unless specifically excluded shall be deemed to be included in the scope of the specification and shall be supplied without any extra cost All similar standard components/ parts of similar standard equipment provided, shall be inter-changeable with one another.

- 1.2 The Bidder shall supply type tested (including special test as per technical specification) equipments and materials. The test reports/details shall be furnished by the Bidder in the bid.

In the event of any discrepancy in the test reports i.e. any test report not acceptable due to any design/manufacturing changes or due to non-compliance with the requirement stipulated in the Technical Specification and/or IEC/ IS, same, shall be carried out without any additional cost implication to the Purchaser. The Purchaser reserves the right to get any or all type tests conducted/ repeated.

The reports for all type tests and additional type tests as per technical specification furnished by the Bidder shall be of the tests conducted within last 05(five) years prior to the date of bid opening. The type tests conducted should have either been conducted in 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) or witnessed by UPPTCL or representative authorized by UPPTCL or Utility or representative of accredited test lab or reputed consultant.

2. SYSTEM PARTICULARS

	Rated System voltage	420 kV, 245kV, 145kV, 36kV
	System frequency	50 Hz, This may vary by $\pm 5\%$
	Number of phases	Three
	Neutral	Effectively Earthed
	Auxiliary power supply:-	
	Auxiliary electrical equipment shall be suitable for operation on the following supply system:	
(a)	Power device (Like drive motors)	400V, 3Phase, 4Wire 50Hz Effectively earthed AC system.
(b)	Lighting fixtures, space heaters, fractional Horse Power motors and control devices.	250V, 2wire, 50Hz, AC supply with one point grounded.
(c)	DC alarm, Control and Protective Devices from sub station batteries as under	2 wire ungrounded DC supplies (i) 400 kV S/S : 220V DC (ii) 220/132kV S/S : 110V DC (iii) Communication : 48 V DC The above supply voltage is subject to variation as follows: All devices must be suitable for a continuous operation over the entire range of voltage variations : (i) AC Voltage may vary by $\pm 10\%$. Frequency by $\pm 5\%$ Combined Voltage & frequency by $\pm 10\%$. (ii) DC a) 220 V may vary between 187 & 242 V b) 110 V may vary between 93 & 121 V c) 48 V may vary between 41 & 53 V

3. System parameters

Sl. No.	Description of Parameters	400 kV System	220 kV System	132 kV System	33 kV System
1	Nominal system voltage	4000kV	220kV	132kV	33kV
2	Maximum operating voltage of the system(rms)	420kV	245kV	145kV	36kV
3	Rated frequency	50Hz	50Hz	50Hz	50Hz
4	No. of phase	3	3	3	3
5	Rated short time current	50 kA for 3 Sec.	40 kA for 3 SEC	40 kA for 3 SEC	25 kA for 3 SEC
6	Dry and wet one minute power frequency withstand voltage	680 kV	460 kV	275 kV	95 kV
7	Dry and wet impulse withstand voltage positive and negative	1550 kVp	1050 kVp	650 kVp	250 kVp
8	Corona extinction voltage	320 kV	156 kV	105 kV	-
9	Max. Radio interference voltage for frequency between 0.5 MHz and 2 MHz at 508 kV rms for 765kV, 320kV rms for 400kV system and 156kV rms for 220kV system & 92kV rms for 132kV system system & 92kV rms for 132kV system	1000 microvolt	1000 microvolt	500 microvolt	-
10	Minimum total creepage	25mm/kV (10500 mm)	25mm/kV (6125 mm)	25mm/kV (3625 mm)	25mm/kV (1300 mm)
11	Min. clearances				
	i. Phase to phase	4000mm (for Conductor-conductor)	2100 mm	1300 mm	320 mm
		4200mm (for rod - Conductor)			
	ii. Phase to earth	3500 mm	2100 mm	1300 mm	320 mm
	iii) Sectional clearances	6500 mm	5000 mm	4000 mm	3000 mm
12.	System neutral earthing	Effectively Earthed			

4. SERVICES TO BE PERFORMED BY THE EQUIPMENT BEING FURNISHED

- 4.1** All equipments shall perform satisfactorily under various electrical, electromechanical and meteorological conditions of the installation site.
- 4.2** All equipment shall be able to withstand all external and internal mechanical thermal and electromechanical forces due to various factors like wind load temperature variation, ice & snow (wherever applicable) short circuit etc for the equipment.

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- 4.3 The Bidder shall design the various forces which the terminal connectors of the equipment are required to withstand.
- 4.4 All outdoor EHV equipments except marshalling kiosks shall be suitable for hot line washing.
- 4.5 To facilitate erection of equipment, all items to be assembled at site shall be "matchmarked".

5. SUPPORT STRUCTURES (If in the scope of Bidder)

The base design of all the equipments, to be installed on auxiliary structures, shall conform to the standard auxiliary structure designs presently being used in UPPTCL at 400/220/132/33kV Substations.

All equipment support structures shall be supplied along with brackets, angles, stools etc. for attaching the operating mechanism, control cabinets and marshalling box (wherever applicable) etc. The support structures should be hot dip galvanised with minimum 610 gram/sq.m net of zinc.

6. STANDARDS

- 6.1 **Except** as modified by this Bid specification, all material and equipment shall conform to the requirement of the latest editions of relevant ISS/ IEC and other applicable standards. The equipments/ works shall be designed, engineered, manufactured, built, tested and commissioned shall be carried out in accordance with the Acts, Rules, Laws and Regulations in force in India.
- 6.2 In addition to meeting the specific requirements called for in the respective sections of the Technical Specification, the equipment shall also conform to the general requirement of the relevant standards which shall form an integral part of the specification. When the specific requirements stipulated in the specifications exceed or differ than those required by the applicable standards, the stipulation of the specification shall take precedence.
- 6.3 In the event of the Bidder offering equipment conforming to standards other than ISS/IES standards, which ensure equivalent or better performance than that specified in the standards, the salient point of comparison between the standards adopted and relevant ISS/ IEC standards shall be indicated clearly in the proposal, along with English language version of such standard or relevant extract of the same. The equipment conforming to standards other than IS/IEC shall be subject to Purchaser's approval.
- 6.4 The standards mentioned in the respective equipment specifications are not mutually exclusive or complete in themselves. The equipment &/or work shall also conform to any other applicable standard, even if not specifically mentioned in these specifications.
- 6.5 Should the Bidder wish to depart from the provisions of the specifications, either on accounts of manufacturing practices or for any other reason, he shall clearly mention the departure and submit complete justification supported by information, drawings etc. as will enable to assess the suitability of equipment(s) offered. In the event of the Bidder's specifications, drawings, forms and tables etc. being found to disagree with the

requirement of the Bid specifications at any stage, Bid specifications shall be binding, unless the departures have been duly approved in writing by the purchaser.

6.6 REFERENCE OF STANDARDS

Reference	Abbreviation	Name and Address
BS	British Standards,	British Standards Institution, 101, Pentonville Road, N-19-ND UK
ISO	International Organization	Danish Board of Standardization Danish Standardising Sraat, Aurehoegvej-12, DK-2900, Heelstrup, DENMARK
NEMA	For Standardization, National Electric Manufacture Associate	115, East 44th Street, New York NY 10017 U.S.A
BS	British Standards,	British Standards Institution, 101, Pentonville Road, N-19-ND UK
ISO	International Organization	Danish Board of Standardization Danish Standardising Sraat, Aurehoegvej-12, DK-2900, Heelstrup, DENMARK
NEMA	For Standardization, National Electric Manufacture Associate	115, East 44th Street, New York NY 10017 U.S.A

7. ENGINEERING DATA AND DRAWINGS

7.1 SUBMISSION AND APPROVAL OF DRAWINGS/ DOCUMENTS

- 7.1.1 The Bidder shall follow a well-defined coding system for proper and quick identification of all systems/ sub-systems/ equipments/ assemblies/ sub-assemblies/ accessories/ other plant material/ spare parts/ special tools and plants and drawings for the execution of the plant and later for its operation and maintenance.

Copies of coding documents defining the above shall be supplied along with drawings to understand the system.

- 7.1.2 All drawings submitted by the Bidder shall be in sufficient details to indicate the type, size arrangement, weight of each component, details for packing and shipment, the external connections, fixing arrangements, dimensions required for installation arrangement, dimensions required for installation and interconnections with other equipment and other information specifically, as called for in the drawing schedules. All the equipments tapping points etc. shall be numbered according to pre-determined scheme/ system which shall be subject to approval of Purchaser.

7.1.3 Each drawing shall be clearly marked with the name of the Purchaser, unit designation, UPPTCL's Contract No. and the name of the project. If standard catalogue pages are submitted the applicable items shall be indicated therein. All titles, noting, markings and writings on the drawings shall be in English. All the dimensions should be in metric units.

7.1.4 If any dimension figures on a drawing or a plan differs from those obtained by scaling the drawing or plan, the dimensions as mentioned in figures on the drawing or plan shall be taken as correct.

7.2 Submission and distribution of drawings/ documents

All the drawings which do not require approval shall be submitted along with reproducible in required number and those requiring approval shall be initially submitted for comments/ approval before submitting along with reproducible as per "Document Distribution Schedule".

7.3 APPROVAL OF DRAWINGS

7.3.1 The Purchaser shall return to the Bidder one set of drawings, plans and technical data requiring approval after marking them with their comments/ corrections, if any, either (a) marked 'Approved' or (b) marked 'Approved subject to incorporation of comments' or (c) marked 'Not Approved' with comments requiring resubmission of drawings etc. in 14 days or (d) marked 'Approval not required', where drawing is for information only. In case of (a) no further revision of drawings will be required. In case of (b) Bidder can proceed with the work but will resubmit the drawings incorporating the corrections as per comments only within fourteen (14) days. In case of (c) Bidder can proceed with the work only after resubmitting the drawings within fourteen (14) days and getting approval under (a) or (b) categories above. In case of (d) the Bidder drawing is deemed to have been received only for information purpose.

7.3.2 The Purchaser shall have the right to ask the Bidder to make any change in the design/ drawing which may be necessary to make equipment conform to the provisions and intent of the contract, without any extra cost to the Purchaser.

The drawings submitted shall be re-viewed by the Purchaser and shall be modified by the Bidder as required. The Bidder shall incorporate such modifications and/or corrections and submit the final drawings for approval/ reference.

7.3.3 No deviation from the approved drawings shall be permitted without the written approval of the Engineer.

7.3.4 The review of drawings/ data by the Purchaser will cover only general conformance of the data of the specifications and document, interfaces with the equipment provided under the specifications, external connections and the dimensions which might effect substation layout.

This review by the Purchaser may not indicate thorough review of all dimensions, quantities and details of the equipment, wiring, materials, any devices or items indicated or the accuracy of the information submitted. This review and/ or approval by the purchaser shall not be considered by the Bidder, as limiting any of his responsibilities specified under these specifications and documents.

Approval/ comments conveyed as above shall neither relieve the Bidder of his contractual obligations and his responsibilities for correctness of dimensions, material of construction, quantities, design details, assembly fits, performance particulars, guarantees and conformity of the supplies with the specifications, schemes, systems and statutory laws, nor does it limit the Purchasers right under the contract.

- 7.3.5 Should any minor revision be made after 'approval', at the time of erection/ commissioning the Bidder shall redistribute prints and reproducible, clearly certifying the changes incorporated in the drawing and marking it in a block. Every revision shall be marked by a revision number, date and subject, in a revision block provided in the drawing, clearly marking the changes incorporated.
- 7.3.6 The Bidder shall be responsible for and shall pay for any alterations of the work due to any discrepancies, errors and omissions in the drawings or other particulars supplied by him, whether such drawings or particulars have been approved by Engineer or not.

No extension of delivery periods shall be granted on this account.

7.3.7 As- build drawings

Drawings of all equipments as detailed in technical specifications of respective equipments necessarily including schematic drawings and terminal block drawings wherever applicable whether mentioned in respective technical specifications or not.

8. NAME PLATE, MARKING OF PARTS, LABELS

- 8.1 All equipment shall have metal name plates fixed in suitable position with full particulars engraved legibly thereon and not painted.
- 8.2 Each main and auxiliary item of plant is to have permanently attached to it in a conspicuous position, a rating plate of non corrosive material upon which is to be engraved identifying manufacturer's name, equipment type or serial number, rating together with details of the loading/ operating conditions under which the item or plant in question has been designed to operate and such diagram plates as may be required by the Engineer.
- 8.3 Each item of plant is to be provided with a name plate or label designating the service of the particular equipment. These inscriptions are to be approved by the Engineer or as detailed in the appropriate sections of the technical specifications.
- 8.4 Such name plates or labels are to be white non hygroscopic material with engraved block lettering or, alternatively, in the case of indoor equipments of transparent plastic material with suitably colored lettering engraved on the back
- 8.5 Each bay module in GIS room will have a clear marking showing the name of bay, identification, name and rating plate marking for each individual equipment like circuit breaker, disconnectors grounding switches, current transformer, voltage transformers and bushings etc. as per relevant IEC to facilitate identification during routine operation/ maintenance.
- 8.6 All such name plates, instruction plates, lubrication charts etc. shall be bilingual with Hindi inscription first followed by English. Provisions shall be made to fit in name plates, lubrication/ connection diagram plates etc.
- 8.7 In order to facilitate identification, the parts of the equipment shall be suitably marked.

9. INSTRUCTION MANUALS

- 9.1 The Bidder shall submit to the Engineer 'Descriptive Manuals', i.e. system design concept, detailed catalogues of equipment and typical equipment instructions for this project, for all major systems and equipment, covered under this contract along with dispatch of equipment.
These initial copies of descriptive manuals shall be in sufficient details, bringing out detailed internal construction, characteristics, performance parameters, principles of operation, maintenance requirements, replacement and renewals needed, erection and overhauling procedure, testing and operation procedure etc. for various equipment.
- 9.2 The integrated instruction manuals, fully defining the interfaces between various systems and complete in all respects shall be submitted by the Bidder one month before scheduled date of commissioning. The instruction manuals shall contain full details of designation and drawings of all the equipment furnished, the erection procedure, testing procedure, operation and maintenance procedure of the equipment, single line diagrams, and schematics. After the commissioning and initial operation of the plant, modifications/ additions/ changes, wherever required shall be incorporated in the instruction manuals and drawings shall be submitted by the Bidder to the Purchaser.
- 9.3 The manuals shall be specific to the equipment supplied and not of general nature.

10. DOCUMENTS AND ERECTION DRAWINGS

The Bidder shall submit within a reasonable time but at least four (4) weeks before dispatch of equipment (as per distribution schedule) the following drawings/ documents and instruction manuals etc. to the consignee and the Engineer.

- I. List of item-wise equipment as proposed to be dispatched by the Bidder.
- II. Erection drawings along with reproducible prints of each drawings.
- III. Instruction books for proper handling/ checking of material on receipt at site/storage,
- IV. erection and assembly of all equipment and necessary instruction for checking and
- V. recording proper assembly of the plant.
- VI. Instruction sheets for proper balancing, alignment, adjustment, checking and calibrations
- VII. as may be necessary.
- VIII. Descriptive literature and drawings to illustrate the working principals, methods of
- IX. assembly and dismantling of plants and equipment.
- X. Testing/commissioning format for recording data during erection/testing/
- XI. commissioning and trial run. These formats/data sheets shall clearly indicate the results
- XII. obtained during shop tests and permissible deviations.

11. QUALITY CONTROL PROGRAMME

To ensure that the equipment construction work and the services covered under this job are in accordance with the specifications and conform to the high standard of workmanship. It is obligatory on the part of the Bidder to adopt a suitable quality control program. Such a program shall include suitable hold point for check for major equipments during manufacture at supplier's work, during erection at site and during the construction

stage such that material checks for attaining proper strength and dimensional checks for attaining close tolerances required for equipment installation can be obtained.

In order to attain the above objectives, the Bidder shall draw out a plan listing all quality control checks in detail, including all hold points at which the quality checks shall be applied, also specifically mentioning those hold points where the Purchaser shall also participate in the quality check to assure him of the quality of the products supplied. Such a program shall be outlined by the Bidder for the acceptance by the Purchaser. The Bidder shall furnish detailed information regarding his quality control program and its strict implementation. Following information shall be included in the proposal along with others regarding quality control program:

- I. The quality control organizations and the proposal of its implementation.
- II. The system for controlling drawings and documents for correctness.
- III. The system of quality control for raw materials, process control and maintaining tolerances during manufacturing, assembly and fabrication.
- IV. Quality control during purchase of components, sub-systems and assemblies.
- V. Methods for ensuring selection of proper vendors/ sub-vendors.
- VI. Inspection of testing at shop after assembly.
- VII. Control of accuracy during calibration of measuring and testing equipments.
- IX. Preservation and quality control during the transit.
- X. Procedure for inspection before erection and quality control during erection.
- XI. System for storage and delivery.

Bidder shall be wholly responsible for the quality control and quality assurance for the manufacture, supply, erection, testing and commissioning etc.

During inspection, destructive testing and non destructive test evaluation shall be done wherever applicable, in presence of Purchaser's representative in accordance with established

norms. Directions of Purchaser shall be rigorously followed.

12. INSPECTION

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TESTING

- 12.1 The Purchaser reserves the right to inspect any machinery and material to ensure that approved Q.A.P. is being strictly implemented by the Bidder or his Sub Bidder/ Supplier under this contract and to reject any item found defective in workmanship or design or otherwise unsuitable for the use and purpose intended or which is not in accordance with the intent of this contract. The Bidder should on demand by the Purchaser, rectify or replace such defective or unsuitable equipment, or the Purchaser may at the Bidder's expense, rectify or replace such defective or unsuitable equipment whether before or after supply.
- 12.2 That Bidder shall, for purpose of clause 15 of the annexed conditions of contract Form-A inform to the Purchaser places of manufacture, testing and inspection of various equipment offered by him. Unless specifically provided otherwise, all tests shall be carried out at the Bidder's work or for bought out items at sub-vendors works before dispatch.
- 12.3 The Bidder shall advise the Purchaser at least 4 weeks in advance as to when the equipment will be ready for stage/ final inspection at the Bidder's works or at his Sub-

Bidder's works.

PENAL CHARGES

In case the equipment is not available for inspection at the time of arrival of inspection officers, the Bidder shall pay to UPPTCL towards futile journey a sum decided by Chief Engineer (765 KV DU), UPPTCL and demanded by "Engineer of Contract". This amount shall be paid within 10 days from the date of demand. Further action for inspection of the material shall be taken only after the said amount is deposited.

- 12.4** During inspection, the Purchaser's Inspecting Engineers at all times have access to all part of shops where the equipment is being manufactured and also shall be provided with all reasonable inspection facilities by the Bidder and/ or sub-Bidders. Even without scheduled inspection, the Engineer and/or his duly authorized representative shall have at all reasonable times access to the Bidder's premises, works or site and shall have the power to inspect and examine the materials and workmanship of the works during it's manufacture or erection.

- 12.5** All plants equipment/ parts, sub assemblies/ assemblies shall comply with the requirement of type tests and shall be subjected to the routine/ acceptance tests specified in the set of standards adopted and to such other tests as are stipulated in the respective technical specifications.

The Purchaser reserves to himself the right of having at his own expense any inspection or special test of a reasonable nature at Bidder's premises or at site, in addition to those prescribed in applicable standards and the enclosed technical specifications.

- 12.6** The Engineer shall either depute his representative to witness the tests as applicable and inspect the material or shall waive the inspection. In case of waiver the Bidder or his sub-Bidder shall carryout the all applicable tests in absence of Purchaser's representative. In both the cases i.e. either inspection or waiver the test certificates shall be submitted to Engineer of Contract for approval and issue of dispatch authorization. In case of inspection the test certificates must bear signatures of the Purchaser's inspecting officer.

The Engineer of Contract, within 10 days of receipt of test certificates, shall issue approval/ dispatch authorization, if test certificates are found satisfactory.

In case test certificates are not found satisfactory the Engineer of Contract, within 10 days of receipt of test certificates, shall communicate his objections and actions required to be taken in writing to the Bidder. The Bidder shall take remedial action and shall re-submit the test certificates or re-offer the material for inspection as asked for by the Engineer. Subsequent actions shall follow as in case of fresh offer for inspection. No extension of delivery/ completion period shall be granted on this account.

12.7 REJECTON

Purchaser reserves the right to reject any equipment if during the tests at works or site, the test value achieved do not comply with the respective standard/ specifications and

exceeds that tolerable limits. Rejection of any equipment will not be held as a valid reason for delay in timely completion of the work.

- 12.8** No equipment to be furnished or used in connection with this contract shall be dispatched, until factory inspection and acceptance test have been carried out satisfactorily and dispatch authorization issued by Engineer of Contract. Such factory inspection of the equipment or approval of acceptance tests shall not however, relieve the Bidder from full responsibility for supplying equipment conforming to the requirements of this contract, nor prejudice any claim, right or privilege which the Purchaser may have because of the use of defective or unsatisfactory equipment. Should Purchaser waive the right to inspect any equipment, such waiver shall not relieve the Bidder in any way from his obligations under this contract. The inspection/waiver by Engineer and/ or approval of test certificates shall in no way limit the liabilities and responsibilities of the Bidder in respect of the agreed quality assurance program, and the desired performance of the equipment.
- 12.9** In all cases where the contract provides for tests whether at the premises or works of the Bidder or of any Sub-Bidder, the Bidder shall provide free of charge such items as labour, materials, electricity, fuel, water, stores, apparatus and instruments as may be reasonably required to carry out effectively, such tests on the equipment in accordance with the contract and shall give facilities to the Engineer or to his authorized representative to accomplish inspection. All the expenses incurred for testing including material consumed in testing shall be to the Bidder's account.
- 12.10** Purchaser will not entertain any request for waiver of inspection on the ground that subvendors are not agreeing for the Purchaser's inspection. It is the responsibility of the Bidder to ensure that all the requirements of the Purchaser as envisaged in the technical specifications are incorporated.
- 12.11** The Bidder is required to record the following certificates on the invoices and challans of each and every consignment:
"Certified that material being dispatched against the above invoices and challan has been inspected and tested by the representative of Engineer of the contract on (date) and all the test results were satisfactory, as per approved test certificate enclosed."

Or
Certified that inspection of material being dispatched against the above invoice and challan has been waived off by Engineer of Contract vide letter No.....Dt..... (Copy enclosed) and all the acceptance and routine tests as per relevant standards and those provided in Contract, have been conducted and all the test results were found satisfactory as per test certificates enclosed."
- 12.12** In case the inspection or testing of the material is to be carried out outside India, all the expenditure including boarding and lodging etc. of the inspecting officer/ officers shall be borne by the contractor and information regarding inspection has to be given at least 8 weeks in advance.

13. PACKING

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- 13.1** All equipment shall be suitably protected, coated, covered or boxed and crated to prevent damage or deterioration during transit, handling and storage at site till the time of erection.
While packing all the materials, the limitations from the point of view of availability of transportation facilities in India should be taken into account. The Bidder shall be responsible for any loss or damage during transportation, handling and storage.
- 13.2** The Bidder shall include and provide for security protection and packing the plant so as to avoid loss or damage during transport by any mode.
- 13.3** All packing shall allow for easy removal and checking at site. Wherever necessary, proper arrangement for attaching slings for lifting shall be provided. All packages shall be clearly marked for with signs showing 'UP' and 'DOWN' side of boxes, and handling and unpacking instructions as considered necessary. Special precautions shall be taken to prevent rusting of steel and iron parts during transit and storage. Gas seals or other methods proposed to be adopted for protection against moisture during transit shall be to the satisfaction of the engineer.
- 13.4** The cases containing easily damageable material shall be very carefully packed and marked with appropriate caution symbols i.e. FRAGILE, HANDLE WITH CARE, USE NO HOOKS etc.
- 13.5** Each package delivered under the contract shall be marked by the Bidder at his expense and such marking must be distinct (all previous irrelevant marking being carefully obliterated). Such marking shall show the description and quantity of contents, the name of consignee and address, the gross and net weights of the package, the name of Bidder with a distinctive number of mark sufficient for purpose of identification. All markings shall be carried out with such materials as to ensure quickness of drying, fastness and legibility.
- 13.6** Each Package shall contain a note quoting specifically the name of the Bidder, the number and date of contract or order and the name of office placing the contract, nomenclature of the stores and include a schedule of parts for each complete equipment giving the parts number with reference to the General Arrangement/ Assembly drawing and the quantity of each part, drawing number and tag numbers.
- 13.7** All equipment/ material shall be suitably packed for transport, carriage at site and outdoor storage during transit. The Bidder shall be responsible for any damage to the equipment during transit. The contents of each package shall bear marking that can be readily identified from the package list and packing shall provide complete protection from moisture, termites and mechanical shocks etc.
- 13.8** Any material found short inside the packing cases shall be supplied by the Bidder without any extra cost.
- 13.9** Notwithstanding anything stated in this clause the Bidder shall be entirely responsible for any loss, damage or depreciation to the stores.

14. DESPATCH OF EQUIPMENT

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- 14.1** Detailed dispatch instructions will be intimated to the Bidder. All materials shall be dispatched by road.
- 14.2** The Bidder shall intimate, at least thirty (30) days in advance to the consignee as well as the concerned Superintending Engineer at site, the probable date when the equipment will be ready for dispatch from the works. Notification of delivery or dispatch in regard to each and every consignment shall be made to the Purchaser immediately after dispatch or delivery. The supplier shall further supply to the consignee a priced invoice and packing account of all stores delivered or dispatched by him. All packages, containers, bundles and loose materials forming parts of each and every consignment shall be described fully in the packing account, and full details of the contents of packages and quantity of material shall be given to enable the consignee to check the stores on arrival at destination.
- 14.3** A list in duplicate containing details of equipment for verification at site shall also be placed inside each package and shall correspond with the advice note. One additional copy of each of the package lists shall also be sent to the consignee.

15. TYPE TESTING, INSPECTION, TESTING & INSPECTION CERTIFICATE

The Bidder shall supply type tested (including special test as per technical specification) equipments and materials. The test reports/details shall be furnished by the Bidder in the bid.

In the event of any discrepancy in the test reports i.e. any test report not acceptable due to any design/manufacturing changes or due to non-compliance with the requirement stipulated in the Technical Specification and/or IEC/ IS, same, shall be carried out without any additional cost implication to the Purchaser. The Purchaser reserves the right to get any or all type tests conducted/ repeated.

The reports for all type tests and additional type tests as per technical specification furnished by the Bidder shall be of the tests conducted within last 10(five) years prior to the date of bid opening. The type tests conducted should have either been conducted in 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) or witnessed by UPPTCL or representative authorized by UPPTCL or Utility or representative of accredited test lab or reputed consultant.

15.1 Pre-commissioning Tests

On completion of erection of the equipment and before charging, each item of the equipment shall be thoroughly cleaned and then inspected jointly by the Purchaser and the Contractor for correctness and completeness of installation and acceptability for charging, leading to initial pre-commissioning tests at Site. The list of pre-commissioning tests to be performed are given in respective chapters and shall be included in the Contractor's quality assurance programme.

15.2 Commissioning Tests

- 15.2.1** The available instrumentation and control equipment will to be used during such tests and the Purchaser will calibrate, all such measuring equipment and devices as far as practicable.

- 15.2.2 Any special equipment, tools and tackles required for the successful completion of the Commissioning Tests shall be provided by the Contractor, free of cost.
- 15.2.3 The specific tests requirement on equipment have been brought out in the respective chapters of the technical specification.
- 15.2.4 The Contractor shall be responsible for obtaining statutory clearances from the concerned authorities for commissioning the equipment and the switchyard. However necessary fee shall be reimbursed by POWERGRID on production of requisite documents.

16. MATERIAL WORKMANSHIP

16.1 General Requirement

Where the specification does not contain references to workmanship, equipment, materials and components of the covered equipment, it is understood that the same must be new, of highest grade of the best quality of their kind, conforming to best engineering practice and suitable for the purpose for which they are intended.

The design of the works shall be such that installation, future expansions, replacements and general maintenance may be undertaken with a minimum of time and expenses. Each component shall be designed to be consistent with its duty and suitable factors of safety, subject to mutual agreements. All joints and fastenings shall be devised, constructed and documented so that the component parts shall be accurately positioned and restrained to fulfil their required function. In general screw threads shall be standard metric threads. The use of other thread forms will only be permitted when prior approval has been obtained from the Purchaser.

Whenever possible, all similar part of the Works shall be made to gauge and shall also be made interchangeable with similar parts. All spare parts shall also be interchangeable and shall be made of the same materials and workmanship as the corresponding parts of the Equipment supplied under the Specification. Where feasible, common component units shall be employed in different pieces of equipment in order to minimize spare parts stocking requirements. All equipment of the same type and rating shall be physically and electrically interchangeable.

All materials and equipment shall be installed in strict accordance with the manufacturer's recommendation(s). Only first-class work in accordance with the best modern practices will be accepted. Installation shall be considered as being the erection of equipment at its permanent location. This, unless otherwise specified, shall include unpacking, cleaning and lifting into position, grouting, leveling, aligning, coupling of or bolting down to previously installed equipment bases/foundations, performing the alignment check and final adjustment prior to initial operation, testing and commissioning in accordance with the manufacturer's tolerances, instructions and the Specification. All factory assembled rotating machinery shall be checked for alignment and adjustments made as necessary to re-establish the manufacturer's limits.

Suitable guards shall be provided for the protection of personnel on all exposed rotating and/ or moving machine parts and shall be designed for easy installation and removal for maintenance purposes. The spare equipment(s) shall be installed at designated locations and tested for healthiness.

The Bidder shall apply oil and grease of the proper specification to suit the machinery, as is necessary for the installation of the equipment. Lubricants used for installation purposes shall be drained out and the system flushed through where necessary for applying the lubricant required for operation. The Bidder shall apply all operational lubricants to the equipment installed by him.

All oil, grease and other consumables used in the Works/ Equipment shall be purchased in India unless the Bidder has any special requirement for the specific application of a type of oil or grease not available in India. In such is the case he shall declare in the proposal, where such oil or grease is available. He shall help Purchaser in establishing equivalent Indian make and Indian Contractor. The same shall be applicable to other consumables too.

A cast iron or welded steel base plate shall be provided for all rotating equipment which are to be installed on a concrete base unless otherwise agreed to by the Purchaser. Each base plate shall support the unit and its drive assembly, shall be of design with pads for anchoring the units and shall have a raised up all around and shall have threaded in air connections, of so required.

16.2 Provisions For Exposure to Hot and Humid climate

Outdoor equipment supplied under the specification shall be suitable for service and storage under tropical conditions of high temperature, high humidity, heavy rainfall and environment favourable to the growth of fungi and mildew. The indoor equipments located in non-air conditioned areas shall also be of same type.

16.3 Space Heaters

The heaters shall be suitable for continuous operation at 240V AC supply. On-off switch and fuse shall be provided for the heater.

One or more adequately rated thermostatically connected heaters shall be supplied to prevent condensation in any compartment. The heaters shall be installed in the lower portion of the compartment and electrical connections shall be made sufficiently away from below the heaters to minimize deterioration of supply wire insulation. The heaters shall be suitable to maintain the compartment temperature to prevent condensation.

The heaters shall be suitably designed to prevent any contact between the heater wire and the air and shall consist of coiled resistance wire centred in a metal sheath and completely encased in a highly compacted powder of magnesium oxide or other material having equal heat conduction and electrical insulation properties, or they shall consist of resistance wire wound on a ceramic and completely covered with a ceramic material to prevent any contact between the wire and the air. Alternatively, they shall consist of a resistance wire mounted into a tubular ceramic body built into an envelope of stainless steel or the resistance wire is wound on a tubular ceramic body and embedded in glaze. The surface temperature of the heaters shall be restricted to a value which will not shorten the life of the heater sheaths or that of insulator wire or other component in the compartments.

16.4 FUNGI STATIC VARNISH

Besides the space heaters, special moisture and fungus resistant varnish shall be applied on parts which may be subjected or predisposed to the formation of fungi due to the presence or deposit of nutrient substances. The varnish shall not be applied to any surface of part where the treatment will interface with the operation or performance of the equipment. Such surfaces or parts shall be protected against the application of the varnish.

16.5 Ventilation opening

In order to ensure adequate ventilation, compartments shall have ventilation openings provided with fine wire mesh of brass to prevent the entry of insects and to reduce to a minimum the entry of dirt and dust. Outdoor compartment openings shall be provided with shutter type blinds and suitable provision shall be made so as to avoid any communication of air/ dust with any part in the enclosures of the Control Cabinets, Junction boxes and Marshalling Boxes, panels etc.

16.6 Degree of Protection

The enclosures of the Control Cabinets, Junction boxes and Marshalling Boxes, panels etc. to be installed shall provide degree of protection as detailed here under:

- a) Installed out door: IP- 55
- b) Installed indoor in air conditioned area: IP-31
- c) Installed in covered area: IP-52
- d) Installed indoor in non air conditioned area where possibility of entry of water is limited: IP-41.
- e) For LT Switchgear (AC & DC distribution Boards) : IP-52

The degree of protection shall be in accordance with IS:13947 (Part-I) / IEC-60947(Part-I) / IS 12063 / IEC-60529. Type test report for degree of protection test, shall be submitted for approval.

16.7 RATING PLATES, NAME PLATES AND LABELS

Each main and auxiliary item of substation is to have permanently attached to it in a conspicuous position a rating plate of non-corrosive material upon which is to be engraved manufacturer's name, year of manufacture, equipment name, type or serial number together with details of the loading conditions under which the item of substation in question has been designed to operate, and such diagram plates as may be required by the Purchaser. The rating plate of each equipment shall be according to IEC requirement.

All such nameplates, instructions plates, rating plates CB, CT, VT, SA, Isolators and Relay & Protection panels equipments shall be bilingual with Hindi inscription first followed by English.

Alternatively, two separate plates one with Hindi and the other with English inscriptions may be provided.

16.8 FIRST FILL OF CONSUMABLES, OIL AND LUBRICANTS

All the first fill of consumables such as oils, lubricants, filling compounds, touch up paints, soldering/brazing material for all copper piping of circuit breakers and essential chemicals etc. which will be required to put the equipment, covered under the scope of the specifications, into successful operation, shall be furnished by the Bidder unless specifically excluded under the exclusions in these specifications and documents.

17. Surface finish

All interiors and exteriors of tanks, control cubicles and other metal parts shall be thoroughly cleaned to remove all rust, scales, corrosion, greases or other adhering foreign matter. All steel surfaces in contact with insulating oil as far as accessible shall be painted with not less than two coats of heat resistant, oil insoluble, insulating paints.

All metal surfaces exposed to atmosphere shall be given two primer coats of zinc chromate and two coats of epoxy paint with epoxy base thinner. All metal parts not accessible for painting shall be made of corrosion resisting material. All machine finished or bright surfaces shall be coated with a suitable preventive compound and suitably wrapped or otherwise protected. All paints shall be carefully selected to withstand tropical heat and extremes of weather within the limit specified. The paint shall not scale off or wrinkle or be removed by abrasion due to normal handling.

All external painting shall be as per shade No. 631 of IS: 5.

18. HOT DIP GALVANISING

All ferrous parts including all sizes of nuts, bolts, plain and spring washers, support channels, structures, shall be hot dip galvanized conforming to latest version of IS: 2629 or any other equivalent authoritative standard. However, hardware less than M12 size shall be electrogalvanized.

Minimum weight of zinc coating shall be 610 gm/ sq.mm and minimum thickness of coating shall be 85 microns for all items thicker than 6 mm. For items lower than 6mm thickness, requirement of coating shall be as per relevant ASTM. For surface which shall be embedded in concrete, the zinc coating shall be 610 gm/sq. m minimum.

The galvanized surfaces shall have a continuous and uniform thick coating of zinc, firmly adhering to the surface of steel. The finished surface shall be clean and smooth and shall be free from defects like discoloured patches, bare spots, unevenness of coating, spelter which is loosely attached to the steel globules, spiky deposits, blistered surface, flaking or peeling off, etc. The presence of any of these defects noticed on visual or microscopic inspection shall render the material liable to rejection.

After galvanizing, no drilling or welding shall be performed on the galvanized parts of the equipment excepting that nuts may be threaded after galvanizing. Sodium dichromate treatment shall be provided to avoid formation of white rust after hot dip galvanization.

Galvanised material must be transported properly to ensure that galvanised surfaces are not damaged during transit. Application of zinc rich paint at site shall not be allowed.

19. PAINTING

- 19.1** All sheet steel work shall be degreased, pickled, phosphated in accordance with the IS-6005 "Code of practice for phosphating iron and sheet". All surfaces, which will not be easily accessible after shop assembly, shall beforehand be treated and protected for the life of the equipment. The surfaces, which are to be finished painted after installation or require corrosion protection until installation, shall be shop painted with at least two coats of primer. Oil, grease, dirt and swaf shall be thoroughly removed by emulsion cleaning. Rust and scale shall be removed by pickling with dilute acid followed by washing with running water, rinsing with slightly alkaline hot water and drying.
- 19.2** After phosphating, thorough rinsing shall be carried out with clean water followed by final rinsing with dilute dichromate solution and oven drying. The phosphate coating shall be sealed with application of two coats of ready mixed, stoving type zinc chromate primer. The first coat may be "flash dried" while the second coat shall be stoved.
- 19.3** After application of the primer, two coats of finishing synthetic enamel paint shall be applied, each coat followed by stoving. The second finishing coat shall be applied after inspection of first coat of painting.
- 19.4** The exterior and interior colour of the paint in case of new substations shall preferably be RAL 7032 for all equipment, marshalling boxes, junction boxes, control cabinets, panels etc. unless specifically mentioned under respective sections of the equipments. Glossy white colour inside the equipments /boards/panels/junction boxes is also acceptable. The exterior colour for panels shall bematching with the existing panels in case of extension of a substation. Each coatof primer and finishing paint shall be of slightly different shade to enable inspection of the painting. A small quantity of finishing paint shall be supplied for minor touching up required at site after installation of the equipments.
- 19.5** In case the Bidder proposes to follow his own standard surface finish and protection procedures or any other established painting procedures, like electrostatic painting etc., the procedure shall be submitted alongwith the Bids for Purchaser's review & approval.

The colour scheme as given below shall be followed for Fire Protection and Air Conditioning systems

S.No.	PIPE LINE	Base colour	Band colour
Fire Protection System			
1	Hydrant and Emulsifier system pipeline	FIRE RED	-
2	Emulsifier system detection line – water	FIRE RED	Sea Green
3	Emulsifier system detection line – Air	FIRE RED	Sky Blue
4	Pylon support pipes	FIRE RED	
Air Conditioning System			

5	Refrigerant gas pipeline – at compressor suction	Canary Yellow	-
6	Refrigerant gas pipeline – at compressor discharge	Canary Yellow	Red
7	Refrigerant liquid pipeline	Dark Admiralty Green	-
8	Chilled water pipeline	Sea Green	-
9	Condenser water pipeline	Sea Green	Dark Blue

19.6 COLOUR SCHEME AND CODES FOR PIPE SERVICE

The Bidder shall propose a colour scheme for the those equipments/ items for which the colour scheme has not been specified in the specification. For the approval of

- a) For connecting ACSR/ AAC conductor Aluminum alloy casting conforming to designation A6 of IS:617 and shall be tested for all tests as per IS:617
- b) For connecting equipment terminals made of copper or ACSR conductor Bimetallic connectors made from aluminum alloy casting conforming to designation A6 IS: 617 with 4mm thick cast copper lines and shall be tested as per IS:617
- c) For connecting G.I.Shield wire Malleable iron casting.
- d) Bolts, nuts and plain washers. Hot dip galvanising mild steel
- e) Spring washers for items 'a' to 'c' Electrogalvanised-suitable for at least 3 service conditions as per IS:3063 & IS:1573
- f) Misc. Mild steel.

21. CLAMPS AND CONNECTORS INCLUDING TERMINAL CONNECTORS

21.1 All power clamps and connectors shall conform to IS:5561 & NEMA CC1 and shall be made of materials listed below:

- ε For connecting ACSR conductors Aluminum alloy casting, conforming to designation A6 of IS:617 and all test shall conform to IS:617

k	For connecting equipment terminals made of copper with ACSR conductors	Bimetallic connectors made from aluminum alloy casting, conforming to designation A6 of IS:617 with 2mm thick bimetallic liner and all test shall conform to IS:617
c	For connecting G.I	Galvanised mild steel shield wire
d) i)	Bolts, nuts & Plain, washers galvanised.	i) Electrogalvanised for sizes below M12, for others hot dip
ii)	Spring washers items 'a' to 'c' IS:1573	ii) Electro-galvanised mild for steel suitable for atleast service condition-3 as per

- 21.2** Necessary clamps and connectors shall be supplied for all equipment and connections. The requirement regarding external corona and RIV as specified for any equipment shall include its terminal fittings. If corona rings are required to meet these requirements they shall be considered as part of that equipment and included in the scope of work.
- 21.3** Where copper to aluminum connections are required, bi-metallic clamps shall be used, which shall be properly designed to ensure that any deterioration of the connection is kept to a minimum and restricted to parts which are not current carrying or subjected to stress.
- 21.4** Low voltage connectors, grounding connectors and accessories for grounding allequipment as specified in each particular case, are also included in the scope of Work.
- 21.5** No current carrying part of any clamp shall be less than 10 mm thick. All ferrous parts shall be hot dip galvanised. Copper alloy liner of minimum 2 mm thickness shall be cast integral with aluminum body or 2 mm thick bi-metallic strips shall be provided for Bi-metallic clamps.
- 21.6** All casting shall be free from blow holes, surface blisters, cracks and cavities. All sharp edges and corners shall be blurred and rounded off.
- 21.7** Flexible connectors, braids or laminated straps made for the terminal clamps for bus posts shall be suitable for both expansion or through (fixed/sliding) type connection of 4" IPS AL. tube as required. In both the cases the clamp height (top of the mounting pad to centre line of the tube) should be same.
- 21.8** Clamp shall be designed to carry the same current as the conductor and the temperature rise shall be equal or less than that of the conductor at the specified ambient temperature. The rated current for which the clamp/connector is designed with respect to the specified reference ambient temperature, shall also be indelibly marked on each component of the clamp/connector, except on the hardware.
- 21.9** All current carrying parts shall be designed and manufactured to have minimum contact resistance.
- 21.10** Clamps and connectors shall be designed to be corona controlled.
- 21.11** Tests

Clamps and connectors should be type tested as per IS:5561 and shall also be subjected to routine tests as per IS:5561. Following type test reports shall be submitted for approval as per clause 9.2 above except for sl. no.(ii) & (iii) for which type test once conducted shall be applicable (i.e. the requirement of test conducted within last ten years shall not be applicable).

- I. Temperature rise test (maximum temperature rise allowed is 35°C over 50°C ambient)
- II. Short time current test
- III. Corona (dry) and RIV (dry) test (for 220 KV and above voltage level clamps)
- IV. Resistance test and tensile test

22. CONTROL CABINETS, JUNCTION BOXES, TERMINAL BOXES & MARSHALLING BOXES FOR OUTDOOR EQUIPMENT

- 22.1** All types of boxes, cabinets etc. shall generally conform to and be tested in accordance with IS- 5039/ IS-8623, IEC-60439, as applicable, and the clauses given below.
- 22.2** Control cabinets, junction boxes, marshalling boxes and terminal boxes shall be made of sheet steel or aluminum enclosure and shall be dust, water and vermin proof. Sheet steel used shall be at least 2.0 mm thick cold rolled or 2.5 mm hot rolled. The box shall be properly braced to prevent wobbling. There shall be sufficient reinforcement to provide level surfaces, resistance to vibrations and rigidity during transportation and installation. In case of aluminum enclosed box, the thickness of aluminum shall be such that it provides adequate rigidity and long life as comparable with sheet steel of specified thickness.
- 22.3** Cabinet/boxes shall be free standing floor mounting type, wall mounting type or pedestal mounting type as per requirements. A canopy and sealing arrangements for operating rods shall be provided in marshalling boxes/ Control cabinets to prevent ingress of rain water.
- 22.4** Cabinet/boxes shall be provided with double hinged doors with padlocking arrangements. The distance between two hinges shall be adequate to ensure uniform sealing pressure against atmosphere. The quality of the gasket shall be such that it does not get damaged/cracked during the operation of the equipment.
- 22.5** All doors, removable covers and plates shall be provided gasket all around with suitably profiled EPDM/Neoprene gaskets. The gasket shall be tested in accordance with approved quality plan, IS:11149 and IS:3400. The quality of gasket shall be such that it does not get damaged/cracked during 10(ten) years of operation of the equipment or its major overhaul whichever is earlier.

All gasketed surfaces shall be smooth straight and reinforced if necessary to minimize distortion and to make a tight seal. Ventilating Louvers, if provided, shall have screen and filters, the screen shall be fine wire mesh made of brass.

- 22.6** All boxes/ cabinets shall be designed for the entry of cables from bottom by means of weather proof and dust-proof connections. Boxes and cabinets shall be designed with generous clearances to avoid interference between the wiring entering from below and any terminal blocks or accessories mounted within the box or cabinet. Suitable cable

gland plate projecting at least 150 mm above the base of the marshalling kiosk/box shall be provided for this purpose along with the proper blanking plates. Necessary number of cable glands shall be supplied and fitted on this gland plate. Gland plate shall have provision for some future glands to be provided later, if required.

22.7 A 240V, single phase, 50 Hz, 15 amp AC plug and socket shall be provided in the cabinet with ON-OFF switch for connection of hand lamps. Plug and socket shall be of industrial grade.

22.8 For illumination, a 20 Watts fluorescent tube or 15 watts CFL/LED bulb shall be provided. The switching of the fittings shall be controlled by the door switch.

For junction boxes of smaller sizes such as lighting junction box, manual operated earth switch mechanism box etc., plug socket, heater and illumination is not required to be provided.

22.9 All control switches shall be of rotary type. Toggle piano switches shall not be accepted.

22.10 Positive earthing of the cabinet shall be ensured by providing two separate earthing pads. The earth wire/ strip shall be terminated on to the earthing pad and secured by the use of self etching washer. Earthing of hinged door shall be done by using a separate earth wire.

22.11 The bay marshalling kiosks shall be provided with danger plate and a diagram showing the numbering/connection/feruling by pasting the same on the inside of the door.

22.12 The following routine tests alongwith the routine tests as per IS: 5039 shall also be conducted:
Check for wiring
Visual and dimension check

The enclosure of bay marshalling kiosk, junction box, terminal box shall be type tested for IP-55 as per IS: 13947. After IP-55 test, 2.5 kVrms for 1 (one) minute, insulation resistance and functional test should be conducted.

22.13 Auxiliary Switches

All the auxiliary switches shall be fully type tested as per relevant IS.

The following type test reports on auxiliary switches shall be submitted:

- a) Electrical endurance test - A minimum of 2000 operation for 2A D. C. with a time constant greater than or equal to 20 millisecond with a subsequent examination of mV drop/visual defects/temperature rise test.
- b) Mechanical endurance test. A minimum of 1,00,000 operations with a subsequent checking of contact pressure test/visual examination.
- c) Heat run test on contacts.
- d) IR/HV test etc.

23. TERMINAL BLOCKS AND WIRING

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- 23.1** Control and instrument leads from the switchboards or from other equipment will be brought to terminal boxes or control cabinets in conduits. All interphase and external connections to equipment or to control cubicles will be made through terminal blocks.
- 23.2** Terminal blocks shall be 1100 V grade and have continuous rating to carry the maximum expected current on the terminals. These shall be of moulded piece, complete with insulated/barriers stud type terminals, washers, nuts and lock nuts. Screw clamp, overall insulated, insertion type, rail mounted terminals can be used in place of stud type terminals.
- 23.3** But preferably the terminal blocks shall be non-disconnecting stud type of Elmex type CATM4, phoenix cage clamp type or equivalent. The insulating material of terminal block shall be nylon which shall be free of halogens, fluorocarbons etc.
- 23.4** Terminal blocks for current transformer and voltage transformer secondary leads shall be provided with test links and isolating facilities. The current transformer secondary leads shall also be provided with short circuiting and earthing facilities.
- 23.5** The terminals shall be such that maximum contact area is achieved when a cable is terminated. The terminal shall have a locking characteristic to prevent cable from escaping from the terminal clamp unless it is done intentionally.
- 23.6** The conducting part in contact with cable shall preferably be tinned or silver plated, however Nickel plated copper or zinc plated steel shall also be acceptable.
- 23.7** The terminal blocks shall be of extensible design.
- 23.8** The terminal blocks shall have locking arrangement to prevent its escape from the mounting rails.
- 23.9** The terminal blocks shall be fully enclosed with removable covers of transparent, non-deterioration type plastic material. Insulating barriers shall be provided between the terminal blocks. These barriers shall not hinder the operator from carrying out the wiring without removing the barriers.
- 23.10** Unless otherwise specified terminal blocks shall be suitable for connecting the following conductors on each side.
- a) All circuits except CT circuits - Minimum of 2 nos. of 2.5 sq. mm copper flexible
 - b) All CT circuits - Minimum of 4 nos. of 2.5 sq.mm copper flexible
- 23.11** The arrangements shall be in such a manner so that it is possible to safely connect or disconnect terminals on live circuits and replace fuse links when the cabinet is live.
- 23.12** At least 20% spare terminals shall be provided on each panel/cubicle/box and these spare terminals shall be uniformly distributed on all terminal rows.
- 23.13** There shall be minimum clearance of 250 mm between the first bottom row of terminal block and the associated cable gland plate. Also the clearance between two rows of terminal blocks shall be a minimum of 150 mm.
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23.14 The Bidder shall furnish all wire, conduits and terminals for the necessary interphase electrical connections (where applicable) as well as between phases and common terminal boxes or control cabinets.

23.15 All input and output terminals of each control cubicle shall be tested for surge withstand capability in accordance with the relevant IEC Publications, in both longitudinal and transverse modes. The Bidder shall also provide necessary filtering, surge protection, interface relays and any other measures necessary to achieve an impulse withstand level at the cable interfaces of the equipment.

24. LAMPS & SOCKETS

24.1 Lamps

All incandescent lamps shall use a socket base as per IS-1258, except in the case of signal lamps.

24.2 Sockets

All sockets (convenience outlets) shall be suitable to accept both 5 Amp & 15 Amp pin round Standard Indian plugs. They shall be switched sockets with shutters.

24.3 Hand Lamp

A 240 Volts, single Phase, 50 Hz AC plug point shall be provided in the interior of each cubicle with ON- OFF Switch for connection of hand lamps.

24.4 Switches and Fuses

Each panel shall be provided with necessary arrangements for receiving, distributing, isolating and fusing of DC and AC supplies for various control, signalling, lighting and space heater circuits. The incoming and sub-circuits shall be separately provided with miniature circuit breaker/ switchfuse units. Selection of the main and Sub-circuit fuse ratings shall be such as to ensure selective clearance of sub-circuit faults. Potential circuits for relaying and metering shall be protected by HRC fuses.

All fuses shall be of HRC cartridge type conforming to IS-9228 mounted on plug-in type fuse bases. Miniature circuit breakers with thermal protection and alarm contacts will also be accepted. All accessible live connection to fuse bases shall be adequately shrouded. Fuses shall have operation indicators for indicating blown fuse condition. Fuse carrier base shall have imprints to the fuse rating and voltage. All control switches shall be of rotary type. Toggle piano switches shall not be accepted.

25. Bushings, Hollow Column Insulators, Support Insulators:

25.1 Bushings shall be manufactured and tested in accordance with IS:2099 & IEC-60137 while hollow column insulators shall be manufactured and tested in accordance with IEC-62155/IS:5621. The support insulators shall be manufactured and tested as per IS:2544/IEC-60168 and IEC-60273. The insulators shall also conform to IEC-60815 as applicable. The bidder may also offer composite hollow insulators, conforming to IEC-61462.

25.2 Support insulators, bushings and hollow column insulators shall be manufactured from high quality porcelain. Porcelain used shall be homogeneous, free from laminations, cavities and other flaws or imperfections that might affect the mechanical or dielectric quality and shall be thoroughly vitrified tough and impervious to

moisture.

- 25.3** Glazing of the porcelain shall be uniform brown in colour, free from blisters, burrs and similar other defects.
- 25.4** Support insulators/bushings/hollow column insulators shall be designed to have ample insulation, mechanical strength and rigidity for the conditions under which they will be used.
- 25.5** When operating at normal rated voltage there shall be no electric discharge between the conductors and bushing which would cause corrosion or injury to conductors, insulators or supports by the formation of substances produced by chemical action. No radio interference shall be caused by the insulators/bushings when operating at the normal rated voltage.
- 25.6** Bushing porcelain shall be robust and capable of withstanding the internal pressures likely to occur in service. The design and location of clamps and the shape and the strength of the porcelain flange securing the bushing to the tank shall be such that there is no risk of fracture. All portions of the assembled porcelain enclosures and supports other than gaskets, which may in any way be exposed to the atmosphere shall be composed of completely non hygroscopic material such as metal or glazed porcelain.
- 25.7** All iron parts shall be hot dip galvanised and all joints shall be air tight. Surface of joints shall be trued up porcelain parts by grinding and metal parts by machining. Insulator/bushing design shall be such as to ensure a uniform compressive pressure on the joints.
- 25.8 Tests**
- In bushing, hollow column insulators and support insulators shall conform to type tests and shall be subjected to routine tests in accordance with IS: 2099 & IS:2544 & IS : 5621.
- 26. MOTORS**
- Motors shall be "Squirrel Cage" three phase induction motors of sufficient size capable of satisfactory operation for the application and duty as required for the driven equipment and shall be subjected to routine tests as per applicable standards. The motors shall be of approved make.
- 26.1 Enclosures**
- Motors to be installed outdoor without enclosure shall have hose proof enclosure equivalent to IP-55 as per IS: 4691. For motors to be installed indoor i.e. inside a box, the motor enclosure, shall be dust proof equivalent to IP-44 as per IS: 4691.
 - Two independent earthing points shall be provided on opposite sides of the motor for bolted connection of earthing conductor.
 - Motors shall have drain plugs so located that they will drain water resulting from condensation or other causes from all pockets in the motor

casing.

- d) Motors weighing more than 25 Kg. shall be provided with eyebolts, lugs or other means to facilitate lifting.

26.2 Operational Features

- a) Continuous motor rating (name plate rating) shall be at least ten (10) percent above the maximum load demand of the driven equipment at design duty point and the motor shall not be over loaded at any operating point of driven equipment that will rise in service.
- b) Motor shall be capable at giving rated output without reduction in the expected life span when operated continuously in the system having the particulars as given in Clause 15.0 of this Section.

26.3 Starting Requirements:

- a) All induction motors shall be suitable for full voltage direct-on-line starting. These shall be capable of starting and accelerating to the rated speed alongwith the driven equipment without exceeding the acceptable winding temperature even when the supply voltage drops down to 80% of the rated voltage.
- b) Motors shall be capable of withstanding the electrodynamic stresses and heating imposed if it is started at a voltage of 110% of the rated value.
- c) The locked rotor current shall not exceed six (6) times the rated full load current for all motors, subject to tolerance as given in IS:325.
- d) Motors when started with the driven equipment imposing full starting torque under the supply voltage conditions specified under Clause 15.0 shall be capable of withstanding atleast two successive starts from cold condition at room temperature and one start from hot condition without injurious heating of winding. The motors shall also be suitable for three equally spread starts per hour under the above referred supply condition.
- e) The locked rotor withstand time under hot condition at 110% of rated voltage shall be more than starting time with the driven equipment of minimum permissible voltage by at least two seconds or 15% of the accelerating time whichever is greater. In case it is not possible to meet the above requirement, the Bidder shall offer centrifugal type speed switch mounted on the motor shaft which shall remain closed for speed lower than 20% and open for speeds above 20% of the rated speed. The speed switch shall be capable of withstanding 120% of the rated speed in either direction of rotation.

26.4 Running Requirements:

- a) The maximum permissible temperature rise over the ambient temperature of 50 degree C shall be within the limits specified in IS:325 (for 3 - phase induction motors) after adjustment due to increased ambient temperature specified.
- b) The double amplitude of motor vibration shall be within the limits

specified in IS: 4729. Vibration shall also be within the limits specified by the relevant standard for the driven equipment when measured at the motor bearings.

- c) All the induction motors shall be capable of running at 80% of rated voltage for a period of 5 minutes with rated load commencing from hot condition.

26.5 TESTING AND COMMISSIONING

An indicative list of tests is given below. Contractor shall perform any additional test based on specialities of the items as per the field Q.P./Instructions of the equipment Contractor or Purchaser without any extra cost to the Purchaser. The Contractor shall arrange all instruments required for conducting these tests alongwith calibration certificates and shall furnish the list of instruments to the Purchaser for approval.

- (a) Insulation resistance.
 - (b) Phase sequence and proper direction of rotation.
 - (c) Any motor operating incorrectly shall be checked to determine the cause and the conditions corrected.
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Section 4: **Annexures**

The Break-up for section is as follows,

1. Annexure A-Compliance Certificate for Technical Specification
2. Annexure B-Deviation/ Change Request for Technical Specification
3. Annexure C-Guaranteed Technical Particulars for GIS & its accessories
4. Annexure D-Technical Checklist

ANNEXURE-A:
COMPLIANCE CERTIFICATE OF TECHNICAL SPECIFICATION

The bidder shall confirm compliance to the following by signing/ stamping this compliance certificate and furnishing same with the offer.

1. The scope of supply, technical details, construction features, design parameters etc. shall be as per technical specification & there are no exclusion/ deviation with regard to same.
2. There are no deviation(s) with respect to specification other than those furnished in the 'Deviation/ Change request to technical specification'.
3. Only those technical submittals which are specifically asked for in NIT to be submitted at tender stage shall be considered as part of offer. Any other submission, even if made, shall not be considered as part of offer.
4. Any comments/ clarifications on technical/ inspection requirements furnished as part of bidder's covering letter shall not be considered by BHEL, and bidder's offer shall be construed to be in conformance with the specification.
5. Any changes made by the bidder in the price schedule with respect to the description/ quantities from those given in 'BOQ' of the specification shall not be considered (i.e., technical description & quantities as per the specification shall prevail).

Date

Bidder's Stamp & Signature

ANNEXURE-B:
DEVIATION/ CHANGE REQUEST OF TECHNICAL SPECIFICATION

Bidder shall list out all technical potential deviation/ change request (s) along with clause with respect to technical specifications.

<u>Sl. No.</u>	<u>Page No.</u>	<u>Clause No.</u>	<u>Deviation</u>	<u>Reason / Justification</u>
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Any deviation not specifically brought out in this section shall not be admissible for any commercial implication at later stage. Except to the technical deviations listed in this schedule, bidder's offer shall be considered in full compliance to the tender specifications irrespective of any such deviation indicated / taken elsewhere in the submitted offer.

Date:

Bidder's Stamp & Signature

ANNEXURE-C

SCHEDULE OF GUARANTEED TECHNICAL PARTICULARS

XLPE POWER CABLES (220kV/132kV/33kV)

1	Name of the Manufacturer	
2	Country of Manufacturer	
3	Type of cable	XLPE
4	Standard according to which cable is manufactured	
5	Rated voltage	
6	Nominal cross sectional area of conductor	
7	Conductor material	
8	Impulse withstand voltage 1.2/50 micro second wave	
9	Power frequency withstand voltage	
10	Maximum dielectric stress at the conductor	
11	Maximum dielectric stress at the conductor	
12	Minimum radial thickness of insulation between conductor screen and insulation screen	
13	Conductor screen :	
	a) Material	
	b) Nominal thickness	
14	Insulation	
	a) Material	
	b) Nominal thickness	
15	Insulation Screening	
	a) Material	
	b) Nominal thickness	
16	Longitudinal water Sealing Over Insulation Screen	
	a) Material & Type	
	b) Nominal thickness	
17	Metal Sheath	
	a) Minimum radial thickness	
	b) Composition	
	c) Maximum working stress	
	Bonding under the copper wire screen (Over iron metal sheath)	
	a) Material & type	
	b) Nominal thickness	

19. Metallic screen
 - i) Material
 - ii) Nominal area of copper screen.
 - iii) Nominal thickness of open helix copper tape.
20. Nominal diameter over metal sheath
21. Nominal radial clearance allowed under metal sheath
22. Protective outer covering (sheath):
 - a) Type and composition
 - b) Nominal thickness
 - c) Test voltage at works
23. Overall Conductive layer(graphite coating over outer sheath)
24. Short Circuit rating Of lead alloy sheath and copper wire screen combined.(KA for 1 sec)
25. Nominal overall diameter of completed single core cable
26. Nominal weight per meter of complete cable
27. Short circuit capacities with a conductor temperature of 90 deg C with
 - i) 0.5 second duration
 - ii) 1 second duration
 - iii) 2 second duration
 - iv) 3 second duration
28. Minimum radius of bend round which cable can be laid :
 - a) Direct burial in ground
 - b) In ducts
29. Maximum D.C. resistance of conductor per kM at 20 deg C
30. Maximum A.C. resistance of conductor per kM at 90 deg C
31. Equivalent star resistance per kM of 3-phase circuit at 50 Hz
32. Maximum electrostatic capacitance per kM of cable
33. Maximum continuous current carrying capacity per cable when laid in ground in close trefoil at a depth of 1.5 meters (ground temperature 35 deg C soil thermal resistivity 150 deg C cm/watt, maximum conductor temperature 90 deg C)

- a) Only one 3-phase ckt. loaded.
 - b) Both the three phase ckts. Loaded.
34. Maximum continuous current carrying capacity per cable when drawn into pipes (conditions as in item 33 above).
- a) Only one 3-phase ckt. loaded.
 - b) Both the three phase ckts. Loaded.
35. Continuous current carrying capacity which will permit a further 10% overload for two hours without exceeding a maximum conductor temperature of 90 deg C laid (conditions as in item 33 above).
- a) Only one 3-phase ckt. loaded.
 - b) Both the three phase ckts. Loaded.
36. Continuous current carrying capacity which will permit a further 10% overload for two hours with cables drawn into pipes (conditions as in item 33 above).
- a) Only one 3-phase ckt. loaded.
 - b) Both the three phase ckts. Loaded.
37. Max. power factor of charging KVA of cable when laid direct in the ground, at normal voltage, frequency at conductor temperature of 15,30, 45, 65, 90 deg C
38. Max. dielectric power loss of cable per kM per phase of 3-phase circuit, laid direct in ground, at normal voltage, frequency and maximum conductor temperature
39. Max. power factor of charging kVA of cable at normal frequency and at a conductor temperature of 20 deg C and at 0.5, 1.0, 1.5, 2.0 times nominal voltage
40. Sheath loss of cable per kM per phase of 3-phase circuit at normal voltage, frequency at maximum continuous current rating :
- a) Laid direct in ground
 - b) Drawn into ducts
41. Approx. Impedance per kM of 3-phase circuit at 50 c/s and maximum conductor temperature :
- a) Positive and negative sequence
 - b) Zero sequence
42. Attenuation to carrier current signal/s operating over a frequency range of 50 to 200 Kc/s

43.
 - a) Phase to ground characteristic impedance at 50 to 200 Kc/s
 - b) Screening factor
44. Maximum drum length of cable
45. Approximate shipping weight and size of drums :
 - a) For ----- M length
 - b) For -----M length
46. Method of Bonding Of Sheaths (double end/cross)
47. For 1-core cables please recommend with reasons:
 - a) Method of laying(trefoil, horizontal)
 - b) Whether sheaths are to be bounded and Earthed at one end or both ends.
 - c) Transposed.
40. Straight through joint.
 - a) Make
 - b) Type
41. End Terminations
 - a) Make
 - b) Type
48. Warning tape :
 - i) Material
 - ii) Width
 - iii) Thickness
 - iv) Tensile strength
 - v) Breaking load
49. Brick Cable covers
 - i) Dimension
 - ii) Design
 - iii) Drawing
50. Cable Marker
 - i) Size
 - ii) Drawing
51. Cross -Sectional drawing of cable enclosed
52. Type test Certificates enclosed

TECHNICAL CHECKLIST

Sl. No.	Particulars	Confirmation	
1	Technical qualifying requirements		
1.1	Documents for meeting technical qualifying requirements are enclosed.	Confirmed	Yes/ No
1.2	The bid shall be submitted by the manufacturer of 220kV and 132 kV cables only. The bidder's scope includes supply and services like installation, testing and commissioning. Bids submitted by agents shall not be considered, however, in case of foreign manufacturer, bid by agents shall be acceptable.	Confirmed	Yes/ No
1.3	All the documents shall be submitted in English language in Roman script. Translated pages shall be duly attested.	Confirmed	Yes/ No
2	Un-priced offer		
2.1	Confirm that all BOQ items have been quoted. Any item, which is not quoted, the same shall be specifically brought out in Schedule of technical deviation with technical reasons of thereof. However, it shall be discretion of BHEL/UPPTCL to take final decision on this.	Confirmed	Yes/ No
2.2	The specification entails complete solution to 220kV & 132kV cabling system i.e. scope includes all materials and installation services i.e. cable installation, termination/ jointing, clamping, testing and commissioning of the cable system, point to point, necessary to execute the work to the satisfaction of BHEL/UPPTCL. The scope includes all accessories required to complete the work in all respect.	Confirmed	Yes/ No
2.3	Any other item/ service required for the execution/ completion of work is deemed to be included in the offer, whether specifically mentioned in the specification or not. Hence, bidder shall bring out such requirements during tendering stage only. The bill of quantities included in the offer by bidder shall clearly reflect such additional items along with their respective quantities & unit prices. Bidder to attach list of item (s), if required, for completeness of work.	List of additional item (s) attached	Yes/ No
2.4	Installation of support structure and civil works for foundation for supporting the cable/ termination/ jointing etc. at GIS end & transformer cable box end is in bidder's scope. The supply of	Confirmed	Yes/ No

	cable clamps for fixing of the cable on structure shall be bidder's scope.		
2.5	The cable tray/ rack assembly in cable trench/ pipe rack assembly shall be installed by BHEL as per detailed design and drawing inputs provided by bidder.	Confirmed	Yes/ No
2.6	Confirm that the consumables list, to be enclosed by bidder during contract stage only with shelf life of fewer than two years shall be supplied before erection and due clearance from BHEL.	Confirmed	Yes/ No
3	Cable lengths		
3.1	The exact length shall also be decided by supplier either after visiting site & making precise measurements at contract stage or by inferring details from layout drawings. Manufacturing lengths and drum length shall be determined as per details provided by bidder and approved by BHEL/UPPTCL.	Confirmed	Yes/ No
3.2	The Payment of cables length for supply shall be as per approved quantities by BHEL/UPPTCL.	Confirmed	Yes/ No
3.3	The Payment of cables length installation will be as per actual measurement at site which shall also include cable terminations.	Confirmed	Yes/ No
3.4	The exact length may vary by $\pm 30\%$ at contract stage based on actual measurement at site and calculations submitted by the bidder. Individual quantity of other items may vary to any extent and may get deleted during contract/ execution stage.	Confirmed	Yes/ No
4	Technical		
4.2	Calculations		
4.2.1	Bidder will submit short circuit current calculation, continuous current rating calculation and sheath standing voltage calculation including any other calculations/ documentation for justifying the size of the 220kV & 132kV cable in line with proposed laying conditions and customer requirements. Any other detailed calculations, if required/ envisaged during detailed engineering stage shall also be in bidder's scope.	Confirmed, Calculations attached with bid	Yes/ No
4.2.2	Bidder shall furnish calculations of cable for following during tendering stage only, (a) Screen/ sheath voltage under full load condition, (b) Screen/ sheath voltage during an external three phase symmetrical through-fault.	Confirmed, Calculations attached with bid	Yes/ No

4.3	Technical deviations		
4.3.1	Confirm that the complete system has been offered as per the requirements of technical specification and in this regard, compliance certificate to technical specification is duly signed and sealed.	Confirmed	Yes/ No
4.3.2	If there is certain clarification/ deviations, same is to be filled, signed and sealed in the schedule of technical deviation and hence deviations/ clarifications mentioned elsewhere in bid shall not be considered.	Confirmed	Yes/ No
5	Bar-chart		
5.1	Bidder will submit detailed bar chart indicating all the milestones from engineering till manufacturing/ testing, dispatch to site, installation, testing and commissioning.	Confirmed	Yes/ No
6	Conditions		
6.1	For construction purpose, the necessary power supply at site shall be provided by BHEL at one point only, however supply requirements for testing etc. shall be arranged by bidder only.	Confirmed	Yes/ No
6.2	Installation		
6.2.1	The cables shall be laid in cable racks in cable trench/ pipe rack assembly, as per requirement at site. The cable racks in cable trench/ pipe rack assembly shall be supplied and fixed by BHEL based on detailed input design and drawing provided by bidder. These details shall be furnished during tender stage only.	Confirmed	Yes/ No
6.2.2	Provision of site supervisor and skilled technician, qualified jointer etc. along with tools & tackles, testing instruments/ kits etc. shall be deemed to be included in bidder's scope.	Confirmed	Yes/ No
6.2.3	The required drilling, fabrication and minor civil works required for fixing clamp in cable racks in cable trench/ pipe rack assembly shall be in bidder's scope.	Confirmed	Yes/ No
6.3	Termination		
6.3.1	Tools & tackles, testing instruments/ kits required for carrying out termination/ jointing works shall be bidder's scope.	Confirmed	Yes/ No
6.3.2	For terminations at GIS end identified as customer use, approved datasheet has been as Annexure-Datasheet of 220 kV, 1200sqmm XLPE Cable, Annexure-Datasheet of 132kV, 630sqmm XLPE Cable.	Confirmed	Yes/ No
6.4	Any cable or accessories damaged during installation, testing	Confirmed	Yes/

	& commissioning shall be made good/ repaired/ replaced by bidder to the satisfaction of BHEL/UPPTCL.		No
6.5	Bidder to note that different bays may be commissioned different point of time, and hence bidder shall be required to deploy the resources multiple times.	Confirmed	Yes/ No
6.6	Complete earthing of 220kV & 132kV cables shall be in bidder's scope. The items and accessories required for completeness of earthing at termination/ joints but not limited to only earthing/ bonding cable/ earth continuity cables, link boxes etc as per the requirements shall also be in bidder's scope. Any special earthing required for cable jointing area inside, associated earthing material shall be supplied and installed by the bidder. Bidder shall provide the complete earthing BOQ items along with quantity and price.	Confirmed, List is attached.	Yes/ No
6.7	Office facilities & accommodation for bidder's staff along with conveyance, transportation of all special tools & plants, testing kits etc. shall be in bidder's scope, however, unloading, storage and installation under bidder's supervision shall be in BHEL's scope.	Confirmed	Yes/ No
6.8	Any special tools and tackles required to complete the cable laying, termination, testing & commissioning shall be included in the offer. BHEL shall arrange general tools and tackles for laying of cables only.	Confirmed	Yes/ No
6.9	The bidder must fill up all the details required for offered item/s. Instead of indicating "refer drawing, or as per IS/IEC", the exact value/s must be filled in.	Confirmed	Yes/ No
7	Field testing & commissioning		
7.1	Bidder shall depute its qualified testing & commissioning engineer including supply of all testing instruments/ kits (DC test for outer sheath etc.) bidder's scope. Bidder shall submit complete methodology for conduction of site tests for further approval of BHEL/UPPTCL.	Confirmed	Yes/ No
7.2	All field tests including tests during installation, pre-commissioning, commissioning, field acceptance tests shall be conducted by bidder, in presence of BHEL/UPPTCL.	Confirmed	Yes/ No
7.3	Bidder shall carry out the supervision of installation, field testing and commissioning of 220kV & 132kV XLPE Cable & its	Confirmed	Yes/ No

	accessories. Further appropriate test and commissioning reports and as-built documentation as necessary shall be submitted.		
7.4	Field testing and commissioning of 220kV & 132kV cable & its accessories shall be done by Bidder/OEM only.	Confirmed	Yes/ No
7.5	Bidder shall also submit site acceptance testing (SAT) procedures and get them approved from BHEL/UPPTCL before carrying out the site testing at site.	Confirmed	Yes/ No
7.6	Bidder shall coordinate with manufacturers of other items wherever required and shall freely and readily supply all technical information as and when called for.	Confirmed	Yes/ No
8	Quality plan		
8.1	The successful bidder shall submit the Quality Plan for BHEL/UPPTCL approval. In case bidder has reference Quality plan agreed with BHEL/UPPTCL, same can be submitted for specific project after award of contract for BHEL/UPPTCL approval. There shall be no commercial implication to BHEL on account of Quality Plan approval.	Confirmed	Yes/ No
9	Inspection, testing & acceptance.		
9.1	After completion of manufacture of cables and prior to despatch, the cables shall be subjected to type tests, as applicable, routine, acceptance, optional and special tests on cables and accessories in accordance with the applicable IEC /IS and the material shall be offered for final inspection by BHEL/UPPTCL in accordance with approved quality assurance plan.	Confirmed	Yes/ No
9.2	The test reports for all cables shall be got approved before despatch of the cables.	Confirmed	Yes/ No