BHARAT HEAVY ELECTRICALS LIMITED
TRANSMISSION BUSINESS ENGINEERING MANAGEMENT
NOIDA

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TYPE OF DOC.	TECHNICAL SPECFICATION	NAME	TTR	SKS	AG
TITLE: 132 kV XLPE CABLE & ACCESSORIES		SIGN			
		DATE	23.06.19		26/6/19
		GROUP	TBEM		
		WO No.	88009		

CUSTOMER	UPPTCL
PROJECT	400/220/132 KV GIS Sub Station, Shamli (UP)
TENDER NO./ NOA NO.	

Contents

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	
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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 132 kV complete in all respect for efficient & trouble free operation mentioned under this specification.

Cable required for connecting (refer SLD)

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

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 132kV cable in accordance with standard IEC 62067/ IEC 61462/ IEC 60840 as applicable.
Scope of supply of cable termination kit by Cable bidder shall be as per scope division as specified in IEC 62271-209. Accordingly, the supervision shall be quoted.

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 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 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 under the Project).
Section-4 : 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 400/220/132 kV GIS Substation at Shamli (UP)**

The compete 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 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 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 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 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 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 BILL OF QUANTITIES

Quantities for supply and services for EHV XLPE Cable & Cable Jointing/ Termination Accessories for working voltage of 132 kV shall be as per 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-0-406-510-001	Single line diagram 400/220/132kV GIS Sub station
2.	TB-0-406-510-002	400/220/132kV Electrical Layout- Shamli
3.	TB-1-406-316-005	Conceptual Drawing for 132kV GIS Building
4.	Sketch-1	Trench section drg

1.6 TYPE TESTING

Bidder shall ensure that the cables and accessories procured have valid type test certificates as per relevant IS/IEC from CPRI or any other accredited testing lab. Type test certificates for EHV XLPE Cable & Cable Jointing/ Termination Accessories for working voltage of 132kV shall not be more than five years old as on 07.09.18. In those cases, where type test certificates are of dates earlier than 07.09.13, Bidder/manufacturer shall carry out the type tests at CPRI or any other accredited testing lab prior to dispatch of equipment with no commercial implication to BHEL/UPPTCL.

Type tests and special tests to be conducted/ valid certificates to be submitted shall be governed as follows,

If type tests and special tests certificates (applicable for flammability test, acid gas generation test, smoke density test, accelerated water absorption test, ultra violet radiation test, oxygen index test, rodent & termite repulsion test, drum length/ surface finish check by re-winding, and any other tests) are not available for any size of cable, same shall be conducted by bidder at his own cost from CPRI or any other accredited testing lab. There shall not be any delivery and cost implication on account of this.

In case any of Type tests have not been conducted on the offered design of 132 kV XLPE cables & its accessories, there has been a change in the design after the type tests, the requisite tests shall be conducted by bidder on the offered cable and accessories without any extra cost and delivery impact to BHEL/UPPTCL.

Type test as per BOQ may be carried out if asked by UPPTCL. But will be payable only if bidder is already having valid reports for the same.

1.7 PREQUALIFYING CONDITIONS FOR SUPPLY OF EQUIPMENT

A. Operational Experience

The cable shall be from the manufacturer who must have designed, manufactured, type tested and supplied in a single contract at least 1 km of single core, 132kV or higher grade XLPE insulated cable which must be in operation for at least 3 (three) years as on the date of 07.09.18.

B. Manufacturing Experience

The indigenous manufacturers or their foreign collaborator must have manufactured at least 20% of the specified quantities of each item of identical or similar equipment

C. 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 ISS/IEC and any other routine and acceptance test as specified in the specification. Documentary evidence of existence of such facilities will be submitted along with the proposal

D. Type Test for Indigenous or Fully Imported Equipments

The offered equipments must have been fully type tested as per relevant ISS and/or any other specified international standards, during the last 5 years period to be reckoned from the date of 07.09.2018. Photo copy of such type test reports/ certificates must be submitted along with the proposal. the test certificates of proto type manufactured and tested by foreign collaborators of the tenderers at their works shall not be acceptable for indigenously manufactured equipment

1.8 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.

1.9 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

1.10 FIELD TESTING & COMMISSIONING

(i) Field testing and commissioning of 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.

1.11 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.

1.12 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 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.

1.13 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.

1.14 Mistakes in drawing

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.

400/220/132 kV GIS Sub station at Shamli (UP) **ANNEXURE-BOQ/132kV**

BOQ for 132kV Cable & Accessories **Rev No. 00**

Sl. No.	Item Description	Unit	Qty.
1A	**Main supply items**		
1A1	132kV XLPE,1Cx630sqmm, Cu conductor cable	Running Meter	**3315**
	Cable Accessories		
1A2	132kV Indoor cable sealing end termination suitable/ compatible for 1Cx630sqmm, 132kV XLPE, copper cable for GIS end (as per scope division in IEC 62271-209)	Set	**33**
1A3	132kV outdoor cable sealing end (oil type/dry type) suitable/ compatible for 1Cx630sqmm copper cable, complete with mounting plate insulators to insulate the sealing end from supporting structures, two terminals, diametrically opposite each, suitable for bolting of the copper screen and/or metallic sheath of cable.	Set	**33**
1A4	132kV straight through jointing kit suitable/ compatible for 1Cx630 sqmm copper cable	Set	**3**
1B	**Other Cable Accessories**		
1B1	1nox3 phase link box without SVL(sheath voltage limiter) at GIS end	Set	**11**
1B2	1nox3 phase link box with SVL(sheath voltage limiter) at line end	Set	**11**
1B3	Metallic screen bonding/ earthing cable along with accessories	set	**11**
1B4	EARTH CONTINUITY CONDUCTOR CABLE ALONG WITH ACCESSORIES SUITABLE/ COMPATIBLE FOR CABLE SYSTEM	set	**11**
1B5	Trefoil clamps, non-magnetic suitable/ compatible for 1Cx630sqmm, 132kV XLPE, copper cable	lot	**1**
1B6	Single clamps, non-magnetic suitable/ compatible for 1Cx630sqmm, 132kV XLPE, copper cable	lot	**1**
1B7	Structure materials for cable support structure for GIS end	set	**11**
1B8	Consumables with limited shelf life required for 132kV XLPE cable and accessories	Lot	1
1B9	Miscellaneous Items including cable route marker, pipe/ rod electrode etc. required earthing requirements of single point/ cross bonding	Lot	1
1B10	Any other item(s) not mentioned above, but required for completion of the suppply	Lot	1
1B11	Tools and tackles as per section 2	lot	1
1C	**Services**		
	132kV XLPE, Cu conductor cable		
1C1	Site survey for route & length finalization of 1Cx630sqmm, 132kV XLPE, Cu conductor cable	Lot	1
1C2	**Type tests for 1Cx630sqmm, 132kV XLPE, Cu conductor cable**		
1C2.1	Bending test on the cable followed by installation of accessories and a partial discharge test at ambient temperature.	Lot	1
1C2.2	Tan delta measurement.	Lot	1
1C2.3	Heating cycle voltage test	Lot	1
1C2.4	Partial discharge test at ambient temperature and high temperature	Lot	1
1C2.5	Lightning impulse voltage test followed by a power frequency voltage test.	Lot	1
1C2.6	Tests of outer protection for buried joints.	Lot	1
1C2.7	Examination of the cable system with cable and accessories shall be carried out after completion of the tests above	Lot	1
1C2.8	Non electrical type tests on cable as per cl. 12.5 of IEC 62067	Lot	1
1C3	**Special tests for 1Cx630sqmm, 132kV XLPE, Cu conductor cable**		
1C3.1	Conductor examination as per clause 10.4 of IEC-62067.	Lot	1
1C3.2	Hot set test for XLPE insulation as per clause 10.9 of IEC 62067.	Lot	1

Sl. No.	Item Description	Unit	Qty.
1C4	**Type test on cable accessories as per IEC**		
1C4.1	Partial discharge test (Clause 9.2 of IEC 60840: 2004)	Lot	1
1C4.2	Voltage test (Clause 9.3 of IEC 60840: 2004)	Lot	1
1C5	Installation of 1Cx630sqmm, 132kV XLPE, Cu conductor cable in trefoil form by fixing trefoil clamps and/or single form on support structure using cleats/ clamps and fixing of clamps on cable rack assembly/ support structure by making holes etc, as required.	Running Meter	**3315**
1C6	Field testing and commissiong of 1Cx630sqmm, 132kV XLPE, Cu conductor cable along with accessories	Circuit-no	**11**
1C7	Termination of 132kV Indoor cable termination (plug/ socket type) kit suitable/ compatible for 1Cx630sqmm, 132kV XLPE, copper cable for GIS end. It includes fixing of clamps & connectors, if required.	No	33
1C8	Termination of 132kV Outdoor cable sealing end suitable/ compatible for 1Cx630sqmm copper cable including fixing of clamp, connector etc.	No	33
1C9	132kV straight through jointing kit suitable/ compatible for 1Cx630sqmm copper cable complete with accessories	No	3
1D	**SERVICES - Other Cable Accessories**		
1D1	Installation of 1nox3phase link box without SVL(sheath voltage limiter) at GIS end along with installation of metallic screen bonding/ earthing cable along with accessories to complete earthing.	Set	**11**
1D2	Installation of 1nox3phase link box with SVL(sheath voltage limiter) at weatherproof cable box of transfomer along with installation of metallic screen bonding/ earthing cable along with accessories to complete earthing	Set	**11**
1D3	Fixing of support structure for cable terminations at GIS end	set	11
1D4	Any other service(s) not mentioned above, but required for completion of the suppply	Lot	1
1E	**TRAINING**		
1E1	Services - Training during erection/ installation at site (1 lot=6 UPPTCL/BHEL Engineers at site for 1 day).	Lot	1
1E2	Services - Training during testing & commissioning at site (1 lot=4 UPPTCL/BHEL Engineers at site for 1 day).	Lot	1

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.

SECTION 2

Equipment specification

- UPPTCL SPECIFICATION FOR 132KV XLPE CABLES –SECTION -IV (A) 132kV XLPE CABLES (18 PAGES)
- UPPTCL SPECIFICATION FOR 132KV XLPE CABLES TERMINATIONS AND JOINTING KITS –SECTION -IV (B) 145kV XLPE CABLE TERMINATIONS AND JOINTING KITS (17 PAGES)
- UPPTCL SPECIFICATION FOR INSTALLATION OF CABLE –SECTION -IVC INSTALLATION OF CABLES (11 PAGES)

Kindly read the below amendment in conjunction with Section -IV (A) 132kV XLPE cables

Sl. No	***Reference clause***	***Extract from specification***	***Amendment***
1	SECTION -IV (A) 132kV XLPE CABLES	Clause 4.1 The cable shall be made of stranded, compacted and segmented electrolytic grade copper, tapped with semi conducting tape. Conductor screening shall be, ……	Clause 4.1 The cable shall be made of stranded, compacted **circular conductor** electrolytic grade copper, tapped with semi conducting tape. Conductor screening shall be, ……

SECTION – IV (A)

132 kV XLPE CABLE

INDEX

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 –1

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 lighting 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 swell-able 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 that the value calculated as per the recommendation of IEC 60502/ IS 7098 (Part-3). The outer sheath shall he 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 MANUFATURING PROCESS

6.1 XLPE cable should be processed in a modern triple head extrusion manufacturing line. XLPE extrusion and curing through Continuous Catanary Vulcanisation (CCV) or vertical Catanary 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 for 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 reminder 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 accredition from National Accredition 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/ real 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 ± 3% will be permissible on standard drum length. The ordered quantity of the cable(s) can be supplied with quantity tolerance of ± 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 PARTIULARS

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**
1.	132 kV XLPE Cable	Rs. 1,34,000.00

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.

ANNEXURE – 1

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 Normal thickness of insulation	Table – IV of IEC 60840: 2004-04 /IS 7098 (Part-3) 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

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.

IFC 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 lighting strikes or switching surges by means of station type lighting 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 lighting 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 repute 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-1.

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.

5.13 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.

5.14 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.

5.15 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 determent 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 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 determent 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 Alcated 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 o 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 o 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 from. 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 repute test house conforming to IEC 680840,1999 or 2004 must be enclosed with the offer. The offer without type tests 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 accredition from National Accredition 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, dismanling 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.

Annexure-1

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 ± 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) (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	132 kV (rms.)
2.	Rated / Highest System Voltage Um	145 kV (rms.)
3.	Rated frequency & No. od phase	50 Hz ± 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 Coper 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 - IVC

INSTALLATION OF CABLES

CONSISTING OF

Section-IV (C 1): Laying and Installation of cable

Section-IV (C 2): Earthing, Site Testing, commissioning of complete cable system

INSTALLATION OF CABLES

CONTENTS

SECTION-IV (C2)
EARTHING, SITE TESTING, COMMISSIONING OF COMPLETE CABLE SYSTEM

2.1.0	Earthing of System
2.2.0	Earth Conductor
2.3.0	Pipe Earth Station
2.4.0	Bonding of Cable Screens/ Sheath
2.5.0	Earth Tests
2.6.0	Electrical Tests after Installation
2.7.0	D.C. Testing
2.8.0	AC Testing
2.9.0	Tests on Non Metallic Sheath
2.10.0	Any other site installation/ commissioning tests

TECHNICAL SPECIFICATION FOR INSTALLATION OF CABLE

SECTION-IV (C1)
LAYING AND INSTALLATION OF CABLE

1.1.0 GENERAL

220/132/33 kV XLPE power cable shall be laid throughout the route/ designated portion of the switchyard as under:

[Cables are to be laid within the existing switchyard hence trenching/ duct arrangements are to be done by the bidder and work to be executed as per approved drawings by purchaser. All type of cable laying methods are mentioned below for reference of the bidder]

However, as per requirement of the field, the cables shall also have to be laid as per approved drawings:

1. In ducts.
2. In HDPE pipes at road crossings (pipes to be filled with sand/ suitable material after cabling)
3. In air at terminations.
4. At varying depths due to obstructions.
5. HDPE Pipes at crossing of private loads, gates of residential houses/ buildings.
6. On trough under bridge.

1.2.0 LAYING OF POWER CABLES

1.2.1 Two circuits of the XLPE cable shall be laid in the same/ separate trench/ duct. The contractor shall furnish detailed drawing complying with all applicable standards for approval by the purchaser.

1.2.2 The cable shall be laid wherever required in HDPE pipes of ISI approved quality.

1.3.0 TRENCHING

1.3.1 The cable trench work involves earth excavation for cable trench, back filling and removal of excess earth from site. The work site shall be left as clean as possible.

1.3.2 The trench shall be excavated using manual/ mechanical modes as per field conditions. Most main roads are of asphalt surface and some of the roads with cement concrete surface.

1.3.3 Where paved footpaths are encountered, the pavement slabs shall be properly stored and reinstated. Identification markers of other services shall be properly stored and restored.

1.3.4 The sides of the excavated trenches shall wherever required, be well shored up.

1.3.5 The bottom of the excavated trench should be leveled flat and free from any object which would damage the cables. Any gradient encountered shall be gradual.

1.4.0 DEPTH OF LAYING OF CABLES

Depth of laying shall be 1.5 m. During detailed engineering depth offered for more than 1.5 m at typical location(s) shall be accepted subject to approval of Purchaser.

1.5.0 PAYING OUT THE CABLE

The excavated cable trench shall be drained of all water and the bed surface shall be smooth, uniform and fairly hard before paying out the cable. The cable shall be rolled in the trench on cable rollers, spaced out at uniform intervals. The paying out process must be smooth and steady without subjecting the cable to abnormal tension. The cable on being paid out shall be smoothly and evenly transferred to the ground after providing the cushion. The cables shall never be dropped. All snake bends shall be straightened. Suitable size cable stocking pulling eye shall be used for pulling the cable. While pulling the cable by winches or machines, the tension loading shall be by tension indicator and shall not exceed the permissible value for the cable. The cable laying shall be performed continuously at a speed not exceeding 200 to 300 meters per hour.

1.6.0 CABLE END SEALS

The cable end seals shall be checked after laying and if found damaged shall immediately be resealed. Sufficient number of heat shrinkable cable end sealing caps shall be stocked at site stores for testing and jointing work. The integrity of the outer sheath shall be checked after the cable is laid in position.

1.7.0 FLAKING

The cables shall be flaked and left with slight extra lengths at jointing bays for expansion and flexibility. This shall have prior approval of Purchaser.

1.8.0 SAND CUSHION

The sand cushion for the cables shall be provided as per the drawings. Sand covering shall be done by hand and in such manner as to provide complete envelope for the cables.

1.9.0 SAND BEDDING

The cable shall be completely surrounded by well-compacted cable sand to such a thickness and of such size that the cable is protected against damage. The thickness of the cable sand should normally be a minimum of l0 cm in all directions from the cable surface.

1.10.0 THERMAL BACKFILL

Based on the evaluation of soil thermal resistivity along the cable route and after

approval from the Purchaser the contractor shall design, specify, supply, lay and monitor the installation of thermal backfill surrounding the cables.

1.11.0 IMMEDIATE ENVELOPE TO CABLE

The option on the use of the material that immediately envelopes the cable viz., thermal backfill or sand or sieved native soil rests with the Purchaser. The contractor shall seek prior approval on the use of the envelop material from the Purchaser before execution of the works.

1.12.0 BACK FILLING

Normally back filling shall consist of the material earlier excavated. However, bigger stones or pieces of rock should be removed.

1.13.0 PREVENTION OF DAMAGE DUE TO SHARP EDGES

1.13.1 After the cables have been laid in the trench and until the cables are covered with protective covering, no sharp metal tool shall be used in the trench or placed in such a position that may fall into the trench.

1.13.2 Straight and curved rollers used shall have no sharp projecting parts liable to damage the cable.

1.13.3 While pulling through pipes and ducts, the cable shall be protected to avoid damage due to sharp edges,

1.13.4 The cables shall never be bent, beyond the specified bending radius.

1.14.0 WARNING TAPE

A pre-warning, Red colour plastic/ PVC tape, 450 mm wide 100 microns thick, shall be laid at approx. 0.4 m above the cable specified depth, throughout the cable route. The tape shall carry the legend printed in black continuously as under CAUTION; UPPTCL, 2,20,000V or 1,32,000V or 33,000V CABLES.

1.15.0 IDENTIFICATION

An identification marker/ Tag of lead of size 50 mm x 25 mm x 2 mm shall be provided at 2.5 meter intervals through out the route length of the cable and fastened with a suitable nylon string. The marker shall be embossed/ bunched on both sides with the letters UPPTCL 245kV or 145kV or 36kV, Ckt-I or II, respectively. In case of double circuits phase identification by colored PVC tape shall be at 1 M interval. Alternatively plastic tags may be used. These tags should also be fixed at the cable inlet and outlets of a duct, tunnel, manhole and joint bays.

1.16.0 CABLE OVER BRIDGES

1.16.1 Wherever the cable route crosses the bridges, the cables shall be laid in ducts. In existing ducts by removing and replacing the R.C.C. covers and properly back filled.

1.16.2 Cable Crossing Open Drains With Long Span

a) Wherever the cable route has to cross an open drain, with a long span, the cable shall be laid in suitable size ducts or pipes, suitably jointed with collars. The entire duct system shall be designed as per civil engineering practice and shall be got approved by the concerned authorities and owner.

b) At places where the cables cross private roads, gates of residential houses or buildings, the cables shall be laid in HDPE pipes.

1.17.0 ROAD CUTTING (NOT APPLICABLE FOR THIS CASE)

The road cutting, whether of cement concrete/ asphalt or macadam road surface shall be taken after obtaining approval for cutting from the civic authorities, traffic police, telephone authorities and work should be planned to be completed in the shortest possible time. Where necessary the work shall be planned during night or light traffic periods.

1.18.0 ROAD CROSSING

HDPE pipes shall be used for cable. Pipes diameter should not be less than 1.5 times the cable diameter.

1.19.0 FOOTPATH CUTTING

The slabs, kerb-stones, on the roads shall be removed and reinstated without damage.

1.20.0 REINSTATEMENT

1.20.1 After the cables and pipes have been laid and before the trench is backfilled all joints and cable positions should be carefully plotted and preserved till such time the cable is energized and taken over by the Engineer. The protective covers shall then be provided, the excavated soil riddled, sieved and replaced. It is advisable to leave a crown of earth not less than 50 mm and not more than 100 mm in the centre and tapering towards the sides of the trench.

1.20.2 The temporary reinstatement of roadways should be inspected at regular intervals, more frequently in rainy season and immediately after overnight rain for checking settlement and if required the temporary reinstatement should be done.

1.20.3 After the subsidence has ceased the trench may be permanently reinstated and the surface restored to the best possible condition.

1.20.4 The road surface being cement concrete, asphalt or tarred macadam, resurfacing will be done by the civic authorities at owner's cost. The fixing of markers etc. shall be co-ordinated by bidder.

1.20.5 All works shall be carried out under supervision of the engineer in charge or his representative.

1.21.0 CABLE ROUTE MARKERS/ CABLE JOINT MARKERS

1.21.1 Permanent means of indicating the position of joints and cable route shall be fabricated, supplied and erected by successful bidder as per approved drawings.

1.21.2 Markers provided shall be as per the field requirement, if the route passes through open fields, markers should be conspicuously visible and above ground surface.

1.21.3 The marker should incorporate the relevant information. The name of the UPPTCL voltage, circuit and distance of cable from the marker

1.22.0 TOOLS AND PLANTS

2.22.1 The successful bidder shall have all necessary tools, plant and equipment to carry out the survey and cable installation work.

122.2 The bidders are instructed to give all the details of equipment at their disposal, to carry out the work successfully and speedily.

1.23.0 MAINTENANCE OF SITE CONDITIONS

The contractor shall clean the completed cable route and shall remove all surplus and waste materials, empty cable reels etc. preferably the same day but not later than the next day after the particular work is completed.

1.24.0 BENDING RADIUS

The minimum bending radius of XLPE insulated cables are as follows:

Cable	**Bending radius**
Single Core	25 x Overall diameter of cable

SECTION-IV (C2)

EARTHING, SITE TESTING, COMMISSIONING OF

COMPLETE CABLE SYSTEM

2.1.0 EARTHING OF SYSTEM

2.1.1 The earthing system required is for the

a) Earthing of all non-current carrying metal parts and

b) Earthing system for cable screens/ sheath bonding at terminations.

2.1.2 The latest edition of following standards and codes are applicable:-

i) IS: 3043: Code or practice for earthing.

ii) IS: 2309: Code of practice for the protection of buildings and allied structures against lightning.

iii) Indian Electricity Rules 1956: Provision of Rules on EHV systems

iv) IEEE- 80: Guide for safety in sub-station grounding.

2.1.3 All equipment, supporting and mounting structures of the installation shall be bonded together and connected by separate and distinct conductor to earth electrode.

2.2.0 EARTH CONDUCTOR

The earth conductor shall be of G.I flat, of approved size and shall be protected against mechanical damage and corrosion. The connection of the earth continuity conductors to earth bus and earth electrodes shall be strong, secure and sound and shall be easily accessible.

2.3.0 PIPE EARTH STATION

2.3.1 The pipe earth electrodes shall be in conformity with IS: 3043, buried vertically and the pit filled with alternate layers of charcoal, salt and earth. The earth lead shall be properly fastened with brass bolts. nuts and connections shall be enclosed in a masonry chamber. The chamber shall be provided with a RCC inspection cover.

2.3.2 The connection between the earthing terminal of equipment and earth electrode shall be made by short and direct earthing lead, free from kinks and splices.

2.3.3 The distance between any two electrode shall not he less than twice and length of the electrode.

2.3.4 All joints shall be covered with suitable compound to protect against corrosion. Earthing connections with equipment earthing terminals shall be of bolted type. The contact surfaces shall be free from scale, paint, enamels, grease, rust or dirt. Two bolts shall be provided for making earth connection. The bolted connections after

being checked and tested shall be painted with anticorrosive paint or compound.

2.3.5 Welds and brazed joints shall be treated with red lead and afterwards coated with bitumen compound to prevent corrosion.

2.3.6 Steel to copper connection shall be brazed type and shall be treated to prevent moisture ingress.

2.3.7 The resistance of the welded joint shall not be more than the resistance of equivalent length of the conductor.

2.3.8 All welded joints shall be made by electric are welding. All welded joints shall be allowed to cool down gradually to atmospheric temperature.

2.3.9 Arc welding with large diameter conductor shall be done with low hydrogen content electrodes.

2.4.0 BONDING OF CABLE SCREENS/ SHEATH

Each single phase cable shall have a separate earth for the screen earthing. The system short circuit level is 40kA for 1 sec. The earthing lead at solid earth position shall be single core, 300 sq.mm copper conductor PVC insulated 3.3kV voltage grade (or appropriate size/ type supported by calculation and approved by purchaser) cable.

2.5.0 EARTH TESTS

2.5.1 Tests on earths shall be carried out by the contractor in presence of UPPTCL Engineer for testing the effectiveness of earth resistance of electrodes and the results furnished to the purchaser.

TESTS ON CABLE SYSTEM

2.6.0 ELECTRICAL TESTS AFTER INSTALLATION

2.6.1 The contractor shall conduct the following tests during and after installation of complete cable system as per IEC 60840: 2004-04.

2.6.2 In the event of the installation failing the tests, the contractor shall at his expense identify the cause and rectify the defects and render the installation serviceable.

2.7.0 D.C. TESTING

a) The insulation resistance of each cable length shall be checked after laying and before jointing and terminating.

b) Polarization Index test.

c) After laying, jointing and terminating the cables shall be tested with all accessories.

2.8.0 AC TESTING

2.8.1 The installation shall be tested with AC voltage at power frequency.

2.8.2 The installation shall withstand for 5 minutes with the phase to phase voltage applied between the conductor and metallic screen/ sheath.

OR

2.8.3 Test for 24 hours with normal operative voltage of the system.

2.9.0 TESTS ON NON METALLIC SHEATH

The non-metallic sheath shall be subjected to test as per lEC publication 60229. The bidder can recommend any other test. for satisfactory performance of the installed system.

2.10.0 Any other site installation/ commissioning tests as specified in Section lV A & lVB shall be conducted by the bidder in presence of UPPTCL Engineer.

SECTION-3

GENERAL TECHNICAL REQUIREMENTS OF SPECIFICATIONS (GTR)

INDEX

GENERAL TECHNICAL REQUIREMENTS OF SPECIFICATIONS (GTR)

1.0 GENERAL

This section stipulates the General Technical Requirements (GTR) under the Contract and will form an integral part of the Technical Specification.

The provisions under this section are intended to supplement general requirements for the materials, equipments and services covered under respective equipment sections and are not exclusive. However in case of conflict between the requirement specified in this section and requirements specified under respective equipment sections, the requirements specified under respective sections shall hold good.

Every effort will be made to supply all equipment as per the technical details furnished in the specification. However, due to the standard manufacturing practice of various equipment suppliers and depending on the selected vendor, there may be slight variations from indicated values at the contract stage. Such variations should not affect the quality and performance of the equipment.

It is not the intent to specify completely in technical specifications of equipments/ materials all details of the design and construction of equipment. However, the equipment shall conform in all respects to high standards of engineering, design and workmanship and shall be capable of performing in continuous commercial operation. The Purchaser will interpret the meaning of drawing and specification and shall have the power to reject any work or material which in his judgement is not in accordance therewith. The equipment offered shall be complete with all components necessary for its effective and trouble free operation. Such components shall be deemed to be within the scope of Bidder's supply, irrespective of whether these are specifically brought out in this specification and/or commercial order or not.

2.0 COMPLETENESS OF EQUIPMENTS

2.1 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.

2.2 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.

3.0 STANDARDS

3.1 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.

3.2 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.

3.3 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.

3.4 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.

3.5 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.

3.6 REFERENCE OF STANDARDS

Reference	**Abbreviation**	**Name and Address**
IEC/ CISPR	International Electro technical Commission	Bureau Central de la Commission, Electro Technique International, 1 Rue de verembe Geneva, Switzerland
IS	Indian Standards,	Bureau of Indian Standard, Manak Bhavan, 9, Bahadur Shah Zafar Marg, New Delhi-110 002, INDIA

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

4.0 PROJECT DATA

i.	Location	UTTAR PRADESH
ii.	Altitude	not exceeding 1000 Meters
iii.	Climatic Conditions	
(a)	Design maximum ambient Air Temperature	50^0 C
(b)	Minimum ambient air temperature in shade	0^0C
(c)	Relative Humidity	100%Max.
(d)	Wind Load	195 Kg./ Sq.m.
(e)	Seismic Level	0.3 g
(f)	Isoceraunic Level	50days/ year
(g)	Average annual rain fall	1200 mm
(h)	Hot and humid tropical Climate conductive to rust and fungus growth	

5.0 SYSTEM PARTICULARS

(i)	Rated System voltage	420 kV, 245kV, 145kV, 36kV
(ii)	System frequency	50 Hz, This may vary by ± 5%
(iii)	Number of phases	Three
(iv)	Neutral	Effectively Earthed
(v)	**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	2wire ungrounded DC supplies

(i) 400 kV S/S : 220V DC (ii) 220/132kV S/S : 110V DC (iii) Communication equipment : 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 ± 10%.
Frequency by ± 5%
Combined Voltage & frequency by ±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

6.0 SYSTEM PARAMETERS

The following system parameters shall prevail:

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	31.5 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	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) 4200mm (for rod - Conductor)	2100 mm	1300 mm	320 mm
	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	Effectively Earthed	Effectively Earthed	Effectively Earthed

Major technical parameters of bushings/ hollow column/ support insulators are given below:

Sl. No	**. Parameters**	**400 kV System**	**220 kV System**	**132 kV System**	**33 kV System**
(a)	Max. System voltage Um (kV)	420	245	145	36
(b)	Impulse withstand voltage (dry & wet) (kVp)	± 1425	± 1050	± 650	±170
(c)	Switching surge withstand voltage (dry & wet) (kVp)	1050	-	-	-
(d)	Power frequency withstand voltage (dry and wet) (kV rms)	650	460	275	75
(e)	Total creepage distance(min) (mm)	10500	6125	3625	900

Insulator shall also meet requirement of IEC- 815 for 420kV, 245kV, 145kV and 36kV systems, as applicable having alternate long and short sheds.

7.0 SERVICES TO BE PERFORMED BY THE EQUIPMENT

All equipments shall perform satisfactorily under various electrical, electromechanical and meteorological conditions of the installation site.

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.

The Bidder shall design the various forces which the terminal connectors of the equipment are required to withstand.

All outdoor EHV equipments except marshalling kiosks shall be suitable for hot line washing.

To facilitate erection of equipment, all items to be assembled at site shall be "match marked".

8.0 CLAMPS AND CONNECTORS INCLUDING TERMINAL CONNECTORS

8.1 Each equipment shall be supplied with necessary terminals and connectors as required by the design for the particular installation. The terminal connector shall be suitable for the conductor used for particular installation, which are as under as per UPPTCL's practice:

8.2 Where copper to aluminum connections are required, bimetallic 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 part which are not current carrying or subjected to stress. The design details of the joint shall be furnished to the Purchaser by the Bidder.

8.3 Low voltage connectors, grounding connectors and accessories for grounding all equipment are also included in the scope of work.

8.4 No current carrying part of any clamp shall be less than 10 mm thick. All ferrous parts shall be hot dip galvanized. Copper alloy liner of minimum 2 mm thickness shall be used with aluminum body for Bimetallic clamps.

8.5 All casting shall be free from blow holes, surface blisters cracks and cavities. Sharp edges and corners shall be blurred and rounded off.

8.6 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.

8.7 The clamps/ connectors 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 specified reference ambient temperature, shall also be indelibly marked on each component of the clamp/connector, except on hardware.

8.8 All current carrying parts shall be designed and manufactured to have minimum contact resistant.

8.9 Clamps and connectors shall be designed to be corona controlled. Corona extinction voltage for 420kV, 220kV and 132kV class clamps shall not be less than 320, 156 and 105kV (rms) respectively and R.I.V. level shall not be more than specified 1000, 1000 and 500 micro volts for 420kV, 220kV and 132kV system at the test voltage specified.

9.0 SUPPORT STRUCTURES

9.1 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.

9.2 All equipment support structures shall be supplied alongwith brackets, angles, stools etc. for attaching the operating mechanism, control cabinets and marshalling box (wherever applicable) etc.

9.3 The support structures should be hot dip galvanised with minimum 610 gram/sq.m net of zinc.

10.0 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 purchaser. The decision of Purchaser shall be final. The scheme shall include.

Finishing colour of Indoor equipment.

Finishing colour of Outdoor equipment.

Finish colour of all cubicles.

Finishing colour of various auxiliary system equipment including piping

Finishing colour of various building items.

All steel structures, plates etc. shall be painted with non-corrosive paint with a suitable primer. It may be noted that normally all electrical equipments in switchyard are painted with shade 631 of IS-5. The indoor cubicles, GIS enclosures and other miscellaneous items, the colour scheme shall be approved by the Purchaser during detailed engineering.

11.0 MATERIAL/ WORKMANSHIP

11.1 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 fulfill 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 in 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.

11.2 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.

12.0 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 centered 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 sherns or that of insulator wire or other component in the compartments.

13.0 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.

14.0 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.

15.0 DEGREE OF PROTECTION

The enclosures of the Control Cabinets, junction boxes and Marshalling Boxes, panels etc. to be installed shall be provided with 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 :13947 (Part-I)/ IEC-60947 (Part-I)/ IS 12063 / IEC-60529. Type test report for degree of protection test, on each type of the box shall be submitted for approval.

16.0 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.

17.0 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.

18.0 PACKAGING AND PROTECTION

All the equipments 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. The Bidder shall also submit packing details/associated drawing for any equipment/material, to facilitate the Purchaser to repack any equipment/material at a later date. The Bidder shall be responsible for any loss or damage during transportation, handling and storage due to improper packing. Any demurrage, wharfage and other such charges claimed by the transporters, railways etc. shall be to the account of the Bidder.

All coated surfaces shall be protected against abrasion, impact, discolouration and any other damages. All exposed threaded portions shall be suitably protected with either a metallic or a non-metallic protectin device. All ends of all valves and pipings and conduit equipment connections shall be properly sealed with suitable devices to protect them from damage. The parts which are likely to get rusted, due to exposure to weather should also be properly treated and protected in a suitable manner.

19.0 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.

20.0 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 electro-galvanized. 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.

21.0 PROTECTIVE GUARDS

Suitable guards shall be provided for protection of personnel on all exposed rotation and/of moving machine parts. All such guards with necessary spares and accessories shall be designed for easy installation and removal for maintenance purpose.

22.0 TOOLS AND TACKLES

The Bidder shall supply with the equipment one complete set of all special tools and tackles for the erection, assembly, dis-assembly and maintenance of the equipment. However, these tools and tackles shall be separately packed and brought on to site.

23.0 CONTROL CABINETS, JUNCTION BOXES, TERMINAL BOXES AND MARSHALLING BOXES FOR OUTDOOR EQUIPMENT

23.1 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.

23.2 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 braces 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.

23.3 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.

23.4 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.

23.5 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.

23.6 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.

23.7 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.

23.8 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.

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

23.10 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.

23.11 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.

23.12 a) The following routine tests alongwith the routine tests as per IS: 5039 shall also be conducted.

Check for wiring
Visual and dimension check

b) 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.

23.13 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.

24.0 TERMINAL BLOCKS AND WIRING

24.1 Control and instrument leads form 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.

24.2 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. 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 6.6 which shall be free of halogens, fluorocarbons etc.

24.3 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.

24.4 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 form escaping form the terminal clamp unless it is done intentionally.

24.5 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.

24.6 The terminal blocks shall be of extensible design.

24.7 The terminal blocks shall have locking arrangement to prevent its escape from the mounting rails.

24.8 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 form carrying out the wiring without removing the barriers.

24.9 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

24.10 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.

24.11 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.

24.12 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.

24.13 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.

24.14 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.

25.0 LAMPS AND SOCKETS

25.1 Lamps

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

25.2 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.

25.3 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.

25.4 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.

26.0 BUSHINGS, HOLLOW COLUMN INSULATORS, SUPPORT INSULATORS

26.1 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 silicon rubber insulator, conforming to IEC-61462.

26.2 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.

26.3 Glazing of the porcelain shall be uniform brown in colour, free from blisters, burrs and similar other defects.

26.4 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.

26.5 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.

26.6 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.

26.7 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.

26.8 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.

27.0 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.

27.1 Enclosures

a) 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.

b) Two independent earthing points shall be provided on opposite sides of the motor for bolted connection of earthing conductor.

c) 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.

27.2 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.

27.3 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, 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.

27.4 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.

27.5 TESTING AND COMMISSIONING

The Bidder shall conduct following tests alongwith list of instruments and calibration certificates to the Purchaser. If any additional test is required the same shall be conducted without any extra cost to the Purchaser.

(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.

28.0 TECHNICAL REQUIREMENT OF EQUIPMENTS

28.1 Circuit Breakers (Applicable for 400kV, 220kV & 132 kV)

28.1.(i) The manufacturer(s) whose SF6 Circuit Breaker are offered should have designed, manufactured tested as per IEC/IS or equivalent standard supplied the same for the specified system voltage and **40kA/ 50kA fault level or above class** which are in satisfactory operation for at least 2 (two) years as on the date of bid opening

Or

28.1.(ii)(a) The manufacturer(s) whose SF6 Circuit Breaker are offered who have recently established production line in India for the specified system voltage or above class, based on technological support of a parent company or collaborator for the respective equipment(s) can also be considered provided the parent company (Principal) or collaborator meets qualifying requirements stipulated under clause no 28.1.(i) given above.

And

28.1.(ii)(b) Furnishes (jointly with parent company or collaborator) a legally enforceable undertaking to guarantee quality, timely supply, performance and warranty obligations as specified for the equipment(s)

And

28.1.(ii)(c) Furnishes a confirmation letter from the parent company or collaborator along with the bid stating that parent company or collaborator shall furnish performance guarantee for an amount of 10% of the cost of such equipment(s). This performance guarantee shall be in addition to contract performance guarantee to be submitted by the Bidder

28.2 Isolators (Applicable for 400kV, 220kV & 132kV)

28.2.(i) The manufacturer whose isolator are offered, should have designed, manufactured & tested as per IS/IEC or equivalent standard and supplied the isolator for the specified system voltage and and **40kA/ 50kA fault level or above class** and should be in satisfactory operation for at least 2 (two) years as on the date of bid opening

Or

28.2.(ii)(a) The manufacturer(s) whose Isolator are offered who have recently established production line in India for the specified system voltage or above class, based on technological support of a

parent company or collaborator for the respective equipment(s) can also be considered provided the parent company (Principal) or collaborator meets qualifying requirements stipulated under clause no 28.2.(i) given above.

And

28.2.(ii)(b) Furnishes (jointly with parent company or collaborator) a legally enforceable undertaking to guarantee quality, timely supply, performance and warranty obligations as specified for the equipment(s)

And

28.2.(ii)(c) Furnishes a confirmation letter from the parent company or collaborator along with the bid stating that parent company or collaborator shall furnish performance guarantee for an amount of 10% of the cost of such equipment(s). This performance guarantee shall be in addition to contract performance guarantee to be submitted by the Bidder

28.3 Instrument Transformers (Applicable for 400kV, 220kV & 132kV)

28.3.(i) The manufacturer whose instrument transformers are offered, should have designed, manufactured & tested as per IS/IEC or equivalent standard and supplied the same for the specified system voltage for CT & VT and 40kA/ 50kA fault level or above class. These equipment should be in satisfactory operation for at least 2 (two) years as on the date of bid opening

Or

28.3.(ii)(a) The manufacturer(s) whose Instrument Transformer are offered who have recently established production line in India for the specified system voltage or above class, based on technological support of a parent company or collaborator for the respective equipment(s) can also be considered provided the parent company (Principal) or collaborator meets qualifying requirements stipulated under clause no 28.3.(i) given above.

And

28.3.(ii)(b) Furnishes (jointly with parent company or collaborator) a legally enforceable undertaking to guarantee quality, timely supply, performance and warranty obligations as specified for the equipment(s)

And

28.3.(ii)(c) Furnishes a confirmation letter from the parent company or collaborator alongwith the bid stating that parent company or collaborator shall furnish performance guarantee for an amount of 10% of the cost of such equipment(s). This performance guarantee shall be in addition to contract performance guarantee to be submitted by the Bidder

28.4 Surge Arresters (Applicable for 400kV, 220kV & 132kV)

(a) The manufacturer whose Surge Arresters are offered should have designed, manufactured and tested as per IEC/IS or equivalent standard and supplied the Surge Arrester for the specified energy capability with rated system voltage and which are in satisfactory operation for at least 2 (two) years as on the date of bid opening.

Or

(b) The manufacturer(s) whose Surge Arrestors are offered who have recently established production line in India for the specified system voltage or above class, based on technological support of a parent company or collaborator for the respective equipment(s) can also be considered provided the parent company (Principal) or collaborator meets qualifying requirements stipulated under clause no (a) given above.

And

Furnishes (jointly with parent company or collaborator) a legally enforceable undertaking to

guarantee quality, timely supply, performance and warranty obligations as specified for the equipment(s)

And

Furnishes a confirmation letter from the parent company or collaborator alongwith the bid stating that parent company or collaborator shall furnish performance guarantee for an amount of 10% of the cost of such equipment(s). This performance guarantee shall be in addition to contract performance guarantee to be submitted by the Bidder.

28.5 220 kV Grade XLPE Power Cables

The cable shall be from the manufacturer who must have designed, manufactured, type tested and supplied in a single contract at least 15 (fifteen) km of single core, 220kV or higher grade XLPE insulated cable which must be in operation for at least 2 (two) years as on the date of bid opening.

28.6 132 kV Grade XLPE Power Cables

The cable shall be from the manufacturer who must have designed, manufactured, type tested and supplied in a single contract at least 15 (fifteen) km of single core, 132kV or higher grade XLPE insulated cable which must be in operation for at least 2 (two) years as on the date of bid opening.

28.7 33 kV Grade XLPE Power Cables

The cable shall be from the manufacturer who must have designed, manufactured, type tested and supplied in a single contract at least 15 (fifteen) km of single core, 33kV or higher grade XLPE insulated cable which must be in operation for at least 2 (two) years as on the date of bid opening.

28.8 1.1 kV Grade Power & Control Cables

28.8.1 Applicable for PVC Control Cable

The manufacturers, whose PVC control cables are offered, should have designed, manufactured, tested and supplied in a single contract at least 100 kms of 1.1 kV grade PVC insulated control cables as on the date of bid opening. Further the manufacturer should also have designed, manufactured, tested and supplied at least 1 km of 27C x 2.5 Sq.mm or higher size as on the date of bid opening.

28.8.2 Applicable for PVC Power Cable

The manufacturer, whose PVC Power Cables are offered, should have designed, manufactured, tested and supplied in a single contract atleast 100 kms of 1.1 kV or higher grade PVC insulated power cables as on the date of bid opening. Further the manufacturer should also have designed, manufactured, tested and supplied at least 1 km of 1C x 150 Sq. mm or higher size as on the date of bid opening.

28.8.3 Applicable for XLPE Power Cables

The Manufacturer, whose XLPE Power cables are offered, should have designed, manufactured,

tested and supplied in a single contract atleast 25 kms of 1.1 kV or higher grade XLPE insulated power cables as on the date of bid opening. Further the manufacturer should also have designed, manufactured, tested and supplied at least 1 km of 1C x 630 Sq. mm or higher size as on the date of bid opening.

28.9 LT Switchgear

28.9.1 The Manufacturer whose LT Switchgear are offered, should be a manufacturer of LT Switchboards of the type and rating being offered. He should have designe manufactured, tested and supplied at least 50 nos. draw out circuit breaker panels, out of which at least 5 nos. should have been with relay and protection schemes with current transformer. He should have also manufactured at least 50 nos. MCC panels comprising of MCCBs (ie Moulded Case Circuit Breakers) modules of the type offered which should be in successful operation as on date of bid opening.

28.9.2 The Switchgear items (such as circuit breakers, fuse switch units, contactors etc.), may be of his own make or shall be procured from reputed manufacturers and of proven design. At least one hundred circuit breakers of the make and type being offered shall be operating satisfactory as on date of bid opening.

28.10 Battery and Battery Charger

28.10.1 Requirements for Battery Manufacturers

The manufacturer whose Batteries are offered should have designed, manufactured and supplied DC Batteries of the type specified and being offered, having a capacity of at least 600 AH and these shall be operating satisfactorily for two years in power sector and/or industrial installations as on date of bid opening.

28.10.2 Requirements for Battery Charger Manufacturers

The manufacturer, whose Battery Chargers are offered, should have designed, manufactured and supplied Battery Chargers generally of the type offered, with static automatic voltage regulators and having a continuous output of at least ten (10) kW and these should be in successful as on the date of bid opening.

28.11 LT Transformers

The manufacturer, whose transformers are offered should have designed, manufactured, type tested including short circuit test as per IEC/IS or equivalent standards and supplied transformers of at least 33 kV class of 800 kVA or higher. The transformer should have been in successful operation for at least 2 years as on the date of bid opening.

28.12 Fire Fighting System

The bidder or his sub-vendor should have designed, supplied, tested, erected and commissioned at least one number fire protection system of the each type described in (i), (ii), (iii) and (iv) below in installations such as power plants, substations, refineries, fertilizer plants or other industrial or commercial installations. Such systems must have been designed to the recommendations of Tariff Advisory Committee of India or any other international reputed

authority like (FOC, London or NFPA, USA etc.) executed during last ten (10) years and should have been in successful operation for at least 2 (two) years as on the date of bid opening.

i) Nitrogen Injection Fire Prevention cum Extinguishing System
ii) Portable Fire Extinguishers
iii) GI Buckets – 9.0 liters capacity and Steel stand for Buckets
iv) Fire Detection and Alarm System

In case bidder himself do not meet the requirement of design, he can engage a consultant(s) who must have designed the above system, which must be in successful operation for at least two years as on the date of bid opening.

28.13 Control and Relay Panels (400 kV, 220 kV, 132 kV & 33 kV)

The manufacturer whose Control, Relay & Protection System (Control & protection Intelligent Electronic Devices (IEDs)), and Sub-station Automation System (If applicable) are offered should have designed, manufactured, tested, installed and commissioned Control, Relay & Protection system along with Sub-station Automation System which must be in satisfactory operation on specified voltage level or above for atleast 2 (two) years on the date of bid opening.

AND

The Manufacturer or their joint venture or subsidiary company must have established repair, testing and integration (for at least 4 bays) facilities for Control, Relay & Protection System and Sub-station Automation System in India.

CORONA AND RADIO INTERFERENCE VOLTAGE (RIV) TEST

1.0 General

Unless otherwise stipulated, all equipment together with its associated connectors, where applicable, shall be tested for external corona (for 400 kV & above) both by observing the voltage level for the extinction of visible corona under falling power frequency voltage and by measurement of radio interference voltage (RIV) for 132 kV above.

2.0 Test Levels

The test voltage levels for measurement of external RIV and for corona extinction voltage are listed under the relevant clauses of the specification.

3.0 Test Methods for RIV

3.1 RIV tests shall be made according to measuring circuit as per International Special-Committee on Radio Interference (CISPR) Publication 16-1(1993) Part -1. The measuring circuit shall preferably be tuned to frequency with 10% of 0.5 MHz but other frequencies in the range of 0.5 MHz to 2 MHz may be used, the measuring frequency being recorded. The results shall be in microvolts.

3.2 Alternatively, RIV tests shall be in accordance with NEMA standard Publication No. 107-1964, except otherwise noted herein.

3.3 In measurement of, RIV, temporary additional external corona shielding may be provided. In measurements of RIV only standard fittings of identical type supplied with the equipment and a simulation of the connections as used in the actual installation will be permitted in the vicinity within 3.5 meters of terminals.

3.4 Ambient noise shall be measured before and after each series of tests to ensure that there is no variation in ambient noise level. If variation is present, the lowest ambient noise level will form basis for the measurements. RIV levels shall be measured at increasing and decreasing voltages of 85%, 100%, and 110% of the specified RIV test voltage for all equipment unless otherwise specified. The specified RIV test voltage for 400kV, 220kV, 132kV is listed in the detailed specification together with maximum permissible RIV level in microvolts.

3.5 The metering instruments shall be as per CISPR recommendation or equivalent device so long as it has been used by other testing authorities.

3.6 The RIV measurement may be made with a noise meter. A calibration procedure of the frequency to which noise meter shall be tuned shall establish the ratio of voltage at the high voltage terminal to voltage read by noisel meter.

4.0 Test Methods for Visible Corona

The purpose of this test is to determine the corona extinction voltage of apparatus, connectors etc. The test shall be carried out in the same manner as RIV test described above with the exception that RIV measurements are not required during test and a search technique shall be used near the onset and extinction voltage, when the test voltage is raised

and lowered to determine their precise values. The test voltage shall be raised to 110% of specified corona extinction voltage and maintained there for five minutes. In case corona inception does not take place at 110%, test shall be stopped, otherwise test shall be continued and the voltage will then be decreased slowly until all visible corona disappears. The procedure shall be repeated at least 4 times with corona inception and extinction voltage recorded each time. The corona extinction voltage for purposes of determining compliance with the specification shall be the lowest of the four values at which visible corona (negative or positive polarity) disappears. Photographs with laboratory in complete darkness shall be taken under test conditions, at all voltage steps i.e. 85%, 100%, and 110%. Additional photographs shall be taken at corona inception and extinction voltages. At least two views shall be photographed in each case using Panchromatic film with an ASA daylight rating of 400 with an exposure of two minutes at a lens aperture of f/5.6 or equivalent. The photographic process shall be such that prints are available for inspection and comparison with conditions as determined from direct observation. Photographs shall be taken from above and below the level of connector so as to show corona on bushing, insulators and all parts of energised connectors. The photographs shall be framed such that test object essentially, fills the frame with no cut-off.

For recording purpose, modern devices utilizing UV recording methods such as image intensifier may also be used.

4.1 The test shall be recorded on each photograph. Additional photograph shall be taken from each camera position with lights on to show the relative position of test object to facilitate precise corona location from the photographic evidence.

4.2 In addition to photographs of the test object preferably four photographs shall be taken of the complete test assembly showing relative positions of all the test equipment and test objects. These four photographs shall be taken from four points equally spaced around the test arrangement to show its features from all sides. Drawings of the laboratory and test set up locations shall be provided to indicate camera positions and angles. The precise location of camera shall be approved by Purchaser's inspector, after determining the best camera locations by trial energisation of test object at a voltage which results in corona.

4.3 The test to determine the visible corona extinction voltage need not be carried out simultaneously with test to determine RIV levels.

4.4 However, both test shall be carried out with the same test set up and as little time duration between tests as possible. No modification on treatment of the sample between tests will be allowed. Simultaneous RIV and visible corona extinction voltage testing may be permitted at the discretion of Purchaser's inspector if, in his opinion, it will not prejudice other test.

5.0 Test Records

In addition to the information previously mentioned and the requirements specified as per CISPR or NEMA 107-1964 the following data shall be included in test report:

a) Background noise before and after test.
b) Detailed procedure of application of test voltage.
c) Measurements of RIV levels expressed in micro volts at each level.

d) Results and observations with regard to location and type of interference sources detected at each step.

e) Test voltage shall be recorded when measured RIV passes through 100 microvolts in each direction.

f) Onset and extinction of visual corona for each of the four tests required shall be recorded.

ANNEXURE – B

SEISMIC WITHSTAND TEST PROCEDURE

The seismic withstanding test on the complete equipment (for 132 kV and above) shall be carried out alongwith supporting structure.

The Bidder shall arrange to transport the structure from his Contractor's premises/UPPTCL sites for the purpose of seismic withstand test only.

The seismic level specified shall be applied at the base of the structure. The accelerometers shall be provided at the Terminal Pad of the equipment and any other point as agreed by the Purchaser. The seismic test shall be carried out in all possible combinations of the equipment. The seismic test procedure shall be furnished for approval of the Purchaser.

ANNEXURE – C

LIST OF SPECIFICATIONS

GENERAL STANDARDS AND CODES

India Electricity Rules

Indian Electricity Act

Indian Electricity (Supply) Act

Indian Factories Act

IS-5,	-	Colors for Ready Mixed Paints and Enamels.
IS-335,	-	New Insulating Oils.
IS-617,	-	Aluminium and Aluminium Alloy Ingots and Castings for General Engineering Purposes
IS-1448 (P1 to P 145)	-	Methods of Test for Petroleum and its Products.
IS-2071 (P1 to P3)	-	Methods of High Voltage Testing.
IS-12063	-	Classification of degrees of protection provided by enclosures of electrical equipment.
IS-2165 P1:1997 P2:1983	-	Insulation Coordination.
IS-3043	-	Code of Practice for Earthing
IS-6103	-	Method of Test for Specific Resistance (Resistivity) of Electrical Insulating Liquids
IS-6104	-	Method of Test for Interfacial Tension of Oil against Water by the Ring Method
IS-6262	-	Method of test for Power factor & Dielectric Constant of Electrical Insulating Liquids.
IS-6792	-	Method for determination of electric strength of insulating oils.
IS-5578	-	Guide for marking of insulated conductors.
IS-11353	-	Guide for uniform system of marking & identification of conductors & apparatus terminals.
IS-8263	-	Methods for Radio Interference Test on High voltage Insulators.
IS-9224 (Part 1,2&4)	-	Low Voltage Fuses
IEC-60060 (Part 1 to P4)	-	High Voltage Test Techniques
IEC 60068	-	Environmental Test

IEC-60117	-	Graphical Symbols
IEC-60156,	-	Method for the Determination of the Electrical Strength of Insulation Oils.
IEC-60270,	-	Partial Discharge Measurements.
IEC-60376	-	Specification and Acceptance of New Sulphur Hexafloride
IEC-60437	-	Radio Interference Test on High Voltage Insulators.
IEC-60507	-	Artificial Pollution Tests on High Voltage Insulators to be used on AC Systems.
IEC-62271-1	-	Common Specification for High Voltage Switchgear & Controlgear Standards.
IEC-60815	-	Guide for the Selection of Insulators in respect of Polluted Conditions.
IEC-60865 (P1 & P2)	-	Short Circuit Current - Calculation of effects.
ANSI-C.1/NFPA.70	-	National Electrical Code
ANSI-C37.90A	-	Guide for Surge Withstand Capability (SWC) Tests
ANSI-C63.21,	-	Specification for Electromagnetic Noise and
C63.3	-	Field Strength Instrumentation 10 KHz to 1 GHZ
C36.4ANSI-C68.1	-	Techniquest for Dielectric Tests
ANSI-C76.1/EEE21	-	Standard General Requirements and Test Procedure for Outdoor Apparatus Bushings.
ANSI-SI-4	-	Specification for Sound Level Metres
ANSI-Y32-2/C337.2	-	Drawing Symbols
ANSI-Z55.11	-	Gray Finishes for Industrial Apparatus and Equipment No. 61 Light Gray
NEMA-107T	-	Methods of Measurements of RIV of High Voltage Apparatus
NEMA-ICS-II	-	General Standards for Industrial Control and Systems Part ICSI-109
CISPR-1	-	Specification for CISPR Radio Interference Measuring Apparatus for the frequency range 0.15 MHz to 30 MHz
CSA-Z299.1-1978h	-	Quality Assurance Program Requirements
CSA-Z299.2-1979h	-	Quality Control Program Requirements
CSA-Z299.3-1979h	-	Quality Verification Program Requirements

CSA-Z299.4-1979h	-	Inspection Program Requirements

TRANSFORMERS AND REACTORS

IS:10028 (Part 2 & 3)	-	Code of practice for selection, installation & maintenance of Transformers (P1:1993), (P2:1991), (P3:1991)
IS-2026 (P1 to P4)	-	Power Transformers
IS-3347 (part 1 to Part 8)	-	Dimensions for Porcelain transformer Bushings for use in lightly polluted atmospheres.
IS-3639	-	Fittings and Accessories for Power Transformers
IS-6600	-	Guide for Loading of OIl immersed Transformers.
IEC-60076 (Part 1 to 5)	-	Power Transformers
IEC-60214	-	On-Load Tap-Changers.
IEC-60289	-	Reactors.
IEC- 60354	-	Loading Guide for Oil - Immersed power trans formers
IEC-60076-10	-	Determination of Transformer and Reactor Sound Levels
ANSI-C571280	-	General requirements for Distribution, Power and Regulating Transformers
ANSI-C571290	-	Test Code for Distribution, Power and Regulation Transformers
ANSI-C5716	-	Terminology & Test Code for Current Limiting Reactors
ANSI-C5721	-	Requirements, Terminology and Test Code for Shunt Reactors Rated Over 500 KVA
ANSI-C5792	-	Guide for Loading Oil-Immersed Power Transformers upto and including 100 MVA with 55 deg C or 65 deg C Winding Rise
ANSI-CG,1EEE-4	-	Standard Techniques for High Voltage Testing

CIRCUIT BREAKERS

IEC-62271-100	-	High-voltage switchgear and controlgear - Part 100: Alternating current circuit-breakers
IEC-62271-101	-	High-voltage switchgear and controlgear - Part 101:

		Synthetic testing
IEC-62155	-	Hollow pressurized and unpressurized ceramic and glass insulators for use in electrical equipment with rated voltages greater than 1000 V
IEC-62271-110	-	High-voltage switchgear and controlgear - Part 110: Inductive load switching
IEC-62271-109	-	High-voltage switchgear and controlgear - Part 110: Inductive load switching

CURRENT TRANSFORMERS, VOLTAGE TRANSFORMERS AND COUPLING CAPACITOR VOLTAGE TRANSFORMERS

IS-2705- (P1 to P4)	-	Current Transformers.
IS:3156- (P1 to P4)	-	Voltage Transformers.
IS-4379	-	Identification of the Contents of Industrial Gas Cylinders
IEC-60044-1	-	Current transformers.
IEC-60044-2	-	Inductive Voltage Transformers.
IEC-60044-4	-	Instrument Transformes : Measurement of Partial Discharges
IEC-60044-5	-	Instrument transformers - Part 5: Capacitor voltage transformers
IEC-60358	-	Coupling capacitors and capacitor dividers.
IEC-60481	-	Coupling Devices for power Line Carrier Systems.
ANSI-C5713	-	Requirements for Instrument transformers
ANSIC92.2	-	Power Line Coupling voltage Transformers
ANSI-C93.1	-	Requirements for Power Line Carrier Coupling Capacitors
BUSHING		
IS-2099	-	Bushings for Alternating Voltages above 1000V
IEC-60137	-	Insulated Bushings for Alternating Voltages above 1000V

SURGE ARRESTERS

IS-3070 (PART2)	-	Lightning arresters for alternating current systems

		: Metal oxide lightning arrestors without gaps.
IEC-60099-4	-	Metal oxide surge arrestors without gaps
IEC-60099-5	-	Selection and application recommendation
ANSI-C62.1	-	IEE Standards for S A for AC Power Circuits
NEMA-LA 1	-	Surge Arresters

CUBICLES AND PANELS & OTHER RELATED EQUIPMENTS

IS-722, IS-1248, IS-3231, 3231 (P-3)	-	Electrical relays for power system protection
IS:5039	-	Distributed pillars for Voltages not Exceeding 1000 Volts.
IEC-60068.2.2	-	Basic environmental testing procedures Part 2: Test B: Dry heat
IEC-60529	-	Degree of Protection provided by enclosures.
IEC-60947-4-1	-	Low voltage switchgear and control gear.
IEC-61095	-	Electromechanical Contactors for household and similar purposes.
IEC-60439 (P1 & 2)	-	Low Voltage Switchgear and control gear assemblies
ANSI-C37.20	-	Switchgear Assemblies, including metal enclosed bus.
ANSI-C37.50	-	Test Procedures for Low Voltage Alternating Current Power Circuit Breakers
ANSI-C39	-	Electric Measuring instrument
ANSI-C83	-	Components for Electric Equipment
IS: 8623: (Part I to 3)	-	Specification for Switchgear & Control Assemblies.
NEMA-AB	-	Moulded Case Circuit and Systems
NEMA-CS	-	Industrial Controls and Systems
NEMA-PB-1	-	Panel Boards
NEMA-SG-5	-	Low voltage Power Circuit breakers
NEMA-SG-3	-	Power Switchgear Assemblies
NEMA-SG-6	-	Power switching Equipment
NEMA-5E-3	-	Motor Control Centers
1248 (P1 to P9)	-	Direct acting indicating analogue electrical

		measuring instruments & their accessories.

Disconnecting Switches

IEC-62271-102	-	High-voltage switchgear and controlgear - Part 102: Alternating current disconnectors and earthing switches
IEC-60129	-	Alternating Current Disconnectors (Isolators) and Earthing switches
IEC-1129	-	Alternating Current Earthing Switches Induced Current switching
IEC-60265 (Part 1 & 2)	-	High Voltage switches
ANSI-C37.32	-	Schedule of preferred Ratings, Manufacturing Specifications and Application Guide for high voltage Air Switches, Bus supports and switch accessories
ANSI-C37.34	-	Test Code for high voltage air switches
NEMA-SG6	-	Power switching equipment

PLCC and Line Traps

IS-8792	-	Line traps for AC power system.
IS-8793	-	Methods of tests for line traps.
IS-8997	-	Coupling devices for PLC systems.
IS-8998	-	Methods of test for coupling devices for PLC systems.
IEC-60353	-	Line traps for A.C. power systems.
IEC-60481	-	Coupling Devices for power line carrier systems.
IEC-60495	-	Single sideboard power line carrier terminals
IEC-60683	-	Planning of (single Side-Band) power line carrier systems.
CIGRE	-	Teleprotection report by Committee 34 & 35.
CIGRE	-	Guide on power line carrier 1979.
CCIR	-	International Radio Consultative Committee
CCITT	-	International Telegraph & Telephone Consultative Committee

EIA	-	Electric Industries Association

Protection and Control Equipment

IEC-60051 : (P1 to P9)	-	Recommendations for Direct Acting indicating analogue electrical measuring instruments and their accessories.
IEC-60255 (Part 1 to 23)	-	Electrical relays.
IEC-60297		
(P1 to P4)	-	Dimensions of mechanical structures of the 482.6mm (19 inches) series.
IEC-60359	-	Expression of the performance of electrical & electronic measuring equipment.
IEC-60387	-	Symbols for Alternating-Current Electricity meters.
IEC-60447	-	Man machine interface (MMI) - Actuating principles.
IEC-60521	-	Class 0.5, 1 and 2 alternating current watt hour metres
IEC-60547	-	Modular plug-in Unit and standard 19-inch rack mounting unit based on NIM Standard (for electronic nuclear instruments)
ANSI-81	-	Screw threads
ANSI-B18	-	Bolts and Nuts
ANSI-C37.1	-	Relays, Station Controls etc.
ANSI-C37.2	-	Manual and automatic station control, supervisory and associated telemetering equipment
ANSI-C37.2	-	Relays and relay systems associated with electric power apparatus
ANSI-C39.1	-	Requirements for electrical analog indicating Instruments

MOTORS

IS-325	-	Three phase induction motors.
IS-4691	-	Degree of protection provided by enclosure for rotating electrical machinery.
IEC-60034 (P1 to P19:)	-	Rotating electrical machines

IEC-Document 2	-	Three phase induction motors

(Central Office) NEMA-MGI Motors and Generators

Electronic Equipment and Components

MIL-21B, MIL-833 & MIL-2750

IEC-60068 (P1 to P5)	-	Environmental testing
IEC-60326 (P1 to P2)	-	Printed boards Material and workmanship standards
IS-1363 (P1 to P3)	-	Hexagon headbolts, screws and nuts of product grade C.
IS-1364 (P1 to P5)	-	Hexagon head bolts, screws and nuts of products grades A and B.
IS-3138	-	Hexagonal Bolts and Nuts (M42 to M150)
ISO-898	-	Fasteners: Bolts, screws and studs
ASTM	-	Specification and tests for materials

Clamps & Connectors

IS-5561	-	Electric power connectors.
NEMA-CC1	-	Electric Power connectors for sub station
NEMA-CC 3	-	Connectors for Use between aluminium or aluminum-Copper Overhead Conductors

Bus Hardware and Insulators

IS: 2121	-	Fittings for Aluminum and steel cored Al conductors for overhead power lines.
IS-731	-	Porcelain insulators for overhead power lines with a nominal voltage greater than 1000 V.
IS-2486 (P1 to P4)	-	Insulator fittings for overhead power lines with a nominal voltage greater than 1000 V.
IEC-60120	-	Dimensions of Ball and Socket Couplings of string insulator units.
IEC-60137	-	Insulated bushings for alternating voltages above 1000 V.
IEC-60168	-	Tests on indoor and outdoor post insulators of ceramic material or glass for Systems with Nominal Voltages Greater than 1000 V.

IEC-62155	-	Hollow pressurized and unpressurized ceramic and glass insulators for use in electrical equipment with rated voltages greater than 1 000 V
IEC-60233	-	Tests on Hollow Insulators for use in electrical equipment.
IEC-60273	-	Characteristices of indoor and outdoor post insulators for systems with nominal voltages greater than 1000V.
IEC-61462	-	Pressurized and un-pressurized insulator for use in electrical equipment with rated voltage greater than 1000V – Definitions, Test methods, acceptance criteria and design recommendations
IEC-60305	-	Insulators for overhead lines with nominal voltage above 1000V-ceramic or glass insulator units for a.c. systems Characteristics of String Insulator Units of the cap and pintype.
IEC-60372 (1984)	-	Locking devices for ball and socket couplings of string insulator units : dimensions and tests.
IEC-60383 (P1 and P2)	-	Insulators for overhead lines with a nominal voltage above 1000 V.
IEC-60433	-	Characteristics of string insulator units of the long rod type.
IEC-60471	-	Dimensions of Clevis and tongue couplings of string insulator units.
ANSI-C29	-	Wet process proelain insulators
ANSI-C29.1	-	Test methods for electrical power insulators
ANSI-C92.2	-	For insulators, wet-process porcelain and toughened glass suspension type
ANSI-C29.8	-	For wet-process porcelain insulators apparatus, post-type
ANSI-G.8	-	Iron and steel hardware
CISPR-7B	-	Recommendations of the CISPR, tolerances of form and of Position, Part 1
ASTM A-153	-	Zinc Coating (Hot-Dip) on iron and steel hardware

Strain and Rigid Bus-Conductor

IS-2678	-	Dimensions & tolerances for Wrought Aluminum and Aluminum Alloys drawn round tube.

IS-5082	-	Wrought Aluminum and Aluminum Alloy Bars. Rods, Tubes and Sections for Electrical purposes.
ASTM-B 230-82	-	Aluminum 1350 H19 Wire for electrical purposes
ASTM-B 231-81	-	Concentric - lay - stranded, aluminum 1350 conductors
ASTM-B 221	-	Aluminum - Alloy extruded bar, road, wire, shape
ASTM-B 236-83	-	Aluminum bars for electrical purpose (Bus-bars)
ASTM-B 317-83	-	Aluminum-Alloy extruded bar, rod, pipe and structural shapes for electrical purposes (Bus Conductors)

Batteries and Batteries Charger

Battery

IS:1651	-	Stationary Cells and Batteries, Lead-Acid Type (with Tubular Positive Plates)
IS:1652	-	Stationary Cells and Batteries, Lead-Acid Type (with Plante Positive Plates)
IS:1146	-	Rubber and Plastic Containers for Lead-Acid Storage Batteries
IS:6071	-	Synthetic Separators for Lead-Acid Batteries
IS:266	-	Specification for Sulphuric Acid
IS:1069	-	Specification for Water for Storage Batteries
IS:3116	-	Specification for Sealing Compound for Lead-Acid Batteries
IS:1248	-	Indicating Instruments
IS:10918	-	Vented type nickel Cadmium Batteries
IEC:60896-21&22	-	Lead Acid Batteries Valve Regulated types – Methods of Tests & Requirements
IEC: 60623	-	Vented type nickel Cadmium Batteries
IEC:60622	-	Secondary Cells & Batteries – Sealed Ni-Cd rechargeable single cell
IEC:60623	-	Secondary Cells & Batteries – Vented Ni-Cd rechargeable single cell
IEC:60896-11	-	Stationary Lead Acid Batteries – Vented Type – General requirements & method of tests
IEEE-485	-	Recommended practices for sizing of Lead Acid

		Batteries
IEEE-1115	-	Sizing of Ni-Cd Batteries
IEEE-1187	-	Recommended practices for design & installation of VRLA Batteries
IEEE-1188	-	Recommended practices for design & installation of VRLA Batteries
IEEE-1189	-	Guide for selection of VRLA Batteries

Battery Charger

IS:3895	-	Mono-crystalline Semiconductor Rectifier Cells and Stacks
IS:4540	-	Mono-crystalline Semiconductor Rectifier Assemblies and Equipment.
IS:6619	-	Safety Code for Semiconductor Rectifier Equipment
IS:2026	-	Power Transformers
IS:2959	-	AC Contactors for Voltages not Exceeding 1000 Volts
IS:1248	-	Indicating Instruments
IS:2208	-	HRC Fuses
IS:13947 (Part-3)	-	Air break switches, air break disconnectors & fuse combination units for voltage not exceeding 1000V AC or 1200V DC
IS:2147	-	Degree of protection provided by enclosures for low voltage switchgear and controlgear.
IS:6005	-	Code of practice for phosphating of Iron and Steel
IS:3231	-	Electrical relays for power system protection
IS:3842	-	Electrical relay for AC Systems
IS:5	-	Colours for ready mix paint
IEEE-484	-	Recommended Design for installation design and installation of large lead storage batteries for generating stations and substations.
IEEE-485	-	Sizing large lead storage batteries for generating stations and substations

Wires and Cables

ASTMD-2863	-	Measuring the minimum oxygen concentration to support candle like combustion of plastics (oxygen index)
IS-694	-	PVC insulated cables for working voltages upto and including 1100 Volts.
IS-1255	-	Code of practice for installation and maintenance of power cables, upto and including 33 kV rating
IS-1554 (P1 and P2)	-	PVC insulated (heavy duty) electric cables (part 1) for working voltage upto and including 1100 V.
	-	Part (2) for working voltage from 3.3 kV upto and including 11kV.
IS:1753	-	Aluminium conductor for insulated cables
IS:2982	-	Copper Conductor in insulated cables.
IS-3961 (P1 to P5)	-	Recommended current ratings for cables.
IS-3975	-	Mild steel wires, formed wires and tapes for armouring of cables.
IS-5831	-	PVC insulating and sheath of electric cables.
IS-6380	-	Elastometric insulating and sheath of electric cables.
IS-7098	-	Cross linked polyethylene insulated PVC sheathed cables for working voltage upto and including 1100 volts.
IS-7098	-	Cross-linked polyethyle insulated PVC sheathed cables for working voltage from 3.3kV upto and including 33 kV.
IS-8130	-	Conductors for insulated electrical cables and flexible cords.
IS-1753	-	Aluminum Conductors for insulated cables.
IS-10418	-	Specification for drums for electric cables.
IEC-60096 (part 0 to p4)	-	Radio Frequency cables.
IEC-60183	-	Guide to the Selection of High Voltage Cables.
IEC-60189 (P1 to P7)	-	Low frequency cables and wires with PVC insulation and PVC sheath.
IEC-60227 (P1 to P7)	-	Polyvinyl Chloride insulated cables of rated voltages up to and including 450/750V.
IEC-60228	-	Conductors of insulated cables
IEC-60230	-	Impulse tests on cables and their accessories.

IEC-60287 (P1 to P3)	-	Calculation of the continuous current rating of cables (100% load factor).
IEC-60304	-	Standard colours for insulation for low-frequency cables and wires.
IEC-60331	-	Fire resisting characteristics of Electric cables.
IEC-60332 (P1 to P3)	-	Tests on electric cables under fire conditions.
IEC-60502	-	Extruded solid dielectric insulated power cables for rated voltages from 1 kV upto to 30 kV
IEC-754 (P1 and P2)	-	Tests on gases evolved during combustion of electric cables.

Air Conditioning and Ventilation

IS-659	-	Safety code for air conditioning
IS-660	-	Safety code for Mechanical Refrigeration
ARI:520	-	Standard for Positive Displacement RefrigerationCompressor and Condensing Units
IS:4503	-	Shell and tube type heat exchanger
ASHRAE-24	-	Method of testing for rating of liquid coolers
ANSI-B-31.5	-	Refrigeration Piping
IS:2062	-	Steel for general structural purposes
IS:655	-	Specification for Metal Air Dust
IS:277	-	Specification for Galvanised Steel Sheets
IS-737	-	Specification for Wrought Aluminium and Aluminium Sheet & Strip
IS-1079	-	Hot rolled cast steel sheet & strip
IS-3588	-	Specification for Electrical Axial Flow Fans
IS-2312	-	Propeller Type AC VentilationFans
BS-848	-	Methods of Performance Test for Fans
BS-6540 Part-I	-	Air Filters used in Air Conditioning and General Ventilation
BS-3928	-	Sodium Flame Test for Air Filters (Other than for Air Supply to I.C. Engines and Compressors)
US-PED-2098	-	Method of cold DOP & hot DOP test
MIL-STD-282	-	DOP smoke penetration method
ASHRAE-52	-	Air cleaning device used in general ventilation for

		removing particle matter
IS:3069	-	Glossary of Terms, Symbols and Units Relating to Thermal Insulation Materials.
IS:4671	-	Expanded Polystyrene for Thermal Insulation Purposes
IS:8183	-	Bonded Mineral Wool
IS:3346	-	Evaluation of Thermal Conductivity properties by means of guarded hot plate method
ASTM-C-591-69	-	Standard specification for rigid preformed cellular urethane thermal insulation
IS:4894	-	Centrifugal Fans
BS:848 Fans	-	Method of Performance Test for Centrifugal
IS:325	-	Induction motors, three-phase
IS:4722	-	Rotating electrical machines
IS:1231	-	Three phase foot mounted Induction motors, dimensions of
IS:2233	-	Designations of types of construction and mounting arrangements of rotating electrical machines
IS:2254	-	Vertical shaft motors for pumps, dimensions of
IS:7816	-	Guide for testing insulation resistance of rotating machines
IS:4029	-	Guide for testing three phase induction motors
IS:4729	-	Rotating electrical machines, vibration of, Measurement and evaluation of
IS:4691	-	Degree of protection provided by enclosures for rotating electrical machinery
IS:7572	-	Guide for testing single-phase a.c. motors
IS:2148	-	Flame proof enclosure for electrical apparatus
BS:4999 (Part-51)	-	Noise levels

Galvanizing

IS-209	-	Zinc Ingot
IS-2629	-	Recommended Practice for Hot-Dip galvanizing

		on iron and steel.
IS-2633	-	Methods for testing uniformity of coating of zinc coated articles.
ASTM-A-123	-	Specification for zinc (Hot Galavanizing) Coatings, on products Fabricated from rolled, pressed and forged steel shapes, plates, bars and strips.
ASTM-A-121-77	-	Zinc-coated (Galvanized) steel barbed wire

Painting

IS-6005	-	Code of practice for phosphating of iron and steel.
ANSI-Z551	-	Gray finishes for industrial apparatus and equipment
SSPEC	-	Steel structure painting council

Fire Protection System

Fire protection manul issued by tariff advisory committee (TAC) of India

HORIZONTAL CENTRIFUGAL PUMPS

IS:1520	-	Horizontal centrifugal pumps for clear, cold and fresh water
IS:9137	-	Code for acceptance test for centrifugal & axial pumps
IS:5120	-	Technical requirement - Rotodynamic special purpose pumps
API-610	-	Centrifugal pumps for general services
	-	Hydraulic Institutes Standards
BS:599		- Methods of testing pumps
PTC-8.2	-	Power Test Codes - Centrifugal pumps

DIESEL ENGINES

IS:10000	-	Methods of tests for internal combustion engines
IS:10002	-	Specification for performance requirements for

		constant speed compression ignition engines for general purposes (above 20 kW)
BS:5514	-	The performance of reciprocating compression ignition (Diesel) engines, utilising liquid fuel only, for general purposes
ISO:3046	-	Reciprocating internal combustion engines performance
IS:554	-	Dimensions for pipe threads where pressure tight joints are required on threads
ASME Power Test Code	-	Internal combustion engine PTC-17
	-	Codes of Diesel Engine Manufacturer's Association, USA

PIPING VALVES & SPECIALITIES

IS:636	-	Non percolating flexible fire fighting delivery hose
IS:638	-	Sheet rubber jointing and rubber inserting jointing
IS:778	-	Gun metal gate, globe and check valves for general purpose
IS:780	-	Sluice valves for water works purposes (50 to 300 mm)
IS:901	-	Couplings, double male and double female instantaneous pattern for fire fighting
IS:902	-	Suction hose couplings for fire fighting purposes
IS:903	-	Fire hose delivery couplings branch pipe nozzles and nozzle spanner
IS:1538	-	Cast iron fittings for pressure pipes for water, gas and sewage
IS:1903	-	Ball valve (horizontal plunger type) including floats for water supply purposes
IS:2062	-	SP for weldable structural steel
IS:2379	-	Colour Code for the identification of pipelines
IS:2643	-	Dimensions of pipe threads for fastening purposes
IS:2685	-	Code of Practice for selection, installation and maintenance of sluice valves
IS:2906	-	Sluice valves for water-works purposes (350 to 1200 mm size)

IS:3582	-	Basket strainers for fire fighting purposes (cylindrical type)
IS:3589	-	Electrically welded steel pipes for water, gas and sewage (150 to 2000 mm nominal diameter)
IS:4038	-	Foot valves for water works purposes
IS:4927	-	Unlined flax canvas hose for fire fighting
IS:5290	-	Landing valves (internal hydrant)
IS:5312	-	Swing check type reflex (non-return) valves
(Part-I)		
IS:5306	-	Code of practice for fire extinguishing installations and equipment on premises
Part-I	-	Hydrant systems, hose reels and foam inlets
Part-II	-	Sprinkler systems
BS:5150	-	Specification for cast iron gate valves

MOTORS & ANNUNCIATION PANELS

IS:325	-	Three phase induction motors
IS:900	-	Code of practice for installation and maintenance of induction motors
IS:996	-	Single phase small AC and universal electric motors
IS:1231	-	Dimensions of three phase foot mounted induction motors
IS:2148	-	Flame proof enclosure of electrical apparatus
IS:2223	-	Dimensions of flange mounted AC induction motors
IS:2253	-	Designations for types of construction and mounting arrangements of rotating electrical machines
IS:2254	-	Dimensions of vertical shaft motors for pumps
IS:3202	-	Code of practice for climate proofing of electrical equipment
IS:4029	-	Guide for testing three phase induction motors
IS:4691	-	Degree of protection provided by enclosure for rotating electrical machinery
IS:4722	-	Rotating electrical machines

IS:4729	-	Measurement and evaluation of vibration of rotating electrical machines
IS:5572	-	Classification of hazardous areas for electrical (Part-I) installations (Areas having gases and vapours)
IS:6362	-	Designation of methods of cooling for rotating electrical machines
IS:6381	-	Construction and testing of electrical apparatus with type of protection 'e'
IS:7816	-	Guide for testing insulation for rotating machine
IS:4064	-	Air break switches
IEC DOCUMENT 2	-	Three Phase Induction Motor
(Control Office) 432		
VDE 0530 Part I/66	-	Three Phase Induction Motor
IS:9224	-	HRC Fuses
(Part-II)		
IS:6875	-	Push Button and Control Switches
IS:694	-	PVC Insulated cables
IS:1248	-	Indicating instruments
IS:375	-	Auxiliary wiring & busbar markings
IS:2147	-	Degree of protection
IS:5	-	Colour Relay and timers
IS:2959	-	Contactors

PG Test Procedures

NFPA-13	-	Standard for the installation of sprinkler system
NFPA-15	-	Standard for water spray fixed system for the fire protection
NFPA-12A	-	Standard for Halong 1301 Fire Extinguishing System
NFPA-72E	-	Standard on Antomatic Fire Detectors

Fire Protection Manual by TAC (Latest Edition)

NFPA-12	-	Standard on Carbon dioxide extinguisher systems
IS:3034	-	Fire of industrial building:

Electrical generating and distributing stations code of practice

IS:2878	-	CO2 (Carbon dioxide) Type Extinguisher
IS:2171	-	DC (Dry Chemical Powder) type
IS:940	-	Pressurised Water Type

D.G. SET

IS:10002	-	Specification for performance requirements for constant speed compression ignition (diesel engine) for general purposes
IS:10000	-	Method of tests for internal combustion engines
IS:4722	-	Rotating electrical machines-specification
IS:12063	-	Degree of protection provided by enclosures
IS:12065	-	Permissible limit of noise levels for rotating electrical machines.
	-	Indian Explosive Act 1932

Steel Structures

IS-228 (1992)	-	Method of Chemical Analysis of pig iron, cast iron and plain carbon and low alloy steels.
IS-802 (P1 to 3:)	-	Code of practice for use of structural steel in overhead transmission line towers.
IS-806	-	Code of practice for use of steel tubes in general building construction
IS-808	-	Dimensions for hot rolled steel beam, column channel and angle sections.
IS-814	-	Covered electrodes for manual arc welding of carbon of carbon manganese steel.
IS-816	-	Code of Practice for use of metal arc welding for general construction in Mild steel
IS-817	-	Code of practice for training and testing of metal arc welders. Part 1 : Manual Metal arc welding.
IS-875 (P1 to P4)	-	Code of practice for design loads (other than earthquake) for buildings and structures.
IS-1161	-	Steel tubes for structural purposes.
IS-1182	-	Recommended practice for radiographic examination of fusion welded butt joints in steel

		plates.
IS-1363 (P1 to P3)	-	Hexagonal head bolts, screws & nuts of products grade C.
IS-1364	-	Hexagon headbolts, screws and nuts of product grades A and B.
IS-1367 (P1 to P18)	-	Technical supply condition for threaded steel fasteners.
IS-1599	-	Methods for bend test.
IS-1608	-	Method for tensile testing of steel products.
IS-1893	-	Criteria for earthquake resistant design of structures.
IS-1978	-	Line Pipe.
IS-2062	-	Steel for general structural purposes.
IS-2595	-	Code of practice for Radiographic testing.
IS-3063	-	Single coil rectagular section spring washers for bolts, nuts and screws.
IS-3664	-	Code of practice for ultrasonic pulse echo testing by contact and immersion methods.
IS-7205	-	Safety code for erection of structural steel work.
IS-9595	-	Recommendations for metal arc welding of carbon and carbon manganese steels.
ANSI-B18.2.1	-	Inch series square and Hexagonal bolts and screws
ANSI-B18.2.2	-	Square and hexagonal nuts
ANSI-G8.14	-	Round head bolts
ASTM-A6	-	Specification for General Requirements for rolled steel plates, shapes, sheet piling and bars of structural use
ASTM-A36	-	Specifications of structural steel
ASTM-A47	-	Specification for malleable iron castings
ASTM-A143	-	Practice for safeguarding against embilement of Hot Galvanized structural steel products and procedure for detaching embrilement
ASTM-A242	-	Specification for high strength low alloy structural steel
ASTM-A283	-	Specification for low and intermediate tensile strength carbon steel plates of structural quality
ASTM-A394	-	Specification for Galvanized steel transmission

		tower bolts and nuts
ASTM-441	-	Specification for High strength low alloy structural manganese vanadium steel.
ASTM-A572	-	Specification for High strength low alloy colombium-Vanadium steel of structural quality
AWS D1-0	-	Code for welding in building construction welding inspection
AWS D1-1	-	Structural welding code
AISC	-	American institute of steel construction
NEMA-CG1	-	Manufactured graphite electrodes

Piping and Pressure Vessels

IS-1239 (Part 1 and 2) steel	-	Mild steel tubes, tubulars and other wrought fittings
IS-3589	-	Seamless Electrically welded steel pipes for water, gas and sewage.
IS-6392	-	Steel pipe flanges
ASME	-	Boiler and pressure vessel code
ASTM-A120	-	Specification for pipe steel, black and hot dipped, zinc-coated (Galvanized) welded and seamless steel pipe for ordinary use
ASTM-A53	-	Specification for pipe, steel, black, and hotdipped, zinc coated welded and seamless
ASTM-A106	-	Seamless carbon steel pipe for high temperature service
ASTM-A284	-	Low and intermediate tensile strength carbonsilicon steel plates for machine parts and general construction.
ASTM-A234	-	Pipe fittings of wrought carbon steel and alloy steel for moderate and elevated temperatures
ASTM-S181	-	Specification for forgings, carbon steel for general purpose piping
ASTM-A105	-	Forgings, carbon steel for piping components
ASTM-A307	-	Carbon steel externally threated standard fasteners
ASTM-A193	-	Alloy steel and stainless steel bolting materials for

		high temperature service
ASTM-A345	-	Flat rolled electrical steel for magnetic applications
ASTM-A197	-	Cupola malleable iron
ANSI-B2.1	-	Pipe threads (Except dry seal)
ANSI-B16.1	-	Cast iron pipe flangesand glanged fitting. Class 25, 125, 250 and 800
ANSI-B16.1	-	Malleable iron threaded fittings, class 150 and 300
ANSI-B16.5	-	Pipe flanges and flanged fittings, steel nickel alloy and other special alloys
ANSI-B16.9	-	Factory-made wrought steel butt welding fittings
ANSI-B16.11	-	Forged steel fittings, socket-welding and threaded
ANSI-B16.14	-	Ferrous pipe plug, bushings and locknuts with piplethreads
ANSI-B16.25	-	Butt welding ends
ANSI-B18.1.1	-	Fire hose couplings screw thread.
ANSI-B18.2.1	-	Inch series square and hexagonal bolts and screws
ANSI-B18.2.2	-	Square and hexagonal nuts
NSI-B18.21.1	-	Lock washers
ANSI-B18.21.2	-	Plain washers
ANSI-B31.1	-	Power piping
ANSI-B36.10	-	Welded and seamless wrought steel pipe
ANSI-B36.9	-	Stainless steel pipe

Other Civil Works Standards

IS-269	-	33 grade ordinary portland cement.
IS2721	-	Galvanized steel chain link fence fabric
IS-278	-	Galvanized steel barbed wire for fencing.
IS-383	-	Coarse and fine aggregates from natural sources for concrete.
IS-432 (P1 and P2)	-	Mild steel and medium tensile steel bars and hard-dawn steel wire for concrete reinforcement.
IS-456	-	Code of practice for plain and reinforced concrete.

IS-516	-	Method of test for strength of concrete.
IS-800	-	Code of practice for general construction in steel.
IS-806	-	Steel tubes for structural purposes.
IS-1172	-	Basic requirements for water supply, drainage and sanitation.
IS-1199	-	Methods of sampling and analysis of concrete.
IS-1566	-	Hard-dawn steel wire fabric for concrete reinforcement.
IS-1742	-	Code of Practice for Building drainage.
IS-1785	-	Plain hard-drawn steel wire for prestressed concrete.
IS-1786	-	High strength deformed Steel Bars and wires for concrete reinforcement.
IS-1811	-	Methods of sampling Foundry sands.
IS-1893	-	Criteria for earthquake resistant design of structures.
IS-2062	-	Steel for general structural purposes.
IS-2064	-	Selection, installation and maintenance of sanitary appliances-code of practices.
IS-2065	-	Code of practice for water supply in buildings.
IS-2090	-	High tension steel bars used in prestressed concrete.
IS-2140	-	Standard Galvanized steel wire for fencing.
IS-2470 (P1 & P2)	-	Code of practice for installation of septic tanks.
IS-2514	-	Concrete vibrating tables.
IS-2645	-	Integral cement waterproofing compounds.
IS-3025 (Part 1 to Part 48)	-	Methods of sampling and test (Physical and chemical) for water and waste water.
IS-4091	-	Code of practice for design and construction of foundations for transmission line towers and poles.
IS-4111 (Part 1 to P5)	-	Code of practice for ancillary structures in sewerage system.
IS-4990	-	Plywood for concrete shuttering work.
IS-5600	-	Sewage and drainage pumps.

National Buiding Code of India 1970

USBR E12	-	Earth Manual by United States Department of the interior Bureau of Reclamation
ASTM-A392-81	-	Zinc/Coated steel chain link fence fabric
ASTM-D1557-80	-	test for moisture-density relation of soils using 10-lb (4.5 kg) rame land 18-in. (457 mm) Drop.
ASTM-D1586	-	Penetration Test and Split-Barrel
(1967)	-	Sampling of Soils
ASTM-D2049-69	-	Test Method for Relative Density of Cohesionless Soils
ASTM-D2435	-	Test method for Unconsolidated, (1982) Undrained Strengths of Cohesive Soils in Triaxial Compression.
BS-5075	-	Specification for accelerating Part I Admixtures, Retarding Admixtures and Water Reducing Admixtures.
CPWD	-	Latest CPWD specifications

ACSR MOOSE CONDUCTOR

IS:6745	Methods for Determination of BS:443-1969 Mass of zinc coating on zinc coated Iron and Steel Articles
IS:8263	Methods for Radio Interference
IEC:437-1973	Test on High Voltage Insulators NEMA:107-1964 CISPR
IS:209	Zinc Ingot BS:3436-1961
IS:398	Aluminum Conductors for IEC:209-1966
Part - V	Overhead Transmission Purposes
BS:215(Part-II)	Aluminium Conductors galvanized IEC:209-1966 steel reinforced extra high
BS:215(Part-II)	voltage (400 kV and above)
IS:1778	Reels and Drums forBS:1559-1949 Bare Conductors
IS:1521	Method for Tensile Testing ISO/R89-1959of steel wire

IS:2629	Recommended practice for Hot dip Galvanising on Iron and Steel.
IS:2633	Method for Testing Uniformity of coating of zinc Coated Articles.
IS:4826	Hot dip galvanised coatings on round steel wires ASTMA-472-729

GALVANISED STEEL EARTHWIRE

IS:1521	Method for Tensile Testing ISO/R:89-1959 of Steel Wire
IS:1778	Reels and Drums for Bare Conductors
IS:2629	Recommended practice for Hot Dip Galvanising on Iron and Steel.
IS:2633 Coated	Methods for testing Uniformity of Coating of Zinc Articles.
IS:4826	Hot dip Galvanised Coatings ASTM:A 475-72a on Round Steel Wires BS:443-1969
IS:6745	Method for Determination BS:443-1969of mass of Zinc Coating on Zinc coated Iron and Steel Articles.
IS:209	Zinc ingot BS:3463-1961
IS:398 (Pt. I to P5:1992)	Aluminum Conductors for BS:215 (Part-II) overhead transmission purposes.

Lighting Fixtures and Accessories

IS:1913	General and safety requirements for electric lighting fittings.
IS:3528	Water proof electric lighting fittings.
IS:4012	Dust proof electric lighting fittings.
IS:4013	Dust tight proof electric lighting fittings.
IS:10322	Industrial lighting fittings with metal reflectors.
IS:10322	Industrial lighting fittings with plastic reflectors.
IS:2206 mines	Well glass lighting fittings for use under ground in

	(non-flameproof type).
IS:10322	Specification for flood light.
IS:10322	Specification for decorative lighting outfits.
IS:10322	Luminaries for street lighting
IS:2418	Tubular fluorescent lamps
IS:9900	High pressure mercury vapour lamps.
IS:1258	Specification for Bayonet lamp fluorescent lamp.
IS:3323	Bi-pin lamp holder tubular fluorescent lamps.
IS:1534	Ballasts for use in fluorescent lighting fittings. (Part-I)
IS:1569	Capacitors for use in fluorescent lighting fittings.
IS:2215	Starters for fluorescent lamps.
IS:3324	Holders for starters for tubular fluorescent lamps
IS:418	GLS lamps
IS:3553	Water tight electric fittings
IS:2713	Tubular steel poles
IS:280	MS wire for general engg. Purposes

Conduits, Accessories and Junction Boxes

IS:9537	Rigid steel conduits for electrical wiring
IS:3480	Flexible steel conduits for electrical wiring
IS:2667	Fittings for rigid steel conduits for electrical wiring
IS:3837	Accessories for rigid steel conduits for electrical wiring
IS:4649	Adaptors for flexible steel conduits.
IS:5133	Steel and Cast Iron Boxes
IS:2629	Hot dip galvanising of Iron & Steel.

Lighting Panels

IS:13947	LV Switchgear and Control gear(Part 1 to 5)
IS:8828	Circuit breakers for over current protection for house hold
	and similar installations.
IS:5	Ready mix paints

IS:2551	Danger notice plates
IS:2705	Current transformers
IS:9224	HRC Cartridge fuse links for voltage above 650V(Part-2)
(7)IS:5082 and	Wrought aluminium and Al. alloys, bars, rods, tubes sections for electrical purposes.
(8)IS:8623 Gear	Factory built Assemblies of Switchgear and Control for voltages upto and including 1000V AC and 1200V DC.
(9)IS:1248	Direct Acting electrical indicating instruments

Electrical Installation

IS:1293 3	pin plug
IS:371	Two to three ceiling roses
IS:3854	Switches for domestic and similar purposes
IS:5216	Guide for safety procedures and practices in electrical work.
IS:732 (system	Code of practice for electrical wiring installation voltage not exceeding 650 Volts.)
IS:3043	Code of practice for earthing.
IS:3646	Code of practice of interior illumination part II & III.
IS:1944	Code of practice for lighting of public through fares.
IS:5571 hazardous	Guide for selection of electrical equipment for areas.
IS:800	Code of practice for use of structural steel in general building construction.
IS:2633 coated	Methods of Testing uniformity of coating on zinc articles.
IS:6005	Code of practice for phosphating iron and steel.
	INDIAN ELECTRICITY ACT
	INDIAN ELECTRICITY RULES

LT SWITCHGEAR

IS:8623 (Part-I) gear	Specification for low voltage switchgear and control assemblies
IS:13947 (Part-I) gear,	Specification for low voltage switchgear and control Part 1 General Rules
IS:13947 (part-2) gear,	Specification for low voltage switchgear and control Part 2 circuit breakers.
IS:13947 (part-3) gear.	Specification for low voltage switchgear and control Part 3 Switches, Disconnectors, Switch-disconnectors and fuse combination units
IS:13947 (part-4) gear.	Specification for low voltage switchgear and control Part 4 Contactors and motors starters.
IS:13947 (part-5) gear.	Specification for low voltage switchgear and control Part 5 Control-circuit devices and switching elements
IS:13947 (part-6) gear.	Specification for low voltage switchgear and control Part 6 Multiple function switching devices.
IS:13947 (part-7) gear.	Specification for low voltage switchgear and control Part 7 Ancillary equipments
IS:12063	Degree of protection provided by enclosures
IS:2705	Current Transformers
IS:3156	Voltage Transformers
IS:3231	Electrical relays for power system protection
IS:1248	Electrical indicating instruments
IS:722	AC Electricity meters
IS:5578	Guide for Marking of insulated conductors of apparatus terminals
IS:13703 (part 1) or	Low voltage fuses for voltage not exceeding 1000V AC 1500V DC Part 1 General Requirements
IS:13703 (part 2) or	Low voltage fuses for voltage not exceeding 1000V AC 1500V DC Part 2 Fuses for use of authorized persons

IS:6005	Code of practice of phosphating iron and steel
IS:5082	Wrought Aluminum and Aluminum alloys for electrical purposes
IS:2633	Hot dip galvanising

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.

Sl. No.	Page No.	Clause No.	Deviation	Reason / Justification

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 Sceening	
	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	
18.	Bedding Under the copper wire screen (Over the metal sheath)	
	i) Material & type	
	ii) 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 signals 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

Annexure -D

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 the 132 kV cable 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 132kV cabling system i.e. scope includes all materials and installation services i.e. cable installation only, termination/ jointing, clamping, testing and commissioning of the cable system, point to point, necessary to execute the work to the satisfaction of BHEL/UPPTCL. This includes all accessories required to complete the work in all respect.	Confirmed	Yes/ No
2.3	Any other item /service required for the execution for the complete 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 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 (located at first floor above cable cellar) & transformer cable	Confirmed	Yes/ No

	box end is in bidder's scope. The supply of 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 -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.	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 for justifying the size of the 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

Annexure -D

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 132 kV, 630 sq. mm XLPE Cable.	Confirmed	Yes/ No
6.4	Any cable or accessories damaged during installation, testing & commissioning shall be made good/ repaired/ replaced by	Confirmed	Yes/ No

	bidder to the satisfaction of BHEL/UPPTCL.		
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 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 and HV test) 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/PMC/ Owner.	Confirmed	Yes/ No
7.3	Bidder shall carry out the supervision of installation, field testing and commissioning of 132kV XLPE Cable & its accessories. Further appropriate test and commissioning reports and as-built documentation as necessary shall be	Confirmed	Yes/ No

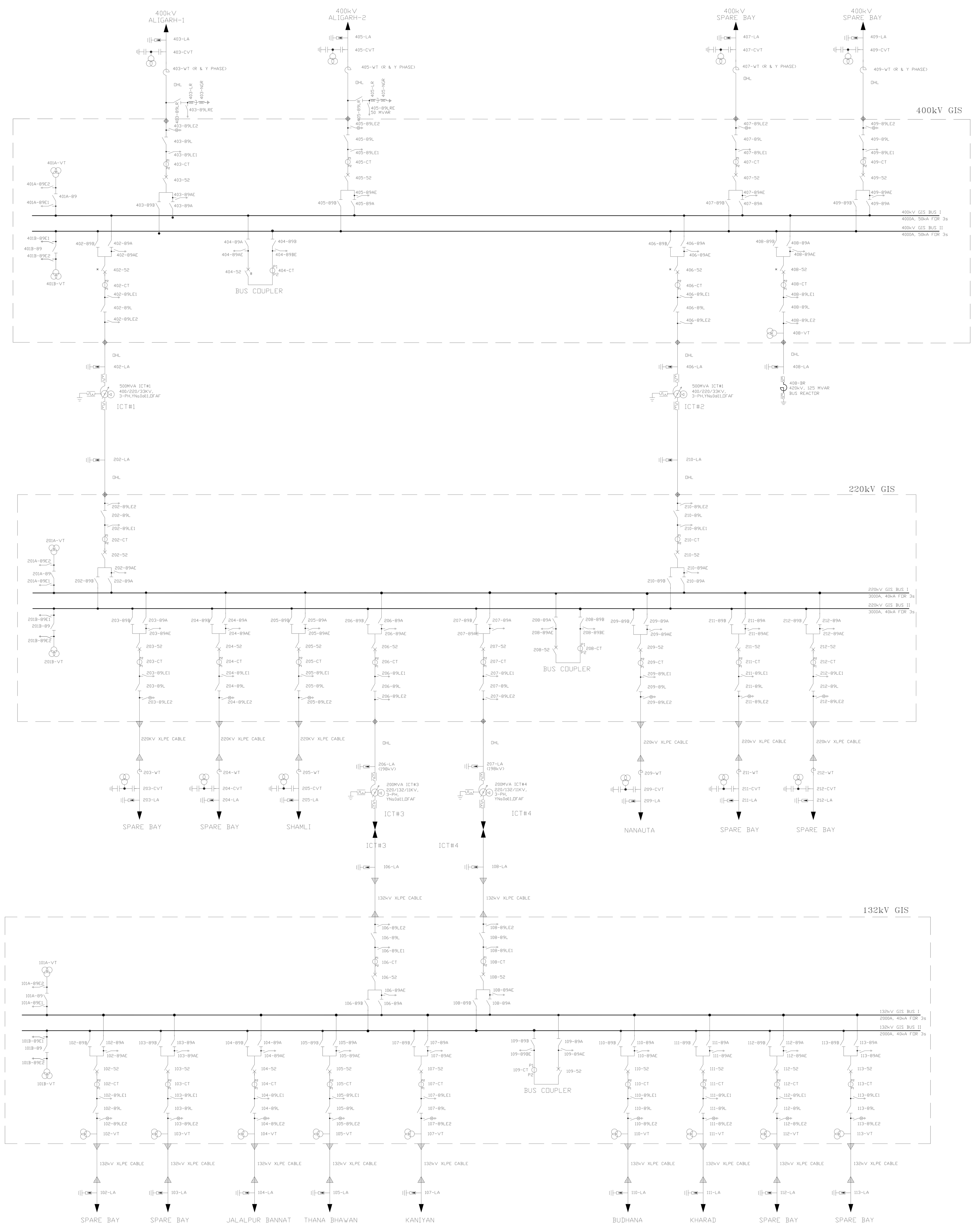
	submitted.		
7.4	Field testing and commissioning of 132kV cable & its accessories shall be done by Bidder/OEM only.	Confirmed	Yes/ No
7.5	Bidder shall also submit site acceptance testing (SAT) procedures and get them approved from BHEL/UPPTCL before carrying out the site testing at site.	Confirmed	Yes/ No
7.6	Bidder shall coordinate with manufacturers of other equipment wherever required and shall freely and readily supply all technical information for this purpose as and when called for.	Confirmed	Yes/ No
8	**Type Test Requirements**		
8.1	The 132kV Cabling system (132 kV XLPE Cables, cable termination/ jointing etc., shall be complete in all respect along with accessories should have been type tested as per relevant IEC 60840 / IEEE 48 standard. The cable termination/ jointing kit shall be of same make and type as that used in type test.	Confirmed	Yes/ No
8.2	Bidder shall ensure that the electrical equipment procured have valid type test certificates as per relevant IS/IEC from CPRI or any other accredited testing lab. Type test certificates for EHV XLPE Cable & Cable Jointing/ Termination Accessories for working voltage of 132kV shall not be more than five years old as on 07.09.18. In those cases, where type test certificates are more than five years old from 07.09.18, or reports not acceptable to customer, Bidder/manufacturer shall carry out the type tests at CPRI or any other accredited testing lab prior to dispatch of equipment with no commercial implication to BHEL/UPPTCL.	Confirmed, Enclosed with bid	Yes/ No
8.3	The Type Tests on 132kV System (XLPE Cables, cable joints, cable sealing end etc.) shall meet the requirements as per IEC.	Confirmed	Yes/ No
8.4	The type tests conducted earlier should have either been conducted in an accredited laboratory (accredited base on ISO / IEC Guide 25 / 17025 or EN 45001 by the national accreditation body of the country where laboratory is located). If the laboratory is not a national laboratory and member of STL, relevant papers of accreditation shall be submitted in English. If the laboratory is in-house, the tests should have been witnessed by an independent agency.	Confirmed	Yes/ No

Annexure -D

8.9	The short circuit test should have been conducted in a laboratory which should be a member of STL (Short-Circuit Testing Liaison-www.stl-liaison.org).	Confirmed	Yes/ No
8.10	The type test report shall be complete including list the test objects, photographs, oscillographs, test arrangement, drawing of tested objects (cables, accessories, etc), test connections. The type test report shall be in English. If it is in any other language, it should include an English version (Translation shall be attested by the Bidder). The English version should be complete with measured values and conclusion.	Confirmed	Yes/ No
8.12	In case any of Type tests have not been conducted on the offered design of 132kV XLPE cables & its accessories, there has been a change in the design after the type tests, the requisite tests shall be conducted by bidder on the offered design of GIS and relays without any extra cost and delivery impact to BHEL/UPPTCL.	Confirmed	Yes/ No
9	**Quality plan**		
9.1	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
10	**Inspection, testing & acceptance.**		
10.1	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
10.2	The test reports for all cables shall be got approved before despatch of the cables. For Further details, refer section-2.	Confirmed	Yes/ No

FIRST ANGLE PROJECTION (ALL DIMENSIONS ARE IN mm)

DRG. NO. TB-0-406-510-001



NOTES :

1. PRESENT
FUTURE/ SPARE
SF6/AIR BUSHING
OHL - OVERHEAD LINE
SF6/XLPE CABLE TERMINATION
2. ✳ - CB WITH CONTROLLED SWITCHING DEVICE IN ICT & BUS REACTOR BAYS.
\# - CB RATED 4000A IN BUS COUPLER BAYS

A. 400 kV OUTDOOR EQUIPMENT:-

S.N.	DESCRIPTION	SYMBOLS	LEGEND	BAY NO/LOCATION	UNIT	QTY
1.	500MVA, 400/220/33KV, YNa0d11, OFAF, 3-PH ICT		ICT	402, 406	NOS	02
2.	400kV, 125MVA, 3-PH BUS REACTOR		BR	408	NOS	01
3.	400kV, 1-PH, 8800pF CAPACITIVE VOLTAGE TRANFORMER		CVT	403,405,407,409	NOS	12
4.	390kV, 20kA, CLASS-IV, 1-PH, LIGHTNING ARRESTER		LA	402,403,405,406,407,408,409	NOS	21
5.	400kV, 3150A, 1.0mH, 1-PH, PEDESTAL TYPE WAVE TRAP ✳		WT	403, 405, 407, 409	NOS	08

'✳' WAVE TRAPS WOULD BE IN TWO PHASES OF LINES ONLY. CUSTOMER SHALL CONFIRM THOSE PHASES.

B. 400 kV INDOOR GIS:-

S.N.	DESCRIPTION	SYMBOLS	LEGEND	BAY NO/LOCATION	UNIT	QTY
1.	400kV, 4000A, 50kA FOR 3 SEC., 3-PH. CIRCUIT BREAKER		52	404	SETS	01
2.	400kV, 3150A, 50kA FOR 3 SEC., 3-PH. CIRCUIT BREAKER WITH PIR		52	403, 405	SETS	02
2.	400kV, 3150A, 50kA FOR 3 SEC., 3-PH. CIRCUIT BREAKER WITHOUT PIR		52	407, 409	SETS	02
3.	400kV, 3150A, 50kA FOR 3 SEC., 3-PH. CIRCUIT BREAKER WITH CSD		52	402, 406, 408	SETS	03
4.	400kV, 4000A, 50kA FOR 3 SEC., 3-PH., GROUP OPERATED DISCONNECTING SWITCH		89A 89B	404 404	SETS	02
5.	400kV, 3150A, 50kA FOR 3 SEC., 3-PH., GROUP OPERATED DISCONNECTING SWITCH		89A 89B 89L	403, 405, 407, 409 403, 405, 407, 409 403, 405, 407, 409	SETS	12
6.	400kV, 2000A, 50kA FOR 3 SEC., 3-PH. GROUP OPERATED DISCONNECTING SWITCH		89 89A 89B 89L	401A, 401B 402, 406, 408 402, 406, 408 402, 406, 408	SETS	11
7.	EARTH SWITCH, 3-PH, GROUP OPERATED		89E1 89E2 89AE 89BE 89LE1 89LE2	401A, 401B 401A, 401B 402, 403, 404, 405, 406, 407, 408, 409 404 402, 403, 404, 405, 407, 408, 409 402, 406, 408	SETS	23
8.	HIGH SPEED EARTHING SWITCH, 3-PH, GROUP OPERATED		89LE2	403, 405, 407, 409	SETS	4
9.	400kV, 3000A, 50kA FOR 3 SEC, 1-PH., 5-CORE CURRENT TRANSFORMER WITH 120% EXTENDED CURRENT RATING		CT	402, 403, 404, 405, 406, 407, 408, 409.	NOS.	24
10.	400kV, 1-PH. VOLTAGE TRANSFORMER		VT	401A, 401B, 408	NOS.	09

A. 220 kV OUTDOOR EQUIPMENT:-

S.N.	DESCRIPTION	SYMBOLS	LEGEND	BAY NO/LOCATION	UNIT	QTY
1.	200MVA, 220/132/11KV, YNa0d11, OFAF, 3-PH ICT		ICT	206, 207	NOS	02
2.	220kV, 1-PH, 4400pF CAPACITIVE VOLTAGE TRANFORMER		CVT	203, 204, 205, 209, 211, 212	NOS	18
3.	216kV, 10kA, CLASS-III, 1-PH, LIGHTNING ARRESTER		LA	203, 204, 205, 209, 211, 212	NOS	18
4.	198kV, 10kA, CLASS-III, 1-PH, LIGHTNING ARRESTER		LA	202, 206, 207, 210	NOS	12
5.	220kV, 1600A, 0.5mH, 1-PH, PEDESTAL TYPE WAVE TRAP ✳		WT	203, 204, 205, 209, 211, 212	NOS	12

'✳' WAVE TRAPS WOULD BE IN TWO PHASES OF LINES ONLY. CUSTOMER SHALL CONFIRM THOSE PHASES.

B. 220 kV INDOOR GIS:-

S.N.	DESCRIPTION	SYMBOLS	LEGEND	BAY NO/LOCATION	UNIT	QTY
1.	220kV, 3150A, 40kA FOR 3 SEC., 3-PH. CIRCUIT BREAKER		52	202,203,204,205,206,207,208,209,210,211,212	SETS	11
2.	220kV, 3150A, 40kA FOR 3 SEC., 3 PH., GROUP OPERATED DISCONNECTING SWITCH		89A 89B	208 208	SETS	02
3.	220kV, 2000A, 40kA FOR 3 SEC., 3 PH. GROUP OPERATED DISCONNECTING SWITCH		89 89A 89B 89L	201A, 201B 202, 203, 204, 205, 206, 207, 209, 210, 211, 212 202, 203, 204, 205, 206, 207, 209, 210, 211, 212 202, 203, 204, 205, 206, 207, 209, 210, 211, 212	SETS	32
4.	EARTH SWITCH, 3-PH		89E1 89E2 89AE 89BE 89LE1 89LE2	201A, 201B 201A, 201B 202, 203, 204, 205, 206, 207, 208, 209, 210, 211, 212 208 202, 203, 204, 205, 206, 207, 209, 210, 211, 212 202, 206, 207, 210	SETS	30
5.	HIGH SPEED EARTHING SWITCH, 3-PH		89LE2	203, 204, 205, 209, 211, 212	SETS	6
6.	220kV, 2000A, 40kA FOR 1 SEC, 1-PH., 5-CORE CURRENT TRANSFORMER WITH 120% EXTENDED CURRENT RATING		CT	202, 203, 204, 205, 206, 207, 208, 209, 210, 211, 212	NOS.	33
7.	220kV, 1-PH. VOLTAGE TRANSFORMER		VT	201A, 201B	NOS.	06

A. 132 kV OUTDOOR EQUIPMENT:-

S.N.	DESCRIPTION	SYMBOLS	LEGEND	BAY NO/LOCATION	UNIT	QTY
1.	120kV, 10kA, CLASS-III, 1-PH, LIGHTNING ARRESTER		LA	102, 103, 104, 105, 106, 107, 108, 110. 111, 112, 113	NOS	33

B. 132 kV INDOOR GIS:-

S.N.	DESCRIPTION	SYMBOLS	LEGEND	BAY NO/LOCATION	UNIT	QTY
1.	132kV, 2500A, 40kA FOR 1 SEC., 3-PH. CIRCUIT BREAKER		52	109	SETS	01
2.	132kV, 1600A, 40kA FOR 1 SEC., 3-PH. CIRCUIT BREAKER		52	102, 103, 104, 105, 106, 107, 108, 110, 111, 112, 113	SETS	11
3.	132kV, 1600A, 40kA FOR 1 SEC., 3-PH. DISCONNECTING SWITCH		89 89A 89B 89L	101A, 101B 102, 103, 104, 105, 106, 107, 108, 109, 110, 111, 112, 113 102, 103, 104, 105, 106, 107, 108, 109, 110, 111, 112, 113 102, 103, 104, 105, 106, 107, 108, 110, 111, 112, 113	SETS	37
4.	EARTH SWITCH, 3-PH		89E1 89E2 89AE 89BE 89LE1 89LE2	101A, 101B 101A, 101B 101, 102, 103, 104, 106, 107, 108, 109, 110, 111, 112, 113 109 102, 103, 104, 105, 106, 107, 108, 110, 111, 112, 113 106, 108	SETS	30
5.	HIGH SPEED EARTHING SWITCH, 3-PH		89LE2	102, 103, 104, 105, 107, 110, 111, 112, 113	SETS	9
6.	132kV, 1000A, 40kA FOR 1 SEC, 1-PH., 5-CORE CURRENT TRANSFORMER WITH 120% EXTENDED CURRENT RATING		CT	102, 103, 104, 105, 106, 107, 108, 110, 111, 112, 113	NOS.	33
7.	132kV, 1600A, 40kA FOR 1 SEC, 1-PH., 5-CORE CURRENT TRANSFORMER WITH 120% EXTENDED CURRENT RATING		CT	109	NOS.	03
8.	132kV, 1-PH. VOLTAGE TRANSFORMER		VT	101A, 101B	NOS.	01

400 kV SYSTEM PARAMETERS:-

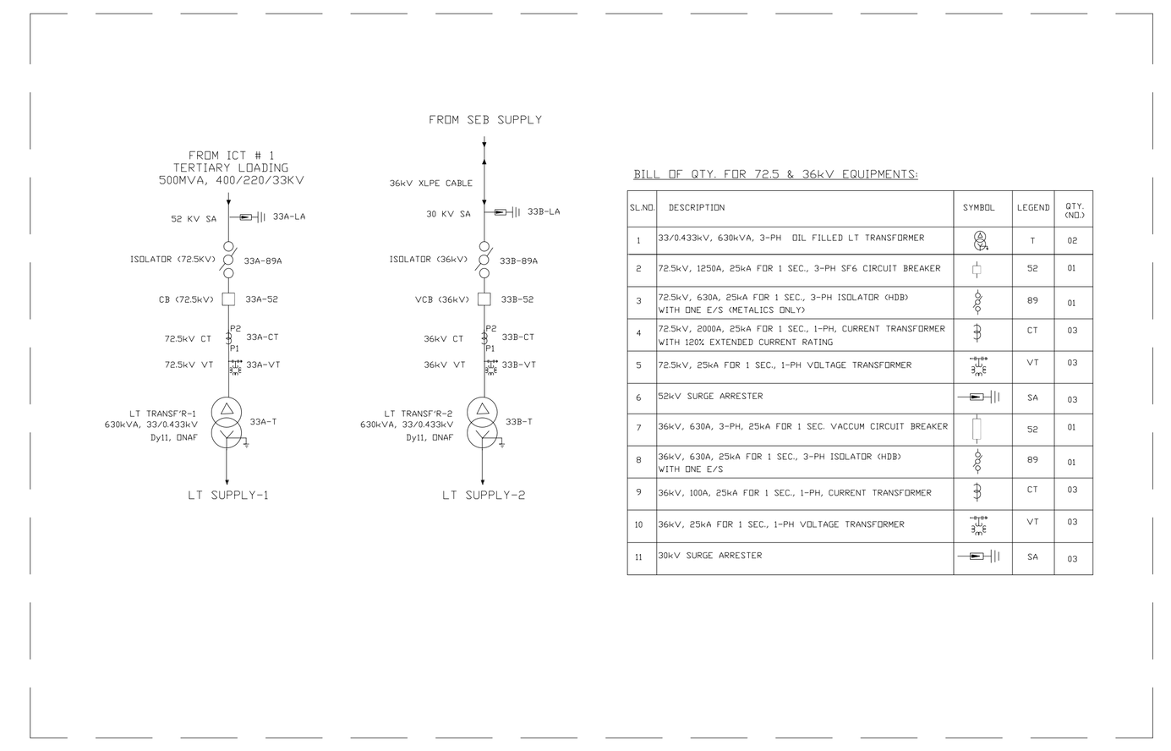
S.N.	SYSTEM PARAMETERS	400kV
1.	NOMINAL VOLTAGE	400kV
2.	HIGHEST SYSTEM VOLTAGE	420kV
3.	RATED FREQUENCY	50Hz
4.	RATED SHORT TIME CURRENT	50kA for 3sec.
5.	POWER FREQUENCY WITHSTAND VOLTAGE	650kV (rms)
6.	LIGHTNING IMPULSE WITHSTAND VOLTAGE	±1425 kV peak
7.	SWITCHING IMPULSE WITHSTAND VOLTAGE	±1050 kV peak
8.	CREEPAGE	25mm/kV (10500 mm)
9.	GROUNDING	Effectively earthed

220 kV SYSTEM PARAMETERS:-

S.N.	SYSTEM PARAMETERS	220kV
1.	NOMINAL VOLTAGE	220kV
2.	HIGHEST SYSTEM VOLTAGE	245kV
3.	RATED FREQUENCY	50Hz
4.	RATED SHORT TIME CURRENT	40kA for 3sec.
5.	POWER FREQUENCY WITHSTAND VOLTAGE	460kV (rms)
6.	LIGHTNING IMPULSE WITHSTAND VOLTAGE	±1050 kV peak
7.	SWITCHING IMPULSE WITHSTAND VOLTAGE	N.A.
8.	CREEPAGE	25mm/kV (6125 mm)
9.	GROUNDING	Effectively earthed

132 kV SYSTEM PARAMETERS:-

S.N.	SYSTEM PARAMETERS	132kV
1.	NOMINAL VOLTAGE	132kV
2.	HIGHEST SYSTEM VOLTAGE	145kV
3.	RATED FREQUENCY	50Hz
4.	RATED SHORT TIME CURRENT	40kA for 3 sec.
5.	POWER FREQUENCY WITHSTAND VOLTAGE	275kV (rms)
6.	LIGHTNING IMPULSE WITHSTAND VOLTAGE	±650 kV peak
7.	SWITCHING IMPULSE WITHSTAND VOLTAGE	N.A.
8.	CREEPAGE	25mm/kV (3625 mm)
9.	GROUNDING	EFFECTIVELY EARTHED



LOI No. 1311/ESD-8/126/III/400kV SHAMLI Dated: 14.11.2018

REFERENCE DRG.:- TENDER SINGLE LINE DIAGRAM 400/220/132kV GIS S/S

PROJECT: 400/220/132kV GIS SUBSTATION AT SHAMLI (U.P.)

CUSTOMER: UTTAR PRADESH TRANSMIISSIION CORPORATIION LIMITED

REV.	DATE	ALTERED	CHD/APPD	ZONE	NOTES
02	15.03.19	SY	MSP/SKS		1. EARTHING SWITCHES IN 400KV BUS VT, 125MVAR BUS RAECTOR, 500MVA ICT O/G FEEDER ADDED AS PER CONTRACT. 2. EARTHING SWITCHES IN 500MVA ICT I/C, 220KV BUS VT,200MVA ICT O/G FEEDER ADDED AS PER CONTRACT. 3. EARTHING SWITCHES IN 200MVA ICT I/C, 132KV BUS VT, ADDED AS PER CONTRACT. 4. 50MVAR LINE REACTOR CT PARAMETERS REVISED AS PER BHEL BHOPAL INPUT.
01	18.01.19	SY	MSP/SKS		1. HIGH SPEED SWITCHES IN 400KV BUS VT, 125MVAR BUS RAECTOR, 500MVA ICT O/G FEEDER REMOVED AS PER CONTRACT. 2. HIGH SPEED SWITCHES IN 500MVA ICT I/C, 220KV BUS VT,200MVA ICT O/G FEEDER REMOVED AS PER CONTRACT. 3. HIGH SPEED SWITCHES IN 200MVA ICT I/C, 132KV BUS VT, REMOVED AS PER CONTRACT. 4. 125MVAR BUS REACTOR CT PARAMETERS REVISED AS PER BHEL BHOPAL INPUT.

भारत हैवी इलेक्ट्रिकल्स लिमिटेड
BHARAT HEAVY ELECTRICALS LTD.
TRANSMISSION BUSINESS GROUP
NOIDA

	NAME	SIGN.	DATE	NO.OF VAR.
DRN.	SY		25.10.19	N.A.
CHD.	MSP			
APPD.	SKS			

DEPT.	UNTOL. DIMS. GR.	SCALE	WEIGHT (KG)	REF. TO ASSY. DRG.	ITEM NO.	NO.OF ITEMS
TBG	g/M/f	N.T.S	N.A.	N.A.	N.A.	N.A.

TITLE: SINGLE LINE DIAGRAM 400/220/132kV GIS SUB STATION

CARD CODE: NA
DRG.NO. TB-0-406-510-001
REV. 02
SHT. No 01 NO. OF SHT. 02
SIZE-A0

400kV GIS CT DETAILS

Core No.	Current Ratio	Output Burden (VA) at	Minimum KPV (Volts)	Max Ie (mA) at KPV	Maximum Rct (Ohms)	Accuracy Class	Purpose
1	3000-2000-1000/1 A	-	3000-2000-1000	20-30-60	15-10-5	PS	Protection
2	3000-2000-1000/1 A	-	3000-2000-1000	20-30-60	15-10-5	PS	Protection
3	3000-2000-1000-500/1 A	20	-	-	-	0.2s, ISF ≤ 5	Metering
4	3000-2000-1000-500/1 A	-	6000-4000-2000-1000	20-30-60-120	15-10-5-2.5	PS	Protection
5	3000-2000-1000-500/1 A	-	6000-4000-2000-1000	20-30-60-120	15-10-5-2.5	PS	Protection

400kV GIS VT DETAILS

Winding No.	Ratio	Accuracy Class	Rated Burden (VA)	Purpose
1	(400 kV/√3) / (110V/√3)	3P	50	Protection
2	(400 kV/√3) / (110V/√3)	3P	50	Protection
3	(400 kV/√3) / (110V/√3)	0.2	50	Metering

400kV, 8800pF (+10%, -5%) OUTDOOR CVT DETAILS

Winding No.	Ratio	Accuracy Class	Rated Burden (VA)	Purpose
1	(400 kV/√3) / (110V/√3)	3P	50	Protection
2	(400 kV/√3) / (110V/√3)	3P	50	Protection
3	(400 kV/√3) / (110V/√3)	0.2	50	Metering

220kV GIS CT DETAILS

Core No.	Current Ratio	Output Burden (VA) at lowest Tap	Minimum KPV (Volts)	Max Ie (mA) at KPV	Maximum Rct (Ohms)	Accuracy Class	Purpose
1	2000-1600-1000-500/1 A	-	2000-1600-1000-500	30-37.5-60-120	10-8-5-2.5	PS	Protection
2	2000-1600-1000-500/1 A	-	2000-1600-1000-500	30-37.5-60-120	10-8-5-2.5	PS	Protection
3	2000-1600-1000-500/1 A	20	-	-	-	0.2s, ISF ≤ 5	Metering
4	2000-1600-1000-500/1 A	-	2000-1600-1000-500	30-37.5-60-120	10-8-5-2.5	PS	Protection
5	2000-1600-1000-500/1 A	-	2000-1600-1000-500	30-37.5-60-120	10-8-5-2.5	PS	Protection

220kV GIS VT DETAILS

Winding No.	Ratio	Accuracy Class	Rated Burden (VA)	Purpose
1	(220 kV/√3) / (110V/√3)	3P	50	Protection
2	(220 kV/√3) / (110V/√3)	3P	50	Protection
3	(220 kV/√3) / (110V/√3)	0.2	50	Metering

220kV, 4400pF (+10%, -5%) OUTDOOR CVT DETAILS

Winding No.	Ratio	Accuracy Class	Rated Burden (VA)	Purpose
1	(220 kV/√3) / (110V/√3)	3P	50	Protection
2	(220 kV/√3) / (110V/√3)	3P	50	Protection
3	(220 kV/√3) / (110V/√3)	0.2	50	Metering

132kV GIS VT DETAILS

Winding No.	Ratio	Accuracy Class	Rated Burden (VA)	Purpose
1	(132 kV/√3) / (110V/√3)	3P	50	Protection
2	(132 kV/√3) / (110V/√3)	3P	50	Protection
3	(132 kV/√3) / (110V/√3)	0.2	50	Metering

500 MVA, 400/220/33kV ICT BUSHING CT DETAILS

400kV SIDE BUSHING CT

Core No.	Current Ratio	Output Burden (VA) at lowest Tap	Minimum KPV (Volts)	Max Ie (mA) at KPV	Maximum Rct (Ohms)	Accuracy Class	Purpose
1	1600/1 A	-	1600	25	4	PS	REF
2	1000/1 A	30	-	-	-	0.2, ISF ≤ 5	Metering

220kV SIDE BUSHING CT

Core No.	Current Ratio	Output Burden (VA) at lowest Tap	Minimum KPV (Volts)	Max Ie (mA) at KPV	Maximum Rct (Ohms)	Accuracy Class	Purpose
1	1600/1 A	-	1600	25	4	PS	REF
2	1600/1 A	30	-	-	-	0.2, ISF ≤ 5	Metering

NEUTRAL SIDE BUSHING CT

Core No.	Current Ratio	Output Burden (VA) at lowest Tap	Minimum KPV (Volts)	Max Ie (mA) at KPV	Maximum Rct (Ohms)	Accuracy Class	Purpose
1	1600/1 A	-	1600	25	4	PS	REF

125MVAR, 400kV SHUNT REACTOR BUSHING CT DETAILS

400kV SHUNT REACTOR (LINE SIDE)

Core No.	Current Ratio	Output Burden (VA) at lowest Tap	Minimum KPV (Volts)	Max Ie (mA) at KPV/2	Maximum Rct (Ohms)	Accuracy Class	Purpose
1	200/1 A	-	200	100	1	PS	REACTOR DIFF
2	200/1 A	-	200	100	1	PS	REF
3	200/1 A	15	-	-	-	PS	REACTOR BACK-UP

400kV SHUNT REACTOR (NEUTRAL SIDE)

Core No.	Current Ratio	Output Burden (VA) at lowest Tap	Minimum KPV (Volts)	Max Ie (mA) at KPV/2	Maximum Rct (Ohms)	Accuracy Class	Purpose
1	200/1 A	-	200	100	1	PS	REACTOR DIFF
2	200/1 A	-	200	100	1	PS	REF
3	500/1 A	10	-	-	-	0.2, ISF ≤ 5	METERING
4	172/2.2-2.0-1.8-1.6 A	10	-	-	-	5	WTI CT (Y-PH ONLY)

200 MVA, 220/132/11 kV ICT BUSHING CT DETAILS

220kV SIDE BUSHING CT

Core No.	Current Ratio	Output Burden (VA) at lowest Tap	Minimum KPV (Volts)	Max Ie (mA) at KPV/2	Maximum Rct (Ohms)	Accuracy Class	Purpose
1	1000/1 A	-	1000	40	5	PS	REF

132kV SIDE BUSHING CT

Core No.	Current Ratio	Output Burden (VA) at lowest Tap	Minimum KPV (Volts)	Max Ie (mA) at KPV/2	Maximum Rct (Ohms)	Accuracy Class	Purpose
1	1000/1 A	-	1000	40	5	PS	REF

NEUTRAL SIDE BUSHING CT

Core No.	Current Ratio	Output Burden (VA) at lowest Tap	Minimum KPV (Volts)	Max Ie (mA) at KPV/2	Maximum Rct (Ohms)	Accuracy Class	Purpose
1	1000/1 A	-	1000	40	5	PS	REF

11kV TERTIARY BUSHING CT

Core No.	Current Ratio	Output Burden (VA) at lowest Tap	Minimum KPV (Volts)	Max Ie (mA) at KPV/4	Maximum Rct (Ohms)	Accuracy Class	Purpose
1	2500/1 A	-	600	30	5	PS	DIFF
2	2500/1 A	-	300	40	5	PS	SPARE
3	2500/1 A	30	-	-	5	1	METERING

132kV GIS CT DETAILS (BUS COUPLER BAY)

Core No.	Current Ratio	Output Burden (VA) at lowest Tap	Minimum KPV (Volts)	Max Ie (mA) at KPV	Maximum Rct (Ohms)	Accuracy Class	Purpose
1	1600-800-400/1 A	-	1600-800-400	25-50-100	8-4-2	PS	Protection
2	1600-800-400/1 A	-	1600-800-400	25-50-100	8-4-2	PS	Protection
3	1600-800-400/1 A	20	-	-	-	0.2s, ISF ≤ 5	Metering
4	1600-800-400/1 A	-	1600-800-400	25-50-100	8-4-2	PS	Protection
5	1600-800-400/1 A	-	1600-800-400	25-50-100	8-4-2	PS	Protection

132kV GIS CT DETAILS (LINE & TRF BAY)

Core No.	Current Ratio	Output Burden (VA) at lowest Tap	Minimum KPV (Volts)	Max Ie (mA) at KPV	Maximum Rct (Ohms)	Accuracy Class	Purpose
1	1000-500-250/1 A	-	1000-500-250	25-50-100	5-2.5-1.25	PS	Protection
2	1000-500-250/1 A	-	1000-500-250	25-50-100	5-2.5-1.25	PS	Protection
3	1000-500-250/1 A	20	-	-	-	0.2s, ISF ≤ 5	Metering
4	1000-500-250/1 A	-	1000-500-250	25-50-100	5-2.5-1.25	PS	Protection
5	1000-500-250/1 A	-	1000-500-250	25-50-100	5-2.5-1.25	PS	Protection

50MVAR, 400kV SHUNT REACTOR BUSHING CT DETAILS

400kV SHUNT REACTOR (LINE SIDE)

Core No.	Current Ratio	Output Burden (VA) at lowest Tap	Minimum KPV (Volts)	Max Ie (mA) at KPV/2	Maximum Rct (Ohms)	Accuracy Class	Purpose
1	200/1 A	-	200	100	1	PS	REACTOR DIFF
2	200/1 A	-	200	100	1	PS	REF
3	200/1 A	15	-	-	-	5P20	REACTOR BACK-UP
4	500/1 A	10	-	-	-	0.2, ISF ≤ 5	METERING

400kV SHUNT REACTOR (NEUTRAL SIDE)

Core No.	Current Ratio	Output Burden (VA) at lowest Tap	Minimum KPV (Volts)	Max Ie (mA) at KPV/2	Maximum Rct (Ohms)	Accuracy Class	Purpose
1	2000-1000-500/1 A	-	1000-500-250	30-15-8	10-5-2.5	PS	LINE PROTN
2	2000-1000-500/1 A	-	1000-500-250	30-15-8	10-5-2.5	PS	LINE PROTN
3	200/1 A	-	200	100	1	PS	REACTOR DIFF
4	69/2.3-1.9-1.5	10	-	-	-	5	WTI CT (Y-PH ONLY)

50MVAR, 400kV SHUNT REACTOR NGR BUSHING CT DETAILS

400kV NGR (LINE SIDE)

Core No.	Current Ratio	Output Burden (VA) at lowest Tap	Minimum KPV (Volts)	Max Ie (mA) at KPV/2	Maximum Rct (Ohms)	Accuracy Class	Purpose
1	200/1 A	-	200	100	1	PS	SPARE

400kV NGR (NEUTRAL SIDE)

Core No.	Current Ratio	Output Burden (VA) at lowest Tap	Minimum KPV (Volts)	Max Ie (mA) at KPV/2	Maximum Rct (Ohms)	Accuracy Class	Purpose
3	200/1 A	-	200	100	1	PS	REF

REV.	DATE	ALTERED	CHD/APPD
02	15.03.19	SY	MSP/SKS
01	18.01.19	SY	MSP/SKS

ZONE

1. EARTHING SWITCHES IN 400KV BUS VT, 125MVAR BUS RAECTOR, 500MVA ICT O/G FEEDER ADDED AS PER CONTRACT.
2. EARTHING SWITCHES IN 500MVA ICT I/C, 220KV BUS VT,200MVA ICT O/G FEEDER ADDED AS PER CONTRACT.
3. EARTHING SWITCHES IN 200MVA ICT I/C, 132KV BUS VT, ADDED AS PER CONTRACT.
4. 50MVAR LINE REACTOR CT PARAMETERS REVISED AS PER BHEL BHOPAL INPUT.

ZONE

1. HIGH SPEED SWITCHES IN 400KV BUS VT, 125MVAR BUS RAECTOR, 500MVA ICT O/G FEEDER REMOVED AS PER CONTRACT.
2. HIGH SPEED SWITCHES IN 500MVA ICT I/C, 220KV BUS VT,200MVA ICT O/G FEEDER REMOVED AS PER CONTRACT.
3. HIGH SPEED SWITCHES IN 200MVA ICT I/C, 132KV BUS VT, REMOVED AS PER CONTRACT.
4. 125MVAR BUS REACTOR CT PARAMETERS REVISED AS PER BHEL BHOPAL INPUT.

LOI No. 1311/ESD-8/126/III/400kV SHAMLI Dated: 14.11.2018

REFERENCE DRG.:- TENDER SINGLE LINE DIAGRAM 400/220/132kV GIS S/S

PROJECT:

400/220/132kV GIS SUBSTATION AT SHAMLI (U.P.)

CUSTOMER:

UTTAR PRADESH TRANSMIISSIION CORPORATIION LIMITED

BHARAT HEAVY ELECTRICALS LTD.
TRANSMISSION BUSINESS GROUP
NOIDA

	NAME	SIGN.	DATE
DRN.	PK		25.10.2018
CHD.	MPS/SKS		
APPD.	AG		

NO.OF VAR. N.A.

DEPT.	UNTOL. DIMS.		SCALE	WEIGHT (KG)	REF. TO ASSY. DRG.	ITEM NO.	NO.OF ITEMS
TBG	GR.		N.T.S	N.A.	N.A.	N.A.	N.A.
CODE	C/M/F						

TITLE: SINGLE LINE DIAGRAM 400/220/132kV GIS SUB STATION

CARD CODE: NA

DRG.NO. TB-0-406-510-001

REV. 02

SHT. No 02 NO. OF SHT. --

SIZE-A0

FIRST ANGLE PROJECTION (ALL DIMENSIONS ARE IN MM.)

DRG. NO. TB-0-406-510-002

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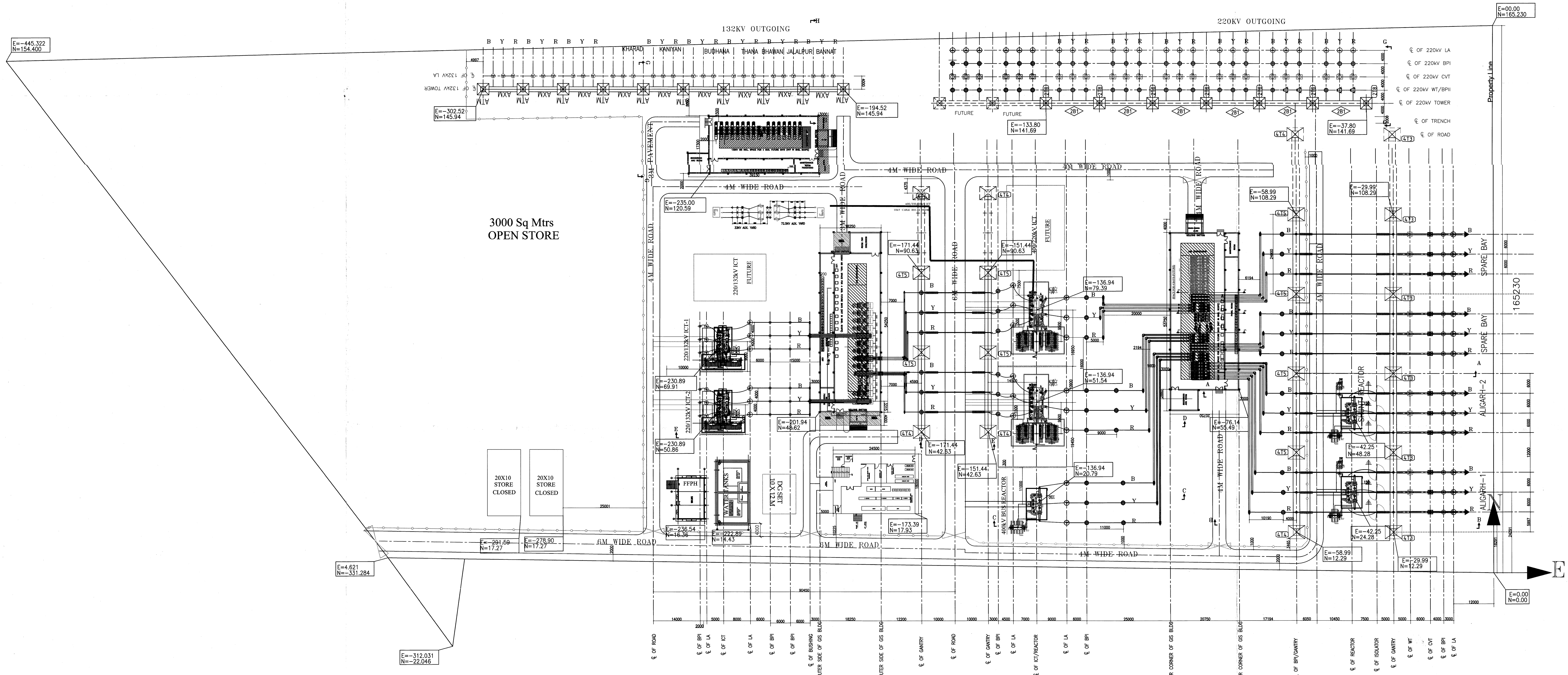


REFERENCE DRAWINGS:

1. TENDER SPECIFICATION REF: ESD-8/126
2. APPROVED ESLD DOC NO: TB-0-406-510-001 Rev 02

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE SPECIFIED.
2. DEPTH OF INDIVIDUAL TRANSFORMER (500MVA, 200MVA) SOAK PIT WILL BE 600MM BELOW THE FGL. THE TOP OF SOAK PIT SHALL BE PROVIDED WITH MS FLAT GRATING SUPPORTED BY ISMB/ISMC SECTION. ON THE ABOVE GARTING 40 MM METAL SPREADING FOR 100MM THICK SHALL BE PROVIDED .
3. DETAILS DESIGN OF INDIVIDUAL SOAK PIT AND COMMON CENTRAL OIL COLLECTING PIT SHALL BE SHOWN IN SEPARATE CIVIL DRAWING.
4. EQUIPMENT DIMENSIONS ARE TENTATIVE & SUBJECT TO CHANGE AFTER APPROVAL OF FINAL DOCUMENTS. SAME SHALL BE INCORPORATED SUBSEQUENTLY.
5. SPACE FOR 4 No FUTURE BAYS (NOT IN BHEL SCOPE OF SUPPLY) IS SHOWN IN 400kV/220kV/132kV GIS BUILDING.
6. ALL EQUIPMENT DIMENSIONS ARE TENTATIVE & FINAL DIMENSIONS SHALL BE AS PER MANUFACTURER DRAWING.
7. TYPE OF CONDUCTOR SHALL BE AS PER APPROVED CONDUCTOR SIZING CALCULATION, SHORT CIRCUIT CALCULATIONS & STRUCTURE LOADING DIAGRAM.
8. CONTROL BUILDING DIMENSION & ROOMS PLAN/ARCHITECTURE SHALL BE AS PER APPROVED CONCEPTUAL DRAWING.
9. CABLE TRENCH/CABLING LAYOUT DRAWING SHALL BE SUBMITTED SEPERATELY.
10. IPS ALUMINUM TUBE SHALL BE USED FOR CONNECTIONS AS SHOWN IN THE SECTION SHALL BE 4 INCH FOR 400KV/220KV.
11. FOR 220KV OUTDOOR FEEDERS, LA & BPI SHALL BE IN BHEL SCOPE. WAVE TRAP & CVT SHALL BE CUSTOMER SCOPE AS PER TENDER BOQ.

(2)

Layout approved for R-2 revision only.

Office of The Superintending Engineer
Electricity 765/400KV Substation Design Circle-II
UP Power Transmission Corporation Limited
11th Floor,, Shakti Bhawan Extn. Lucknow
APPROVED
AE EE SE

REF. DRG. NO.	TITLE
	TENDER SINGLE LINE DIAGRAM 400/220/132kV GIS S/S

LOI NO. : 1311/ESD-8/126/III/400kV SHAMLI dated 14.11.2018

ADDITIONAL INFORMATION
W.O.No.
STATUS OF DRAWING CONTRACT
DISTRIBUTION OF PRINTS

ग्राहक/परियोजना का नाम
NAME OF CUSTOMER / PROJECT
UPPTCL
UTTAR PRADESH POWER TRANSMIISSIION CORPORATIION LIMITED
400/220/132kV GIS SUBSTATION AT SHAMLI, (U.P.)

भारत हेवी इलेक्ट्रिकल्स लिमिटेड
ट्रांसमिशन परियोजना विभाग
BHARAT HEAVY ELECTRICALS LTD.
TRANSMISSION PROJECTS DIVISION

	नाम /NAME	हस्ता./SIGN.	दि./DATE
बनाया DRAWN	SY	-SIGNED-	24.04.19
जाँचा CHECKED	MSP	-SIGNED-	24.04.19
स्वीकृत APPROVED	SKS	-SIGNED-	24.04.19

REV.	DATE	ALTERED / CHECKED / APPROVED
02	26.04.19	ALTERED SY / CHECKED MSP / APPROVED SKS

ZONE: DRAWING REVISED IN LINE WITH -REVISED COORDINATES AS PER JOINT SURVEY WITH UPPTCL SHAMLI CIVIL -COORDINATES BEING SHOWN ON THE DRAWING

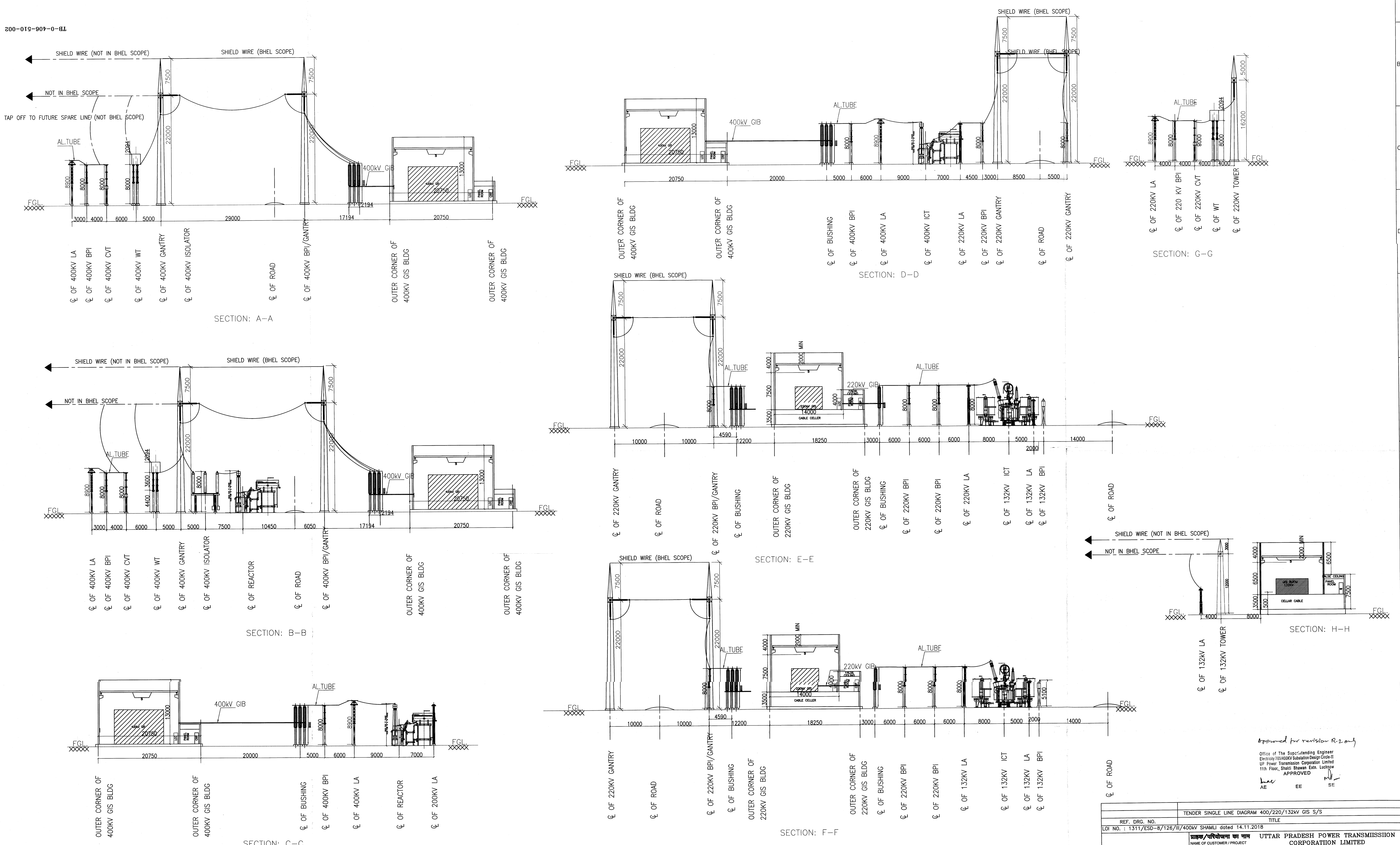
विभाग DEPT. TBEM
कोड CODE 422
अनुपात / SCALE
कार्ड कोड CARD CODE

शीर्षक/TITLE
400/220/132KV ELECTRICAL LAYOUT-SHAMLI

ड्राइंग.क्र./DRAWING NO. TB-0-406-510-002
पुनः/REV. 02
पृष्ठ क्र./SHEET No.01 अगला पृष्ठ /NEXT SHEET 02

FIRST ANGLE PROJECTION (ALL DIMENSIONS ARE IN MM.)

DRG. NO. TB-0-406-510-002



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Approved for revision R-2 only

Office of The Superintending Engineer
Electricity 765/400KV Substation Design Circle-II
UP Power Transmission Corporation Limited
11th Floor, Shakti Bhawan Extn. Lucknow
APPROVED

AE EE SE

	TENDER SINGLE LINE DIAGRAM 400/220/132kV GIS S/S
REF. DRG. NO.	TITLE

LOI NO. : 1311/ESD-8/126/III/400kV SHAMLI dated 14.11.2018

ग्राहक/परियोजना का नाम
NAME OF CUSTOMER / PROJECT
UTTAR PRADESH POWER TRANSMIISSIION CORPORATIION LIMITED
400/220/132kV GIS SUBSTATION AT SHAMLI, (U.P.)

UPPTCL

ADDITIONAL INFORMATION
W.O.No.

STATUS OF DRAWING CONTRACT

DISTRIBUTION OF PRINTS

भारत हेवी इलेक्ट्रिकल्स लिमिटेड
ट्रांसमिशन परियोजना विभाग
BHARAT HEAVY ELECTRICALS LTD.
TRANSMISSION PROJECTS DIVISION

	नाम /NAME	हस्ता./SIGN.	दि./DATE
बनाया DRAWN	SY	-SIGNED-	24.04.19
जॅचा CHECKED	MSP	-SIGNED-	24.04.19
स्वीकृत APPROVED	SKS	-SIGNED-	24.04.19

REV.	DATE	ALTERED / CHECKED / APPROVED
02	26.04.19	SY / MSP / SKS

ZONE: DRAWING REVISED IN LINE WITH
-REVISED COORDINATES AS PER JOINT SURVEY WITH UPPTCL SHAMLI CIVIL
-COORDINATES BEING SHOWN ON THE DRAWING

विभाग DEPT. TBEM
कोड CODE 422
अनुपात / SCALE
कार्ड कोड CARD CODE

शीर्षक/TITLE
400/220/132KV ELECTRICAL LAYOUT-SHAMLI

ड्राइंग.क्र./DRAWING NO. TB-0-406-510-002
पुनः/REV. 02
पृष्ठ क्र./SHEET No. 02 अगला पृष्ठ /NEXT SHEET ~~02~~

ZONE	REV.	DATE	ALTERED	CHD/APPD
ZONE	REV.	DATE	ALTERED	CHD/APPD
ZONE	REV.	DATE	ALTERED	CHD/APPD
ZONE	REV.	DATE	ALTERED	CHD/APPD

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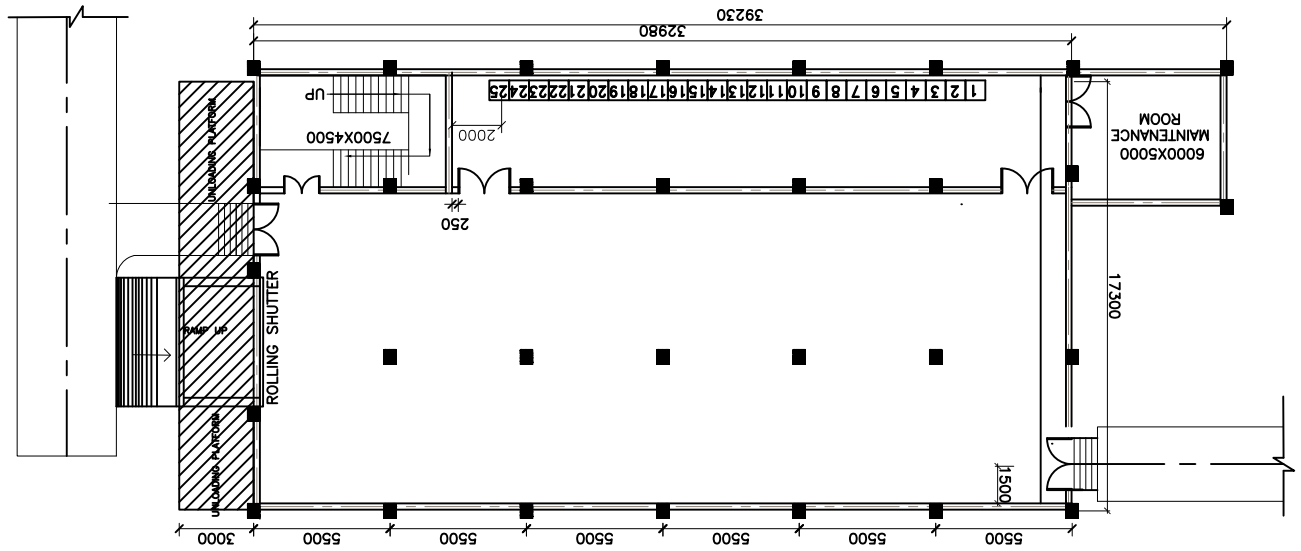
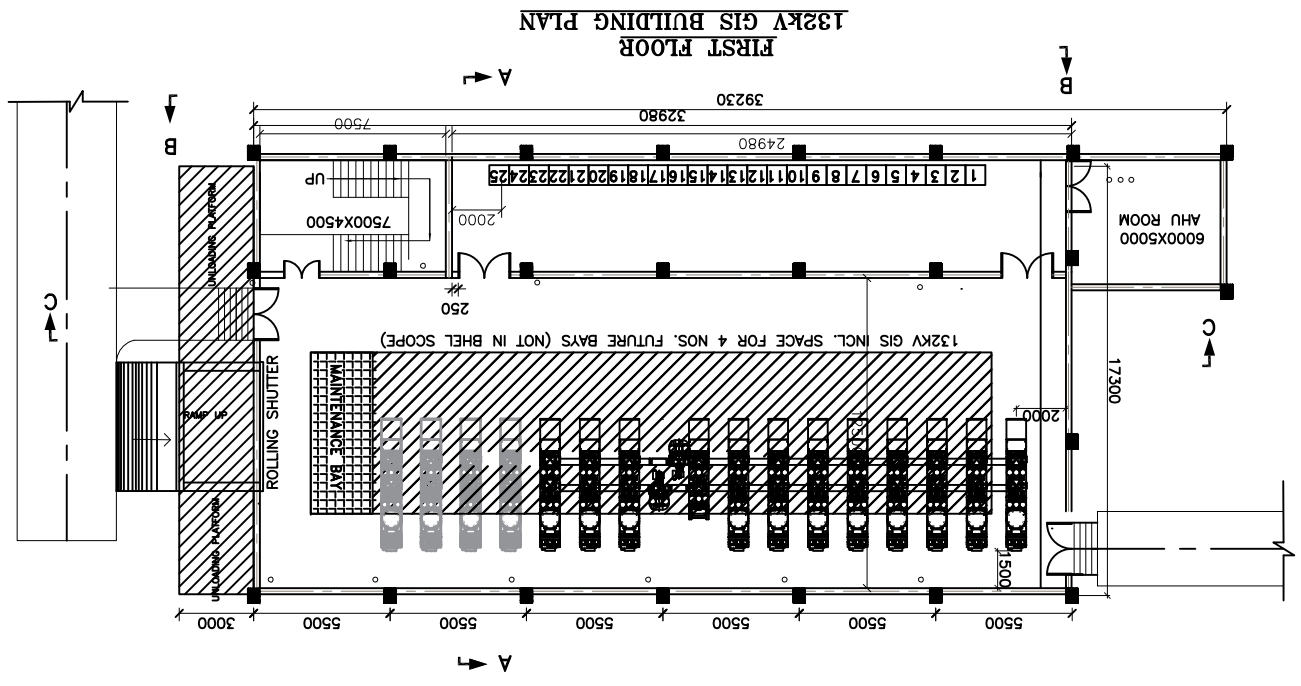
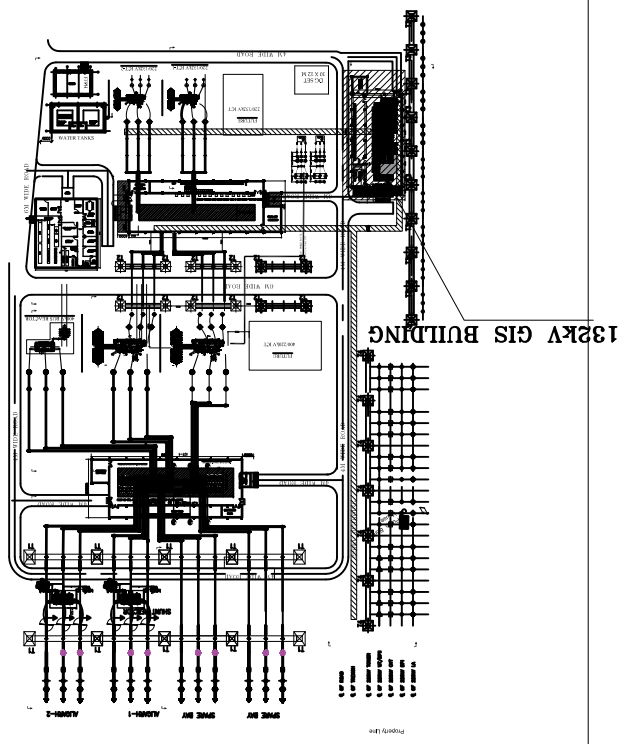
GROUND FLOOR
132kV GIS BUILDING PLAN



FIRST FLOOR
132kV GIS BUILDING PLAN





REFERENCE DRG.:- TENDER SINGLE LINE DIAGRAM 400/220/132kV GIS S/S

PROJECT: LOI NO. : 1311/ESD-8/126/III/400kV SHAMLI dated 14.11.2018

CUSTOMER: UTTAR PRADESH TRANSMISSION CORPORATION LIMITED

BHARAT HEAVY ELECTRICALS LTD.
TRANSMISSION BUSINESS GROUP
NOIDA

	NAME	SIGN.	DATE	NO.OF VAR.
DRN.	SY	-SIGNED-	06.02.19	
CHD.	MSP	-SIGNED-	06.02.19	N.A.
APPD.	SKS	-SIGNED-	06.02.19	N.A.

DEPT.	UNTOL. DIMS.	SCALE	WEIGHT (KG)	REF. TO ASSY. DRG.	ITEM NO.	NO.OF ITEMS
TBG	GR.	N.T.S	N.A.	N.A.	N.A.	N.A.
CODE	g/M/f					

TITLE: CONCEPTUAL DRAWING FOR 132kV GIS BUILDING

CARD CODE: NA

DRG.NO. TB-1-406-316-005

REV. 00

SHT. No 04 NO. OF SHT. 05

SIZE-A3

(ALL DIMENSIONS ARE IN mm)

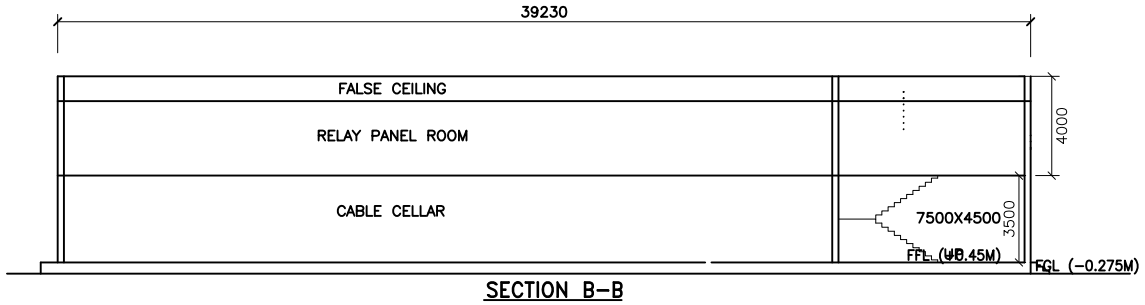
FIRST ANGLE PROJECTION

DRG. NO. TB-1-406-316-005

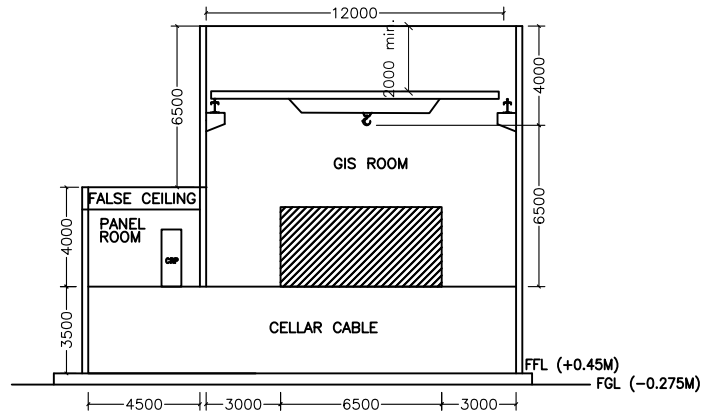
FIRST ANGLE PROJECTION

(ALL DIMENSIONS ARE IN mm)

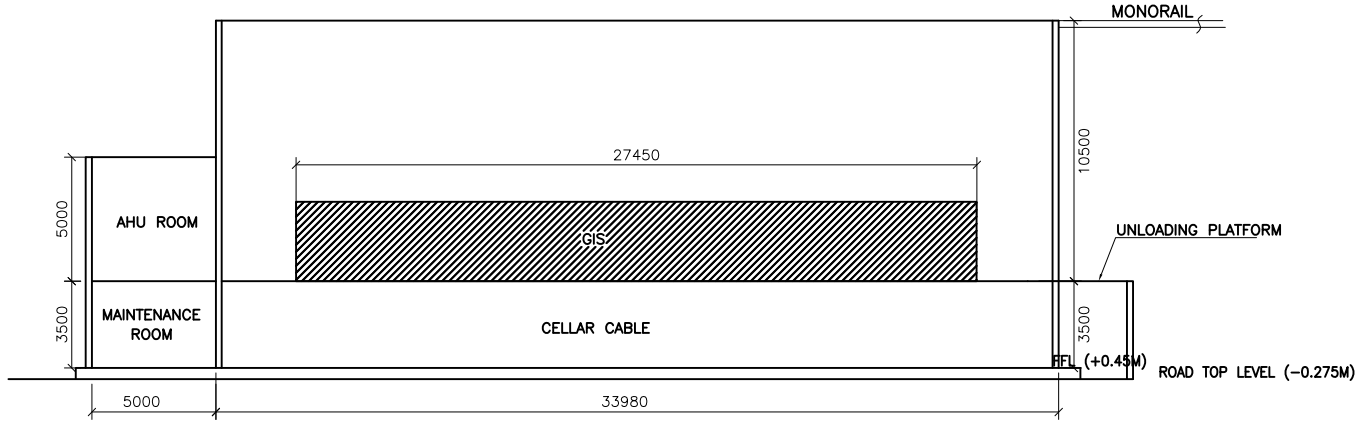
DRG. NO. TB-1-406-316-005



SECTION B–B



SECTION A–A



SECTION C–C

NOTE:–

1. ALL DIMENSIONS ARE IN MM AND MINIMUM CLEAR DIMENSIONS.
2. GIS ROOM SHALL BE PROVIDED WITH DUCTED VENTILATION .
3. FINAL LOCATION OF CABLE TRENCH ENTRY SHALL BE AS PER
4. DOOR SHALL BE 2500(H)X1500(W) IN SIZE.
5. ROLLING SHUTTER FOR GIS ROOM SHALL BE 5500(H)X4500(W) IN SIZE.
7. DETAILS OF STAIRS AS PER CIVIL DRG.
8. DOOR FOR AHU ROOM SHALL BE 3300(H)X2200(W) IN SIZE.
9. ALL THE DIMENSIONS ARE TENTATIVE. HOWEVER THE ACTUAL DIMENSIONS/SIZE SHALL BE AS PER FINAL APPROVED GIS MANUFACTURER DRAWINGS.

REFERENCE:–

1. ESLD DRAWING : TB–0–406–510–001
1. OVERALL GENERAL ARRANGEMENT DRAWING : TB–0–406–510–002

REV.	DATE	ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED
		CHD/APPD			CHD/APPD			CHD/APPD			CHD/APPD
ZONE			ZONE			ZONE			ZONE		

REFERENCE DRG.:– TENDER SINGLE LINE DIAGRAM 400/220/132kV GIS S/S

PROJECT: LOI NO. : 1311/ESD–8/126/III/400kV SHAMLI dated 14.11.2018

CUSTOMER: UTTAR PRADESH TRANSMIISSIION CORPORATIION LIMITED

BHARAT HEAVY ELECTRICALS LTD.
TRANSMISSION BUSINESS GROUP
NOIDA

	NAME	SIGN.	DATE	NO.OF VAR.
DRN.	SY	–SIGNED–	06.02.19	N.A.
CHD.	MSP	–SIGNED–	06.02.19	
APPD.	SKS	–SIGNED–	06.02.19	

DEPT. TBG CODE	UNTOL. DIMS. GR.		SCALE	WEIGHT (KG)	REF. TO ASSY. DRG.	ITEM NO.	NO.OF ITEMS
	g/m/f		N.T.S	N.A.	N.A.	N.A.	N.A.

TITLE: CONCEPTUAL DRAWING FOR 132kV GIS BUILDING

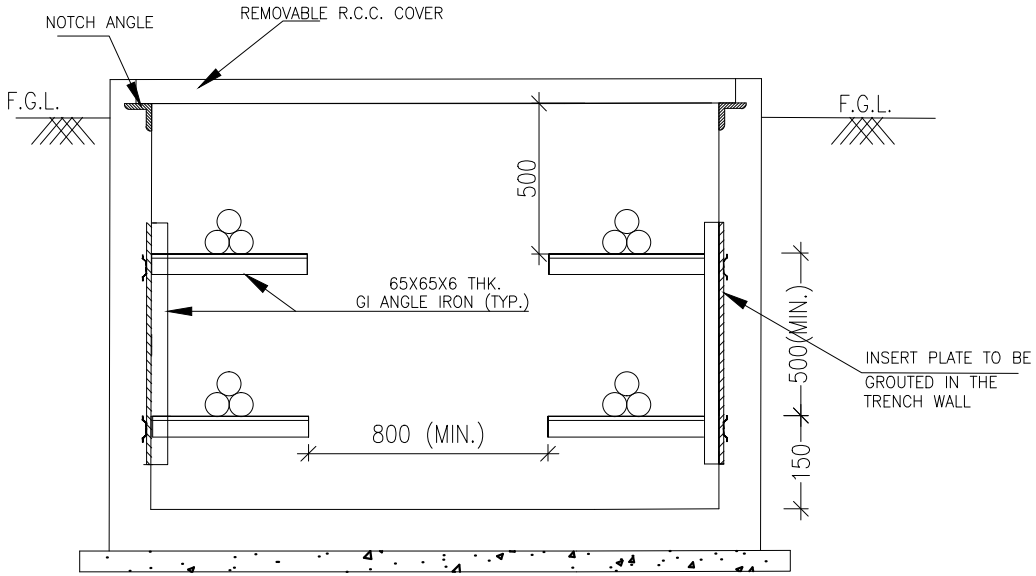
CARD CODE: NA

DRG.NO. TB–1–406–316–005 REV. 02

SHT. No 06 NO. OF SHT. 05

SIZE–A3

SKETCH–1



TYPICAL TRENCH SECTION FOR EHV CABLE