STANDARD BIDDING DOCUMENT

FOR

URBAN ELECTRIFICATION WORKS OF 6 (SIX) TOWNS OF MIZORAM UNDER INTEGRATED POWER DEVELOPMENT SCHEME

VOLUME-III

(TECHNICAL SPECIFICATONS & DRAWINGS)

Section-I : Technical Specifications

Section-II : Tender Drawings

SPECIFICATION No.:IPDS/MIZ/2016

POWER & ELECTRICITY DEPARTMENT
GOVT. OF MIZORAM : AIZAWL

VOLUME-III

SECTION – I

TECHNICAL SPECIFICATIONS

Section-I

Technical Specification for Equipment's

All materials required to complete the work as per given specifications & drawings etc. must be manufactured and supplied using fresh raw material. Re-moulded, re-circulated materials are not acceptable. The procurement of materials must be made by the contractor directly from manufacturer or through authorized dealer/distributors. Documentary evidences to this effect are to be made available to Employer for necessary checks/verification of source of supply of materials. Second hand materials/ partial used materials/ used materials would not acceptable.

Climatic condition details are given with various materials specifications however, bidder shall note that materials covered under project specific IPDS works shall be utilized in that particular project only. Hence, the geographical location of that particular project site and its associated climatic condition shall be applicable for all the materials of that particular project.

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TECHNICAL SPECIFICATIONS FOR CONSTRUCTION

OF NEW 33/11 kV SUBSTATION

1.0 SCOPE OF 33 / 11 kV SUBSTATION

1.1 Construction of New Sub-stations

1.1.1 Design, engineering, manufacture, assembly, inspection, testing at manufacturer's works before dispatch; packing, supply, delivery at site, subsequent storage, erection and commissioning at site; including insurance during transit and storage of all equipments, structures & associated equipments, construction of control room, approach roads, compound wall, security fencing, providing yard & indoor wiring, lighting and water supply in connection with construction of new 33/11 kV Substation.

1.1.2 Separate 33 kV bay is proposed for each incoming line, outgoing line and power transformer. Where possible, provision is to be kept for extension of one more bay to facilitate future augmentation.

1.1.3 Constructions of 33/11 kV substations as per BPS

1.1.4 The Contractor shall also be responsible for the overall co-ordination with internal / external agencies, project management, and training of Owner's manpower, loading, unloading, handling, moving to final destination the required equipment and materials for successful erection, testing and commissioning of the substation / switchyard.

1.1.5 Design of substation and its associated electrical and mechanical auxiliary systems includes preparation of single line diagrams and electrical layouts, erection key diagrams, electrical and physical clearance diagrams, design calculations for earth mat, direct stroke lightning protection (DSLP). Bus Bar & Spacers, control and protection schematics, wiring and termination schedules, civil designs and drawings, design of fire fighting, indoor and outdoor lighting / illumination and other relevant drawings and documents required for engineering of all facilities within the fencing to be provided under this contract, are covered under the scope of the Contractor.

1.2 Construction of 33 kV Line for the New Sub-station.

1.2.1 Actual route survey and peg marking for erection of 33 kV lines between identified locations of the Power Department.

1.2.2 Design, engineering, manufacture, assembly, inspection, testing at manufacturer's works before dispatch, packing, supply, delivery at site, subsequent storage, erection and commissioning at site including insurance during transit and storage of all materials for 33 kV feeders in identified locations of Power Department for new substations including numbering of poles and preparation of actual route map with pole schedules.

1.2.3 Providing 33 kV bay extensions, erection of controlling equipment for the new line at the tapping point.

1.3 Construction of 11 kV Line under the New Sub-station.

1.3.1 Detailed route survey and peg marking for erection of 11 kV lines between identified locations of Power Department.

1.3.2 Design, engineering, manufacture, assembly, inspection, testing at manufacturer's works before dispatch, packing, supply, delivery at site, subsequent storage, erection and commissioning at site including insurance during transit and storage of all materials for 11 kV feeder in identified locations of Power Department for new substations including numbering of pole and preparation of actual route map with pole schedules.

1.4 The detailed scope of work is brought out in subsequent clauses of this section.

1.4.1 Design, engineering, manufacture, testing, supply on FOR destination site basis, transportation, storage, erection, insurance, testing and commissioning of following items at above mentioned 33/ 11 kV substations.

a) 33 kV and 11 kV circuit breakers, isolators and surge arrestors.

b) 1 no. of 100 kVA, 33/ 0.415 kV auxiliary transformer per 33/11 kV substation.

c) Complete indication, control, relay and protection system of the substation.

d) For indoor 11 kV system, draw out type 11 kV panels with Vacuum circuit breakers, current transformers, 11 kV/ 110 V bus PT and protective relaying for 11 kV lines & incomer (from 33/ 11kV transformer).

e) LT switchgear (AC/ DC distribution boards).

f) Portable Fire extinguishers consisting of CO_2, 5 kg type

g) 110 V, 100 AH maintenance free valve regulated lead acid (VRLA) battery lead along with battery chargers.

h) 1.1 kV grade, armoured, aluminium/copper cable of suitable size for power along with complete accessories.

i) Indoor Vacuum circuit breakers are proposed in the control room. 11 kV XLPE cable of suitable size shall be laid from LV side of power transformer to indoor VCB through cable ducts. Similarly 11 kV XLPE cable of suitable size shall be laid through cable ducts from indoor VCB to 11 kV feeders in the outdoor yard.

j) Steel Tubular Poles (SP-29) with MS Channel 100 x 50 mm and the MS flat 75 x 8 mm proposed for 11 kV Outgoing Feeder.

k) Bus post insulators, insulator strings and hardware, clamps and connectors, ACSR Conductor strung bus/aluminium pipe bus, cable supporting angles /channels, cable trays and covers, sag compensating springs, junction box, buried cable trenches MS flat and G.I. Pipe Electrode for earthing mat etc.

l) Complete lighting and illumination of the switchyard (including the roads in switch yard and approaching roads), is as follows:

At manned substations: Required numbers of 250-Watts HP sodium vapour lamps mounted on Lighting cum lightning structure for switch yard area and on Steel tubular swaged Pole for approach road and other area.

m) Terminal connectors of all types (including terminal connectors for various bus voltages).

n) Substation shielding with G.I. wire of suitable size.

1.4.2 Receipt, unloading, storage, handling, insurance, erection, testing and commissioning of 33/ 11 kV, Power transformers to be supplied by the Contractor.

1.4.3 Supplying and laying of 11 kV cables from 11 kV VCB to over head lines. The payment for the same shall be based on actual quantity and unit rates quoted in the BPS. The scope includes supply and erection of necessary cable joints and termination, for which the unit rates quoted, shall be applicable.

1.4.4 Civil works – The work shall include but not limited to the following:

a) Soil investigation, survey & land development.

b) Foundation for 33/ 11 kV transformers along with jacking pads.

c) Foundation for equipments structure, fabricated steel structure including supply & erection of structures wherever necessary.

d) Foundation for lighting cum lighting structure, marshalling box, panels, control cubicles of equipments wherever required.

e) Cable trenches along with covers and sump pits and sump pump, pump room wherever required.

f) Cable trench crossings with roads, culverts etc.

g) Gravel filling and anti weed treatment of substation area.

h) Drainage system in the substation.

i) Permanent water supply for control room.

j) Substation Boundary wall with retention wall if necessary, Yard fencing, gates, security room & approach road.

k) Buildings for substation control room.

l) Type-II Quarter for Substation Engineer.

m) Foundation of 100 kVA auxiliary transformer.

n) Before proceeding with the construction work of the new substation, the Contractor shall fully familiarize himself with the site conditions and general arrangements and scheme etc. Though the owner shall endeavor to provide the information, it shall not be binding for the owner to provide the same. The Contractors are advised to visit the substation site and acquaint themselves with the topography, infrastructure and also the design philosophy. The Contractor shall be fully responsible for providing all equipment, materials, system and services specified or otherwise which are required to complete the construction and successful commissioning, operation and maintenance of the substation in all respects.

o) All materials required for the civil works and the Contractor shall supply all materials for construction / installation work. The Contractor shall also supply the cement and steel.

p) The Contractor based on conceptual tender drawings shall do the complete design and detailed engineering.

1.4.5 Miscellaneous items

The following items of work are also to be covered under this specification:

a) Boundary wall along substation property line.

b) Contouring and substation leveling, including land filling/cutting if required.

c) Security fencing around switchyard

d) Supply of 33/11 kV & 33/0.415 kV transformers

e) Fire wall between transformers, as required

f) Required number of office furniture like table, chair, filing cabinet or equivalent

g) Any other items not specifically mentioned in the specification but which are required for erection, testing and commissioning and satisfactory operation of the substation are deemed to be included in the scope of the specification unless specifically excluded.

h) Wherever word "purchaser" or "employer" appears in this section and other sections enclosed with this section, the same shall be read as "Owner".

i) Owner / purchaser / employer is having Technical Specification for various equipments and work for different voltage levels. This Technical Specification shall accordingly be applicable to the extent of the items, which are specified in BPS along with all accessories, assembly's components, parts, etc. associated with them.

2.0 PHYSICAL AND OTHER PARAMETERS

2.1 **Meteorological Data** The meteorological data of the substations shall be provided to the successful Contractor. However for design purposes, ambient temperature should be considered as 50ºC and relative humidity as 100%, 5 months of monsoon, annual rainfall up to 2280 mm, lightning prone area with average 40 thunder storms per annum, height above mean sea level shall be taken as up to 1000 meter.

2.2 **Soil Data** The Contractor shall be responsible for carrying out the required tests and should fully satisfy himself about the nature of soil expected to encounter. Any variation of soil data during detailed engineering or construction stage shall not constitute a valid reason in affecting the terms and conditions of the Contract.

3.0 SCHEDULE OF QUANTITIES

The bill of quantity of major equipments/ items / works is indicated in the Work/Material Schedule.

Wherever the quantities of items / works are not indicated, the Contractor is required to estimate the quantity required for entire execution and completion of works and incorporate their price in respective Work/Material Schedule. For erection of hardware items, Contractors shall estimate the total requirements of the works and indicate module-wise lump sum price bay wise and include the same in relevant Work/Material Schedule. For module identification, Contractor may refer typical drawings enclosed with the specifications. Any material / works for the modules not specifically mentioned in the description in BPS, as may be required shall be deemed to be included in the module itself.

Contractor should include all such items in the Work/Material Schedule, which are not specifically mentioned but are essential for the execution of the contract. Item which explicitly may not appear in various schedules and required for successful commissioning of substation shall be included in the Contract price and shall be provided at no extra cost to Owner.

4.0 BASIC REFERENCE DRAWINGS

4.1 The Contractor shall maintain the overall dimensions of the substation, buildings, bay length, bay width, phase to earth clearance, phase to phase clearance and sectional clearances, clearances between buses, bus heights but may alter the locations of equipment to obtain the statutory electrical clearances required as per I.E. Rules for the substation.

4.2 The auxiliary transformers of rating 100 kVA, 33/ 0.400 kV shall be used to feed the substation auxiliaries.

5.0 SYSTEM PARAMETERS

Sl. No.	Description of the Parameter	33 kV System	11 kV System
1.	System operating voltage	33 kV	11 kV
2.	Maximum operating voltage of the system (rms)	36 kV	12 kV
3.	Rated frequency	50 Hz	50 Hz
4.	No. of phases	3	3
5.	i. Rated insulation level Full wave impulse withstand voltage (1.2 / 50 micro sec.)	170 kVA	75 kVA
	ii. One minute power frequency dry and wet withstand voltage (rms)	70 kV	28 KV
6.	Min. creepage distance	840 mm	320 mm
7.	Min. clearances		
	i) Phase to earth	320 mm	140 (77**) mm
	ii) Phase to phase	320 mm	280 (127**) mm
	iii) Sectional ** for indoor switch gear	3000	Clearances as per IS
8.	Rated short circuit current	17.5 kA for 1 sec.	16 kA for 1 sec.
9.	System neutral earthing	Delta connection	Effectively earthed

Note: The insulation and RIV levels of the equipments shall be as per values given in the technical specifications.

TECHNICAL SPECIFICATION OF 33kV CIRCUIT BREAKERS

1.0 **SCOPE** :

1.1 This Specifications intended to cover the design, manufacture, assembly and Testing at manufacturer's works of 33 KV, 3 Ph., 50 C/S, 1250A, 25KA, Outdoor Type Porcelain Clad, Vacuum Circuit Breaker for efficient and trouble-free operation as specified hereunder.

1.2 The Circuit Breakers are required complete with structures, operating mechanism and all associated accessories and auxiliaries.

2. STANDARDS : The Equipment to be furnished under this Specification, shall be designed, constructed and tested in accordance with the latest revisions of relevant Indian Standards (IS-13118), or International Electric-Technical Commission (IEC-56). The Equipment conforming to any other national Technical standards which ensure equivalent quality are acceptable. In such cases the Tenders shall clearly indicate the standard adopted and should furnish a copy of the English translation of the standard along with the tender. Relevant Indian Standards of CT, PT, Insulators and other devices, accessories etc. shall be followed.

3. DEVIATION : Normally the offer should be as per Technical Specification without any deviation. But any deviation felt necessary to improve performance, efficiency and utility of Equipment must be mentioned in the "Deviation Schedule" with reasons of such deviation. Such deviation suggested may not be accepted. Deviations not mentioned in Deviation Schedule will never be considered.

4. **GENERAL INFORMATION** :

4.1 The Circuit Breakers specified herein are to be normally installed anywhere in Mizoram.

4.2 The General Weather Conditions are stated below.

i) Climate condition : The area is Tropical with monsoon from June to October, about 3000 mm annual rain fall.
ii) Number of Thunderstorm days : 75 days.
iii) Ambient Temp. : 50oC (max) and 4oC (minm).
iv) Maximum Wind Pressure : 150 Kg. Per Mtr. Sq.
v) The site falls within seismic zones-III & IV as classified by the IS:1893 (1984)

4.3 The Equipment offered shall be suitable for heavily polluted atmosphere.

4.4 The Equipment to be furnished under this Specification shall be packed for shipment so as to meet the weight and space limitations of transport facilities, specifically along with Rail, Road, right of way.

4.5 The Equipment covered by this Specification shall be complete in all respects. Any material or accessory which may not have been specifically mentioned, but is essential or necessary for satisfactory and trouble free operation and maintenance of the Equipment shall be furnished without any extra charge to the purchaser.

4.6 The Equipment shall be supplied with all accessories listed in this Specification with such modifications and alternations as to safeguard the Technical requirements.

5. DESIGN CRITERIA :

5.1 The Equipment will be used in non effectively neutral grounded System with fault level of 20 KA at highest system voltage of 36 KV.

5.2 Continuous current rating shall be 1250 Amp. Maximum temperature attained by any part of the Equipment at specified rating should not exceed the permissible limit as stipulate in the relevant standards. Equipment shall be designed taking 50 0C as maximum ambient temperature.

5.3 The circuit breakers and their components shall be capable of withstanding the mechanical forces and thermal stresses of the short circuit current of the system without any damage or deterioration of material.

5.4 The circuit breakers shall have motor wound spring charged trip free mechanism with anti pumping feature, and shunt trip. In addition, facility for manual charging of spring, shall be provided.

5.5 Each breaker shall be provided with manual close & open facility, mechanical ON-OFF indication, an operation counter and mechanism charge/discharge indicator.

5.6 For motor wound mechanism, spring charging shall take place automatically after each breaker closing operation. One open-close-open operation of the circuit breaker shall be possible after failure of power supply to the motor. A visual mechanical indicating device will also be provided to show the position of the spring.

5.7 All controls shall be suitable for 80%, to 110% for closing & 70% to 110% for tripping of 30V D.C. The A.C. supply shall be available 400 Volt +/- 10%, 50 Hz. 3 phase 4 wire system.

5.8 The operating duty of the Breaker will be 0-0.3 sec-CO-3 min-CO.

5.9 There shall be no radio interference when the Equipment is operated upto maximum service voltage.

5.10 The minimum safe clearance of all live parts of the Equipment shall be as per relevant standards. Clearances of 33 KV Low Level pipe bus of our switchyard are : a) Phase to Phase : 1200 mm and b) Pipe bus to ground level of supporting structure : 4000 mm Please note that usually our plinth height is 300 mm.

5.11 All electrical and mechanical interlocks which are necessary for safe and satisfactory operation of the Breaker shall be furnished. The interlocking device shall be of proven quality.

5.12 The condition of Breaker and its contacts shall be intact even under conditions of phase opposition that may arise due to faulty synchronisation or otherwise. Tenderers should confirm in this regards.

5.13 The Breaker shall be capable of smooth and rapid interruption of current under all conditions, completely suppressing the undesirable phenomenon even under the most severe and persistent rated short circuit conditions. There will be no abnormal voltage rise subsequent to the switching ON/OFF a capacitor bank within the rated capacity.

5.14 The total make and break time (in m sec/cycle) for the breaker throughout the range of their operating duty shall be indicated and guaranteed.

5.15 The breaker shall be suitable for interrupting low inductive currents without generation of abnormal over voltage.

5.16 The breaker shall be capable of interrupting rated breaking current with recovery voltage equal to maximum line Service Voltage and at all inductive power factor of the Circuit equal to or exceeding 0.15.

5.17 The Circuit Breaker shall be capable to withstand power frequency over Voltage 70 KV for 1 sec.

5.18 The tenderer may indicate in his offer the methods adopted for limiting over voltage.

5.19 The Circuit Breaker with its galvanized steel structure shall be suitable for mounting on concrete foundation. The height of the supporting structure will be such that it will be able to maintain clearance as indicated in clause 5.10 above.

5.20 The detail of steel structure, foundation design and erection drawing shall be given. In GA/Structure drawing please indicate the location of CB., point of application of dynamic load and its amplitude, dead load etc. Spec-33KV VCB-2011-2012 4/13

5.21 Special tools & tackles required for erection and dismantling and fitting of the Breaker and its accessories, if required shall be offered indicating the prices etc.

6. **CONSTRUCTION** : Each vacuum Circuit breaker shall comprise of three identical poles linked together electrically and mechanically for synchronous operation.

Vacuum Interrupter The vacuum interrupter, consisting of fixed contact and moving contact, shall be interchangeable among the same type interrupter. Short circuit capacity of vacuum bottle should be 25 KA and design life should be 100 nos. operation at rated short circuit level.

i) Constructional features of the vacuum chamber along with its functional arrangements are to be shown in a drawing submitted along with tender documents.
ii) The gap between contacts of the Circuit Breaker inside interrupter should be capable of withstanding 1.5 time voltage to neutral at one atmospheric pressure at normal ambient condition within Breaker in the event of vacuum pressure drop due to leakage.
iii) Vacuum Bottle shall be of Siemens/ABB/ALSTOM/CGL/BEL/reputed indigenous make. Offered bottle shall be identical with Type tested one. Brochures/leaflet on technical data sheet for vacuum bottle shall be enclosed with technical bid.

6.1 MAIN CONTACTS :

a) In vacuum interrupter the contact configuration, contact area, contact pressure will be sufficient for carrying rated current and short time rates current, without any abnormal phenomena.
b) Complete details of main contacts shall be furnished. The material of contacts and coating of the contacts shall be suitable for vacuum Breaker technology. Evaporation of metal during arcing and deposition of the same in the inner surface of vacuum interrupter should be restricted by adopting suitable material. Tenderer shall furnish the justification of using the materials for contacts.

c) Complete details of main contacts and arc quenching device, if any with sectional drawings shall be furnished at the time of offer. Measures taken to free the contacts from vibration during closing shall be clearly explained in the drawing, support by tests results.

d) The contact erosion should be limited upto 3 mm for useful life and indication to monitor the progress of contact erosion has to be provided.

6.2 The vacuum pressure within interrupter shall be adequate to interrupt the fault current. Precaution shall be taken so that there will be no flush over on outside of the vacuum interrupter inside the porcelain insulator.

6.3 Design of the vacuum bottle and its insulator encasing should be suitable for outdoor use, taking care of required creepage distance considering possibility of moisture condensation if any, in the annular space between the vacuum bottle and insulator enclosure. Type test with identical bottle type with similar encasing arrangement shall be done and accordingly Report shall be submitted along with tender document.

6.4 Vacuum bottle with its insulator encasing chamber shall be hermetically sealed. Free passage of air in the chamber with or without provision of circulation of hot air is not accepted. 6.5 Tripping/Closing Coil burden of Equipment should not be more than 200 watts at 30 V D.C. The value will not be relaxed, specially for tripping coil.

6.5 OPERATING MECHANISM :

a) The operating mechanism shall be suitable for rapid closing and tripping. The opening and closing energy shall be obtained from spring charge mechanism. The spring charging may be done by either motor operation with facility for manual charging when required or by other suitable trouble free mechanism. Local arrangement for operating breakers both electrically and mechanically shall be provided in addition to remote operation.

b) The mechanism shall have anti pumping circuitry and will be trip free electrically and mechanically. The anti pumping arrangement shall be initiated through normally “NO” type, direct auxiliary contact of circuit breaker and shall be of self hold type. Plug-in type relay/Contactor for Anti pumping Relay will not be acceptable.

c) Spring operated mechanism will be complete with opening spring, closing spring, limit switch and all necessary accessories to make the mechanism a complete operating unit.

d) Contactor used for anti pumping relay shall be of reputed make.

e) There shall be mechanical ON/OFF indicator spring charge and operation counter for each Breaker and also provision for remote indication.

f) The operating mechanism box shall be fixed at a working height from ground level. View glass shall be provided on hinged door at the front side.

g) Spring charging LS shall have sufficient no. of spare contact.

6.6 COMMON CONTROL CUBICLE :

a) A free standing outdoor type weather proof, dust and vermin proof cubicle shall be provided to house the operating mechanism and all other accessories except those which must be located in the pole box.

b) The cubicle shall be of 3.00 mm thick sheet steel and shall have hinged doors at front and hinged/bolted door or cover at rear for access to the mechanism. Doors should be of proper design for smooth opening and closing with pad locking arrangement. Double door at front size is preferable.

c) A removable gland plate of 3 mm thickness shall be provided at the bottom of the cubicles for purchasers Cable entry. Glands of sizes suitable for entry of 1 no. 12 core, 2 nos. 8 core and 2 nos. 4 core Cables for Control etc.

d) Terminal blocks for AC & DC shall be kept separate. Terminals shall be stud type and suitable for at least 2x2.5 sq.mm copper leads. All wiring shall be of 1100 V grade PVC. At least 15% spare terminal shall be provided in the Terminal blocks.

e) Thermostat controlled heaters shall be provided to prevent condensation within cubicle. Cubicle illumination Lamp with switch and a 230 V., 15A, 3 pin socket with a Control Switch shall be provided.

f) All controls, alarms, indications and interlocking devices furnished with breaker shall be wired up to the terminal Black in the common control cubicle. Not more than two wires shall be connected to one terminal.

g) All wires shall be identified at both ends with ferrule marking in accordance with approved wiring diagram.

h) Way terminals with bonding screws and washers. At least 15% spare terminal shall be provided.

i) Scheme diagram on a durable sticker shall be fixed on inside door of Control Cubicle.

j) Degree of protection of control cubicle shall be IP-55.

k) ONE NO CLOSING COIL AND ONE NO TRIPPING COIL IN ADDITION TO NORMAL 1 NO CLOSING COIL AND 2 NOS TRIPPING COIL SHALL BE PACKED AND PUT SEPARATELY & CAREFULLY INSIDE THE COMMON CUBICLE. THIS IS TO BE DELIVERED ALONG WITH EACH BREAKER. NO SEPARATE PRICE SHALL BE PAID EXTRA.

7. INSULATORS :

a) Porcelain supports, interrupter housing of adequate mechanical and dielectric strength with suitable creepage distance shall have to be used. All Support/Interrupter Housing of identical ratings shall be interchangeable. Each Interrupter-Housing shall be provided with terminal stud/pad.

b) The porcelain used in interrupter housing shall be made from wet process and shall be homogeneous, free from laminations, caustics and other flaws which may impair its mechanical or dielectric strength and shall be glossy, tough and impervious to moisture.

c) The porcelain supports, interrupter –housing insulation shall be coordinated with that of Circuit Breaker. The puncture strength of the bushings shall be greater than the dry flashover value.

d) When operating at rated voltage, there shall not be any electrical discharge between live terminal and earth. No Radio disturbance shall be caused by the support insulators when operating up to the maximum System Voltage. It shall also be free from corona.

e) All iron parts shall be hot dip galvanised. The nuts, bolts, washers etc. shall also be hot dip galvanised steel or stainless steel.

f) Each Circuit Breaker shall be provided with Bi-metallic terminal stud/pad suitable for connection of pipe bus/ACSR Conductor.

8. AUXILIARY CONTACTS :

a) Breaker shall be provided with 6 NO & 6 NC spare auxiliary contacts in addition to the auxiliary contacts required for Breaker’s own operational requirements. These auxiliary contacts shall preferably be convertible type.

b) These contacts shall have continuous current rating of at least 10A. The breaking capacity shall be adequate for the circuits controlled, or at least 12A at 30 V DC with a circuit time constant of minimum 20 ms.

c) All these contacts shall be wired up to terminal block in the control cubicle. Auxiliary contacts which are to be installed on the frame of Circuit Breaker shall be suitably protected against accidental arcing from main circuit. Insulating materials of contacts shall be ceramics or other non-tracking materials.

9. GROUNDING : Circuit Breaker shall be provided with two grounding pads with 2 nos. tapped holes for M10 bolts and spring washers for connection of purchasers grounding conductor (50x6 mm G.I. strips).

10. PAINTING : External surfaces shall be given a coat of high quality red oxide or other suitable primer and shall be finished with two coats of synthetic enamel paints of shade 631 of I.S.S. Such painting should be able to withstand tropical climate as stipulated in Sl.No.4 of this Specification.

11. EQUIPMENT FOUNDATION AND STEEL STRUCTURE :

a) The Circuit breaker etc. shall be furnished complete with base frame, anchor/foundation bolts and hardware. Details structure assembly drawing, mentioning part no. of each member and also indicating cross sectional area of member used with supporting calculations. The point of C.B., dynamic load and its amplitude, dead load etc. shall be mentioned.
b) To enable the purchaser to proceed with design of Equipment foundation, the successful tenderers shall furnish necessary foundation/anchor details with designed loads within 30 (thirty) days from the date of issue of letter of intent/purchase order.
c) Similar grounding pad as mentioned against Sl.No.9 are also to be provided.
d) If the Centre line of Control Cubicle is more than 1.50m above ground plate, one suitable platform with checker plate shall be fixed at a suitable height of support structure with ladder step arrangement, to access the control cubicle for Local operation & maintenance purpose.

12. TENDER DRAWING, MANUALS AND TYPE TEST CERTIFICATES : The following drawings and manuals shall be furnished for information purpose with each copy of the tender.

12.1 General Arrangement Drawings indicating all dimensions, electrical clearness and distance of each piece of Equipment showing constructional features and dispositions of various fittings and accessories and also static dead load at point of application.

12.2 Technical leaflets/manuals on each piece of Equipment explaining the function of various parts, principle of operation and special features. Technical leaflets/manuals for offered type of vacuum bottle etc.

12.3 Type Test Certificates as per IEC/relevant IS carried out on Similar Breaker from reputed/recognised laboratory shall be furnished.

13. CONTRACT DRAWING AND CATALOGUE : After placement of order, two (2) copies of various drawings data and manuals in hard copies and soft copy of pdf/dwg format as mentioned below shall be submitted to the purchaser for approval.

13.1 Dimensional General Arrangement drawing showing all dimensions and disposition of fittings and space requirement and mounting arrangements.

13.2 Sectional views of contact assembly, operating mechanism and are extinguishing chamber.

13.3 Transport/shipping dimensions with weights.

13.4 Foundation and anchor details including dead-load and impact load with direction and also point of application.

13.5 Assembly drawing for erection at site with part numbers and schedule of materials.

13.6 Electrical schematic and wiring diagram with explanatory notes, if any.

13.7 Schematic diagram for spring charged operating mechanism schematic layout drawings.

13.8 Name plate drawing and any other relevant drawing and data necessary for erection, operation and maintenance.

13.9 Outline drawings of bushings, terminals and terminal connectors.

13.10 After approval, the supplier shall submit Instruction manuals and data sheets for each rating of Equipment. The manuals shall clearly indicate the installation methods, checkups and tests to be carried out for testing the Equipment and maintenance procedure.

14. TEST REPORTS AND TYPE TESTS : The bidder shall submit detailed as well as complete test reports of all tests (including Type Test) as stipulated in relevant IS and IEC with Complete identification, date and serial no., carried out in a Government recognized Test House or Laboratory/ CPRI/ NABL accredited lab/ on Circuit Breakers of identical design.

COPIES OF FOLLOWING TYPE TEST REPORT AS PER LATEST IS/IEC, CARRIED OUT WITHIN FIVE (5) YEARS, FROM THE DATE OF NIT PUBLICATION, FROM CPRI, NABL ACCREDITED/A GOVERNMENT RECOGNISED TEST HOUSE OR LABORATORY SHALL BE SUBMITTED ALONG WITH TENDER DOCUMENTS AS PRE- REQUISITES. FAILING WHICH THEIR OFFER MAY NOT BE TECHNICALLY ACCEPTABLE.

a) Single capacitor bank breaking test
b) Short time withstand and peak withstand current test
c) Lightning impulse voltage withstand test
d) Temperature rise Test
e) Mechanical Endurance

15. SPECIFIC LIMIT OF AUXILIARY SUPPLY VOLTAGE :

i) The auxiliary supply voltage shall be 85% to 110% of the rated 30 V in supply for closing coil and the same shall be 70% to 110% for tripping coil.
ii) The operating voltage for motor operated spring charged mechanism shall be 400V A.C., 3 phase, 50 Hz or 230V. 1-phase, 50 Hz. The motor shall operate at a voltage variation of 85% to 110% of the supply voltage.

16. NAME PLATE :

i. Rated voltage/Maximum voltage
ii. Rated insulation level
iii. Type/Model No./Sl.No./Year of manufacture.
iv. Rated current v. Rated frequency.
vi. Rated short Circuit Breaking Current.
vii. Rated transient recovery voltage for terminal fault.
viii. Rated short circuit making current.
ix. Rated operating sequence.
x. Rated short time current.
xi. Rated line charging/breaking current
xii. Rated Cable charging current.
xiii. Rated single capacitor bank charging/breaking current.
xiv. Rated small inductive breaking current.
xv. Rated Supply Voltage of auxiliary circuits.
xvi. Applicable standard.
xvii) Property Label: P&E Department, Mizoram
xviii) Purchase Order no. & date.

17. ACCESSORIES : Each Breaker shall be furnished complete with fittings and accessories as listed below (The list is illustrative & not exhaustive).

i. Clamp-type terminal connectors for ACSR Conductor
ii. Base frame and foundation/anchor bolts.
iii. Operating mechanism, trip and close coils.
iv. Auxiliary Contacts and Relays/Contacts.
v. Local/Remote selector Switch and Close/Trip Control Switch.
vi. Manual close and trip devices.
vii. Mechanical ON/OFF indicators.
viii. Operation counter.
ix. Weatherproof Control cubicle and operating mechanism boxes, with locking arrangement.
x. Set of Switch-Fuse/MCB/MCCB units for A.C. & D.C. Supply.
xi. Space heaters with thermostat and switch.
xii. Cubicle illumination Lamp with Switch.
xiii. Terminal blocks and internal wiring.
xiv. G.I. conduits and accessories for connection between Central Control Cubicle and operating mechanism boxes where applicable.
xv. Other standard accessories which are not specified, but are necessary for efficient and trouble free operation shall be supplied.

18. TEST AT FACTORY AND TEST CERTIFICATES

18.1 All Acceptance tests may be carried out at manufacturer's works in the presence of the P&E Department and Contractors representatives. In addition to the above, all routine tests are also to be carried on the breakers as per relevant IS. The entire cost of acceptance and routine test that to be carried out as per relevant IS shall be treated as included in the quoted price of breakers. The contractor shall give at least 21(twenty one) days advance notice intimating the actual date of inspection and details of all tests that are to be carried out from the date when the tests will be carried out.

18.2 Routine tests on all breakers shall be carried out as per IEC-56 or IS-13118 and test reports shall be submitted along with respective inspection offer to the purchaser.

19. TYPE TESTS after issuance of order: Besides submission of Type test Report, carried out within five years as per tender specification, Type Test at the discretion of Ordering authority, shall have to be arranged by the successful contractor from any lot offered for inspection, sample chosen at random after successful routine test by our inspection team, as per relevant ISS from CPRI/ NABL accredited/ Government recognized Test House or Laboratory in the presence of P&E Department representative. However the necessary cost of the type test Charges will be reimbursed to the party on production of necessary supporting documents.

REQUIRED TECHNICAL PARAMETERS

Sl.No.	Description	33 KV
1	Service	Outdoor
2	Class of breaker	C1-M2
3	Type	Vacuum
4	Design life to withstand rated short circuit level	100 nos operation
5	Rated frequency (Hz)	50
6	i) Normal System Voltage (KV)	33
	ii) Rated Voltage (KV)	36
7	i) Effectively earthed (EE)	NA
	ii) Non-effectively earthed (NEE)	NE Earthed through grounding Transformer
8	Insulation level (KVp)	
	i) 1.2/50 micro second impulse withstand voltage	170
	ii) Maxm. Permissible Switching over Voltage	112
	iii) 1 minute power frequency withstand Voltage (KV rms)	70
9	Rated Current (Amps)	
	i) Continuous	1250
	ii) Short time rating for 3 sec in KA	25
10	Creepage distance (mm)	900
11	Breaking time (m. sec.)	Not exceeding 60
12	Closing time (m. sec)	Not exceeding 130
13	Rated line charging/breaking Current (Amps)	10
14	Rated Cable charging/breaking Current (Amps.)	50
15	Rated single capacitive making/breaking Current (Amps.) without switching over Voltage exceeding 2.3 p.u.	50
16	Rated small inductive making/breaking Current (Amps.) without switching over Voltage exceeding 2.3 p.u.	Equivalent to magn current of 10MVA & 6.3 MVA Transformer, as applicable
17	Rated operating sequence (0-Opening, C-Closing)	0-0.3sec.-CO-3min-CO
18	Operating mechanism	Spring Charged
19	No. of trip coils	Two nos. Common for 3 pole, each having the capacity to trip all three pole successfully.
20	Trip coil and closing coil voltage (DC Volt)	30
21	Phase to Phase clearance of pipe bus (mm)	1200
22	Minimum clearance of live parts In air and ground (mm)	3700
23	First pole to clear factor	1.5
24	Altitude above mean sea level (meter)	Not exceeding 1000
25	Terminal connectors suitable for ACSR conductor/Aluminium pipe	Panther/Dog/1.5” Al pipe
26	Supply Voltage for operating device	400 Volt, 3 phase 50 Hz or 230 V, 1 phase, 50 Hz
27	Power requirement for Tripping and closing coil	Maximum 200 W at 30Volt

TECHNICAL SPECIFICATION OF 33 kV Current Transformer

1.0. SCOPE

1.1. This specification covers :

a) Design, manufacture, testing at manufacturer's works of 33kV Current Transformer with all fittings and accessories excluding mounting structures as applicable.
b) Loading at manufacturer's works, transportation and delivery at respective substation sites, including unloading at destination sites.
c) Erection, Testing and Commissioning of Current Transformers including dismantling of existing equipments if required.

2.0. SERVICE CONDITIONS

2.1. The plant and materials supplied shall be suitable for operation under the following climatic and other conditions:

i.	Maximum ambient temperature	:	30º C
ii.	Minimum ambient temperature	:	0° C
iii.	Relative humidity	:	35% to 98%
iv.	Average annual rainfall.	:	2540 mm
v.	No of months of tropical monsoon	:	5 months (May to October)
vi.	Seismic Zone	:	V
vii.	Maximum altitude	:	Above 2210m above sea level.

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3.0. TYPE TEST REPORTS

3.1. Equipment, which have never been tested for critical performance, shall not be accepted. In such cases, a promise or agreement by a bidder to have the equipment tested after award of a contract is not acceptable.

3.2. All Bids must be accompanied by the full Type Test Certificates of equipment offered. Such type test certificates shall be acceptable only if:-

(a) Tests are conducted in an independent and well known testing laboratory, or

(b) Tests are conducted in manufacturer's own laboratory. In this case(i) the laboratory must have ISO9000 (or its equivalent) series certification; and (ii) tests have been witnessed by technically qualified representatives of earlier clients or purchaser.

3.3. Test reports to be acceptable must be related directly to the materials offered. Test reports for higher class of equipment are acceptable with commitment to perform the type tests free of any charge on the particular equipment(s) after the award of contract.

3.4. Type Test Reports older than five(5) years on the date of bid opening shall not be accepted.

4.0. GUARANTEED TECHNICAL PARTICULARS

4.1. The Guaranteed Technical Particulars of the various items shall be furnished by the Bidders in the prescribed Schedules of this Section with the Bid. The Bidder shall also furnish any other information's as in their opinion is needed to give full description and details to judge the item(s) offered by them.

4.2. The data furnished in Guaranteed Technical Particulars should be the minimum or maximum value (as per the requirement of the specification) required. A Bidder may guarantee a value more stringent than the specification requirement. However, for testing purpose or from performance point of view, the material shall be considered performed successfully if it achieves the minimum/maximum value required as per the technical specification. No preference whatsoever shall be given to the bidder offering better/more stringent values than those required as per specification except where stated other wise.

5.0. STANDARDS :

The items shall conform in all respects to the following relevant standards/regulations with latest amendments thereof:

S. No.	Relevant Standards	Title
1.0	IS 2705 (Part I to IV)	Current transformers
2.0	IS 4201	Application guide for current transformers.
3.0	IS 2099	High voltage porcelain bushings
4.0	IS 11322	Partial discharge measurement in instrument transformer
5.0	IS 2071	Methods of high voltage testing
6.0	IS 335	Insulating oil
7.0	IS 60529	Degree of protection provided by enclosures for low voltage switchgear and control
8.0	IEC 60044 - 1	Current transformers
9.0	IS 5561	Electric power connections – terminal connectors
10.0	IS 4759	Hot dip zinc coatings on structural steel and other allied products
11.0	IS 2633	Methods of testing weight, thickness and uniformity of coating on hot dipped galvanised articles
12.0	IS 13134/IEC 60815	Guide for selection of insulators in respect of polluted conditions

6.0. GENERAL REQUIREMENTS

6.1. The current transformers shall be single phase, 50Hz, oil immersed and self cooled type, suitable for the services indicated and conforming to the best modern practice of design and manufacture. The design of current transformers shall be such that its accuracy shall not be affected by the presence of pollution on the external surface of its insulators.

6.2. The locations for installation of current transformers are situated in seismic zone- V. The design and construction shall be such as to provide necessary protection against the earthquake forces. Dampers and/or additional supporting structures may be provided with the current transformers, if necessary, to cater for their operation in the seismic zone.

6.3 CORES*:*

The cores for the current transformers shall be of high grade non-ageing electrical silicon laminated steel of low hysteresis loss and high permeability to ensure high accuracy at both normal and over current.

The cores to be used for metering and indicating instruments shall have a saturation factor low enough not to cause any damage to meters and instruments in the event of maximum short circuit currents. The cores to be used for distance protection and differential protection shall

have a high saturation factor. Magnetisation characteristics curves of these cores shall be furnished alongwith the bid.

6.4 WINDINGS:

Primary winding consisting of suitable number and size of conductors shall be insulated with special paper having high mechanical strength, high electrical withstand properties and good ageing qualities. The primary winding shall be of suitably insulated electrolytic copper wire.

The rating of the secondary windings shall be one Ampere. The secondary terminal shall be brought out in a compartment for easy access. The secondary terminals shall be provided with shorting arrangements.

The secondary taps shall be adequately reinforced to withstand the normal handling without damage. Suitably insulated copper wire of electrolytic grade shall be used for secondary windings.

6.5 TANK:

Each current transformer shall be of Live Tank type to be supplied filled with insulating oil and shall be hermetically sealed to prevent atmosphere from coming into contact with oil, avoid filtration and change of oil. In case, the tenderer intends to use nitrogen or any other inert gas above the oil level as to permit expansion and contraction of oil, the same shall be stated in the tender.

Both expansion chamber and tank of the current transformer shall be made of high quality steel and shall be able to withstand full vacuum and pressure occurring during transit, and thermal and mechanical stresses resulting from maximum short circuit current during operation.

All interiors or exteriors of tanks, secondary box and other metal parts shall be thoroughly cleaned to remove all rust, scales, corrosion, grease or other adhering foreign matters. 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 insulating varnish. Steel surface exposed to atmosphere if not hotdip galvanized shall be given a priming coat of zinc chromate and two coats of light grey rust preventing paint. Other ferrous parts shall be hot-dip galvanized as per relevant standard.

The metal tank shall have bare minimum number of welded joints so as to minimize possible locations of oil leakage.

Metal tank of the current transformer shall be provided with two separate earthing terminals for bolted connection to 50x6 mm. flat to be provided by the purchaser for connection to the station earth mat. The earthing terminals shall be provided complete with adequate size washers, nuts and bolts.

The current transformer shall be provided with suitable lifting arrangement for lifting of the entire unit. The lifting arrangement (lifting eye) shall be positioned such that the porcelain bushings and tank shall not be damaged during lifting for transportation/installation.

6.6 TERMINAL CONNECTORS:

Appropriate number of terminal connectors suitable for **ACSR Dog/Racoon/Weasel** conductor shall be supplied. Suitable terminal connectors for earth connections shall also be supplied.

6.7 BUSHINGS:

The bushing and terminal insulator, where provided for the current transformer shall conform to the latest edition of IS: 2099. The bushings shall be made of homogeneous, vitreous porcelain of high mechanical and dielectric strength. Glazing of porcelain shall be of uniform brown or dark brown colour with smooth surface, arranged to shed away rain water or condensed water particles.

The bushings shall have ample insulation, mechanical strength and rigidity for the conditions under which they will be used and shall be designed to prevent accumulation of explosive gases and to provide adequate oil circulation to remove internal heat. There shall be no undue stressing of any part of the bushings due to temperature changes and adequate means shall be provided to accommodate conductor expansion.

The bushings shall be so designed that when operating at the specified highest system voltage there will be no electric discharge between the conductors and bushings. No corrosion or injury would because to conductor, insulation or supports by the formation of substances produced by chemical action. The insulation of bushing shall be coordinated with that of the current transformer such that flash-over will occur only externally to the current transformers. The bushing should not cause radio disturbances when operated at rated voltage.

6.8 TERMINAL BOX AND JUNCTION BOX:

All secondary terminals shall be brought out in a weather proof terminal box on one side of each current transformer. The exterior of this terminal box shall be hot dip galvanised. A terminal board for short circuiting of secondary terminals shall be provided.

Cable box along with necessary glands for receiving control cables suitable for mounting on the bottom plate of the terminal box shall be included in the scope of supply.

A door with locking arrangements shall be provided in the front of the terminal box so as to permit easy access to the secondary terminals. The door shall have suitable arrangement to checking ress of moisture into the terminal box.

All terminals shall be clearly marked with identification number to facilitate connection to external wiring.

Polarity shall be indelibly marked on each primary and secondary terminal. In addition to terminal box on each current transformer, tenderer shall also supply a **common junction box for each set of three current transformers of each circuit.** The junction box shall be weather proof type suitable for mounting on the steel structure.

The terminal boxes and junction boxes shall be suitable for outdoor installation and shall conform to IP55 protection class (As per IS 2147).

6.9 OIL LEVEL GAUGE:

An oil level gauge shall be provided in indicate the oil level in the current transformer. The oil gauge shall be mounted in such a way that the oil level can be seen from the ground level.

6.10 PRESSURE RELIEVING DEVICES:

Each current transformer shall be provided with a pressure relieving device so as to prevent bursting of current transformer even under unfavorable conditions.

6.11 OIL DRAIN COCK:

An oil drain cock alongwith a stop cock shall be provided in the bottom flange so as to permit taking of oil samples for testing.

6.12 OIL FILLING COCK:

An oil filling cock alongwith a stop cock shall be provided for filling the oil in the current transformer.

6.13 MOUNTING STRUCTURES:

The current transformers shall be mounted on existing structures. The tenderer shall ensure that the CTs supplied can be mounted on the existing steel (galvanized) structures. Necessary connecting materials such as clamps, bolts, nuts, washers, etc. for the supporting structures shall be supplied by the tenderer.

6.14 RATING PLATE:

Each current transformer shall be provided with a non-corrosive rating plate in accordance with latest edition of IS:2705 Part-I. Following additional particulars shall also be marked on the rating plate of each current transformer.

a) Purpose (measurement or protection), rated output at 0.9 PF lagging, rated accuracy factor and rated class of accuracy of each secondary winding in terms of IS: 2705.
b) Terminal numbering of each secondary winding.
c) Knee point voltage.
d) Maximum exciting current at knee point voltage.
e) Secondary winding resistance at 75°C.
f) Rated instrument security factor in respect of winding meant for measurement and metering.
g) Rated current, extended current rating (if specified) and rated thermal current.
h) Year of manufacture.

6.15 INSULATING OIL:

The quantity of oil for first filling of each CT and the completes pecifications of oil proposed to be used shall be stated. It would be desirable to use oil conforming to the provisions of latest IS: 335.

6.16 TESTS:

ROUTINE TESTS:

Each current transformer shall be subjected to routine tests as specified in the latest edition of IS:2705 (Part I to IV). If the purchaser wishes to have a representative, tests shall be performed in his presence so as to be witnessed by him.

The routine tests shall consist of the following:

(a) Verification of terminal markings and polarity
(b) Power frequency dry withstand tests on primary winding
(c) Power frequency dry withstand test on secondary windings
(d) Overvoltage inter-turn test
(e) Partial discharge tests
(f) Determination of errors or other characteristics according to the requirements of the appropriate designation or accuracy class as per individual parts of IS: 2705.

(g) Knee-point voltage and exciting current for PS Class cores
(h) Secondary winding resistance for PS Class cores
(i) Turns ratio for PS Class cores
(j) Measurement of Capacitance.
(k) Oil leakage test.
(l) Measurement of tan delta at 0.3, 0.7, 1.0 Um/√3 and 10kV

At factory/works tests the Tan Delta shall not exceed 0.3% (at Um/√3). The same shall not exceed 0.7% at the end of warranty period (refer SCC clause 5.11.0). If tan delta value of CTs exceed prescribed limit of 0.7% within warranty period, it will be considered as failure within warranty period (Tan delta & capacitance test of CTs shall be measured at 10kV at site). The bidder has to replenish failed CTs within guarantee period without any cost implication to P&EDM.

TYPE TESTS:

The bidder shall furnish four sets of all the type test reports from CPRI or other accredited laboratories alongwith the offer. The type tests must have been conducted less than five years from the date of opening of bid. The Purchaser reserves the right to repeat the type tests in the presence of a representative at the cost of the Supplier.

The type tests shall be in accordance with the latest edition of IS:2705 (Part-I to IV), and shall consist of the following:

(a) Short-time current test
(b) High voltage power frequency wet withstand test
(c) Determination of errors or other characteristics according to the requirements of the appropriate designation or accuracy class as per individual parts of IS: 2705.
(d) Temperature rise test
(e) Lightning impulse voltage test
(f) Degree of protection tests of secondary terminal, junction box

All the test reports shall be submitted and got approved by the purchaser, before dispatch of the equipment.

SPECIAL TESTS/ ADDITIONAL TEST:

The special tests shall consist of the following:

(a) Chopped lightning impulse test as a type test
(b) Measurement of dielectric dissipation factor for oil immersed current transformers
(c) Mechanical test

PRE-COMMISSIONING TESTS:

Contractor shall carry out following tests as pre-commissioning tests. Contractor shall also perform any additional test based on specialities of the items as per the field instructions of the equipment Supplier or Employer without any extra cost to the Employer. The Contractor shall arrange all instruments required for conducting these tests along with calibration and shall furnish the list of instruments to the Employer for approval:

i. Insulation Resistance Test for primary and secondary.
ii. Polarity test.
iii. Ratio identification test – checking of all ratios on all cores by primary injection of current.
iv. Dielectric test of oil (wherever applicable)

v. Magnetising characteristics test.
vi. Secondary winding resistance measurement.
vii. Contact resistance measurement (wherever possible/accessible)

6.17 DRAWINGS AND INSTRUCTION MANUALS:

The tenderer shall submit, with the tender, all the drawings enumerated in this specification to enable to purchaser to assess the suitability of equipments.

As soon as possible after the award of the contract, the manufacturer shall supply two hard copies & soft copy of the following drawings which shall describe the equipment in full details for approval and shall subsequently provide eight complete sets of final approved drawings, one of which shall be auto positive/softcopy suitable for reproduction.

i. Outline dimensional drawings.
ii. Assembly Drawings.
iii. Cross sectional view of the current transformer.
iv. Drawings giving details of supporting structures and foundation.
v. Drawing showing the details of terminal connectors.
vi. Magnetising curves.
vii. Wiring diagram with polarity mark.

In addition to the above drawings, the tenderer may supply any other drawing, which in his opinion is required to describe the equipment in full details.

After the completion of the erection work, the contractor shall furnish seven sets (including one reproducible on softcopy) of the completion drawings. Six copies of instruction manuals covering instruction for installation and maintenance check tests shall be supplied by the contractor as a part of this contract.

6.18 COMPLETENESS OF EQUIPMENT:

The tenderer shall be complete in all respect and include all accessories which may not be specifically mentioned in this specification but which are essential for the completeness of equipment ordered.

6.19 GUARANTEED TECHNICAL PARTICULARS:

Guaranteed technical particulars as called for in Schedule-I shall be furnished along with the tender. Any tender lacking the complete information in this respect is likely to be rejected. Particulars which are not subject to guarantee shall be clearly marked.

6.20 SCHEDULE OF INSTALLATION:

Tenderer shall furnish a list of similar equipment supplied by him and presently in service**.**

6.21 PACKING & FORWARDING:

The equipment shall be packed in suitable crates so as to withstand handling during transport and outdoor storage. The supplier must be responsible for any damage to the equipment during transit due to improper and inadequate packing. Any material found short/damaged shall be replaced by the supplier at no extra cost to the purchaser.

6.22. TECHNICAL DATA SHEET FOR CURRENT TRANSFORMER

APPENDIX-I

TECHNICAL REQUIREMENTFOR 33kV CURRENT TRANSFORMERS

The Current Transformers under this specification shall conform to the parameters given below:-

Sl. No.	Item	**Specification**
1	Type of CT/Installation.	Single phase, dead tank, oil filled, hermetically sealed, outdoor, self cooled.
2	Type of mounting.	Pedestal type
3	Suitable for system frequency.	**50**HZ± 5 %
4	Rated voltage(KVrms)	33
5	Nominal system voltage(KVrms)	33
6	Highest system voltage (KVrms)	36
7	Current ratio (A/A)	As per requirement
8	Method of earthing the system where the current transformer will be installed.	Solidly effectively earthed.
9	Rated continuous thermal current (A)	120 % of rated primary current
10	Acceptable limit of temperature rise above 50°C ambient temperature for continous operation at rated continuous thermal current.	
(a)	Winding	45°C
(b)	Oil	40°C
(c)	External surface of the core, metallic parts in contact	45°C
11	Acceptable partial discharge level	Less than 10 picco coulombs
12	Maximum radio interference voltage at l.l times the maximum rated voltage.	Less than 500 micro volts
13	l.2/50micro second lightning impulse withstand voltage (kVp) (dry)	170
14	1 minute dry power frequency withstand voltage Primary (kVrms)	70
15	Switching Impulse withstand and voltage (kVp)	
16	l Minute dry power frequency withstand voltage secondary (kVrms)	3
17	Minimum creepage distance of porcelain Housing (mm)	900
18	Rated short time withstand current for l second at all ratios(kArms)	25 kA
19	Instrument security factor at all ratios for metering core.	Not more than 5.0

20	Minimum rated short time thermal current density of the primary winding at all ratios(A/mm^2)	As per clauseNo 9.6.3-Noteof IS: 2705 (Part-I)/l992		
21	Application, current ratio, output burden, accuracy class, minimum knee point voltage, secondary winding resistance, maximum excitation current at minimum knee point voltage etc.	Enclosed in separate sheets for each rating of the Current Transformers.		
22	Type of core	Torroidal type		
23	Seismic acceleration	0.15g(Vertical) / 0.3g(Horizontal)		
25	i) Accuracy class at all ratios ii) Rated Burden at all ratios iii) Accuracy limit or / instrument security factor at all ratios Knee point voltage at all ratios	Core-I	Core-II	Core-III
		0.2S 30 VA ISF $\leq$3.5 -	5P 30 VA ALF:10 -	PS - - $40R_{CT}$+ 155

TECHNICAL SPECIFICATION

OF 33kV Voltage Transformer

1.0. SCOPE This specification covers :

a) Design, manufacture, testing at manufacturer's works of 33 kV Voltage Transformer with all fittings and accessories including mounting structures.
b) Loading at manufacturer's works, transportation and delivery at respective substation sites, including unloading at destination sites.
c) Erection, Testing and Commissioning of Voltage Transformers including dismantling of existing equipments, if required.

2.0. SERVICE CONDITIONS

2.1. The plant and materials supplied shall be suitable for operation under the following climatic and other conditions:

a)	Maximum ambient temperature	:	50^{o} C
b)	Minimum ambient temperature	:	4° C
c)	Relative humidity	:	35% to 98%
d)	Average annual rainfall.	:	3000 mm
e)	No of months of tropical monsoon	:	6 months (May to Oct)
f)	Seismic Zone	:	V
g)	Maximum altitude	:	Above 2210m above sea level.

3.0. TYPE TEST REPORTS

3.1. Equipment, which have never been tested for critical performance, shall not be accepted. In such cases, a promise or agreement by a bidder to have the equipment tested after award of a contract is not acceptable.

3.2. All Bids must be accompanied by the full Type Test Certificates of equipment offered. Such type test certificates shall be acceptable only if:-

(a) Tests are conducted in an independent and well known testing laboratory, or

(b) Tests are conducted in manufacturer's own laboratory. In this case (i) the laboratory must have ISO 9000 (or its equivalent) series certification; and (ii) tests have been witnessed by technically qualified representatives of earlier clients or purchaser.

3.3. Test reports to be acceptable must be related directly to the materials offered. Test reports for higher class of equipment are acceptable with commitment to perform the type tests free of any charge on the particular equipment(s) after the award of contract.

3.4. Type Test Reports older than five (5) years on the date of bid opening shall not be accepted.

4.0. GUARANTEED TECHNICAL PARTICULARS

4.1. The Guaranteed Technical Particulars of the various items shall be furnished by the Bidders in the prescribed Schedules of this Section with the Bid. The Bidder shall also furnish any other information's as in their opinion is needed to give full description and details to judge the item(s) offered by them.

4.2. The data furnished in Guaranteed Technical Particulars should be the minimum or maximum value (as per the requirement of the specification) required. A Bidder may guarantee a value more stringent than the specification requirement. However, for testing purpose or from performance point of view, the material shall be considered performed successfully if it achieves the minimum/maximum value required as per the technical specification. No preference whatsoever shall be given to the bidder offering better/more stringent values than those required as per specification except where stated otherwise.

5.0. STANDARDS:

The items shall conform in all respects to the following relevant standards/ regulations with latest amendments thereof:

Sl. No.	Relevant Standards	Title
1	IS 3156 (Part I to III)	Voltage transformers
2	IS 4146	Application guide for voltage transformers.
3	IS 2099	High voltage porcelain bushings
4	IS 11322	Partial discharge measurement in instrument transformer
5	IS 2071	Methods of high voltage testing
6	IS 335	Insulating oil
7	IS 13947 (Part I), IS 12063	Degree of protection provided by enclosures for low voltage switchgear and control
8	IEC 60044 - 2	Voltage transformers
9	IS 5561	Electric power connections – terminal connectors
10	IS 4759	Hot dip zinc coatings on structural steel and other allied products
11	IS 2633	Methods of testing weight, thickness and uniformity of coating on hot dipped galvanised articles
12	IS 13134	Guide for selection of insulators in respect of polluted conditions

6.0 GENERAL REQUIREMENTS:

6.1 The voltage transformers shall be complete in all respects conforming to the modern practice for design and manufacture. The design of voltage transformers shall be such that its accuracy shall not be affected by the presence of pollution on the external surface of its insulators.

6.2 The locations for installation of voltage transformers are situated in seismic zone - V. The design and construction shall be such as to provide necessary protection against the earthquake forces. Dampers and/or additional supporting structures may be provided with the voltage transformers, if necessary, to cater for their operation in the seismic zone.

6.3. CORES:

The core shall be of high grade non-ageing, electrical silicon laminated steel of low hysteresis and eddy current losses and high permeability to ensure high accuracy at both normal and over voltages.

6.4. WINDINGS*:*

Primary windings: The primary winding of the voltage transformer shall be connected in phase to neutral with the neutral point solidly earthed. The neutral of the system is also solidly earthed. The primary winding shall be of suitably insulated electrolytic copper wire.

Secondary windings: The voltage transformer shall be provided with two separate secondary windings rated for 110V/√3 and 110V/√3. Suitably insulated copper wire of electrolytic grade shall be used for secondary windings.

6.5 TANK*:* Each voltage transformer shall be supplied filled with insulating oil and shall be hermetically sealed to prevent atmosphere from coming into contact with oil, avoid filtration and change of oil.

The tank shall be fitted with oil gauge and provisions for convenient filling and draining of oil. The oil gauge shall be mounted in such a way that the oil level can be seen from the ground level.

Both expansion chamber and tank of the voltage transformer shall be made of high quality steel and shall be able to withstand full vacuum and pressure occurring during transit, and thermal and mechanical stresses resulting from maximum short circuit current during operation.

The tank shall be given three coats of rust preventing paint. Other ferrous parts shall be hot-dip galvanised as per relevant standard.

The metal tank shall have bare minimum number of welded joints so as to minimize possible locations of oil leakage.

Metal tank of the voltage transformer shall be provided with two separate earthing terminals for bolted connection to 50 x 8 mm m.s. flat to be provided by the purchaser for connection to the station earth mat. The earthing terminals shall be provided complete with adequate size washers, nuts and bolts.

The voltage transformer shall be provided with suitable lifting arrangement for lifting of the entire unit. The lifting arrangement (lifting eye) shall be positioned such that the porcelain bushings and tank shall not be damaged during lifting for transportation/installation.

The voltage transformer shall be constructed such that it can be easily transported to site within the allowable transport limitation and in horizontal position, if the transport limitations so demand.

6.6 BUSHING*:*

a) Oil filled condenser type porcelain bushings shall be used on the voltage transformers. The porcelain shall be homogenous, thoroughly vitrified, tough and impervious to moisture. The glazing of porcelain shall be of uniform brown colour, free from blisters, burns and other similar defects. The bushings shall have ample insulation, mechanical strength and rigidity for the conditions under which they will be used and shall be designed to prevent accumulation of explosive gases and to provide adequate oil circulation to remove internal heat. There shall be no undue stressing of any part of the bushings due to temperature changes and adequate means shall be provided to accommodate conductor expansion.

b) The bushings shall be so designed that when operating at the specified highest system

voltage there will be no electric discharge between the conductors and bushings. No corrosion or injury would be cause to conductor, insulation or supports by the formation of substances produced by chemical action. The insulation of bushing shall be coordinated with that of the voltage transformer such that flash-over will occur only externally to the voltage transformers. The bushing should not cause radio disturbances when operated at rated voltage.

c) In general the bushings shall conform to the latest issue of IS: 2099 or equivalent.

d) Each of the bushings shall be complete with the following fittings.

i. Bimetallic expansion type terminal connector complete with washers bolts/nuts.

ii. Oil level sight gauge and convenient means of filling, sampling and drawing of oil.

iii. End shield for even distribution of stresses.

iv. Corona shields for bushing, if required.

6.7 TEMPERATURE RISE: Voltage transformers shall be capable of carrying their rated burden continuously at rated voltage and frequency without the temperature rise exceeding the limits laid down in the approved standard, to which they are designed and corrected to difference in ambient temperature at site and that given in the standard. The temperature rise at 1.2 times rated primary voltage when applied continuously at rated frequency and at rated burden shall not exceed the limits specified in the standard and the temperature rise at 1.5 times rated primary voltage when applied for 30 seconds starting from previous stable operation condition at rated frequency and rated burden shall not exceed the temperature limits by more than 10°C.

6.8 PRESSURE RELIEVING DEVICE: Each voltage transformer shall be provided with a pressure relieving device capable of releasing abnormal internal pressure.

6.9 INSULATING OIL: The quantity of the insulating oil for first filling of each voltage transformer and the complete specifications of oil proposed to be used shall be stated. The oil preferably conforms to the requirement of latest IS: 335 or equivalent IEC standard.

6.10 MOUNTING STRUCTURES*:* The voltage transformers shall be mounted on structures. Necessary connecting materials such as clamps, bolts, nuts, washers, etc. for the supporting structures shall be supplied by the tenderer.

6.11 TERMINAL CONNECTORS*:* Terminal connectors suitable for **ACSR Dog/Racoon/Weasel** conductors shall be supplied. Suitable terminal connectors for earthing connections shall also be supplied.

6.12 TERMINAL BOX AND JUNCTION BOX: Each voltage transformer shall be provided with one or more terminal boxes suitably located to house the terminals of the two secondary windings. The terminal box shall be outdoor type, vermint proof and shall be provided with a door in front so as to have easy access to the secondary terminals. The door shall have a sealing/locking arrangement and shall be suitable to prevent penetration of moisture and rain water.

The terminal box shall be provided with removable gland plate and glands suitable for 1100 volts grade PVC insulated, PVC sheathed multi-core 2.5 sq. mm. to 10 sq. mm.

stranded copper conductor cable.

The terminal box, with the cover closed and tightened and the cable/conduit in position when supplied shall have degree of protection not less than IP55 conforming to latest issue of IS:13947 (Part I).

Polarity shall be indelibly marked at the secondary terminals in the terminal box.

In addition to terminal box on each voltage transformer, tenderer shall also supply a common junction box for each set of three voltage transformers of each circuit. The junction box shall be weather proof type suitable for mounting on the steel structure.

Sufficient number of terminals shall be provided in the junction box for connecting the leads from individual voltage transformer and formation of star or delta as required and to relay metering in the control room.

6.13 MARKING*:*

i) RATING PLATE: Each voltage transformer shall be provided with a non-corrosive and non- rusting name and rating plate as per latest issue of IS: 3156 (Part-I). The plates shall have information such as rated output, accuracy, terminal numbering of secondary windings, as well, as the following indelibly marked on it.

a) Manufacturer's name and country of origin.
b) Manufacturer's serial number.
c) Rated transformer ratio.
d) Rated frequency.
e) Rated output per phase and accuracy class.
f) Number of phase and method of connection.
g) Type of transformer
h) Highest system voltage
i) Insulation level.

ii) TERMINAL MARKING:

The terminal marking shall identify –

a) The primary & secondary winding.
b) The winding section if any.
c) The relative polarities of windings.

iii) METHOD OF MARKING:

a) The terminals shall be marked clearly and indelibly either on the surface or in their immediate vicinity.

b) The marking shall consist of letter followed by numbers.

6.14 TESTS*:*

ROUTINE TESTS: Each voltage transformer shall be subjected to routine tests as specified in the latest edition of IS: 3156 (Part I to III). If the purchaser wishes to have a representative, tests shall be performed in his presence so as to be witnessed by him.

The routine tests shall consist of the following:

(a) Verification of terminal markings and polarity
(b) Power frequency tests on primary winding
(c) Power frequency test on secondary windings
(d) Determination of errors
(e) Oil leakage test

TYPE TESTS: The bidder shall furnish four sets of all the type test reports along with the offer. The type tests must have been conducted less than five years from the date of opening of bid. The Purchaser reserves the right to repeat the type tests in the presence of a representative at the cost of the Supplier.

The type tests shall consist of the following:

(a) Verification of terminal markings and polarity
(b) Power frequency tests on primary winding
(c) Power frequency test on secondary windings
(d) Determination of errors
(e) Temperature rise test
(f) Impulse voltage test
(g) Degree of protection of secondary terminal box
(h) Partial discharge measurement

PRE-COMMISSIONING TESTS: Contractor shall carry out following tests as pre-commissioning tests. Contractor shall also perform any additional test based on specialities of the items as per the field instructions of the equipment Supplier or Employer without any extra cost to the Employer. The Contractor shall arrange all instruments required for conducting these tests along with calibration and shall furnish the list of instruments to the Employer for approval:

i. Insulation Resistance Test for primary (if applicable) and secondary.
ii. Polarity test.
iii. Ratio test.
iv. Dielectric test of oil (wherever applicable)
v. Tan delta and capacitance measurement of individual capacitor stacks.
vi. Secondary winding resistance measurement.

6.15 COMPLETENESS OF THE EQUIPMENT*:-* The tenderer shall be complete in all respect and include all accessories which may not be specifically mentioned in this specification but which are essential for the completeness of the equipment ordered.

6.16 GUARANTEED *&* TECHNICAL PARTICULARS*:-* Guaranteed technical particulars as called for shall be furnished along with the tender. Any tender lacking complete information in this respect is likely to be rejected. Particulars which are subject to guarantee shall be clearly marked.

6.17 SCHEDULE OF INSTALLATION*:-* Tenderer shall furnish a list of similar equipment supplied by him and presently in service.

6.18 PACKING *&* FORWARDING*:* The equipment shall be packed in suitable crates so as to withstand handling during transport and outdoor storage. The supplier must be responsible for any damage to the equipment during transit due, to improper and inadequate packing. Any material found short/damaged shall be replaced by the supplier at no extra cost to the purchaser.

6.19 DRAWINGS AND INSTRUCTION MANUALS*:* The tenderer shall submit, with the tender, all the drawings enumerated in this specification to enable to purchaser to assess the suitability of equipments.

As soon as possible after the award of the contract, the manufacturer shall supply two hard copies and soft copy of the following drawings which shall describe the equipment in full details for approval and shall subsequently provide eight complete sets of final approved drawings, one of which shall be auto positive/soft copy suitable for reproduction.

i. Outline dimensional drawings.
ii. Assembly Drawings.
iii. Cross sectional view of the voltage transformer.
iv. Drawings giving details of supporting structures and foundation.
v. Drawing showing the details of terminal connectors.
vi. Magnetising curves.
vii. Wiring diagram with polarity mark.

In addition to the above drawings, the tenderer may supply any other drawing, which in his opinion is required to describe the equipment in full details.

After the completion of the erection work, the contractor shall furnish seven sets (including one reproducible on soft copy) of the completion drawings. Six copies of instruction manuals covering instruction for installation and maintenance check tests shall be supplied by the contractor as a part of this contract.

TECHNICAL DATA SHEET FOR VOLTAGE TRANSFORMER

APPENDIX-I

TECHNICAL REQUIREMENT FOR 33kV VOLTAGE TRANSFORMERS

a. The voltage transformer shall be single phase, oil immersed, self-cooled, core type suitable for outdoor operation, effectively earthed under the climatic condition as given in this specification.

b. The voltage transformers shall have the following ratings:

Sl. No.	Item	Specification
1	Normal system voltage	33 kV
2	Highest system voltage	36 kV
3	Frequency	50 Hz ± 5%
4	System of earthing	Effectively earthed
5	Ratio	33/√3 KV:110V/√3V-110V/√3
6	No. of secondary windings	Two
7	Rated burden:	
	(a) Winding I	100 VA
	(b) Winding II	75 VA
8	Class of accuracy:	
	(a) Winding I	0.2 (Metering)
	(b) Winding II	3P (Protection)
9	Power frequency withstand voltage for one minute	70 KV
10	Lightning impulse	170 KV
11	Fault level	20.0 kA
12	Rated short circuit withstand capability	25.0 kA
13	Class of insulation	A
14	Rated voltage factor	1.2 – continuous, 1.5 for 30
15	Bushing creepage distance (mm)	3625

TECHNICAL SPECIFICATION OF

33 KV Surge Arresters

1.0 SCOPE

1.1 The specification covers :

a) Design, manufacture, testing at manufacturer's works and of 33kV 10 kA Station Class heavy duty gapless metal (Zinc) oxide Surge Arrester complete with all fittings and accessories, such as surge monitor, insulating base, terminal connectors etc. with mounting structures.

b) Loading at manufacturer's works, transportation and delivery at respective substation sites, including unloading at destination sites.

c) Erection, Testing and Commissioning of Surge Arresters including dismantling of existing equipments if required.

2.0 SERVICE CONDITIONS

2.1 The plant and materials supplied shall be suitable for operation under the following climatic and other conditions:

a)	Maximum ambient temperature	:	50^{o} C
b)	Minimum ambient temperature	:	4° C
c)	Relative humidity	:	35% to 98%
d)	Average annual rainfall.	:	3000 mm
e)	No of months of tropical monsoon	:	6 months (May to October)
f)	Seismic Zone	:	V
g)	Maximum altitude	:	Above 2210m above sea level.

3.0 TYPE TEST REPORTS

3.1 **Equipment, which have never been tested for critical performance, shall not be accepted**. In such cases, a promise or agreement by a bidder to have the equipment tested after award of a contract is not acceptable.

3.2 All Bids must be accompanied by the full Type Test Certificates of equipment offered. Such type test certificates shall be acceptable only if:-

(a) Tests are conducted in an independent and well known testing laboratory, *or*

(b) Tests are conducted in manufacturer's own laboratory. In this case (i) the laboratory must have ISO 9000 (or its equivalent) series certification; and (ii) tests have been witnessed by technically qualified representatives of earlier clients or purchaser.

3.3 Test reports to be acceptable must be related directly to the materials offered. Test reports for higher class of equipment are acceptable with commitment to perform the type tests free of any charge on the particular equipment(s) after the award of contract.

3.4 **Type Test Reports older than five (5) years on the date of bid opening shall not be accepted.**

4.0 GUARANTEED TECHNICAL PARTICULARS

4.1 The Guaranteed Technical Particulars of the various items shall be furnished by the Bidders in the prescribed Schedules of this **Section with the Bid**. The Bidder shall also furnish any other information's as in their opinion is needed to give full description and details to judge the item(s) offered by them.

4.2 The data furnished in Guaranteed Technical Particulars should be the minimum or maximum value (as per the requirement of the specification) required. A Bidder may guarantee a value more stringent than the specification requirement. However, for testing purpose or from performance point of view, the material shall be considered performed successfully if it achieves the minimum/maximum value required as per the technical specification. No preference what so ever shall be given to the bidder offering better/more stringent values than those required as per specification except where stated otherwise.

5.1 STANDARDS

5.1.1 The design, manufacture and performance of Surge Arresters shall comply with IS: 3070 Part-3, unless otherwise specifically specified in this Specification.

5.2 GENERAL REQUIREMENTS

5.2.1 The surge arrester shall draw negligible current at operating voltage and at the same time offer least resistance during the flow of surge current.

5.2.2 The surge arrester shall consist of non-linear resistor elements placed in series and housed in electrical grade porcelain housing/silicon polymeric of specified creepage distance.

5.2.3 The non-linear blocks shall be of sintered metal oxide material. These shall be provided in such a way as to obtain robust construction, with excellent mechanical and electrical properties even after repeated operations.

5.2.4 The assembly shall be hermetically sealed with suitable rubber gaskets with effective sealing system arrangement to prevent ingress of moisture.

5.2.5 The surge arrester shall be provided with line and earth terminals of suitable size. The ground side terminal of surge arrester shall be connected with 25x6 mm galvanized strip, one end connected to the surge arrester and second end to a separate ground electrode.

5.2.6 The surge arrester shall not operate under power frequency and temporary over voltage conditions but under surge conditions, the surge arrester shall change over to the conducting mode

5.2.7 The surge arrester shall be suitable for circuit breaker performing 0-0.3sec.-CO-3min-CO- duty in the system.

5.2.8 Surge arresters shall have a suitable pressure relief system to avoid damage to the porcelain/ silicon polymeric housing and providing path for flow of rated fault currents in the event of arrester failure.

5.2.9 The reference current of the arrester shall be high enough to eliminate the influence

of grading and stray capacitance on the measured reference voltage.

5.2.10 The arrester shall be capable of handling terminal energy for high surges, external pollution and transient over voltage and have low losses at operating voltages.

5.2.11 The Surge Arrester shall be thermally stable and the bidder shall furnish a copy of thermal stability test with the bid.

5.3 ARRESTER HOUSING

5.3.1 The arrester housing shall be made up of ***polymer*** **for 33 kV systems** and shall be homogenous, free from laminations, cavities and other flaws of imperfections that might affect the mechanical and dielectric quality. The housing shall be of uniform brown colour, free from blisters, burrs and other similar defects.

5.3.2 The **housing shall be so coordinated that external flashover shall not occur due to application of** any impulse or switching surge voltage up to the maximum design value for arrester. The arresters shall not fail due to contamination. The arrester housings shall be designed for pressure relief class as given in Technical Parameters of the specification.

5.3.3 Sealed housings shall exhibit no measurable leakage.

5.4 FITTINGS & ACCESSORIES

5.4.1 The surge arrester shall be complete with insulating bases, fasteners for stacking units together, surge counters with leakage current meters and terminal connectors.

5.4.2 The terminals shall be non-magnetic, corrosion proof, robust and of adequate size and shall be so located that incoming and outgoing connections are made with minimum possible bends. The top metal cap and base of surge arrester shall be galvanized. The line terminal shall have a built in clamping device which can be adjusted for both horizontal and vertical takeoff.

5.4.3 Grading corona control rings if necessary shall be provided on each complete arrester pole for proper stress distribution.

5.5 SURGE MONITOR

5.5.1 A self-contained discharge counter suitably enclosed for outdoor use and requiring no auxiliary or battery supply for operation shall be provided for each single pole unit. Leakage current meter with suitable scale range to measure leakage current of surge arrester shall also be supplied within the same enclosure. The number of operations performed by the arrester shall be recorded by a suitable cyclometric counter and surge monitor shall be provided with an inspection window. There shall be a provision for putting ammeter to record the current/alarm contacts in the control room if the leakage current exceeds the permitted value. **Similar provision shall be considered for surge counter also.**

5.5.2 Surge monitor shall be mounted on the support structure at a suitable height so that the reading can be taken from ground level through the inspection window and length of connecting leads up to grounding point and bends are minimum.

5.5.3 The surge counter shall be provided with a potential free contact rated for 110 Volt (DC) which shall close whenever a surge is recorded by the surge monitor. **Necessary arrangement shall be provided for extending the contact information to Substation Automation System/RTU.**

5.6 TESTS

5.6.1 **Test on Surge Arresters**

The Surge Arresters **offered shall be type tested and shall be subjected to routine and acceptance tests in accordance with IS: 3070 (Part-3).** In addition, the suitability of the Surge Arresters shall also be established for the following:

- Residual voltage test
- Reference voltage test
- Leakage current at M.C.O.V
- P.D. test
- Sealing test
- Thermal stability test
- Aging and Energy capability test
- Watt loss test

Each metal oxide block shall be tested for guaranteed specific energy capability in addition to routine/acceptance test as per IEC/IS.

5.6.2 The surge arrester housing shall also be type tested and shall be subjected to routine and acceptance tests in accordance with IS: 2071.

5.6.3 Galvanization Test

All Ferrous parts exposed to atmospheric condition shall have passed the type tests and be subjected to routine and acceptance tests in accordance with IS: 2633 & IS 6745.

5.7 NAME PLATES

5.7.1 The name plate attached to the arrester shall carry the following information:

Rated Voltage
Continuous Operation Voltage
Normal discharge current
Pressure relief rated current
Manufacturers Trade Mark
Name of Sub-station
Year of Manufacturer
Name of the manufacture
Purchase Order Number along with date

5.8 PRE-COMMISSIONING TESTS

5.8.1 Contractor shall carry out following tests as pre-commissioning tests. Contractor shall also perform any additional test based on specialties of the items as per the field instructions of the equipment Supplier or Employer without any extra cost to the Employer. The Contractor shall arrange all instruments required for conducting these tests along with calibration certificates and shall furnish the list of instruments to the Employer for approval.

(a) Operation check of LA counters.
(b) Insulation resistance masurement.
(c) Capacitance and Tan delta measurement of individual stacks.
(d) Third harmonic resistive current measurement (to be conducted after energisation.)

5.9 TYPE AND RATING:

Sl. No.	Particulars	Voltage class 33 kV
1	Rated voltage of arrester, kV	30
2	Rated frequency, Hz	
3	Nominal discharge current of arrester, kA	10
4	Maximum residual voltage at nominal discharge current, kV (peak)	108
5	Maximum steep current impulse residual voltage at kV (kVP)	120
6	One minute power frequency withstand voltage of arrester insulation, kV (rms)	70
7	1.2 / 50 □ second impulse withstand voltage of arrester insulation, kV (peak)	170
8	Line discharge class	2
9	**Insulator Housing**	
	a) Power frequency withstand test voltage (wet) (kV rms)	70
	b) Lightning impulse withstand tests voltage (KVp)	170
	c) Pressure Relief Class	40
	d) Creepage distance not less than (mm)	900

TECHNICAL SPECIFICATION OF

33 kV Isolators

1.0 SCOPE

1.1 The brief description of scope covered is furnished below:

a) Design, manufacture, testing at manufacturer's works and of 33kV gang operated switch (Isolators) with all fittings and accessories including mounting structures as applicable. The Isolators are for outdoor installation suitable for horizontally mounting on mounting structures and for use at sub-stations. Isolators shall be supplied with Earth Switch as and where specified.

b) Loading at manufacturer's works, transportation and delivery at respective substation sites, including unloading at destination sites.

c) Erection, Testing and Commissioning of Isolators including dismantling of existing equipments if required.

2.0. SERVICECONDITIONS

2.1. The plant and materials supplied shall be suitable for operation under the following climatic and other conditions:

i.	Maximum ambient temperature	:	50^{o} C
ii.	Minimum ambient temperature	:	4° C
iii.	Relative humidity	:	35% to 98%
iv.	Average annual rainfall.	:	3000 mm
v.	No of months of tropical monsoon	:	6 months (May to October)
vi.	Seismic Zone	:	V
vii.	Maximum altitude	:	Above 2210m above sea level.

3.0 TYPE TEST REPORTS

3.1 **Equipment, which have never been tested for critical performance, shall not be accepted**. In such cases, a promise or agreement by a bidder to have the equipment tested after award of a contract is not acceptable.

3.2 All Bids must be accompanied by the full Type Test Certificates of equipment offered. Such type test certificates shall be acceptable only if:-

(a) Tests are conducted in an independent and well known testing laboratory, or

(b) Tests are conducted in manufacturer's own laboratory. In this case (i) the laboratory must have ISO 9000 (or its equivalent) series certification; and (ii) tests have been witnessed by technically qualified representatives of earlier clients or purchaser.

3.3 Test reports to be acceptable must be related directly to the materials offered. Test reports for higher class of equipment are acceptable with commitment to perform the type tests free of any charge on the particular equipment(s) after the award of contract.

3.4 **Type Test Reports older than five (5) years on the date of bid opening shall not be accepted.**

4.0 GUARANTEED TECHNICAL PARTICULARS

4.1 The Guaranteed Technical Particulars of the various items shall be furnished by the Bidders in the prescribed Schedules of this Section with the Technical Bid. The Bidder shall also furnish any other information's as in their opinion is needed to give full description and details to judge the item(s) offered by them.

4.2 The data furnished in Guaranteed Technical Particulars should be the minimum or maximum value (as per the requirement of the specification) required. A Bidder may guarantee a value more stringent than the specification requirement. However, for testing purpose or from performance point of view, the material shall be considered performed successfully if it achieves the minimum/maximum value required as per the technical specification. No preference what so ever shall be given to the bidder offering better/more stringent values than those required as per specification except where stated otherwise.

5.0 TECHNICAL SPECIFICATION OF ISOLATORS

5.1 STANDARD

5.1.1 The Isolators and accessories shall conform in general to IEC 9921 or IS: 9921 except to the extent explicitly modified in this Specification.

5.2 GENERAL REQUIREMENTS

5.2.1 Isolators shall be outdoor, off-load type. Earth switches shall be provided on isolators wherever called for, with possibility of being mounted on any side of the isolator.

5.2.2 All isolators shall be double break centre pole type.

5.2.3 All isolating switches and earthing switches shall have rotating blades and pressure releasing contacts. All isolating and earth switches shall operate through 90° angle from closed position to fully open position.

5.2.4 Complete isolator with all the necessary items for successful operation shall be supplied including but not limited to the following:

(i) Isolator assembled with complete base frame, linkages, operating mechanism, control cabinet, interlocks etc.

(ii) All necessary parts to provide a complete and operable isolator installation, control parts and other devices whether specifically called for herein or not.

5.2.5 The isolator shall be designed for use in the geographic and meteorological conditions as given in Clause 2.1.

5.3 DUTY REQUIREMENT

5.3.1 Isolators and earth switches shall be capable of withstanding the dynamic and thermal effects of the maximum possible short circuit current of the systems in their closed position. They shall be constructed such that they do not open under influence of short circuit current.

5.3.2 The earth switches, wherever provided, shall be constructionally interlocked so that the earth switches can be operated only when the isolator is open and vice versa. The constructional interlocks shall be built in construction of isolator and shall be in addition to the electrical and mechanical interlocks provided in the operating mechanism.

5.3.3 In addition to the constructional interlock, isolator and earth switches shall have provision to prevent their electrical and manual operation unless the associated and other interlocking conditions are met. All these interlocks shall be of failsafe type. Suitable individual interlocking coil arrangements shall be provided. The interlocking coil shall be suitable for continuous operation from DC supply and within a variation range as stipulated elsewhere in this specification.

5.3.4 The earthing switches shall be capable of discharging trapped charges of the associated lines.

5.3.5 The isolator shall be capable of making/breaking normal currents when no significant change in voltage occurs across the terminals of each pole of isolator on account of make/break operation.

5.4 CONSTRUCTIONAL DETAILS

5.4.1 All isolating switches and earthing switches shall have rotating blades and pressure releasing contacts. All isolating and earth switches shall operate through 90^0 angle from closed position to fully open position.

5.4.2 Contacts:

a) The contacts shall be self-aligning and self-cleaning and so designed that binding cannot occur after remaining closed for prolonged periods of time in a heavily polluted atmosphere.

b) No undue wear or scuffing shall be evident during the mechanical endurance tests. Contacts and spring shall be designed so that readjustments in contact pressure shall not be necessary throughout the life of the isolator or earthing switch. Each contact or pair of contacts shall be independently sprung so that full pressure is maintained on all contacts at all time.

c) Contact springs shall not carry any current and shall not lose their characteristics due to heating effects.

d) The moving contact of double break isolator shall have turn-and -twist type or other suitable type of locking arrangement to ensure adequate contact pressure.

5.4.3 Blades:

a) All metal parts shall be of non-rusting and non-corroding material. All current carrying parts shall be made from high conductivity electrolytic copper/aluminium. Bolts, screws and pins shall be provided with lock washers. Keys or equivalent locking facilities if provided on current carrying parts, shall be made of copper silicon alloy or stainless steel or equivalent. The bolts or pins used in current carrying parts shall be made of non-corroding material. All ferrous castings except current carrying parts shall be made of malleable cast iron or cast-steel. No grey iron shall be used in the manufacture of any part of the isolator.

b) The live parts shall be designed to eliminate sharp joints, edges and other corona producing surfaces, where this is impracticable adequate corona shield shall be provided. Corona shields/rings etc., shall be made up of aluminium/aluminium alloy.

c) Isolators and earthing switches including their operating parts shall be such that they cannot be dislodged from their open or closed positions by short circuit forces, gravity, wind pressure, vibrations, shocks, or accidental touching of the connecting rods of

the operating mechanism.

d) The switch shall be designed such that no lubrication of any part is required except at very infrequent intervals i.e. after every 1000 operations or after 5 years whichever is earlier.

5.4.4 Insulators:

a) The insulator shall conform to IS: 2544 and/or IEC-60168. The insulators shall have a minimum cantilever strength of **400 Kgs. for 33 kV** isolators.

b) Pressure due to the contact shall not be transferred to the insulators after the main blades are fully closed.

5.4.5 Base:

Each isolator shall be provided with a complete galvanised steel base provided with holes and designed for mounting on a supporting structure.

5.5 EARTHING SWITCHES

5.5.1 Where earthing switches are specified these shall include the complete operating mechanism and auxiliary contacts.

5.5.2 The earthing switches shall form an integral part of the isolator and shall be mounted on the base frame of the isolator.

5.5.3 The earthing switches shall be constructionally interlocked with the isolator so that the earthing switches can be operated only when the isolator is open and vice versa. The constructional interlocks shall be built in construction of isolator and shall be in addition to the electrical interlocks.

5.5.4 Each earth switch shall be provided with flexible copper/aluminum braids for connection to earth terminal.

These braids shall have the same short time current carrying capacity as the earth blade. The transfer of fault current through swivel connection will not be accepted.

5.5.5 The frame of each isolator and earthing switches shall be provided with two reliable earth terminals for connection to the earth mat.

5.5.6 Isolator design shall be such as to permit addition of earth switches at a future date. It should be possible to interchange position of earth switch to either side.

5.5.7 The earth switch should be able to carry the same fault current as the main blades of the Isolators and shall withstand dynamic stresses.

5.6 OPERATING MECHANISM

5.6.1 The bidder shall offer manual operated Isolators and earth switches.

5.6.2 Control cabinet/operating mechanism box shall be made of aluminum sheet of adequate thickness (minimum 3 mm).

5.6.3 Suitable reduction gearing shall be provided.

5.6.4 Manual operation facility (with handle) should be provided with necessary interlock.

5.6.5 Gear should be of forged material suitably chosen to avoid bending/jamming on

operation after a prolonged period of non operation. Also all gear and connected material should be so chosen/surface treated to avoid rusting.

5.7 OPERATION

5.7.1 All the main Isolator and earth switches shall be mechanically gang operated.

5.7.2 The design shall be such as to provide maximum reliability under all service conditions. All operating linkages carrying mechanical loads shall be designed for negligible deflection. The length of inter insulator and interpole operating rods shall be capable of adjustments, by means of screw thread which can be locked with a lock nut after an adjustment has been made. The isolator and earth switches shall be provided with "over center" device in the operating mechanism to prevent accidental opening by wind, vibration, short circuit forces or movement of the support structures.

5.7.3 Each isolator and earthswitch shall be provided with a manual operating handle enabling one man to open or close the isolator with ease in one movement while standing at ground level. Detachable type manual operating handle shall be provided. Suitable provision shall be made inside the operating mechanism box for parking the detached handles. The provision of manual operation shall be located at a height of 1000 mm from the base of isolator support structure.

5.7.4 The isolator shall be provided with positive continuous control throughout the entire cycle of operation. The operating pipes and rods shall be sufficiently rigid to maintain positive control under the most adverse conditions and when operated in tension or compression for isolator closing. They shall also be capable of withstanding all torsional and bending stresses due to operation of the isolator. Wherever supported the operating rods shall be provided with bearings on either ends. The operating rods/ pipes shall be provided with suitable universal couplings to account for any angular misalignment.

5.7.5 All rotating parts shall be provided with grease packed roller or ball bearings in sealed housings designed to prevent the ingress of moisture, dirt or other foreign matter. Bearings pressure shall be kept low to ensure long life and ease of operation. Locking pins wherever used shall be rustproof.

5.7.6 Signaling of closed position shall not take place unless it is certain that the movable contacts, have reached a position in which rated normal current, peak withstand current and short time withstand current can be carried safely. Signaling of open position shall not take place unless movable contacts have reached a position such that clearance between contacts is at least 80% of the isolating distance.

5.7.7 The position of movable contact system (main blades) of each of the Isolators and earthing switches shall be indicated by a mechanical indicator at the lower end of the vertical rod of shaft for the Isolators and earthing switch. The indicator shall be of metal and shall be visible from operating level.

5.7.8 The contractor shall furnish the following details along with quality norms, during detailed engineering stage.

(i) Current transfer arrangement from main blades of isolator along with millivolt drop immediately across transfer point.

(ii) Details to demonstrate smooth transfer of rotary motion from motor shaft to the insulator along with stoppers to prevent over travel.

5.8 TEST AND INSPECTION

5.8.1 The following test reports of the type tests shall also be submitted by the successful bidder for the

Purchaser's review:

I) Dielectric tests as per IEC 62271-102 /IS 9921.

II) Temperature rise test as per IEC 62271-102 /IS 9921.

III) Short time withstand current peak withstand current tests as per IEC 62271-102 /IS 9921.

IV) Tests to Prove the Short-Circuit-Making Performance of Earthing Switches as per IEC 62271-102 /IS 9921.

V) Operating and Mechanical Endurance Tests as per IEC 62271-102

5.8.2 The equipment shall be subjected to the following routine test.

I) Power frequency voltage dry withstand test on the Main Circuit

II) Voltage Tests on control and auxiliary circuits

III) Measurement of resistance of the main circuit

IV) Mechanical Operating test.

5.8.3 The porcelain will have pull out test for embedded component and beam strength of porcelain base.

5.9 AUXILIARY SWITCHES

5.9.1 All isolators and earth switches shall be provided with 110 volts, 6 Ampere auxiliary switches for their remote position indication on the control board and for electrical interlocking with other equipment. In addition to the auxiliary switches required for remote position indications and for their operation. There shall be six pairs of NO and six pairs of NC contacts for each isolating switch and three pairs of NO and three pairs of NC contacts for each earthing switch. All contacts shall be brought out to terminal blocks

5.10 CONNECTORS

5.10.1 Each isolator shall be provided with appropriate number of bimetallic clamping type connectors as detailed in the schedule of requirement. The maximum length of jumper that may be safely connected or any special instruction considered necessary to avoid under loads on the post isolators should be stated by the tenderer.

5.11 SUPPORTING STRUCTURES

5.11.1 All isolators and earthing switches shall be rigidly mounted in an upright position on their own supporting structures. Details of the supporting structures shall be furnished by the successful tenderer. The isolators should have requisite fixing details ready for mounting them on switch structures.

5.12 PRE-COMMISSIONING TESTS

5.12.1 Contractor shall carry out following tests as pre-commissioning tests. Contractor

shall also perform any additional test based on specialties of the items as per the field instructions of the equipment Supplier or Employer without any extra cost to the Employer. The Contractor shall arrange all instruments required for conducting these tests along with calibration certificates and shall furnish the list of instruments to the Employer for approval.

(a) Insulation resistance of each pole.

(b) Manual and electrical operation and interlocks.

(c) Insulation resistance of control circuits and motors.

(d) Ground connections.

(e) Contact resistance.

(f) Proper alignment so as to minimise to the extreme possible the vibration during operation.

(g) Measurement of operating Torque for isolator and Earth switch.

(h) Resistance of operating and interlocks coils.

(i) Functional check of the control schematic and electrical & mechanical interlocks.

(j) 50 operations test on isolator and earth switch.

5.13 TECHNICAL DATA SHEET FOR ISOLATORS

SL No.	Technical Particulars	Isolators class
		33 kV
1	Nominal system voltage, kV	33
2	Highest system voltage, kV	36
3	Rated frequency, Hz.	50
4	Type of Isolator	Double Break, center pole rotating
5	Rated continuous current, A	1250
6	Rated short time current, kA	25
7	Rated duration of short time current, Second	1
8	Rated lightning impulse withstand voltage, kV (peak) i) To earth & between poles ii)Across isolating distance	170 195
9	Rated 1 minute power frequency withstand voltage, kV (rms) i) To earth & between poles ii)Across isolating distance	70 80
10	Minimum creepage distance of insulators, mm	900
11	Temperature rise	As per relevant IEC 62271-102/ IS

TECHNICAL SPECIFICATIONS OF 33kV CONTROL & RELAY PANEL

1.0	**SCOPE**	
1.1	The specification covers design, engineering, manufacture, testing & supply delivery at site, erection, testing and commissioning of Control & relay and protection panels for replacement of existing old panels. The panels should be inclusive of internal wiring and with arrangement for external connection to various Switchyard equipments and Control room building equipments as necessary. The Contractor has to design the Schematics for protection and Control of all equipments including monitoring indications, visual and audible alarm, interlocking schemes between different equipment. Any other requirement which are not specifically covered here but which are necessary for successful commissioning of the Sub-station equipments as a whole are also within the scope of the Contract.	
1.2	It is not the intent to specify here in complete details of design and construction. The equipment manufactured should conform to the relevant standards and of highest quality of engineering design and workmanship. The equipment manufactured shall ensure satisfactory and reliable performance throughout the service life. The Schedule of requirement of the Panel is furnished separately in details.	
2.0	**STANDARDS :**	
2.1	Unless otherwise specified all equipment and material shall conform to the latest IS applicable standards. Equipment complying with other internationally recognized standards will also be considered if it ensures performance equivalent or superior to Indian standards. In the event of supply of equipment conforming to any international / internationally recognized standards other than the standard listed below, the salient features of comparison shall be brought out and furnished along with the bid. One copy of such standard specification in English language shall be enclosed with the tender.	
2.2	The equipment provided shall also comply with the latest revisions of the Electricity act and Indian Electricity rules and any other applicable Statutory provisions, rules and regulations	
2.3	All equipment provided under the specification shall generally conform to the latest issue of the following:	
	IS 3231 & IEC-255	Electrical relays for power system protection
	IS 1248 & IS 2419	Indicating Instrument
	IEC 337 & 337-1, 156875	Control Switches (LV Switching devices for control and auxiliary circuit)
	IS 2705	Current Transformers
	IS 3156	Voltage Transformer
	IS 375, IS 5578	Marking and arrangement for Switchgear Bus bars, main connection and auxiliary wiring.
	IS 8686	Specification for static protective relays

4.0 CT & PT RATIO

CT RATIO : for Feeders : 200-100-50/1-1-1A for Trf. **:** 300-150-75/1-1-1 A

PT RATIO : 132Kv/√3, 33kV/√3

110V/√3 110V/√3.

GENERAL REQUIREMENTS

5.0 **AUXILIARY SUPPLY :**

D.C.Supply voltage shall be normally fed from Battery charger and battery connected in parallel which is 110V +/- 10%. In case of failure of the AC supply to battery charger, DC Supply voltage will be available automatically from lead acid Battery. The D.C Supply voltage may vary from -10% to + 10%. The D.C. system shall be 2 wire with necessary earth fault annunciation scheme. AC Auxiliary supply voltage for the C&R panel shall be 230V, 1-phase, 50Hz grounded with +/- 10% voltage variation.

DRAWINGS : detailed drawings shall be submitted while designing the control and Relay Panels by the contractor for approval of the purchaser.

6.0 **CONTROL AND RELAY BOARD :**

The control and relay panel shall be comprising of a section of duplex board consisting of vertical, front and rear steel panel joined together by a steel topped enclosures with an access passage in between and necessary reinforcing steel members, complete with foundation stilts and mounting bolts. The section shall be placed together to form a continuous Board. Each end of the structure shall be fabricated of steel with flush mounted steel in detachable hinged doors and locks. The doors shall be preferably two leaved in order to minimize space required for operating them. The duplex board shall be readily extensible to either direction. On the front panel, shall be mounted the mimic diagram, annunciation, meters, indication, control switches etc. All the protective and auxiliary relays shall be mounted on the rear panel of the duplex Board. The dimension of the duplex board shall be as indicated below:-

Sl. No	Description	Front width (metres)	Depth (metres)	Height (metres)	Corridoor width (metres)
1	132/66/33kV Feeder Panel	0.8	2.0	2.3	0.76
2	132/66/33kV Transformer Panel	1.0	2.0	2.3	0.76

Layout diagram showing the dimensions are shown in separate sheet enclosed.

The Control and Relay Panels for 132/33kV,132/66kV & 66/33kV transformer shall be for the control and protection of both the HV and LV side of the transformer in one panel. The panels for 33/11kV transformer shall be for the control and protection of the 33kV side of the transformer.

The complete panel shall incorporate all necessary instruments, meters, relays, auxiliary relays, control switches, indicating lamps, mimic, annunciators, audible alarms, horizontal and vertical wiring supports, interior lighting system, terminal blocks, fuses and links etc.

7.0 **PAINTING :**

Panel painting shall be done by the modern process of painting. All unfurnished surface of the steel panel and frame work shall be sand blasted or suitable cured to remove rust, scale, foreign adhering matter or grease. A suitable rust resisting primer shall be applied on the interior and exterior surface of steel, which shall be followed by application of an undercoat suitable to serve as base and binder forth finishing coat. The panel shall be finished to enamel deep Grey for exterior and enamel light Grey for the interior. The Panel shall be given a plastic durable covering coat for protection of the finish during the transshipment, which shall be capable being pealed off after installation. Additionally, a small quantity of finished paint shall be supplied with each Consignment of the Panel to enable the purchaser‘s Store at Site for any finish which may get damaged during the transshipment.

8.0	**WIRING :**
	All wiring shall be carried out with 1100 volts grade single core, multi strand flexible tinned copper wires with PVC insulation. The conductor size shall be 2.5 sq. mm.(minimum). Wiring troughs shall be used for routing the cables. Wire numberings and colour code for wiring shall be as per IS IS:5578/1984. The wiring should been cased in suitable width PVC casing. The wiring diagram for various schematics shall be made on thick and durable white paper in permanent black ink and same should be encased in plastic cover thermally sealed. It should be kept visibly in a pocket of size 350 x 400 mm of MS sheet of 1 mm thickness, on the interior surface.
8.1	a) All internal wiring shall be securely supported, neatly arranged, readily accessible and connected to equipment terminals and terminal blocks. Wiring gutters & trough shall be used for this purpose. b) Longitudinal troughs extending throughout the full length of the panel shall be used for inter panel wiring. Inter connections to adjacent panels shall be brought out to a separate set of terminal blocks located near the slot or holes meant for taking the interconnecting wires. All bus wiring for inter panel connection shall preferably be provided near the top of the panels running through out the entire length of the panels. c) Wiring connected to the space heaters in the cubicles shall have porcelain beaded insulation over a safe length from the heater terminals. d) Wire termination shall be made with solder less crimping type and tinned copper lugs which firmly grip the conductor and insulation. Insulated sleeves shall be provided at all the wire terminations. Engraved core identification plastic ferrules marked to correspond with panel wiring diagram shall be fitted at both ends of each wire. Ferrules shall fit tightly on the wire and shall not fall off when the wire is disconnected for any purpose. Termination shall be such that no strand of a conductor shall left loose or overhanging. Conductor termination shall be secured to the holding nuts/screws, terminal blocks etc. with washers interposed between the terminals/holding nuts/screw heads. The terminals shall be so connected that no conductor ferrule code gets masked due to overlay of conductors. e) All spare contacts of relays shall be wired up to terminal blocks.
8.2	Each wire shall be continuous from end to end and shall not have any joint within itself Individual Wires shall be connected only at the connection terminals or studs of the terminal blocks, meters relays instruments and other switch board devices.
8.3	Terminals Ends of all wires shall be provided with numbered Ferrules suitably coloured for phase identification. At point of inter-connection where a change of number is necessary, duplicate Ferrules shall be provided with the appropriate numbers on the changing end.
8.4	At the terminal connection, washers shall be interposed between terminals, wire terminals and the holding nuts. All holding nuts shall be secured by locking nuts. The connection stud shall project at least 6 mm from the lock nut surface. Wire ends shall be so connected at the terminals studs that no wire terminal number ferruled gets masked due to succeeding connections. All wires shall be suitable for bending to meet the terminal stud at right angles with the stud axis, and they shall not be skewed.
8.5	All studs, nuts, bolt‘s screws etc. shall be threaded according to the British Standard practice unless purchaser‘s prior approval to any other practice of threading is obtained. Spare quantities of nuts, lock and washers of all varieties used on the panel board shall be supplied to the extent of 10% of the used quantities.
9.0	**TERMINAL BLOCKS :**
9.1	Terminal blocks shall be of clip-on design made out of non-trackable insulating material of 1100 V grade. All terminals shall be stud type, with all current carrying and live parts made of tinned plated brass. The studs shall be of min 4 mm dia brass. The washers, nuts, etc. used for terminal connectors shall also be of tinned plated brass.

9.2	The terminal connector/blocks shall be disconnecting type terminal connectors with automatic shorting of C.T. secondary terminals shall be provided in CT secondary circuit. All other terminal connectors shall be non-disconnecting type. Terminal should be shock protected in single moulded piece. Terminal block should have screw-locking design to prevent loosening of conductor.
9.3	At least 20% spare terminals shall be provided. All terminals shall be provided with ferrules indelibly marked or numbered and identification shall correspond to the designations on the relevant wiring diagrams. The terminals shall be rated for adequate capacity, which shall not be less than 10 Amps for control circuit. For power circuit it shall not be less than 15 Amps.
10	**SPACE HEATERS :**
10.1	60W, 230 V, 50 HZ Tubular Space Heaters suitable for connection to the Single Phase A.C. Supply complete with On-Off Switches located at convenient position shall be provided at the bottom of the Switch Board to prevent condemnation of moisture. The Watt loss per Unit surface of heater shall be low enough to keep surface temperature well below sensible heat. The wattage of heater shall be such as to keep 10 deg C above average ambient temp in rainy season but the temp. shall not under any circumstances damage the insulation of the wiring of the panel. Heaters shall be complete with MCB and thermostat.
11.0	**DISTRIBUTION AND CONTROL OF AUX. POWER CIRCUIT :**
11.1	**D.C. CIRCUIT** There shall be only one 110V D.C. for the entire Control and Relay Board fed from a D.C. Distribution Board. A continuous D.C. Bus shall be provided in the Control and Relay Board and D.C. supply for control, protection, indication and supervision of circuit breaker and other equipment shall be off from D.C. bus through a set of 16 Amp. H.R.C. Fuse on positive and negative side. D.C. supply to be teed off shall be distributed within the Panel as below: (a) C.B. remote and protection tripping circuit- 1, C.B. local operation and protective relay circuit without any fuse. (b) C.B. remote closing circuit through a 10A HRC Fuse on the positive side only. (c) C.B. remote and protection tripping circuit, TC-2, through 10A fuse both at +ve and –ve side with trip circuit supervision relay. (d) Indication Circuit through a set of 6 Amp. HRC Fuse and link. In addition to the above, one circuit common to the board shall be teed off for an Alarm Annunciation Circuit from the above incomer D.C. Bus through a set of 6 Amps. HRC Fuse and link. 1) C.B. remote and protection tripping circuit, TC-1, through 16A fuse both at +ve and –ve side with trip circuit supervision relay. 2) C.B. remote and protection tripping circuit, TC-2, through 16A fuse both at +ve and –ve side with trip circuit supervision relay. 3) C.B. local operation remote closing circuit through a 10 Amp HRC fuse on + ve and – ve side. Protective relay circuits through 6A fuse both at +ve and –ve side with DC supervision relay. Alarm Bus shall be run throughout the Control and Relay Board & Alarm Circuit shall be teed off at each Panel through a set of links. A D.C. operated no-volt auxiliary relay provided with hand reset type reverse flag with inscription ―Panel D.C. Fail‖ and two sets of self-reset N/C contact shall be provided at each C&R Panel to supervise the 18 Amp. HRC Fuse, through which D.C. Supply for control, protection and supervision of C.B. and other equipment has been teed off in each panel. One N/C contact shall be used for visual alarm and the other N/C contact shall be used for audible alarm. One Push button having N/C Contact used in Series with the above

	relay for ―D.C. Fall Test‖ purpose. Both contacts shall be connected to D.C. Fail Non-Trip Alarm scheme.
11.2	**A.C. CIRCUITS :** 230 Volts, Single Phase A.C. Aux. Supply to the Control and Relay Board will be fed from A.C. Distribution Board through a suitable Fuse Switch Unit provided there. A continuous A.C. Bus shall be provided to the Control and Relay Board where from A.C. Supply to each Panel shall be teed off through a set of links. One 16 Amps. Rated HRC Fuse shall be provided at the Control & Relay Board for the Incoming A.C. Supply. An A.C. operated no volt auxiliary relay rated for 230V are provided with hand reset reverse flag with inscription ―A.C. Fail‖ and two sets of self reset N/C Contacts shall be provided in the Panel having common equipment (One N/C contact shall be used in Annunciation Circuit and other N/C contact shall be kept as spare. One push button having N/C Contact used in Series with above relay for ―A.C. Fail Test‖ purpose.
11.3	**P.T. SECONDARY CIRCUIT;** There may be two sets bus PT, one in each bus section and one set of PT for feeder. P.T. supply shall be available from either of the two Bus P.T for feeder PT. Two sets of Fuses for phases and link for neutral of suitable rating shall be provided for the Incoming P.T supplies and two sets of 3 nos. LED indicating lamps having coloured top covers for Red, Yellow and Blue phases, shall be provided for supervision of the Fuse. Lamps shall be connected between respective phases and neutral. The arrangement of distribution of P.T. Secondary Circuit shall be as follows: (a) Potential supply to the protective relay circuit for Feeder where necessary shall be fed from respective Bus P.T. supply bus. (b) Potential supply to meters, Energy meters and indicating instrument of each panel shall be fed from respective Bus P.T. supply bus. c) Selected V.T. secondary supply to the protective relays of each panel shall be fed through 3 pole - MCB and link in neutral in each panel where necessary with annunciation contact . d) Selected V.T. secondary supply to metering and indicating instruments of each panel shall be fed through fuse in each phase and link in neutral in each panel of 132kV/33KV system voltage. e) Two position (PT-1/PT-2), minimum 4(four) way PT selector switch (stay put type), minimum 16A rating shall be provided in each panel for metering ckt. Additional 4 way in PT selector switch is required for protection wherever applicable. The no. of way may increase during detailed engineering.
12.0	**MIMIC DIAGRAMS;** Mimic diagram formed from strip of suitable materials about 10mm wide with symbols and engraved name plates shall be provided on the exterior of the front panels to represent the single line arrangement of the sub-station. The mimic bus colour shall be subject to purchaser's approval. The mimic diagram shall incorporate the control switches of the transformer CBs semaphore/feeder CBs semaphore, semaphore for earthing switches, isolators, symbols of transformer, etc. However, the bus arrangement is to be confirmed by the Supplier at the time of detail engineering.
13.0	**CONTROL SWITCH: PISTOL GRIP TYPE;** Control Switches for Circuit Breakers shall be of three position spring return type with pistol grip handle and sequence device to ensure that manual pumping of closing solenoid not possible. The switches shall be robust construction and shall have four effective contact positions. "At after Close" position the switches shall have a maintained contact for using with Circuit Breaker Auto-Trip Indication Lamp Circuit.

13.1 **INDICATING LAMPS;**

L.E.D. Type Indicating Lamps shall be provided on the Control Panel to indicate the following:

Sl.No.	Functions	Quantity	Colour of Lamp
1.	C.B. Spring charged indication	1 No.	Blue
2.	C.B. Trip Circuit healthy indication	1 No.	White
3.	C.B. Auto tripped indication (where necessary)	1 No.	Amber
4.	Panel D.C. Fail indication (For common Equipment panel	1 No.	Amber
5.	P.T. Supply indicating Lamp (where necessary)	2 sets	Red/Yellow/Blue
6.	C.B. "ON" indication	1 No.	Red
7.	C.B. "OFF" indication	1 No.	Green
8.	Isolator "ON" indication	2 Nos.	Red
9.	Isolator "OFF" indication	2 Nos.	Green
10.	C.B. Gas Pressure Low indication	1 No.	Violet

13.1 No indicating lamps under (1) & (2) shall be provided with push button control. All the lamps shall be connected to the auxiliary D.C. supply of the Sub-Station except Sl. No. (4) & Sl. No. (5) which should be connected to the auxiliary A.C. supply and P.T. Secondary supply respectively. The Lamp shall be suitable for Switch Board purpose and shall be Low Watt consumption. The Lamps shall be of cluster LED type of normal colour, this shall be provided with screwed coloured glass covers made translucent to diffuse light. The Lamps should be provided with suitable series resistance. In the initial supply 20% of the lamps actually used on the Switch Board and 10% of the lamps covers used shall be supplied in excess to serve as spares.

14 **TEST BLOCKS**:

1. Terminal Blocks for D.C. Circuit and C.T., P.T. & A.C. Circuit should be located on the front side.
2. Switch Board Type, back connected test terminal blocks with contacts shall be provided with Link type shorting terminals of C.T. leads before interrupting the normal circuit for injection from an external source, or for inserting testing instruments in the circuit without causing open circuit of the C.T. The potential testing studs shall preferably be housed in narrow recesses of the block moulding insulation to prevent accidental short circuit across the studs. All Test Terminal Block for meters, relays etc. shall be placed as close to the respective equipment as possible.
3. 3-Phase, 4-Wire Link type Test Terminal Block having sealing provision shall be provided in Metering Circuit of each Panel.

15 **NAME OF IDENTITY PLATES:**

1. All instruments, relays and such other similar electrical devices mounted on the Control Panels shall be provided with Name Plates bearing the Manufacturer's Name, Serial Number and the Electrical Rating Data.
2. 10mm. wide plastic plates bearing suitable identification marks shall be fixed under the terminal wiring at the test blocks, at the Fuse Blocks and at the Cable Terminals. Similar Plate shall be fixed on the exterior of the Switch Board in appropriate places to indicate functions of Control Switches, push buttons and equipment numbers etc. Suitable identification marks shall be provided for relays and other instruments. Plates should screwed and riveted to the Panel Board.
3. 50 mm. wide brass or plastic plates shall be provided in order to enable the purchaser to engrave suitable circuit description in 30 mm. size letters for each circuit and mounted in a sheet on the top of each Panel. These plates shall be removable type.

	4. SCHEMATIC DIAGRAM OF CT,PT,CB CIRCUITRY & AC,DC CKT, IND and ANNUN CKT ALONG WITH PROTECTION CIRCUITRY GIVING THE TERMINAL NOS AND BUSWIRE DETAILS SHALL BE PRINTED IN DURABLE STICKERS AND PASTED INSIDE THE PANEL DOOR PAGE WISE OF THE RESPECTIVE PANEL.
16	**SAFETY EARTHING**: 1. Earthing of metallic parts or metallic bodies of the equipment on the Switch Board shall be done with soft drawn single conductor bare Copper Tail connections shall have minimum area of 16 sq, mm. and the main earthing connection 60 sq.mm. These wires shall be connected by suitable terminals and clamps junction. Soldered connections shall not be employed. 2. The neutral point of star connected LV winding of instrument transformers and one corner of the open delta connected LV side of instrument transformers shall be similarly earthed by tail connected with main earth wire of Switch Board Earthing System. Multiple earthing of any instrument transformer circuit shall be avoided.
17	**PANEL BOARD LIGHTING**: 01 The Panel Board interior shall be illuminated by CFL lamps connected to 230 Volt Single Phase A.C. The illumination of the interior shall be free from shadows and shall be planned to avoid any strain or fatigue to the wireman likely to be caused due to sub-normal or non-uniform illumination. One emergency D.C. light shall be provided for each panel with individual switch with proper identification mark. 02 A toggle switch or door operated switch shall be provided for control of A.C. lighting in each panel. 03 One combined 15 Amps. 3-Pin and 5 Amps. 2-Pin Power Socket outlet together with Plus Pins shall be provided at convenient points in each Panel Board for A.C. Supply.
18	**ANNUNCIATOR:** **ELECTRONIC ANNUNCIATOR** 01 Suitable Multi-way (Minm. 12 (Twelve) way for feeder and 16 (Sixteen) way for Tr. Panel, this may increase according to scheme requirement during detailed engineering.) Microprocessor based electronic annunciator shall be provided in each panel to indicate over current and earth fault protection operated. In addition to above, each electronic annunciator of Transformer Control Panel shall have provision to indicate Transformer trouble trip/alarm function operated. Also one window of the Annunciator shall have to be used for Non-Trip A.C. Fail Alarm Indication and one window for Trip Circuit unhealthy indication. Each Electronic Annunciator shall have provision for connection with accept/reset/lamp test/mute Push buttons for proper functions. Electronic annunciator shall have provision for connection with Electronic Buzzer/Electronic Bell for Trip & Non-Trip Audio Alarm of common annunciation scheme. Electronic Annunciation shall have provision for flushing illuminating display with inscription for operation of respective Protection Relay. The Micro-Processor based Electronic Annunciator should have separate coloured windows for Trip & Non-Trip Annunciation for easy detection. Electronic Annunciator shall have first Fault Indication Facilities & System Watch Dog. The MAKE of Annunciators shall preferably be of 'ALAN', 'INSTALARM' and 'MINILEC' make. 02 **ALARM SCHEMES** **TRIP & NON-TRIP ALARM SCHEMES:** Each Control & Relay Board assembly shall be provided with one Multi way Micro-processor based Electronic Annunciator for Trip Alarm & Non-Trip Alarm. The Alarm Scheme shall comprise of separate D.C. operated common buzzer/alarm bell mounted inside the panel for Trip Alarm & another for Non-Trip Alarm. The wiring shall be such that single set of buzzer/bell will be sufficient and cover in common with all the alarm actuating device. Alarm Scheme shall have facility for bell and shall be suitable for self reset as well as hand reset type initiating contact. The alarm Scheme operative as above shall be considered to be within the scope of the Tender.

	03 **PANEL D.C. FAIL ALARM SCHEME** Control & Relay Panel Board shall have a common ― "Panel D.C. Fail" Alarm Scheme operated by 230 V Single phase A.C. Aux. Supply for audible as well as visual alarm in case of failure of D.C. incoming supply to the Board.. The Scheme shall comprise of 2 nos. single element Aux. Relays. One number having a reverse flag with inscription ― "Panel D.C. Fail" with 2 nos. self-reset type N/C contacts. Another Single Element Relay without Flag and 1 no. self-reset type N/O & 1 no. N/C contact having inscription ―Panel D.C. fail alarm accept Relay'. Besides above 1 no. Indicating Lamp 1 no. A.C. Operated Electric Hooter and 2 nos. Push Button, one having 1 no. N/C contact other having 1 no. N/O contact shall also be provided for successful operation of the scheme. All auxiliary relays required to render Annunciation System operative and shall be considered to be within the scope of the tender. AC fail DC fail scheme shall be operated by relay not contactor.
19	**INDICATING INSTRUMENT AND METERS:** 01 All instruments shall be Switch Board Type, back connected suitable for semi-flush mounting and provided with dust tight cases for tropical use with dull black enamel finish. All fixing screws, nuts and threaded parts shall be designed to Indian Standards. The dials shall be made of such materials as to ensure freedom from warping, fading, discoloring etc. during full life of instruments. Marking of Scale shall be black on white background. Spring controlled instruments shall be provided with front-of board. Zero adjuster capable of being safely handled while the instrument is in service. The adjustments above mark and below the zero point shall not be less than 3% of the full scale length and need not exceed 6%. It shall have sufficient friction to keep the adjustment in position. All instruments shall have a practicable laboratory means of adjustment of accuracy. The limits of error shall be of class 0.2 type. The calibration of the instruments shall function satisfactorily when mounted on steel panels or alternatively magnetically shielded instruments shall be used. Instruments shall be capable of indicating freely when operated continuous at any temperature from 0 to 50 degree C. All circuits of instruments shall be capable of withstanding applied load of 20% greater than the rated capacity for a period of eight hours. The instruments shall be capable of withstanding the effect of shock vibration and a di-electric test of 2000 Volts r.m.s. to ground for one minute as per relevant ISS. 02 **Ammeters:** All ammeters shall be multi-range type digital meters programmable at side depending on CT ratio to indicate direct reading. The operating current value shall be 1A/5A selectable. The ammeters shall be connected to measuring C.T. Core. Ammeters shall be provided one in each phase. Ammeter shall be of 96 mm sq.Auxiliary Supply voltage = 110VAC/110VDC. The make of Ammeters shall be preferably of AE make. 03 **Voltmeters:** All Volt Meters shall be mulri-range (132-66-33kV) digital meters programmable at site depending on PT ratio to indicate direct reading. The Volt Meters shall be of 96 mm sq. and operating voltage 63.5/110V. Auxiliary Supply voltage = 110VAC/110VDC. The make of Voltmeters shall be preferably of AE make. 04 **MW meters**: All MW meters shall be provided with direct reading scale. The Operating current value shall be 1A/5A selectable and the actual CT& PT ratio shall be programmable at site. The meter shall be of 96 mmsq. Auxiliary supply voltage = 110VAC/110VDC. The make of the instrument shall be preferably of AE make. 05 **PF meters**: The PF meter shall be of single phase or three phase single current type with operating current A1/5A selectable. The Operating voltage shall be 63.5V/110V. The meter shall be 96 mm sq. with a working range of 0.1Lag-1-0.1 lead. The make of the instrument

	shall be preferably of AE make. 06 **Frequency meters**: The frequency meters shall be of Electronic / Digital type with Operating voltage of 110V.The sampling rate shall be 3 samples/sec and the response time shall be less than 3 samples/Sec. The make of the instrument shall be preferably of AE make. 07 **Energy Meters**: Three element Tri-vector Meters with MDI projected mounting type shall be provided in the Panels. The Trivector meters shall be of SECURE make Premium 300, Type:- E3M024, accuracy class 0.2S.

20 RELAYS :

20.1 Relays - General requirements

Protective relays shall comply generally with the requirements of IS 3231, IS 8686, IEC 60255 or BS 142 or other approved standards and shall be contained in dustproof flush mounted cases with transparent fronts and semi gloss bezels. The minimum mounting height of relays shall be such that it provides easy viewing/resetting of relay flag indications, easy checking and maintenance of relays, but shall not be less than 600 mm from the floor level in any case.

The relays shall be of the withdrawable and modern numerical type with substantial field experience. Static relays will only be considered where a particular type/field proven numerical relay is not available. In case of solid state and microprocessor based relays, steps shall be taken to protect the relay circuitry from externally impressed transient voltages which could reach the circuitry via connections to instrument transformers or to the section dc systems.

Separate test facilities by means of front test sockets shall be provided for each current and voltage transformer secondary circuit so as to give access for testing of protective relays, meters and associated circuits. This requirement is additional to any permanently connected injection test scheme or locally mounted CT/VT test links.

If any form of modern modular numerical relays or systems are provided, for which specialised test blocks or test plugs are available, these should be provided for each complete relay or scheme. If any other specialized test blocks are required to obviate any disturbance to external wiring during testing, monitoring of currents or voltages or to enable secondary injection testing to be carried out, these shall also be provided.

Two test plugs to suit each different type of relay case or test socket shall be provided for each switchboard or suite of relay panels. The test plugs shall have terminals for both the relay and wiring side connections, which shall accept both wires and plug connectors, and be complete with lengths of flexible cable for connection to a portable relay test set.

Test facilities shall be provided for testing of signaling schemes between sub-stations. These facilities shall include all features necessary to permit testing with feeder in service, with minimum risk of unwanted tripping.

Auxiliary relays shall also be mounted in dust proof cases.

All protective relays shall be provided with a name and data plate to approved standard which shall include auxiliary supply voltage, rated current/voltage, type, make, catalogue No. Sl. No. etc.

All metal bases and frames of relays shall be earthed except where the latter must be insulated for special requirements, and an earth terminal shall be provided on the back of the relay case.

Relay equipment incorporating electronic devices shall be arranged to jack-in and have positive means of retaining them correctly in the service position. Equipment incorporating telephone type or other plug in relays should have similar facilities.

Relays which initiate tripping of more than one circuit breaker shall be distinctively coloured and provided with a warning label to avoid incorrect tripping during testing.

All relays which are connected to complete either the tripping circuit of circuit breaker or the coil circuit of an auxiliary tripping relay shall be provided with approved operation indicators.

Indicators shall also be provided on additional relay elements as well enable the phase of the fault condition to be identified.

Each indicator, whether of the electrically operated or mechanically operated kind, shall be capable of being reset by hand without opening the relay case and it shall not be possible to operate the relay when resetting the operating indicator. Each indicator shall be so designed that it cannot show before the relay has completed its operation. Indicators shall not reset during a failure of auxiliary power to the relay.

It shall not be possible to operate any relay by hand without opening the case.

All tripping and intertripping relays shall be of high speed and high burden type.

In order to minimise the effects of electrolysis, operation indicator coils and dc relay operating coils shall be so placed in the circuit that they are not connected to the positive pole of the DC system except through contacts which are normally open and shall wherever possible be continuously connected to the negative pole of the DC system, by use of resistors if necessary.

If bolts or nuts are so placed as to be inaccessible with an ordinary spanner, not less than 2 suitable special spanners shall be provided. All calculations to determine the adequacy of CT and VT rating shall be submitted to the Authority for approval. In the event that the rating of the VT or CT proposed is insufficient to accommodate the connected burden in accordance with this specification, the supplier shall supply the CT and VT with the necessary increased capacity at no extra cost. All necessary design calculations for CT /VT shall be submitted within two (2) months of Contract award.

The contractor/relay manufacturer shall provide all necessary literature, methods of checking etc. if required for design of CTs/VTs and checking the calculated relay setting of the supplied protection relays. The contractor/manufacturer of the relaying equipment shall arrange, if required, to carry out site tests required for the determination of correct relay and scheme functioning and settings of special protections such as digital feeder differential protection, distance relaying etc. and sufficient advance information shall be given by the contractor in such cases. The contractor shall co-ordinate all such site testing and all test equipment required for site testing and commissioning.

The contractor shall provide only protection relays and equipment, which are supported by guaranteed works‟ routine test certificates issued by the manufacturers. The contractor shall provide electrical protection relay data to include manufacturer, type designation, characteristic details and ranges to be used, on per circuit basis.

The use of permanently energised relays shall be kept to a minimum and where approved these shall be of a type having a low burden, to prevent drain on the battery. Relays associated with the three phases shall be marked with the appropriate phase identification and the fuses and links shall also be suitably labelled. In addition to the labelling to identify relays on the front of panels, all relays and components shall be identified from the rear of the panels.

Test blocks with sufficient number of contacts shall be employed for each relay scheme. Test plugs shall also be supplied at least two numbers for each type. Test blocks shall have sufficient contacts for connecting CT circuits, VT circuits, DC supply, trip circuit, etc. The type of test block to be applied for the protection scheme shall be subject to approval during detail design stage and shall be supplied within the quoted price.

21 22.1 33kV Line Protection :

Main Protection : Numerical O/C & E/F relay MiCOM P 127 shall be provided.

Backup Protection : Numerical O/C & E/F relay MiCOM P 111 shall be provided.

22.2 33kV Transformer Protection :

Numerical O/C & E/F relay shall be provided on HV side. Buchholz, oil level, oil & winding temperature and PRD alarm & trip auxiliary relays shall be provided.

23 CONTRACT DRAWINGS & LITERATURE :

1. In the event of an order materializing, the Supplier shall be submit four prints of each drawing for approval of the purchaser along with 2 sets of literature as mentioned in the spec.

The Contract drawings shall cover the followings:- (both hard and soft copies).

(a) Details of construction and dimensions of a cubicle and of the complete Panel Board.

(b) Template for foundation and details of Cable Trench and Cable Entry Holes in the Foundation Platform.

(c) Elementary diagrams of all controls, metering, protection annunciation and other circuits. All devices shall be numbered according to ASA or international usage, which shall be separately coded.

(d) Cabling and wiring diagram of the cubicles and inter-connections between them. Ferrule numbers, device number and grouping for cable take off shall be distinctly shown.

(e) Dimensional outline drilling diagram and special mounting arrangement if any, of such type of various devices on the Control Board.

(f) Inter-connection diagram between Control Board and C.B. power and instrument transformer etc.

(g) Wiring Schedule for Control & Relay Panel.

(h) Internal wiring diagram of all devices and elementary wiring diagram of relays where internal wiring is in triplicate. Construction details of switches, terminal blocks and test blocks etc.

(i) After approval 10 sets of the final contract drawing for each set of Control & Relay Boards are to be supplied by the contractor. One set reproducible tracing of the above drawings shall also be supplied.

2. In the event of contract being awarded 4 copies with soft copy of the following literatures shall be supplied along with the drawings as mentioned

(a) Complete Literature describing construction, operation, maintenance, adjustment and rating specifications of all the protective and auxiliary relays, recording instruments, metering instruments and control switches.

(b) Literature giving rating data, details and adjustments for calibration of the indicating instruments.

(c) Calibration instruments for the metering instruments.

(d) List of spare parts, identification number of renewable parts of relays, instruments and switches etc. with the help of which the purchaser will be able to procure spare parts from the contractor at any subsequent time.

24. Type Test & Routine test Report and credential to be submitted along with tender documents:

i) The bidder has to furnish the type test report, including functional tests for all protective relays from CPRI/NABL accredited, Govt. recognized Test House carried out within five years .

ii) Routine test Report carried out within five years signed by any PSU, reputed power utility etc. for similar type C&R panels (with same type protective and auxiliary relays) along with tender documents

iii) Credential for supply& delivery and performance certificate from Power Utilities in India(with same type protective and auxiliary relays) along with tender documents.

25. TEST at FACTORY :

The following tests shall be carried out and 6 copies of test certificates shall be submitted for approval. The equipment shall only be dispatched after approval of the test certificates.

1. Checking of wiring of Circuits and the continuity.
2. One minute applied voltage test. All equipment on Panel and small Wiring shall be tested for a withstand voltage of 2000 Volts to earth & between different Voltage Circuits.
3. Insulation resistance of the complete wiring, circuit by circuit with all equipment mounted on the Board before and after H.V. test mentioned under 2 above.
4. Routine tests according to the relevant national standard are on the instruments, relays and other devices.

26. TEST WITNESS :

(a) Tests shall be performed at Manufacturers' Works in presence of purchaser's representative shall be carried out. The Supplier shall give at least 15 (fifteen) days advance notice of the date when the tests are to be carried out.

(b) Purchaser shall have the right to select any quantity of the item wise offered lot for testing, offered for inspection and in the event of failure in test(s), the purchaser shall have the right to reject the offered equipment(s).

(c) All Relays, Meters & Annunciators provided in the Control & Relay Panel are to be accepted only after successful hundred percent performances testing at the department's works.

27. COMMISSIONING AT SITE :

After successful installation and all necessary pre-Commissioning tests are done at site, the panels will be commissioned by the contractor to the satisfaction of the engineer in-charge of the Sub-Station.

28. GUARANTEE:

The Control and Relay Panels along with all the mounted devices and instruments shall be guaranteed for trouble-free operation for a period of 1 (one) calendar year from the date of successful commissioning. The guarantee cover shall be for free rectification/replacement of damaged components/parts by the contractor.

TECHNICAL SPECIFICATION FOR STORAGE BATTERIES AND BATTERY CHARGER (110 VOLTS DC, 100 AH AT 10 HOURS DISCHARGE RATE)

1.0 GENERAL TECHNICAL REQUIREMENTS

1.1 All materials/components used in battery chargers and batteries shall be free from flaws and defects and shall conform to the relevant Indian standards and good engineering practice.

1.2 DC system shall consist of one float-cum-boost charger and one battery sets for 110 V systems shall have one battery bank with one float cum boost chargers.

1.3 The contractor shall submit the drawings and get the owner's approval before proceeding.

2.0 BATTERY

2.1 The DC Batteries shall be stationary Lead-Acid type with (Plate or Tubular positive plate) for standby duty. Tubular type batteries shall be Normal Discharge type and plate type batteries shall be high discharge type. These Batteries shall be suitable for a long life under continuous float operations at 2.15 to 2.25 volts per cell, and occasional discharges. The 110 V DC system is negative earth system.

2.2 Cell Terminals: All cell terminals shall have adequate current carrying capacity and shall be of lead alloy or lead alloy reinforced with copper core inserts. Cell terminal posts shall be equipped with connection bolts having acid resisting bolts and nuts.

2.3 Container : Containers shall be made of glass or hard rubber or suitable plastic material or glass fibre reinforced plastics or lead lined wood. Containers shall be robust, heat resistant, leak proof, non-absorbent, acid resistant and free from flaws. Glass containers shall be transparent. Electrolyte level lines shall be marked on container in case of transparent containers. Float type level indicator shall be provided in case of opaque containers. The marking for the electrolyte level should be for the upper, normal and lower limits. The material of level indicator shall be acid-proof and oxidation proof.

2.4 Vent Plugs: Vent plugs shall be provided in sealed type cells. They shall be of anti-splash type, having more than one exit hole and shall allow the gases to escape freely but shall prevent acid from coming out. Open type cells shall be provided with suitable arrestors to prevent spilling of electrolyte.

2.5 Plates : The plates shall be designed for maximum durability during all service conditions including high rate of discharge and rapid fluctuations of load. The construction of plates shall conform to latest revisions of IS: 1651 or IS: 1652 as applicable. The separators shall maintain the electrical insulation between the plates and shall allow the electrolyte to flow freely. The positive and negative terminal posts shall be clearly marked.

2.6 Sediment Space: Sufficient sediment space shall be provided so that cells will not have to be cleaned out during normal life.

2.7 Cell Insulator: Each cell shall be separately supported on porcelain or hard rubber insulators fixed on to the racks with adequate clearance between adjacent cells.

2.8 Electrolyte: The electrolyte shall be prepared from battery grade sulphuric acid conforming to IS:226 and distilled water conforming to IS:1069. The cells shall be shipped dry and uncharged. The electrolyte for initial filling shall be furnished separately. A minimum of 10% extra electrolyte shall be supplied after completion of initial charging.

2.9 Manufacturer's Identification System

The following information shall be indelibly marked on outside of each cell :

Manufacturer's name and trade mark

Country and year of manufacture

Manufacturer's type designation

AH capacity at 10 hr. discharge rate
Serial Number

Upper and lower electrolyte level in case of transparent containers.

2.10 Connectors and Fasteners : Lead or lead coated connectors shall be used for connecting up adjacent cells, rows and end take off. Bolts, nuts and washers shall be effectively lead coated to prevent corrosion. End take off connectors shall be provided for end connections from positive and negative poles of the batteries to the Power cables. More than one cable may be required to be connected to the battery terminals. Suitable arrangement for termination of multiple cables shall be provided so as to avoid extra load on the battery terminals The cable will be single core having stranded aluminium conductor and PVC insulation which will be arranged by the Employer separately. Necessary wooden supports and lugs for termination of these cables on Batteries shall also be supplied by the Contractor. All connectors and lugs shall be capable of continuously carrying the 30 Minute discharge current of the respective Batteries and shall be capable to carry 4 kA for 1 sec.

2.11 Battery Racks : Wooden/MS Battery Racks Shall be provided with Battery Bank

3.0 TESTS

3.1 Batteries shall conform to all type tests as per the latest issue of IS: 1651 or IS: 1652 (whichever is applicable depending on type of Battery being offered).

3.2 All Acceptance tests as required by the relevant Indian Standards shall be carried out at site after completion of installation. The capacity tests shall be carried out for 10 hr. discharge rating. The Contractor shall arrange for all necessary equipment, including the variable resistor, tools, tackles and instruments. If a Battery fails to meet the guaranteed requirements the OWNER shall have the option of asking the contractor to replace the same with appropriate batteries at no extra cost and without affecting the commissioning schedule of the employer.

3.3 If successful Contractor has not manufactured & commissioned the specified cell size, they must manufacture & test the prototype in advance and obtain Employer's approval for the same.

3.4 Following type tests shall be carried out on each type of cells in the presence of Employer's representative, if desired by the OWNER:

i. Capacity tests

ii. Watt hour and AH efficiency tests

The Contractor shall give at least three (3) weeks advance notice of the date when the tests are to be carried out. Three (3) copies of Type test certificates shall be furnished to the EMPLOYER for approval before the dispatch of the equipment from works. The cost of the

cells to be used for type tests shall be included in the respective Type tests charges quoted by Contractor, these cells shall not be supplied.

4.0 ACCESSORIES

4.1 The following information shall be given on the instruction cards supplied with the Battery:

a) Manufacturer's instruction for filling and initial charging of the Battery together with starting and finishing charging rate.

b) Maintenance instructions.

c) Designation of cell in accordance with IS: 1651 or IS: 1652 (whichever applicable).
d) Storing conditions of electrolyte and battery cells.

4.2 A complete Set of all the accessories and devices for maintenance of Batteries shall be supplied along with each type of battery bank. The following items comprise the complete set of accessories:

i) 8 Nos. of Hydrometers.

ii) 8 sets of Hydrometer syringes suitable for the vent holes in different cells.

iii) 8 Nos. of thermometers for measuring electrolyte temperature.

iv) 6 No. of Specific gravity correction chart.

v) 8 Nos. of Wall mounting type holders made of teak wood for hydrometer and thermometer.

vi) 6 Nos. of Cell testing voltmeter (3-0-3V) conforming to IS : 1248.

vii) 4 No. of Rubber apron.

viii) 4 Pairs of Rubber gloves

ix) 4 Set of spanners

x) 6 nos. Instructions cards

5.0 BATTERY CHARGER The DC system shall be of 110 Volt, DC having -ve earthed. Rated continuous output current of the Battery Charger shall be 40 A. The Battery Chargers as well as their automatic regulators shall be of static type. All battery chargers shall be capable of continuous operation at the respective rated load in float charging mode, i.e. Float charging the associated DC Lead-Acid Batteries at 2.15 to 2.25 Volts per cell while supplying the DC load. The chargers shall also be capable of Boost charging the associated DC Battery at 2.0-2.7 volts per cell at the desired rate.

5.1 All Battery Chargers shall be provided with facility for both automatic and manual control of output voltage and current. A selector switch shall be provided for se-lecting the mode of output voltage/current control, whether automatic or manual. When on automatic control mode during Float charging, the Charger output voltage shall remain within $\pm$1% of the set value, for AC input voltage variation of $\pm$10%, frequency variation of $\pm$5%, a combined voltage and frequency variation of $\pm$10%, and a DC load variation from zero to full load.

5.2 All battery chargers shall have constant voltage characteristics throughout the range (from zero to full load) at the floating value of the voltage so as to keep the battery fully charged but without harmful overcharge.

5.3 All chargers shall have load limiters having drooping characteristic, which shall cause, when the voltage control is in automatic mode, a gradual lowering of the output voltage when the DC load current exceeds the Load limiter setting of the Charger. The Load-limiter characteristics shall be such that any sustained overload or short circuit in DC System shall not damage the Charger, nor shall it cause blowing of any of the Charger fuses. The Charger shall not trip on overload or external short circuit.

5.4 Uniform and step less adjustments of voltage setting (in both manual and automatic modes) shall be provided on the front of the Charger panel covering the entire float charging output range specified. Stepless adjustments of the Load-limiter setting shall also be possible from 80% to 100% of the rated output current for charging mode.

5.5 During Boost Charging, the Battery Charger shall operate on constant current mode (when automatic regulator is in service). It shall be possible to adjust the Boost charging current continuously over a range of 50 to 100% of the rated output current for Boost charging mode.

5.6 The Charger output voltage shall automatically go on rising, when it is operating on Boost mode, as the Battery charges up. For limiting the output voltage of the Charger, a potentiometer shall be provided on the front of the panel, whereby it shall be possible to set the upper limit of this voltage anywhere in the output range specified for Boost Charging mode.

5.7 The Charger manufacturer may offer an arrangement in which the voltage setting device for Float charging mode is also used as output voltage limit setting device for Boost charging mode and the Load-limiter of Float charging mode is used as current setting device in boost charging mode.

5.8 Suitable filter circuits shall be provided in all the chargers to limit the ripple content (Peak to Peak) in the output voltage to 1%, irrespective of the DC load level, when they are not connected to a Battery.

6.0 **MCCB** All Battery Chargers shall have 1 No. MCCB on the input side to receive cables from one source. It shall be of P2 duty and suitable for continuous duty. MCCBs should have auxiliary contacts for annunciation/hooter.

7.0 **RECTIFIER TRANSFORMER** The rectifier transformer shall be continuously rated, dry air cooled (A.N) and of class F insulation type. The rating of the rectifier transformer shall have 10% overload capacity.

7.1 Rectifier Assembly : The rectifier assembly shall be fully/half controlled bridge type and shall be designed to meet the duty as required by the respective Charger. The rectifier shall be provided with heat sink having their own heat dissipation arrangements with natural air-cooling. Necessary surge protection devices and rectifier type fast acting HRC fuses shall be provided in each arm of the rectifier connections.

8.0 **INSTRUMENTS** One AC voltmeter and one AC ammeter alongwith selector switches shall be provided for all chargers. One DC voltmeter and DC ammeter (with shunt) shall be provided for all Chargers. The instruments shall be flush type, dust proof and moisture resistant. The instruments shall have easily accessible means for zero adjustment. The instruments shall be of 1.5 accuracy classes.

9.0 **AIR BREAK SWITCHES** One DC output switch shall be provided in all chargers. They shall be air break type suitable for 500 volts AC/ 250 Volt DC. The contacts of the switches shall open and close with a snap action. The operating handle of the switch shall be fully

insulated from circuit. `ON' and `OFF' position on the switch shall be clearly indicated. Rating of switches shall be suitable for their continuous load. Alternatively, MCCBs of suitable ratings shall also acceptable in place of Air Break Switch.

10.0 **FUSES** All fuses shall be HRC Link type. Fuses shall be mounted on fuse carriers, which are in turn mounted on fuse bases. Wherever it is not possible to mount fuses on carriers, fuses shall be directly mounted on plug-in type base. In such case one insulated fuse pulling handle shall be supplied for each charger. The Contractor depending on the circuit requirement shall choose fuse rating. All fuses in the chargers shall be monitored. Fuse failure annunciation shall be provided on the failure of any fuse.

11.0 **BLOCKING DIODE** Blocking diode shall be provided in the positive pole of the output circuit of each charger to prevent current flow from the DC Battery into the Charger.

12.0 **ANNUNCIATION SYSTEM** Audio-visual indications through bright LEDs shall be provided in all Chargers for the following abnormalities:

a) AC power failure

b) Rectifier/chargers fuse blown.

c) Over voltage across the battery when boost charging.

d) Abnormal voltage (High/Low)

e) Any other annunciation if required.

Potential free NO Contacts of above abnormal conditions shall also be provided for common remote indication "CHARGER TROUBLE" in Employer's Control Board. Indication for charger in float mode and boost mode through indication lamps shall be provided for chargers. A potential free contact for float/boost mode shall be provided for external interlocks.

13.0 NAME PLATES AND MARKING The nameplates shall be white with black engraved letters. On top of each Charger, on front as well as rear sides, larger and bold nameplates shall be provided to identify the Charger. Nameplates with full and clear inscriptions shall also be provided on and inside of the panels for identification of the various equipments and ease of operation and maintenance.

14.0 CHARGER CONSTRUCTION The Chargers shall be indoor, floor-mounted, self-supporting sheet metal enclosed cubicle type. The Contractor shall supply all necessary base frames, anchor bolts and hardware. The Chargers shall be fabricated from 2.0mm cold rolled sheet steel and shall have folded type of construction. Removable gland plates for all cables and lugs for power cables shall be supplied by the Contractor. The lugs for power cables shall be made of electrolytic copper with tin coat. Power cable sizes shall be advised to the Contractor at a later date for provision of suitable lugs and drilling of gland plates. The Charger shall be tropicalised and vermin proof. Ventilation louvers, if provided shall be backed with screens. All doors and covers shall be fitted with synthetic rubber gaskets. The chargers shall have hinged double leaf doors provided on front and on backside for adequate access to the Charger's internals. All the charger cubicle doors shall be properly earthed. The degree of protection of Charger enclosure shall be at least IP-42 as per IS: 2147.

14.1 All indicating instruments, control switches and indicating lamps shall be mounted on the front side of the Charger.

14.2 Each Charger shall be furnished completely wired upto power cable lugs and terminal blocks and ready for external connections. The control wiring shall be carried out with PVC insulated, 1.5 sq.mm. stranded copper wires. Control terminals shall be suitable for connecting two wires, with 2.5 sq.mm stranded copper conductors. All terminals shall be numbered for ease of connections and identification. Each wire shall bear a ferrule or tag on each end for identification. At least 20% spare terminals shall be provided for control circuits.

14.3 The insulation of all circuits, except the low voltage electronic circuits shall withstand test voltage of 2 KV AC for one minute. An air clearance of at least ten (10) mm shall be maintained throughout for such circuits, right up to the terminal lugs. Whenever this clearance is not available, the live parts shall be insulated or shrouded.

15.0 PAINTING All sheet steel work shall be pretreated, in tanks, in accordance with IS:6005. Degreasing shall be done by alkaline cleaning. Rust and scale shall be removed by pickling with acid. After pickling, the parts shall be washed in running water. Then these shall be rinsed in slightly alkaline hot water and dried. The phosphate coating shall be `Class-C' as specified in IS:6005. Welding shall not be done after phosphating. The phosphating surfaces shall be rinsed and passivated prior to application of stoved lead oxide primer coating. After primer application, two coats of finishing synthetic enamel paint of shade-692 (smoke grey) of IS:5 shall be applied, unless required otherwise by the Employer. The inside of the chargers shall be glossy white. Each coat of finishing synthetic enamel paint shall be properly staved. The paint thickness shall not be less than fifty (50) microns.

16.0 TESTS

16.1 Battery chargers shall conform to all type tests as per relevant Indian Standard. Performance test on the Chargers as per Specification shall also be carried out on each Charger as per specification. Rectifier transformer shall conform to all type tests specified in IS: 4540 and short circuit test as per IS: 2026. Following type tests shall be carried out for compliance of specification requirements:

i) Voltage regulation test

ii) Load limiter characteristics test

iii) Efficiency tests

iv) High voltage tests

v) Temperature rise test

vi) Short circuit test at no load and full load at rated voltage for sustained short-circuit.

vii) Degree of protection test

viii) Measurement of ripple by oscilloscope.

16.2 The Contractor may be required to demonstrate to the Owner that the Chargers conform to the specification particularly regarding continuous rating, ripple free output, voltage regulation and load limiting characteristic, before dispatch as well as after installation at site. At site the following tests shall be carried out:

i) Insulation resistance test

ii) Checking of proper annunciation system operation.

16.3 If a Charger fails to meet the specified requirements, the Contractor shall replace the same with appropriate Charger without affecting the commissioning schedule of the Sub-station, and without any extra cost to the owner.

16.4 The Contractor shall present for inspection, the type and routine test certificates for the following components whenever required by the OWNER.

(i) Switches.	(ii) Relays/MCCBs	(iii) Instruments.
(iv) DC fuses.	(v) SCR.	(vi) Diodes.
(vii) Condensers.	(viii) Potentiometers.	(ix) Semiconductor
(x) Announciator.	(xi) Control wiring	(xii) Push buttons for contactors.

Technical Specification for Polymer Disc Insulator

Scope : This specification cover the design, manufacturing, testing at manufacturers works, transport to site, insurance, storage of 11 KV & 33 KV Polymer Disc Insulator suitable for use in 11 KV & 33 KV Overhead Lines situated in any part of Mizoram under the jurisdiction of PEDM.

General Requirements :

1 . The Composite insulators will be used on lines on which the conductor will be ACSR of size up to 100 Sq.mm. The insulators should withstand the conductor tension, the reversible wind load as well as the high frequency vibrations due to wind.

2 . Insulator shall be suitable for 3 Phase, 50 Hz effectively earthed 11KV Overhead Lines and 33 KV Impedance Grounded distribution system in a moderately/heavily polluted atmosphere.

3 . Bidder must be an indigenous manufacturer and supplier of composite insulators of rating 11KV or above or must have developed proven in house technology and manufacturing process for composite insulators of above rating. The Bidder shall furnish necessary evidence in support of the above along with the bid, which can be in the form of certification from the utilities concerned, or any other documents to the satisfaction of the owner.

4 . Insulators shall be suitable for both Suspension & Strain type of load and shall be of tongue & clevis type.

5 . Insulator shall be suitable for the long Rod Type. The diameter of Composite Insulator shall be as per technical specification.

6 . Insulators shall have sheds with good self-cleaning properties. Insulator shed profile, spacing, projection etc. and selection in respect of polluted conditions shall be generally in accordance with the commendation of IEC- 60815/ IS: 13134.

7 . The tolerances on all dimensions e.g. diameter, length and creepage distance shall be allowed as follows in line with-IEC 61109:

$\pm (0.04d + 1.5)$ mm when $d \leq 300$ mm

$\pm (0.025d+6)$ mm when $d > 300$ mm

Where, d being the dimensions in millimeters for diameter, length or creepage distance as the case may be. However, no negative tolerance shall be applicable to creepage distance.

8 . The composite insulators including the end fitting connection shall be standard design suitable for use with the hardware fittings of any make conforming to relevant IEC/IS standards.

9. All surfaces shall be clean, smooth, without cuts, abrasions or projections. No part shall be subjected to excessive localized pressure. The insulator and metal parts shall be so designed and manufactured that it shall avoid local corona formation and not generate any radio interference beyond specified limit under the operating conditions.

10 . Inter- changeability: The composite insulator together with the tongue & clevis fittings shall be of standard design suitable for use with the hardware of any other indigenous make confirming to relevant standards referred herewith.

Service condition : The insulators to be supplied against this specification shall be suitable for satisfactory continuous operation under the following topical condition :

a) Max. ambient temperature	: 50 º C
b) Min. ambient temperature	: -5 º C
c) Relative humidity	: 10 % to 100 %
d) Avarage number of rainy days	: 100 / annum.
e) Max. Anual Rainfall	: 1500 mm
f) Max. Wind Pressure	: 150 Kg/ sq. Meter
g) Max. Wind Velocity	: 50 Km/ hour
h) Max. Altitude above MSL	: 1000 Meter.
i) Seismic level	: 0.3 g (Horizontal acceleration)
j) Avarage Thunder storm	: 45 Days per annum.

k) Climatic condition : Moderate

System Parameters :

a) Nominal system voltage : 11 KV & 33 KV.
b) Highest system voltage : 12 KV & 36 KV.
c) Power frequency : 50 Hz.
d) Number of Phases : Three.
e) System earthing : 11 KV Solidly earthed, 33 KV Impedence earth.

Standard : The following Indian / International Standards with latest revisions and amendments shall be referred while accessing conformity of insulators with this specification.

Sl. No.	Indian Standard	Title	International Standard
1.		Definition, test methods and acceptance criteria for composite insulators for a.c.overhead lines above 1000V	IEC : 61109
2.	IS : 731	Porcelain insulators for overhead power lines with a nominal voltage greater than 1000V	IEC : 60383
3.	IS : 2071	Methods of High Voltage Testing	IEC : 60060-1
4.	IS : 2486	Specification for insulator fittings for overhead power lines with a nominal voltage greater than 1000V General requirements and Tests Dimensional Requirements Locking Devices	IEC : 60120 IEC : 60372
5.		Thermal Mechanical Performance test and mechanical performance test on string insulator units	IEC : 60575
6.	IS : 13134	Guide for the selection of insulators in respect of polluted conditions	IEC : 60815
7.		Characteristics of string insulator units of the long rod type	IEC : 60433
8.		Hydrophobicity classification guide	STRI guide 1.92/1
9.		Radio interference characteristics of overhead power lines and high-voltage equipment	CISPR:18-2 part
10.	IS : 8263	Methods of RI Test of HV Insulators	IEC : 60437
11.		Standard for insulators – Composite- Distribution Dead-end type	ANSI C29 13-2000
12.	IS : 4759	Hot dip zinc coatings on structural steel & other allied products	ISO : 1459 ISO : 1461
13.	IS : 2629	Recommended Practice for Hot, Dip Galvanisation for iron and steel	ISO-1461 (E)
14.	IS : 6745	Determination of weight of zinc coating on zinc coated iron and steel articles	ISO : 1460
15.	IS : 3203	Methods of testing of local thickness of electroplated coatings	ISO : 2178
16.	IS : 2633	Testing of Uniformity of coating of zinc coated articles	
17.		Standard specification for glass fiber strands	ASTMD 578-05
18.		Standard test method for compositional analysis by Thermo-gravimetric	ASTM E 1131-03
19.	IS : 4699	Specification for refined secondary zinc	

Technical Requirement :

1 . Composite Insulators shall be designed to meet the light quality, safety and reliability and are capable of withstanding a wide range of environmental conditions.

(a) Core : The internal insulating part

(b) Housing : The external insulating part.

(c) Metal and fittings : For attaching to hardware to support conductor.

Core : It shall be a glass-fiber reinforced epoxy resin rod of high strength (FRP rod). Glass fibers and resin shall be optimized in the FRP rod. Glass fibers shall be Boron free electrically corrosion resistant (ECR) glass fiber or Boron free E-Glass and shall exhibit both high electrical integrity and high resistance to acid corrosion. The matrix of the FRP rod shall be Hydrolysis resistant. The FRP shall be manufactured through Pultrusion process. The FRP rod shall be void free.

Housing (Sheath) : The FRP rod shall be covered by a seamless sheath of a silicone elastometric compound or silicone alloy compound of a thickness of 3 mm minimum. It shall be one-piece housing using injection Moulding Principle to cover the core. The elastomer housing shall be designed to provide the necessary creepage distance and protection against environmental influences, external pollution and humidity. Housing shall conform to the requirement of IEC 61109/92-93 with latest amendments. It shall be extruded or directly moulded on core and shall have chemical bonding with the FRP rod. The strength of the bond shall be greater than the tearing strength of the polymer. Sheath material in the bulk as well as in the sealing / bonding area shall be free from voids. Manufacturer should furnish a description of its quality assurance programme including fabrication; testing and inspection for any material (i.e rubber) Components (i.e. rod) or hardware (i.e. end filings). The manufacturer has had fabricated by others should also be included. Manufacturing methods and material composition documentation will be a part of Technical Bid to be submitted along with offer.

WEATHERSHEDS : The composite polymer Weathersheds made of silicone elastometric compound or silicon alloy shall be firmly bonded to the sheath, vulcanized to the sheath or moulded as part of the sheath and shall be free from imperfections. The Weathersheds should have silicon content of minimum 30% by weight. The strength of the Weathersheds to sheath interface shall be greater than the tearing strength of the polymer. The interface, if any, between sheds and sheath (housing) shall be free from voids.

METAL END FITTINGS: End fittings transmit the mechanical load to the core. They shall be made of Malleable Cast Iron or Spherical Graphite Cast Iron. Hardware of respective specified mechanical load and shall be hot dip galvanized with Zinc coated with minimum 99.95% purity of electrolytic high grade Zinc in accordance with IS 2629. The material used in fittings shall be corrosion resistant.

Metal end fittings shall be uniform and without sharp edges or corners and shall be free of cracks, flakes, silvers, slag, blow-holes shrinkages defects and localized porosity.

They shall be connected to the rod by means of a controlled compression technique. As the main duty of the end fittings is the transfer of mechanical loads to the core the fittings should be property attached to the core by a coaxial or hexagonal compression process and should not damage the individual fibers or crack the core.

The gap between fittings and sheath shall be sealed by flexible silicone elastometric compound or silicone alloy compound sealant, system of attached of end fitting to the rod shall provide superior sealing performance between housing, i.e. seamless sheath and metal connection. The sealing must be moisture proof.

The dimensions of end fittings of insulators shall be in accordance with the standard dimensions stated in IEC: 60120/IS:2486 Part-II/1989.

The finished surface shall be smooth and shall have a good performance. The surface shall not crack or get chipped due to ageing effect under normal and abnormal service conditions or while handling during transit or erection.

The design of the fittings and the insulators shall be such that there is no local corona formation or discharges likely to cause the interference to either should or vision transmission.

Workmanship :

a) All the materials shall be of latest design and conform to the best engineering practices adopted in the high voltage filed. Bidders shall offer only such insulators as are guaranteed by them to be satisfactory and suitable for continued good service in power transmission lines.
b) The design, manufacturing process and material control at various stages shall be such as to give maximum working load, highest mobility, best resistance to corrosion, good finish and elimination of sharp edges and corners.
c) The design of the insulators shall be such that stresses due to expansion and contraction in any part of the insulator shall not lead to deterioration.
d) The core shall be sound and free of cracks and voids that may adversely affect the insulators.
e) Weather sheds shall be uniform in quality. They shall be clean, sound and smooth and shall be free from defects and excessive flashing at parting lines.
f) End fittings shall be free from cracks, seams, shrinks, air holes and rough edges. End fittings should be effectively sealed to prevent moisture ingress. Effectiveness of sealing system must be supported by test documents. All surfaces of the metal parts shall be perfectly smooth without projecting points or irregularities, which may cause corona. All load bearing surfaces shall be smooth and uniform so as to distribute the loading stresses uniformly.
g) All ferrous parts shall be hot dip galvanized to give a minimum average coating of zinc equivalent to 610 gm/sq.m. or 87µm thickness and shall be in accordance with the requirement of IS:4579. The zinc used for galvanizing shall be of purity 99.5% as per IS : 4699. The zinc coating shall be uniform, adherent, smooth, reasonably bright continuous and free from imperfections such as flux, ash rust stains, bulky white deposits and blisters. The galvanized metal parts shall be guaranteed to withstand at least four successive dips each lasting for one (1) minute duration under the standard preece test. The galvanizing shall be carried out only after any machining.

Drawing : The bidder shall furnish along with the bid the outline drawing of each insulator unit including a cross sectional view of the long rod insulator unit. The drawing shall include but not be limited to the following information:

(a) Long rod diameter with manufacturing tolerances
(b) Minimum Creepage distance with positive tolerance
(c) Protected creepage distance
(d) Eccentricity of the long rod unit
    (i) Axial run out
    (ii) Radial run out
(e) Unit mechanical and electrical characteristics
(f) Weight of composite long rod units
(g) Identification mark
(h) Manufacturer's catalogue number

Marking: Each insulator shall be legibly and indelibly marked to show the following:

a) Name & Trade mark of the manufacturer
b) Month & Year of manufacturing
c) Voltage & Type
d) Minimum Failling Load (in KN)
e) "PEDM" marking

Type Test : The following Type Test shall have to be conducted as per reference IEC mentioned above on insulator unit, components, materials or complete strings :

a) Sudden Load Release Test
b) Thermal Mechanical Pre-stress Test
c) Dry Positive & Negative Lightning Impulse voltage withstand test
d) Dry Positive & Negative Lightning Impulse Flashover voltage test
e) Dry & Wet Power Frequency Voltage withstand test
f) Dry & Wet Power Frequency Voltage Flashover test
g) Mechanical Failing Load test.
h) Radio Interference test
i) Recovery of Hydrophobicity test.
j) Dye Penetration Test.
k) Water Diffusion Test
l) Chemical composition test for Silicon content
m) Brittle facture resistance test.
n) Damage Limit proof & Mechanical Withstand Test.

Routine Test :

a) Identification of marking
b) Visual inspection
c) Mechanical routine test

Acceptance Test : The following test will be carried out at manufacturers works during inspection of the offered insulators before delivery :

a) Visual examination
b) Verification of dimension
c) Galvanizing test
d) Mechanical performance test
e) Mechanical Failing Load test

Testing Facilities: The tenderer must clearly indicate what testing facilities are available in the works of the manufacturer and whether facilities are adequate to carry out all Routine & Acceptance Test. These facilities should be available to PEDM's Engineers if deputed or carry out or witness the tests in the manufacturer works. If any test cannot be carried out at the manufacturer's work, the reasons should be clearly stated in the tender. The insulators shall be tested in accordance with the procedure detailed in IEC 61109/92-93 with latest amendments.

Inspection: All Acceptance tests shall be carried out at manufacturer's works in presence of the PEDM's and manufacturers representatives. In addition to above, all routine tests are also to be carried on the insulator as per relevant IS / IEC. The entire cost of acceptance and routine test that to be carried out as per relevant IS / IEC shall be treated as included in the quoted price of Insulator. The manufacturer shall give at least 21(twenty one) days advance notice intimating the actual date of inspection and details of all tests that are to be carried out from the date when the tests will be carried out. Routine tests on all insulators shall be carried out as per IEC / IS and test reports shall be submitted along with respective inspection offer to Engineer-in-Chief, PEDM

Sampling & Rejection during inspection: The sampling and rejection procedure for Acceptance Test shall be as per IEC 61109.

Packing:

a) All insulators shall be packed in strong corrugated box of min. 7 ply duly palette or wooden

crates. The gross weight of the crates along with the material shall not normally exceed 100 Kg to avoid handling problem. The crates shall be suitable for outdoor storage under wet climate during rainy season.

b) The packing shall be of sufficient strength to withstand rough handling during transit, storage at site and subsequent handling in the field.

c) Suitable cushioning, protective padding or dunn age or spacers shall be provided to prevent damage or deformation during transit and handling.

d) Each wooden case / crate / corrugated box shall have all the markings stenciled on it in indelible ink.

e) The bidder shall provide instructions regarding handling and storage precautions to be taken at site.

Guarantee : In the event of any defect in the equipment / materials arising out of faulty design, materials, workmanship within a period of 12 (twelve) months of commissioning or 18 (eighteen) months from the date of last despatch of any integral part of the equipment / materials whichever is earlier the supplier shall guarantee to replace or repair the same to the satisfaction of the purchaser. If the supplier fail to do so within a reasonable time, PEDM reserves the right to effect repair or replacement by any other agency and recover charges for repair or replacement from the supplier.

Quality Assurance Plan :

1 . The successful bidder shall submit following information along with the bid.

2. Test certificates of the raw materials and bought out accessories.

3. Statement giving list of important raw material, their grades along with names of sub-suppliers for raw materials, list of standards according to which the raw materials are tested. List of tests normally carried out on raw materials in presence of bidder's representative.

4. List of manufacturing facilities available.

5. Level of automation achieved and lists of areas where manual processing exists.

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

7. List of testing equipments available with the bidder for final testing equipment along with valid calibration reports.

8. The manufacturer shall submit Manufacturing Quality Assurance Plan (QAP) for approval & the same shall be followed during manufacture and testing.

9. The successful bidder shall submit the routine test certificates of bought out raw materials/accessories and central excise passes for raw material at the time of inspection.

10. The Owner's representative shall at all times be entitled to have access to the works and all places of manufacture, where insulator, and its component parts shall be manufactured and the representatives shall have full facilities for unrestricted inspection of the Supplier's and sub-Supplier's works, raw materials, manufacture of the material and for conducting necessary test as detailed herein.

11. The material for final inspection shall be offered by the Supplier only under packed condition. The owner shall select samples at random from the packed lot for carrying out acceptance tests. The lot offered for inspection shall be homogeneous and shall contain insulators manufactured in 3-4 consecutive weeks.

12. The Supplier shall keep the Owner informed in advance of the time of starting and the progress of manufacture of material i/n their various stages so that arrangements could be made for inspection.

13. No material shall be dispatched from its point of manufacture before it has been satisfactorily inspected and tested unless the owner in writing waives off the inspection. In the later case also the material shall be dispatched only after satisfactory testing specified herein has been completed.

14. The acceptance of any quantity of material shall in no way relieve the Supplier of his

responsibility for meeting all the requirements of the specification and shall not prevent subsequent rejection, if such materials are later found to be defective.

ANNEXURE: A

Test on Insulator units :

1. RIV Test (Dry) : The insulator string along with complete hardware fittings shall have a radio interference voltage level below 100 micro volts at one MHz when subjected to 50 Hz voltage of 10 kV & 30 kV for 11 kV & 33 kV class insulators respectively under dry condition. The test procedure shall be in accordance with IS: 8263/IEC: 437/CISPR 18-2.
2. Brittle Fracture Resistance Test : Brittle fracture test shall be carried out on naked rod along with end fittings by applying "1n HNO3 acid" (63 g conc. HNO3 added to 937 g water) to the rod. The rod should be held at 80% of SML for the duration of the test. The rod should not fail within the 96 Hour test duration. Test arrangement should ensure continuous wetting of the rod with Nitric acid.
3. Recovery of Hydrophobicity & Corona Test :
   i) The surface of selected samples shall be cleaned with isopropyl alchohol. Allow the surface to dry and spray with water. Record the Hydrophobicity classification in line with STRI guide for Hydrophobicity classification (Extract enclosed at Annexure-D) Dry the sample surface.

   (ii) The sample shall subjected to mechanical stress by bending the Sample over a ground electrode. Corona is continuously generated by applying 12 kV to a needle like electrode placed 1 mm above the sample surface. Tentative arrangement shall be as shown in Annexure-E. The test shall be done for 100 hrs.
   (iii) Immediately after the corona treatment, spray the surface with Water and record the HC classification. Dry the surface and repeat The corona treatment as at Clause-2 above. Note HC classification. Repeat the cycle for 1000 Hrs. or until an HC of 6 or 7 is obtained. Dry the sample surface.
   (iv) Allow the sample to recover and repeat Hydrophobicity Measurement at several time intervals. Silicone rubber should recover to HC 1– HC 2 within 24 to 48 hours, depending on the Material and the intensity of the corona treatment.
4. Chemical composition test for Silicon content : The content of silicon in the composite polymer shall be evaluated by EDX (Energy Dispersion X-ray) Analysis or Thermo-gravimetric analysis. The test may be carried out at CPRI or any other NABL accredited laboratory.

Technical requirement for 11 KV & 33 KV Polymer Disc Insulator

	11 KV Disc	33 KV Disc
Type of insulator	Polymeric composite Disc Insulator	Polymeric composite Disc Insulator
Reference Standard	IEC 61109	IEC 61109
Material of FRP Rod	Boron free ECR	Boron free ECR
Material of sheds	Silicon Rubber	Silicon Rubber
Type of metal end fittings	Tongue & Clevis	Tongue & Clevis
Material of end fittings	SGCI / MCI	SGCI / MCI
Material of sealing compound	RTV Silicon	RTV Silicon
Colour of sheds	Grey	Grey
Rated voltage	11 KV	33 KV
Highest voltage	12 KV	36 KV
Dry Power Frequency Withstand voltage	60 KV	95 KV
Wet Power Frequency Withstand voltage	35 KV	75 KV
Dry Power Frequency Flashover Voltage	75 KV	130 KV
Visible Discharge Voltage (PF)	9 KV	27 KV
Wet Power Frequency Flashover Voltage	45 KV	90 KV
Dry Lightning Impulse withstand voltage	Positive : 75 KV Negative :80 KV	Positive : 170 KV Negative : 180 KV
Dry Lightning Impulse Flashover voltage	Positive : 95 KV Negative : 100 KV	Positive : 210 KV Negative : 230 KV
RIV at 1 MHz when energised at 10 KV / 30 KV (rms) under dry condition	< 50 microvolt	< 70 microvolt
Creepage distance (min)	320 mm	900 mm
Min Failing load	45 KN	70 KN
Dia of FRP Rod	16 mm	16 mm
Length of FRP Rod (min)	200 mm	425 mm
Dia of weather sheds	100 mm	110 mm
Thickness of housing	3 mm	3 mm
Dry arc distance	170 mm	380 mm
Method of fixing sheds to housing	Injection moulding	Injection moulding
No of weather sheds (min)	Three	Eight
Type of sheds	Aerodynamic	Aerodynamic
Type of packing	Wooden/Corrugated Box	Wooden/Corrugated box
No of insulator in each pack	Thirty	Twenty
Guarantee	12 months from commissioning or 18 months from the date of last despatch.	12 months from commissioning or 18 months from the date of last despatch.

Specification for Polymer Pin Insulator

Scope :

This specification cover the design, manufacturing, testing at manufacturers works, transport to site, insurance, storage of 11 KV & 33 KV Polymer Pin Insulator suitable for use in 11 KV & 33 KV Overhead Lines situated in any part of Mizoram under the jurisdiction of PEDM.

General Requirements :

1 . The Composite insulators will be used on lines on which the conductor will be ACSR of size up to 100 Sq.mm. The insulators should withstand the conductor tension, the reversible wind load as well as the high frequency vibrations due to wind.

2 . Insulator shall be suitable for 3 Phase, 50 Hz effectively earthed 11KV Overhead Lines and 33 KV Impedance Grounded distribution system in a moderately/heavily polluted atmosphere.

3 . Bidder must be an indigenous manufacturer and supplier of composite insulators of rating 11KV or above or must have developed proven in house technology and manufacturing process for composite insulators of above rating or possess technical collaboration /association with a manufacturer of composite insulators of rating 11KV or above. The Bidder shall furnish necessary evidence in support of the above along with the bid, which can be in the form of certification from the utilities concerned, or any other documents to the satisfaction of the owner.

4 . Insulator shall be suitable for the long Rod Type.

5 . Insulators shall have sheds with good self-cleaning properties. Insulator shed profile, spacing, projection etc. and selection in respect of polluted conditions shall be generally in accordance with the commendation of IEC- 60815/ IS: 13134.

6 . The tolerances on all dimensions e.g. diameter, length and creepage distance shall be allowed as follows in line with-IEC 61109:

$\pm (0.04d + 1.5)$ mm when $d \leq 300$ mm

$\pm (0.025d+6)$ mm when $d > 300$ mmWhere, d being the dimensions in millimeters for diameter, length or creepage distance as the case may be. However, no negative tolerance shall be applicable to creepage distance.

7 . The composite insulators including the end fitting connection shall be standard design suitable for use with the hardware fittings of any make conforming to relevant IEC/IS standards.

8 . All surfaces shall be clean, smooth, without cuts, abrasions or projections. No part shall be subjected to excessive localized pressure. The insulator and metal parts shall be so designed and manufactured that it shall avoid local corona formation and not generate any radio interference beyond specified limit under the operating conditions.

Service condition : The insulators to be supplied against this specification shall be suitable for satisfactory continuous operation under the following topical condition :

a) Max. ambient temperature	: 50 º C
b) Min. ambient temperature	: -5 º C
c) Relative humidity	: 10 % to 100 %
d) Average number of rainy days	: 100 / annum.
e) Max. Anual Rainfall	: 1500 mm
f) Max. Wind Pressure	: 150 Kg/ sq. Meter
g) Max. Wind Velocity	: 50 Km/ hour
h) Max. Altitude above MSL	: 1000 Meter.
i) Seismic level	: 0.3 g (Horizontal acceleration)
j) Avarage Thunder storm	: 45 Days per annum.
k) Climatic condition	: Moderately hot and humid tropical climate, conductive to rust and fungus growth.

System Parameters :

a) Nominal system voltage	: 11 KV & 33 KV.
b) Highest system voltage	: 12 KV & 36 KV.

c) Power frequency : 50 Hz.
d) Number of Phases : Three.
e) System earthing : 11 KV Solidly earthed, 33 kV Impedence earth.

Standard : The following Indian / International Standards with latest revisions and amendments shall be referred while accessing conformity of insulators with this specification.

Sl. No.	Title	Indian Standard	International Standard
1.	Definition, test methods and acceptance criteria for composite insulators for a.c. overhead lines above 1000V		IEC : 61109
2.	Porcelain insulators for overhead power lines with a nominal voltage greater than 1000V	IS : 731	IEC : 60383
3.	Methods of High Voltage Testing	IS : 2071	IEC : 60060-1
4.	Specification for insulator fittings for overhead power lines with a nominal voltage greater than 1000V General Requirements and Tests Dimensional Requirements Locking Devices	IS : 2486	IEC : 60120 IEC : 60372
5.	Thermal Mechanical Performance test and mechanical performance test on string insulator units		IEC : 60575
6.	Guide for the selection of insulators in respect of polluted conditions	IS : 13134	IEC : 60815
7.	Characteristics of string insulator units of the long rod type		IEC : 60433
8.	Hydrophobicity classification guide		STRI guide 1.92/1
9.	Radio interference characteristics of overhead power lines and high-voltage equipment part		CISPR:18-2 IEC : 2
10.	Methods of RI Test of HV Insulators	IS : 8263	60437
11.	Standard for insulators – Composite-Distribution Dead-end type		ANSI C29 13-2000
12.	Hot dip zinc coatings on structural steel & other allied products	IS : 4759	ISO : 1459 ISO : 1461
13.	Recommended Practice for Hot, Dip Galvanization for iron and steel	IS : 2629	ISO-1461 (E)
14.	Determination of weight of zinc coating on zinc coated iron and steel articles	IS : 6745	ISO : 1460
15.	Methods of testing of local thickness of electroplated coatings	IS : 3203	ISO : 2178
16.	Testing of Uniformity of coating of zinc coated articles	IS : 2633	
17	Standard specification for glass fiber strands		ASTMD 578-05
18	Standard test method for compositional analysis by Thermo-gravimetric		ASTM E 1131-03
19	Specification for refined secondary zinc	IS : 4699	

Technical Requirement :

1 . Composite Insulators shall be designed to meet the light quality, safety and reliability and are capable of withstanding a wide range of environmental conditions.

(a) Core : The internal insulating part
(b) Housing : The external insulating part.
(c) Metal end fittings : For attaching to hardware to support conductor.

Core: It shall be a glass-fiber reinforced epoxy resin rod of high strength (FRP rod). Glass fibers and resin shall be optimized in the FRP rod.Glass fibers shall be Boron free electrically corrosion resistant (ECR) glass fiber or Boron free E-Glass and shall exhibit both high electrical integrity and high resistance to acid corrosion. The matrix of the FRP rod shall be Hydrolysis resistant. The FRP shall be manufactured through Pultrusion process. The FRP rod shall be void free.

Housing (Sheath) : The FRP rod shall be covered by a seamless sheath of a silicone elastometric compound or silicone alloy compound of a thickness of 3 mm minimum. It shall be one-piece housing using injection Moulding Principle to cover the core. The elastomer housing shall be designed to provide the necessary creepage distance and protection against environmental influences, external pollution and humidity. Housing shall conform to the requirement of IEC 61109/92-93 with latest amendments. It shall be extruded or directly moulded on core and shall have chemical bonding with the FRP rod. The strength of the bond shall be greater than the tearing strength of the polymer. Sheath material in the bulk as well as in the sealing / bonding area shall be free from voids. Manufacturer should furnish a description of its quality assurance programme including fabrication; testing and inspection for any material (i.e rubber) Components (i.e rod) or hardware (i.e. end filings). The manufacturer has had fabricated by others should also be included. Manufacturing methods and material composition documentation will be a part of Technical Bid to be submitted along with offer.

WEATHERSHEDS : The composite polymer Weathersheds made of silicone elastometric compound or silicon alloy shall be firmly bonded to the sheath, vulcanized to the sheath or molded as part of the sheath and shall be free from imperfections. The weathersheds should have silicon content of minimum 30% by weight. The strength of the weathershed to sheath interface shall be greater than the tearing strength of the polymer. The interface, if any, between sheds and sheath (housing) shall be free from voids.

METAL END FITTINGS : End fittings transmit the mechanical load to the core. They shall be made of Malleable Cast Iron or Spherical Graphite Cast Iron. Hardware of respective specified mechanical load and shall be hot dip galvanized in Zinc coated with minimum 99.95 % purity of electrolytic high grade Zinc in accordance with IS 2629. The material used in fittings shall be corrosion resistant. Metal end fittings shall be uniform and without sharp edges or corners and shall be free of cracks, flakes, silvers, slag, blow-holes shrinkages defects and localized porosity. They shall be connected to the rod by means of a controlled compression technique. As the main duty of the end fittings is the transfer of mechanical loads to the core the fittings should be property attached to the core by a coaxial or hexagonal compression process and should not damage the individual fibers or crack the core. The gap between fittings and sheath shall be sealed by flexible silicone elastometric compound or silicone alloy compound sealant, system of attached of end fitting to the rod shall provide superior sealing performance between housing, i.e. seamless sheath and metal connection. The sealing must be moisture proof. The dimensions of end fittings of insulators shall be in accordance with the standard dimensions stated in IEC: 60120/IS:2486 Part-II/1989. Nominal dimensions of the pin insulator shall be in accordance with the Specific Technical Particulars . No joints in pin will be allowed. Outer portion of Pin should be Zinc coated with minimum 99.95% purity of electrolytic high grade Zinc. The finished surface shall be smooth and shall have a good performance. The surface shall not crack or get chipped due to ageing effect under normal and abnormal service conditions or while handling during transit or erection.

The design of the fittings and the insulators shall be such that there is no local corona formation or discharges likely to cause the interference to either should or vision transmission. Bottom end metal fitting (Shank) of Pin Insulator should be as per IS: 2486. Length of thread on

shank should be minimum100 mm and Shank diameter is 20 mm. Minimum Collar diameter should be 40 mm and its minimum thickness should be of 5 mm. Two number nuts as per IS 1363 (P-III) and 4 mm thick Spring Washer shall be as per IS 3063 with latest amendments if any, Nuts and spring washer shall be hot dip galvanized.

Workmanship :

a) All the materials shall be of latest design and conform to the best engineering practices adopted in the high voltage filed. Bidders shall offer only such insulators as are guaranteed by them to be satisfactory and suitable for continued good service in power transmission lines.
b) The design, manufacturing process and material control at various stages shall be such as to give maximum working load, highest mobility, best resistance to corrosion, good finish and elimination of sharp edges and corners.
c) The design of the insulators shall be such that stresses due to expansion and contraction in any part of the insulator shall not lead to deterioration.
d) The core shall be sound and free of cracks and voids that may adversely affect the insulators.
e) Weather sheds shall be uniform in quality. They shall be clean, sound and smooth and shall be free from defects and excessive flashing at parting lines.
f) End fittings shall be free from cracks, seams, shrinks, air holes and rough edges. End fittings should be effectively sealed to prevent moisture ingress. Effectiveness of sealing system must be supported by test documents. All surfaces of the metal parts shall be perfectly smooth without projecting points or irregularities, which may cause corona. All load bearing surfaces shall be smooth and uniform so as to distribute the loading stresses uniformly.
g) All ferrous parts shall be hot dip galvanized to give a minimum average coating of zinc equivalent to 610 gm/sq.m. or 87µm thickness and shall be in accordance with the requirement of IS:4579. The zinc used for galvanizing shall be of purity 99.5% as per IS : 4699. The zinc coating shall be uniform, adherent, smooth, reasonably bright continuous and free from imperfections such as flux, ash rust stains, bulky white deposits and blisters. The galvanized metal parts shall be guaranteed to withstand at least four successive dips each lasting for one (1) minute duration under the standard preece test.

The Drawing : The bidder shall furnish along with the bid the outline drawing of each insulator unit including a cross sectional view of the long rod insulator unit. The drawing shall include but not be limited to the following information :

(a) Long rod diameter with manufacturing tolerances
(b) Minimum Creepage distance with positive tolerance
(c) Protected creepage distance
(d) Eccentricity of the long rod unit
    (i) Axial run out
    (ii) Radial run out
(e) Unit mechanical and electrical characteristics
(f) Weight of composite long rod units
(g) Identification mark
(h) Manufacturer's catalogue number

Marking : Each insulator shall be legibly and indelibly marked to show the following :

a) Name & Trade mark of the manufacturer
b) Month & Year of manufacturing
c) Voltage & Type
d) Minimum Failling Load (in KN)
e) "PEDM" marking

Type Test : The following Type Test shall have to be conducted on insulator unit, components, materials or complete strings ;

a) Sudden Load Release Test
b) Thermal Mechanical Pre-stress Test
c) Dry Lightning Impulse voltage withstand test
d) Dry Lightning Impulse Flashover voltage test
e) Dry & Wet Power Frequency Voltage withstand test
f) Dry & Wet Power Frequency Flashover Voltage withstand test
g) Mechanical Failing Load test.
h) Radio Interference test
i) Recovery of Hydrophobicity test.
j) Dye Penetration Test.
k) Water Diffusion Test
l) Chemical composition test for Silicon content
m) Brittle facture resistance test.
n) Damage Limit proof & Mechanical Withstand Test.

Routine Test :

a) Identification of marking
b) Visual inspection
c) Mechanical routine test

Acceptance Test : The following test will be carried out at manufacturers works during inspection of the offered insulators before delivery :

a) Visual examination
b) Verification of dimension
c) Temperature Cycle test
d) Galvanizing test
e) Mechanical performance test
f) Mechanical Failing Load test.
g) Porosity test

Testing Facilities : The tenderer must clearly indicate what testing facilities are available in the works of the manufacturer and whether facilities are adequate to carry out all Routine & Acceptance Tests. These facilities should be available to PEDM's Engineers if deputed or carry out or witness the tests in the manufacturer works. If any test cannot be carried out at the manufacturer's work, the reasons should be clearly stated in the tender. The insulators shall be tested in accordance with the procedure detailed in IEC 61109/92-93 with latest amendments.

Inspection : As per our GCC.

Sampling & Rejection during inspection : The sampling and rejection procedure for Acceptance Test shall be as per IEC 61109.

Packing :

a) All insulators shall be packed in strong corrugated box of min. 7 ply duly palette or wooden crates. The gross weight of the crates along with the material shall not normally exceed 100 Kg to avoid handling problem. The crates shall be suitable for outdoor storage under wet climate during rainy season.b) The packing shall be of sufficient strength to withstand rough handling during transit, storage at site and subsequent handling in the field.

c) Suitable cushioning, protective padding or dunnage or spacers shall be provided to prevent damage or deformation during transit and handling.

d) Each wooden case / crate / corrugated box shall have all the markings stenciled on it in indelible ink.

e) The bidder shall provide instructions regarding handling and storage precautions to be taken at site.

Guarantee :

In the event of any defect in the equipment / materials arising out of faulty design, materials, workmanship within a period of 12 (twelve) months of commissioning or 18 (eighteen) months from the date of last despatch of any integral part of the equipment / materials whichever is earlier the supplier shall guarantee to replace or repair the same to the satisfaction of the purchaser. If the supplier fail to do so within a reasonable time, PEDM reserves the right to effect repair or replacement by any other agency and recover charges for repair or replacement from the supplier.

Quality Assurance Plan :

1 . The successful bidder shall submit following information along with the bid.
2. Test certificates of the raw materials and bought out accessories.
3. Statement giving list of important raw material, their grades along with names of sub-suppliers for raw materials, list of standards according to which the raw materials are tested. List of tests normally carried out on raw materials in presence of bidder's representative.
4. List of manufacturing facilities available.
5. Level of automation achieved and lists of areas where manual processing exists.
6. List of areas in manufacturing process, where stage inspections are normally carried out for quality control and details of such tests and inspections.
7. List of testing equipments available with the bidder for final testing equipment along with valid calibration reports.
8. The manufacturer shall submit Manufacturing Quality Assurance Plan (QAP) for approval & the same shall be followed during manufacture and testing.
9. The successful bidder shall submit the routine test certificates of bought out raw materials/ accessories and central excise passes for raw material at the time of inspection.
10. The Owner's representative shall at all times be entitled to have access to the works and all places of manufacture, where insulator, and its component parts shall be manufactured and the representatives shall have full facilities for unrestricted inspection of the Supplier's and sub-Supplier's works, raw materials, manufacture of the material and for conducting necessary test as detailed herein.
11. The material for final inspection shall be offered by the Supplier only under packed condition. The owner shall select samples at random from the packed lot for carrying out acceptance tests. The lot offered for inspection shall be homogeneous and shall contain insulators manufactured in 3-4 consecutive weeks.
12. The Supplier shall keep the Owner informed in advance of the time of starting and the progress of manufacture of material i/n their various stages so that arrangements could be made for inspection.
13. No material shall be dispatched from its point of manufacture before it has been satisfactorily inspected and tested unless the owner in writing waives off the inspection. In the later case also the material shall be dispatched only after satisfactory testing specified herein has been completed.
14. The acceptance of any quantity of material shall in no way relieve the Supplier of his responsibility for meeting all the requirements of the specification and shall not prevent subsequent rejection, if such materials are later found to be defective.

ANNEXURE: A

Test on Insulator units

1**. RIV Test (Dry):** The insulator string along with complete hardware fittings shall have a radio interference voltage level below 100 micro volts at one MHz when subjected to 50 Hz voltage of 10 kV & 30 kV for 11 kV & 33 kV class insulators respectively under dry condition. The test procedure shall be in accordance with IS : 8263/IEC: 437/CISPR 18-2.

2. **Brittle Fracture Resistance Test**: Brittle fracture test shall be carried out on naked rod along with end fittings by applying "1n HNO3 acid" (63 g conc. HNO3 added to 937 g water) to the rod.

The rod should be held at 80% of SML for the duration of the test. The rod should not fail within the 96 Hour test duration. Test arrangement should ensure continuous wetting of the rod with Nitric acid.

3. **Recovery of Hydrophobicity & Corona Test** :

i) The surface of selected samples shall be cleaned with isopropyl alchohol. Allow the surface to dry and spray with water. Record the Hydrophobicity classification in line with STRI guide for Hydrophobicity classification (Extract enclosed at Annexure-D) Dry the sample surface.

(ii) The sample shall subjected to mechanical stress by bending the Sample over a ground electrode. Corona is continuously generated by applying 12 kV to a needle like electrode placed 1 mm above the sample surface. Tentative arrangement shall be as shown in Annexure-E. The test shall be done for 100 hrs.

(iii) Immediately after the corona treatment, spray the surface with Water and record the HC classification. Dry the surface and repeat the corona treatment as at Clause-2 above. Note HC classification. Repeat the cycle for 1000 Hrs. or until an HC of 6 or 7 is obtained. Dry the sample surface.

(iv) Allow the sample to recover and repeat hydrophobicity Measurement at several time intervals. Silicone rubber should recover to HC 1– HC 2 within 24 to 48 hours, depending on the Material and the intensity of the corona treatment.

4. **Chemical composition test for Silicon content**:

The content of silicon in the composite polymer shall be evaluated by EDX (Energy Dispersion X-ray) Analysis or Thermo-gravimetric analysis.

The test may be carried out at CPRI or any other NABL accredited laboratory.

Mandatory Particulars for 11 KV & 33 KV Pin Insulator

	11 KV Pin	33 KV Pin
Type of insulator	Polymeric composite Pin Insulator	Polymeric composite Pin Insulator
Reference Standard	IEC 61109	IEC 61109
Material of FRP Rod	Borron free ECR	Borron free ECR
Material of sheds	Silicon Rubber	Silicon Rubber
Material of end fittings	SGCI / MCI	SGCI / MCI
Material of sealing compound	RTV Silicon	RTV Silicon
Colour of sheds	Grey	Grey
Rated voltage	11 KV	33 KV
Highest voltage	12 KV	36 KV
Dry Power Frequency Withstand voltage	60 KV	95 KV
Wet Power Frequency Withstand voltage	> 35 KV	> 75 KV
Dry Flashover Voltage	> 75 KV	> 130 KV
Wet Flashover Voltage	> 45 KV	> 90 KV
Dry Lightning Impulse withstand voltage	Positive : >75 KV Negative : >80 KV	Positive : >170 KV Negative : > 180 KV
Dry Lightning Impulse Flashover voltage	Positive : > 95 KV Negative : >100 KV	Positive : > 210 KV Negative : >230 KV
Power frequency puncture withstand voltage	105 KV (rms)	180 KV (rms)
RIV at 1 MHz when energised at 10 KV / 30 KV (rms) under dry condition	< 50 microvolt	< 70 microvolt
Creepage distance (min)	320 mm	840 mm
Min Failing load	10 KN	10 KN
Dia of FRP Rod	16 mm	20 mm
Length of FRP Rod	210 ± 5 mm	320 ± 5 mm
Dia of weather sheds	100 ± 1 mm	120 ± 1 mm
Thickness of housing	3 mm	3 mm
Dry arc distance	170 ± 5 mm	380 ± 5 mm
Method of fixing sheds to housing	Injection moulding	Injection moulding
Visible Discharge Voltage (PF)	9 KV	30 KV
No of weather sheds	Three	Nine
Type of sheds	Aerodynamic	Aerodynamic
Dia of bottom end fitting	20 mm	20 mm
Thread length of bottom end fitting	110 mm (Min)	130 mm (min)
Type of packing	Wooden / Corrugated Box	Wooden / Corrugated box
No of insulator in each pack	Thirty	Twenty
Guarantee	12 months from commissioning or 18 months from the date of last despatch.	12 months from commissioning or 18 months from the date of last despatch.

Distribution Transformers 11 kV/433V

1. SCOPE:

i) This specification covers design, engineering, manufacture, assembly, stage testing, inspection and testing before supply and delivery at site of oil immersed, naturally cooled 3-phase 11 kV/433 - 250 V distribution transformers for outdoor use.

ii) It is not the intent to specify completely herein all the 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, in a manner acceptable to the purchaser, who will interpret the meanings of drawings and specification and shall have the power to reject any work or material which, in his judgment is not in accordance therewith. The offered equipment shall be complete with all components necessary for their effective and trouble free operation. Such components shall be deemed to be within the scope of bidder's supply irrespective of whether those are specifically brought out in this specification and / or the commercial order or not.

iii) The transformer and accessories shall be designed to facilitate operation, inspection, maintenance and repairs. The design shall incorporate every precaution and provision for the safety of equipment as well as staff engaged in operation and maintenance of equipment.

iv) All outdoor apparatus, including bushing insulators with their mountings, shall be designed so as to avoid any accumulation of water.

2 STANDARD RATINGS:

i) The standard ratings shall be 16, 25, 63, 100, 200, 250, 315, 400, 500, 630, 1000, 1250, 1600, 2000 and 2500 kVA for 11 kV distribution transformers

3 STANDARDS:

3.1 The materials shall conform in all respects to the relevant Indian/International Standards, with latest amendments thereof unless otherwise specified herein. Some of them are listed below:

Indian Standard	Title	International and Internationally Recognized standards
IS -2026	Specification for Power Transformers	IEC 76
IS – 1180 (Part-1): 2014	Outdoor Type Oil Immersed Distribution Transformer	
IS 12444	Specification for Copper wire rod	ASTM B-49
IS-335	Specification for Transformer Oil	IEC Pub 296
IS - 5	Specification for colors for ready mixed paints	
IS - 104	Ready mixed paint, brushing zinc chromate, priming	
IS – 2099	Specification for high voltage porcelain bushing	
IS - 649	Testing for steel sheets and strips and magnetic circuits	
IS - 4257	Dimensions for clamping arrangements for bushings	
IS - 7421	Specification for Low Voltage bushings	
IS - 3347	Specification for Outdoor Bushings	DIN 42531 to 33
IS - 5484	Specification for Al Wire rods	ASTM B - 233
IS - 9335	Specification for Insulating Kraft Paper	IEC 554
IS - 1576	Specification for Insulating Press Board	IEC 641
IS - 6600	Guide for loading of oil Immersed Transformers	IEC 76
IS - 2362	Determination of water content in oil for porcelain bushing of transformer	
IS - 6162	Paper covered aluminium conductor	
IS - 6160	Rectangular Electrical conductor for electrical machines	
IS - 5561	Electrical power connector	
IS - 6103	Testing of specific resistance of electrical insulating liquids	
IS - 6262	Method of test for power factor and dielectric constant of electrical insulating liquids	
IS - 6792	Determination of electrical strength of insulating oil	
IS - 10028	Installation and maintenance of transformers.	

3.2 Material conforming to other internationally accepted standards, which ensure equal or better quality than the standards mentioned above, would also be acceptable. In case the bidders who wish to offer material conforming to other standards, the bidder shall clearly bring out the salient points of difference between the standards adopted and the specific standards in relevant schedule. Four copies of such standards with authentic English translations shall be furnished along with the offer.

4 SERVICE CONDITIONS:

4.1 The Distribution Transformers to be supplied against this Specification shall be suitable for satisfactory continuous operation under the following climatic conditions as per IS 2026 (Part - I).

i)	Location	:	At various locations in the country
ii)	Maximum ambient air temperature (^{0}C)	:	50
iii)	Minimum ambient air temperature (^{0}C)	:	-5
iv)	Maximum average daily ambient air temperature (^{0}C)	:	40
v)	Maximum yearly weighted average ambient temperature(^{0}C)	:	32
vi)	Maximum altitude above mean sea level (Metres)	:	To be specified by the user

Note:

1. The climatic conditions specified above are indicative and can be changed by the user as per requirements.
2. The equipment shall generally be for use in moderately hot and humid tropical climate, conducive to rust and fungus growth unless otherwise specified.

5 PRINCIPAL PARAMETERS:

5.1 The transformers shall be suitable for outdoor installation with three phase, 50 Hz, 11 kV or 33 kV system in which the neutral is effectively earthed and they should be suitable for service with fluctuations in supply voltage upto plus 12.5% to minus 12.5%.

(i) The transformers shall conform to the following specific parameters :

Sl. No.	Item	11 kV Distribution Transformers
1	System voltage (max.)	12 kV
2	Rated voltage HV	11 kV
3	Rated voltage LV	433 - 250 V*
4	Frequency	50 Hz +/- 5%*
5	No. of Phases	Three
6	Connection HV	Delta
7	Connection LV	Star (Neutral brought out)
8	Vector group	Dyn-11
9	Type of cooling	ONAN

*The voltage level can be specified as 415-240 V/400-230 V volts as per the requirements of the purchaser.

Audible sound levels (decibels) at rated voltage and frequency for liquid immersed distribution transformers shall be as below (NEMA Standards):

kVA rating	Audible sound levels (decibels)
0-50	48
51-100	51
101-300	55
301-500	56
750	57
1000	58
1500	60
2000	61
2500	62

6. TECHNICAL REQUIREMENTS:

6.1.1 CORE MATERIAL - CRGO / AMORPHOUS METAL

6.1.2 CRGO Material

6.1.2.1 The core shall be stack / wound type of high grade cold rolled grain oriented annealed steel lamination having low loss and good grain properties, coated with hot oil proof insulation, bolted together and to the frames firmly to prevent vibration or noise. The core shall be stress relieved by annealing under inert atmosphere if required. The complete design of core must ensure permanency of the core loss with continuous working of the transformers. The value of the maximum flux density allowed in the design and grade of lamination used shall be clearly stated in the offer.

6.1.2.2 The bidder should offer the core for inspection and approval by the purchaser during manufacturing stage.

6.1.2.3 The transformers core shall be suitable for over fluxing (due to combined effect of voltage and frequency) up to 12.5% without injurious heating at full load conditions and shall not get saturated. The bidder shall furnish necessary design data in support of this situation.

6.1.2.4 No-load current shall not exceed 3% of full load current and will be measured by energising the transformer at 433 volts, 50 Hz on the secondary. Increase of voltage of 433 volts by 12.5% shall not increase the no-load current by 6% (maximum) of full load current.

7 WINDINGS:

(i) Material:

7.1.1 HV and LV windings shall be wound from Super Enamel covered /Double Paper covered, aluminium conductor winding upto 200 kVA

7.1.2 HV and LV windings shall be wound from Super Enamel covered / Double Paper covered copper conductor winding for ratings above 315 kVA.

7.1.3 LV winding shall be such that neutral formation will be at top.

7.1.4 The winding construction of single HV coil wound over LV coil is preferable.

7.1.5 Inter layer insulation shall be Nomex /Epoxy dotted Kraft Paper.

7.1.6 Proper bonding of inter layer insulation with the conductor shall be ensured. Test for bonding strength shall be conducted.

7.1.7 Dimensions of winding coils are very critical. Dimensional tolerances for winding coils shall be within limits as specified in Guaranteed Technical Particulars (GTP Schedule I).

7.1.8 Current density for HV and LV winding should not be more than 2.8 Ampere per sq mm for copper and 1.6 Ampere per sq mm for Aluminium Conductor.

7.1.9 The core/coil assembly shall be securely held in position to avoid any movement under short circuit conditions.

7.1.10 Joints in the winding shall be avoided. However, if jointing is necessary the joints shall be properly brazed and the resistance of the joints shall be less than that of parent conductor. In case of foil windings, welding of leads to foil can be done within the winding.

8 TAPS:

8.1.1 No tapping shall be provided for transformers up to 100 kVA rating.

8.1.2 For ratings above 100 kVA and up to 200 kVA, tappings shall be provided, if required by the purchaser, on the higher voltage winding for variation of HV voltage within range of (+) 5.0 % to (-) 7.5% in steps of 2.5%.

8.1.3 For ratings higher than 200 kVA, tapping shall be provided on the higher voltage winding for variation of HV voltage within range of (+) 5.0 % to (-) 15.0 % in steps of 2.5%.

8.1.4 Tap changing shall be carried out by means of an externally operated self position switch and when the transformer is in de-energised condition. Switch position No.1 shall correspond to the maximum plus tapping. Each tap change shall result in variation of 2.5% in voltage. Provision shall be made for locking the taping switch handle in position. Suitable aluminium anodised plate shall be fixed for tap changing switch to know the position number of tap.

9 OIL:

9.1 The insulating oil shall comply with the requirements of IS 335 or BS 148. Use of recycled oil is not acceptable. The specific resistance of the oil shall not be less than 2.5 X1012 ohm-cm at 27 0C when tested as per IS 6103.

9.2 Oil shall be filtered and tested for break down voltage (BDV) and moisture content before filling.

9.3 The oil shall be filled under vacuum.

9.4 The design and all materials and processes used in the manufacture of the transformer, shall be such as to reduce to a minimum the risk of the development of acidity in the oil.

10 INSULATION LEVELS:

Sl. No.	Voltage (kV)	Impulse Voltage (kV Peak)	Power Frequency Voltage (kV)
1	0.433	-	3
2	11	95	28
3	33	170	70

11 LOSSES:

11.1 The bidder shall guarantee individually the no-load loss and load loss without any positive tolerance. The bidder shall also guarantee the total losses at 50% and 100% load condition (at rated voltage and frequency and at 75 ^{0}C).

11.2 The maximum allowable losses at rated voltage and rated frequency permitted at 75 ^{0}C for 11/0.433 kV transformers can be chosen by the utility from the values of 3 star, 4 star or 5 star rating for transformers up to rating of 200 kVA as indicated below:

Voltage Ratio	Rating (kVA)	3 Star		4 Star		5 Star	
		Max. Losses at 50% Loading (Watts)	Max. Losses at 100% Loading (Watts)	Max. Losses at 50% Loading (Watts)	Max. Losses at 100% Loading (Watts)	Max. Losses at 50% Loading (Watts)	Max. Losses at 100% Loading (Watts)
11000/433 - 250 V	63	380	1250	340	1140	300	1050
11000/433 - 250 V	100	520	1800	475	1650	435	1500

11.3 For transformers of other ratings the following maximum allowable losses at rated voltage and frequency and at 75 ^{0}C shall be taken:

Voltage Ratio	Rating (kVA)	Max. Losses at 50% loading (Watts)	Max. Losses at 100% loading (Watts)
11000/433 - 250 V	250	1050	3150
33000/433 - 250 V	100	560	1820

11.4 Whenever the star ratings for the above transformers become available the values of 3 star, 4 star or 5 star could be taken by the utility. Bids with higher losses than the above specified values would be treated as non-responsive. However, the manufacturer can offer losses less than above. The utility can evaluate offers with losses lower than the maximum allowable losses on total owning cost as per formula given in Annexure-I

12 TOLERANCES:

12.1 No positive tolerance shall be allowed on the maximum losses displayed on the label for both 50% and 100% loading values.

13 PERCENTAGE IMPEDANCE:

(i) The value of impedance of transformers at 75 ^{0}C shall be 4.5% for transformers up to and 200 kVA and for ratings above 200 kVA shall be in accordance with IS 2026.

14 Temperature rise: The temperature rise over ambient shall not exceed the limits given below:

14.1 Top oil temperature rise measured by thermometer :35 ^{0}C

14.2 Winding temperature rise measured by resistance method :40 ^{0}C

Bids not meeting the above limits of temperature rise will be treated as non-responsive.

14.3 The transformer shall be capable of giving continuous rated output without exceeding the specified temperature rise. Bidder shall submit the calculation sheet in this regard.

15 PENALTY FOR NON PERFORMANCE:

(i) During testing at supplier's works if it is found that the actual measured losses are more than the values quoted by the bidder, the purchaser shall reject the transformer and he shall also have the right to reject the complete lot.

(ii) Purchaser shall reject the entire lot during the test at supplier's works, if the temperature rise exceeds the specified values.

(iii) Purchaser shall reject any transformer during the test at supplier's works, if the impedance values differ from the guaranteed values including tolerance.

16 INSULATION MATERIAL:

16.1 Electrical grade insulation epoxy dotted Kraft Paper/Nomex and pressboard of standard make or any other superior material subject to approval of the purchaser shall be used.

16.2 All spacers, axial wedges / runners used in windings shall be made of pre-compressed Pressboard-solid, conforming to type B 3.1 of IEC 641-3-2. In case of cross-over coil winding of HV all spacers shall be properly sheared and dovetail punched to ensure proper locking. All axial wedges / runners shall be properly milled to dovetail shape so that they pass through the designed spacers freely. Insulation shearing, cutting, milling and punching operations shall be carried out in such a way, that there should not be any burr and dimensional variations.

17.1 TANK:

- The internal clearance of tank shall be such, that it shall facilitate easy lifting of core with coils from the tank without dismantling LV bushings.

- All joints of tank and fittings shall be oil tight and no bulging should occur during service.

- Inside of tank shall be painted with varnish/hot oil resistant paint.

- The top cover of the tank shall be slightly sloping to drain rain water.

- The tank plate and the lifting lugs shall be of such strength that the complete transformer filled with oil may be lifted by means of lifting shackle.

- Manufacturer should carry out all welding operations as per the relevant ASME standards and submit a copy of the welding procedure and welder performance qualification certificates to the customer.

i) PLAIN TANK:

17.2.1 The transformer tank shall be of robust construction rectangular/octagonal/round/ elliptical in shape and shall be built up of electrically tested welded mild steel plates of thickness of 3.15 mm for the bottom and top and not less than 2.5 mm for the sides for distribution transformers upto and including 25 kVA, 5.0 mm and 3.15 mm respectively for transformers of more than 25 kVA and up to and including 100 kVA and 6 mm and 4 mm respectively above 100 kVA. Tolerances as per IS1852 shall be applicable.

17.2.2 In case of rectangular tanks above 100 kVA the corners shall be fully welded at the corners from inside and outside of the tank to withstand a pressure of 0.8 kg/cm^2 for 30 minutes. In case of transformers of 100 kVA and below, there shall be no joints at corners and there shall not be more than 2 joints in total.

17.2.3 Under operating conditions the pressure generated inside the tank should not exceed 0.4 kg/ sq. cm positive or negative. There must be sufficient space from the core to the top cover to take care of oil expansion. The space above oil level in the tank shall be filled with dry air or nitrogen conforming to commercial grade of IS 1747.

(i) The tank shall be reinforced by welded flats on all the outside walls on the edge of the tank.

(ii) Permanent deflection: The permanent deflection, when the tank without oil is subjected to a vacuum of 525 mm of mercury for rectangular tank and 760 mm of mercury for round tank, shall not be more than the values as given below:

(All figures in mm)

Horizontal length of flat plate	**Permanent deflection**
Up to and including 750	5.0
751 to 1250	6.5
1251 to 1750	8.0
1751 to 2000	9.5
2001 to 2250	11.0
2251 to 2500	12.0
2501 to 3000	16.0
Above 3000	19.0

17.2.6 The tank shall further be capable of withstanding a pressure of 0.8 kg/ sq.cm (g) and a vacuum of 0.7 kg/sq.cm (g) without any deformation.

17.2.7 The radiators can be tube type or fin type or pressed steel type to achieve the desired cooling to limit the specified temperature rise.

17.3 CORRUGATED TANK:

17.3.1 The bidder may offer corrugated tanks for transformers of all ratings.

17.3.2 The transformer tank shall be of robust construction corrugated in shape and shall be built up of tested sheets.

17.3.3 Corrugation panel shall be used for cooling. The transformer shall be capable of giving continuous rated output without exceeding the specified temperature rise. Bidder shall submit the calculation sheet in this regard.

17.3.4 Tanks with corrugations shall be tested for leakage test at a pressure of 0.25kg/ sq cm measured at the top of the tank.

17.3.5 The transformers with corrugation should be provided with a pallet for transportation,

the dimensions of which should be more than the length and width of the transformer tank with corrugations.

18 CONSERVATOR:

(i) The conservator shall be provided on transformers of rating 63 kVA and above for plain tank and 200 kVA and above for corrugated tank. For other ratings transformers manufacturer may adopt their standard practice or follow utility's requirement. For sealed type transformers conservator is not required.

(ii) When a conservator is provided, oil gauge and the plain or dehydrating breathing device shall be fitted to the conservator which shall also be provided with a drain plug and a filling hole [32 mm (1¼")] normal size thread with cover. In addition, the cover of the main tank shall be provided with an air release plug.

(iii) The dehydrating agent shall be silica gel. The moisture absorption shall be indicated by a change in the colour of the silica gel crystals which should be easily visible from a distance. Volume of breather shall be suitable for 500g of silicagel conforming to IS 3401 for transformers upto 200 kVA and 1 kg for transformers above 200 kVA .

(iv) The capacity of a conservator tank shall be designed keeping in view the total quantity of oil and its contraction and expansion due to temperature variations. The total volume of conservator shall be such as to contain10% quantity of the oil. Normally 3% quantity the oil shall be contained in the conservator.

(v) The cover of main tank shall be provided with an air release plug to enable air trapped within to be released, unless the conservator is so located as to eliminate the possibility of air being trapped within the main tank.

(vi) The inside diameter of the pipe connecting the conservator to the main tank should be within 20 to 50 mm and it should be projected into the conservator so that its end is approximately 20 mm above the bottom of the conservator so as to create a sump for collection of impurities. The minimum oil level (corresponding to -5 ^{0}C) should be above the sump level.

19 SURFACE PREPARATION AND PAINTING:

(i) GENERAL

19.1.1 All paints, when applied in a normal full coat, shall be free from runs, sags, wrinkles, patchiness, brush marks or other defects.

19.1.2 All primers shall be well marked into the surface, particularly in areas where painting is evident and the first priming coat shall be applied as soon as possible after cleaning. The paint shall be applied by airless spray according to manufacturer's recommendations. However, where ever airless spray is not possible, conventional spray be used with prior approval of purchaser.

19.2 CLEANING AND SURFACE PREPARATION:

a) After all machining, forming and welding has been completed, all steel work surfaces shall be thoroughly cleaned of rust, scale, welding slag or spatter and other contamination prior to any painting.

b) Steel surfaces shall be prepared by shot blast cleaning (IS9954) to grade Sq. 2.5 of ISO 8501-1 or chemical cleaning including phosphating of the appropriate quality (IS 3618).

c) Chipping, scraping and steel wire brushing using manual or power driven tools cannot remove firmly adherent mill-scale. These methods shall only be used where blast cleaning is impractical. Manufacturer to clearly explain such areas in his technical offer.

19.3 PROTECTIVE COATING:

19.3.1 As soon as all items have been cleaned and within four hours of the subsequent drying, they shall be given suitable anti-corrosion protection.

19.4 PAINT MATERIAL:

i) Following are the types of paint which may be suitably used for the items to be painted at shop and supply of matching paint to site: Heat resistant paint (Hot oil proof) for inside surface

ii) For external surfaces one coat of thermo setting powder paint or one coat of epoxy primer followed by two coats of synthetic enamel/polyurethene base paint. These paints can be either air drying or stoving.

iii) For highly polluted areas, chemical atmosphere or for places very near to the sea coast, paint as above with one coat of high build Micaceous iron oxide (MIO) as an intermediate coat may be used.

19.5 PAINTING PROCEDURE:

i) All prepared steel surfaces should be primed before visible re-rusting occurs or within 4 hours, whichever is sooner. Chemical treated steel surfaces shall be primed as soon as the surface is dry and while the surface is still warm.

ii) Where the quality of film is impaired by excess film thickness (wrinkling, mud cracking or general softness) the supplier shall remove the unsatisfactory paint coating and apply another coating. As a general rule, dry film thickness should not exceed the specified minimum dry film thickens by more than 25%.

19.6 DAMAGED PAINTWORK:

(i) Any damage occurring to any part of a painting scheme shall be made good to the same standard of corrosion protection and appearance as that was originally applied.

(ii) Any damaged paint work shall be made good as follows:

19.6.2.1 The damaged area, together with an area extending 25 mm around its boundary, shall be cleaned down to bare metal.

19.6.2.2 A priming coat shall be immediately applied, followed by a full paint finish equal to

that originally applied and extending 50 mm around the perimeter of the original damage.

19.6.2.3 The repainted surface shall present a smooth surface. This shall be obtained by carefully chamfering the paint edges before and after priming.

19.7 DRY FILM THICKNESS:

19.7.1 To the maximum extent practicable the coats shall be applied as a continuous film of uniform thickness and free of pores. Overspray, skips, runs, sags and drips should be avoided. The different coats may or may not be of the same colour.

19.7.2 Each coat of paint shall be allowed to harden before the next is applied as per manufacturer's recommendation.

19.7.3 Particular attention must be paid to full film thickness at the edges.

19.7.4 The requirements for the dry film thickness (DFT) of paint and the materials to be used shall be as given below:

Sl. No.	Paint type	Area to be painted	No. of coats	Total dry film Thickness (min.) (microns)
1.	Thermo setting powder paint	inside outside	01 01	30 60
2.	**Liquid paint**			
	a) Epoxy (primer)	outside	01	30
	b) P.U. Paint (Finish coat)	outside	02	25 each
	c) Hot oil paint/ Varnish	inside	01	35/10

19.8 TESTS FOR PAINTED SURFACE:

19.8.1 The painted surface shall be tested for paint thickness.

19.8.2 The painted surface shall pass the cross hatch adhesion test and impact test as acceptance tests and Salt spray test and Hardness test as type test as per the relevant ASTM standards.

Note: Supplier shall guarantee the painting performance requirement for a period of not less than 5 years.

20 BUSHINGS:

20.1 The bushings shall conform to the relevant standards specified and shall be of outdoor type. The bushing rods and nuts shall be made of brass material 12 mm diameter for both HT and LT bushings. The bushings shall be fixed to the transformers on side with

straight pockets and in the same plane or the top cover for transformers above 100 kVA. For transformers of 100 kVA and below the bushing can be mounted on pipes. The tests as per latest IS 2099 and IS 7421 shall be conducted on the transformer bushings.

20.2 For 33 kV, 52 kV class bushings shall be used for transformers of ratings 500 kVA and above. And for transformers below 500 KVA, 33 kV class bushings, for 11 kV, 17.5 kV class bushings and for 0.433 kV, 1.1 kV class bushings shall be used.

20.3 Bushing can be of porcelain/epoxy material. Polymer insulator bushings conforming with relevant IEC can also be used.

20.4 Bushings of plain shades as per IS 3347 shall be mounted on the side of the

20.5 Dimensions of the bushings of the voltage class shall conform to the Standards specified and dimension of clamping arrangement shall be as per IS 4257

20.6 Minimum external phase to phase and phase to earth clearances of bushing terminals shall be as follows:

	Clearance	
Voltage	**Phase to phase**	**Phase to earth**
33 kV	350 mm	320 mm
11 kV	255 mm	140 mm
LV	75 mm	40 mm

The clearances in case of cable box shall be as below:

Voltage	**Clearance**	
	Phase to phase	**Phase to earth**
33 kV	350 mm	220 mm
11 kV	130 mm	80 mm
LV	25 mm	20 mm

20.7 Arcing horns shall be provided on HV bushings.

20.8 Brazing of all inter connections, jumpers from winding to bushing shall have cross section larger than the winding conductor. All the Brazes shall be qualified as per ASME, section – IX.

20.9 The bushings shall be of reputed make supplied by those manufacturers who are having manufacturing and testing facilities for insulators.

20.10 The terminal arrangement shall not require a separate oil chamber not connected to oil in the main tank.

21 TERMINAL CONNECTORS:

21.1 The LV and HV bushing stems shall be provided with suitable terminal connectors as per IS 5082 so as to connect the jumper without disturbing the bushing stem. Connectors shall be with eye bolts so as to receive conductor for HV. Terminal connectors shall be type tested as per IS 5561.

22 LIGHTNING ARRESTORS:

22.1 9 kV, 5 kA metal oxide lightning arrestors of reputed make conforming to IS 3070 Part-III, one number per phase shall be provided.(To be mounted on pole or to be fitted under the HV bushing with GI earth strip 25x4 mm connected to the body of the transformer with necessary clamping arrangement as per requirement of purchaser.) Lightening arrestors with polymer insulators in conformance with relevant IEC can also be used.

23 CABLE BOXES:

23.1 In case HV/LV terminations are to be made through cables the transformer shall be fitted with suitable cable box on 11 kV side to terminate one 11kV/ 3 core aluminium conductor cable up to 240 sq. mm.(Size as per requirement).

The bidder shall ensure the arrangement of HT Cable box so as to prevent the ingress of moisture into the box due to rain water directly falling on the box. The cable box on HT side shall be of the split type with faces plain and machined and fitted with Neo-k-Tex or similar quality gasket and complete with brass wiping gland to be mounted on separate split type gland plate with nut-bolt arrangement and MS earthing clamp. The bushings of the cable box shall be fitted with nuts and stem to take the cable cores without bending them. The stem shall be of copper with copper nuts. The cross section of the connecting rods shall be stated and shall be adequate for carrying the rated currents. On the HV side the terminal rod shall have a diameter of not less than 12 mm. The material of connecting rod shall be copper. HT Cable support clamp should be provided to avoid tension due to cable weight.

23.2 The transformer shall be fitted with suitable LV cable box having non-magnetic material gland plate with appropriate sized single compression brass glands on LV side to terminate 1.1 kV/single core XLPE armoured cable (Size as per requirement).

24 TERMINAL MARKINGS:

High voltage phase windings shall be marked both in the terminal boards inside the tank and on the outside with capital letter 1U, 1V, 1W and low voltage winding for the same phase marked by corresponding small letter 2u, 2v, 2w. The neutral point terminal shall be indicated by the letter 2n. Neutral terminal is to be brought out and connected to local grounding terminal by an earthing strip.

25 CURRENT TRANSFORMERS:

25.1 CT's shall be provided for transformers of rating 63 kVA and above and if required by purchaser for ratings below 63 kVA on secondary side.

25.2 Current transformer shall be mounted inside the tank or outside with suitable marshalling box on LV side of the transformer.

25.3 The current transformers shall comply with IS 2705.

25.4 All secondary leads of bushing mounted CT's shall be brought to a terminal box near each bushing.

25.5 The CT terminals shall have shorting facility.

25.6 CT should not get saturated upto 200% of rated current.

25.7 CT shall have the following parameters

Parameter	Value
Accuracy class	0.5
Burden	20 VA
Application	Metering
ISF	5

26 FITTINGS:

26.1 The following standard fittings shall be provided :

1. Rating and terminal marking plates, non-detachable.
2. Earthing terminals with lugs - 2 Nos.
3. Lifting lugs for main tank and top cover
4. Terminal connectors on the HV/LV bushings (For bare terminations only).
5. Thermometer pocket with cap - 1 No.
6. Air release device
7. HV bushings - 3 Nos.
8. LV bushings - 4 Nos.
9. Pulling lugs
10. Stiffener
11. Radiators - No. and length may be mentioned (as per heat dissipation calculations)/ corrugations.
12. Arcing horns or 9 kV, 5 kA lightning arrestors on HT side - 3 No.
13. Prismatic oil level gauge.
14. Drain cum sampling valve.
15. Top filter valve
16. Oil filling hole having p. 1- ¼ '' thread with plug and drain plug on the conservator.
17. Silicagel breather
18. Base channel 75x40 mm for up to 100 kVA and 100 mmx50 mm above 100 kVA, 460 mm long with holes to make them suitable for fixing on a platform or plinth.
19. 4 No. rollers for transformers of 200 kVA and above.
20. Pressure relief device or explosion vent.

27 FASTENERS:

27.1 All bolts, studs, screw threads, pipe threads, bolt heads and nuts shall comply with the appropriate Indian Standards for metric threads, or the technical equivalent.

27.2 Bolts or studs shall not be less than 6 mm in diameter except when used for small wiring terminals.

27.3 All nuts and pins shall be adequately locked.

27.4 Wherever possible bolts shall be fitted in such a manner that in the event of failure of locking resulting in the nuts working loose and falling off, the bolt will remain in position.

27.5 All ferrous bolts, nuts and washers placed in outdoor positions shall be treated to prevent corrosion, by hot dip galvanising, except high tensile steel bolts and spring washers which shall be electro-galvanised/plated. Appropriate precautions shall be taken to prevent electrolytic action between dissimilar metals.

27.6 Each bolt or stud shall project at least one thread but not more than three threads through the nut, except when otherwise approved for terminal board studs or relay stems. If bolts and nuts are placed so that they are inaccessible by means of ordinary spanners, special spanners shall be provided.

27.7 The length of the screwed portion of the bolts shall be such that no screw thread may form part of a shear plane between members.

27.8 Taper washers shall be provided where necessary.

27.9 Protective washers of suitable material shall be provided front and back of the securing screws.

28 OVERLOAD CAPACITY:

28.1 The transformers shall be suitable for loading as per IS 6600.

29 COMPLETELY SELF PROTECTED (CSP) TRANSFORMERS:

29.1 CSP transformers can be provided for ratings up to 200 kVA

30 PROTECTION FEATURES:

30.1 **Internal HV fuse on the HV side of transformer**:

30.1.1 Expulsion/any other suitable type of fuse shall be placed in series with the primary winding. This fuse is mounted normally inside of the primary bushing for the three phases and is connected to the high voltage winding through a terminal block. This has to protect that part of the electrical distribution system which is ahead of the distribution transformers from faults which occur inside the distribution transformer i.e., either in the

windings or some other part of the transformer. It shall be ensured that this fuse does not blow for faults on the secondary side (LT side) of the transformer i.e., the blowing characteristics of the fuse and LT breaker shall be so coordinated such that the fuse shall not blow for any faults on the secondary side of the transformer beyond LT breakers and those faults shall be cleared by the LT breaker only.

30.2 Internally/Externally Mounted LT Breaker on the LV Side of the Transformer:

30.2.1 **3 Pole LT circuit breaker**: All LT faults after the breaker shall be cleared by this breaker. As such it shall be designed for perfect coordination with the HT fuse link. The bidder shall furnish the time / current characteristics of LT circuit breaker and 11 kV fuses for various current multiples.

30.2.2 The two characteristics shall be drawn on the same sheet to indicate coordination between the circuit breaker and fuse. The bidder shall carry out coordination test as indicated above and this forms one of the tests for acceptance test.

30.2.3 The breaker shall be coordinated thermally with the transformer design to follow closely the variations of oil temperature due to fluctuating loads and ambient temperatures.

30.2.4 Arrangements shall be provided to enable the circuit breaker to be closed and opened manually standing on ground.

30.2.5 The cross section of the current carrying parts of the breaker shall withstand the full load current at a current density not more than 2.5 A/sq. mm (for additional mechanical strength the area should be more).

30.2.6 Rated short circuit breaking capacity of the breaker shall not be less than 2.5 kA. The circuit breaker shall confirm to IS 13947.

30.2.7 In case the breaker is internal the breaker shall be located in the same oil as the core and coil assembly so that the bimetal is sensitive to the temperature of oil as well as the load.

31 LOAD MANAGEMENT SIGNAL LIGHT:

31.1 A signal light shall be provided to give information about the loading condition of the transformer. It shall forewarn any overloading problem at the installation such that replacement of the existing transformer with a higher capacity transformer can be planned. The signal light mechanism shall not reset itself when the load drops from the overloaded condition. The signal light shall remain lighted once the signal light contacts close due to overload and can be turned off by manual operation. (The signal light shall not give indication for momentary overloading).

31.2 Loading indication shall be available in adjustable steps of 10% starting from 70% to 110%

32 LIGHTNING ARRESTORS:

32.1 9 kV, 5 kA metal oxide lightning arrestors Distribution class type of reputed make as per relevant standard , one number per phase shall be provided to be fitted under the HV

bushing with GI earth strip 25x4 mm connected to the body of the transformer with necessary clamping arrangement

33 TESTS:

33.1 All the equipment offered shall be fully type tested by the bidder or his collaborator as per the relevant standards including the additional type tests.

The type test must have been conducted on a transformer of same design **during the last five years** at the time of bidding. The bidder shall furnish foursets of type test reports along with the offer. Offers without type test reports will be treated as non-responsive.

33.2 Special tests other than type and routine tests, as agreed between purchaser and bidder shall also be carried out as per the relevant standards.

33.3 The requirements of site tests are also given in this clause.

33.4 The test certificates for all routine and type tests for the transformers and also for the bushings and transformer oil shall be submitted with the bid.

33.5 The procedure for testing shall be in accordance with IS1180 (Part-1) :2014 /2026 as the case may be except for temperature rise test.

33.6 Before despatch each of the completely assembled transformers shall be subjected to the routine tests at the manufacturer's works.

34 ROUTINE TESTS:

34.1 Ratio, polarity, phase sequence and vector group.

34.2 No Load current and losses at service voltage and normal frequency.

34.3 Load losses at rated current and normal frequency.

34.4 Impedance voltage test.

34.5 Resistance of windings at each tap, cold (at or near the test bed temperature).

34.6 Insulation resistance.

34.7 Induced over voltage withstand test.

34.8 Separate source voltage withstand test.

34.9 Neutral current measurement-The value of zero sequence current in the neutral of the star winding shall not be more than 2% of the full load current.

34.10 Oil samples (one sample per lot) to comply with IS 1866.

34.11 Measurement of no load losses and magnetizing current at rated frequency and 90%,

100% and 110% rated voltage.

34.12 Pressure and vacuum test for checking the deflection.

35 TYPE TESTS TO BE CONDUCTED ON ONE UNIT:
In addition to the tests mentioned in clause 33 and 34 following tests shall be conducted:

35.1 Temperature rise test for determining the maximum temperature rise after continuous full load run. The ambient temperature and time of test should be stated in the test certificate.

35.2 Impulse voltage test: with chopped wave of IS 2026 part-III. BIL for 11 kV shall be 95 kV peak instead of 75 kV

35.3 Short circuit withstand test: Thermal and dynamic ability.

35.4 Air Pressure Test: As per IS – 1180.

35.5 Magnetic Balance Test.

35.6 Un-balanced current test: The value of unbalanced current indicated by the ammeter shall not be more than 2% of the full load current.

35.7 Noise-level measurement.

35.8 Measurement of zero-phase sequence impedance.

35.9 Measurement of Harmonics of no-load current.

35.10 Transformer tank shall be subjected to specified vacuum. The tank designed for vacuum shall be tested at an internal pressure of 0.35 kg per sq cm absolute(250 mm of Hg) for one hour. The permanent deflection of flat plates after the vacuum has been released shall not exceed the values specified below:

Horizontal length of flat plate (in mm)	**Permanent deflection (in mm)**
Upto and including 750	5.0
751 to 1250	6.5
1251 to 1750	8.0
1751 to 2000	9.5
2001 to 2250	11.0
2251 to 2500	12.0
2501 to 3000	16.0
Above 3000	19.0

35.11 Transformer tank together with its radiator and other fittings shall be subjected to pressure corresponding to twice the normal pressure or 0.35 kg / sq.cm whichever is lower, measured at the base of the tank and maintained for an hour. The permanent deflection of the flat plates after the excess pressure has been released, shall not exceed the figures for vacuum test.

35.12 Pressure relief device test: The pressure relief device shall be subject to increasing fluid pressure. It shall operate before reaching the test pressure as specified in the above class. The operating pressure shall be recorded.
The device shall seal-off after the excess pressure has been released.

35.13 **Short Circuit Test and Impulse Voltage Withstand Tests**: The purchaserintends to procure transformers designed and successfully tested for short circuit and impulse test. In case the transformers proposed for supply against the order are not exactly as per the tested design, the supplier shall be required to carry out the short circuit test and impulse voltage withstand test at their own cost in the presence of the representative of the purchaser.

35.13.1The supply shall be accepted only after such test is done successfully, as it confirms on successful withstand of short circuit and healthiness of the active parts thereafter on un-tanking after a short circuit test.

35.13.2Apart from dynamic ability test, the transformers shall also be required to withstand thermal ability test or thermal withstand ability will have to be established by way of calculations.

35.13.3It may also be noted that the purchaser reserves the right to conduct short circuit test and impulse voltage withstand test in accordance with the IS, afresh on each ordered rating at purchaser cost, even if the transformers of the same rating and similar design are already tested. This test shall be carried out on a transformer to be selected by the purchaser either at the manufacturer's works when they are offered in a lot for supply or randomly from the supplies already made to purchaser's stores. The findings and conclusions of these tests shall be binding on the supplier.

35.13.4Type test certificates for the tests carried out on prototype of same specifications shall be submitted along with the bid. The purchaser may select the transformer for type tests randomly.

36 ACCEPTANCE TESTS:

36.1 **At least 10% transformers of the offered lot (minimum of one)** shall besubjected to the following routine/ acceptance test in presence of purchaser's representative at the place of manufacture before dispatch without any extra charges. The testing shall be carried out in accordance with IS:1180 (Part-1): 2014 and IS:2026.

36.2 Checking of weights, dimensions, fitting and accessories, tank sheet thickness, oil quality, material, finish and workmanship as per GTP and contract drawings.

36.3 Physical verification of core coil assembly and measurement of flux density of one unit

of each rating, in every inspection with reference to short circuit test report

36.4 Temperature rise test on one unit of the total ordered quantity

37 TESTS AT SITE:

The purchaser reserves the right to conduct all tests on transformer after arrival at site and the manufacturer shall guarantee test certificate figures under actual service conditions.

38 INSPECTION:

38.1 In respect of raw material such as core stampings, winding conductors, insulating paper and oil, supplier shall use materials manufactured/supplied by standard manufacturers and furnish the manufacturers' test certificate as well as the proof of purchase from these manufacturers (excise gate pass) for information of the purchaser. The bidder shall furnish following documents along with their offer in respect of the raw materials:

i. Invoice of supplier.
ii. Mill's certificate.
iii. Packing list.
iv. Bill of landing.
v. Bill of entry certificate by custom.

39 INSPECTION AND TESTING OF TRANSFORMER OIL:

39.1 To ascertain the quality of the transformer oil, the original manufacturer's

tests report should be submitted at the time of inspection. Arrangements should also be made for testing of transformer oil, after taking out the sample from the manufactured transformers and tested in the presence of purchaser's representative.

39.2 To ensure about the quality of transformers, the inspection shall be carried out by the purchaser's representative at following two stages:-

39.2.1 Online anytime during receipt of raw material and manufacture/ assembly whenever the purchaser desires.

39.2.2 At finished stage i.e. transformers are fully assembled and are ready for despatch.

39.3 The stage inspection shall be carried out in accordance with **Annexure-II.**

39.4 After the main raw-material i.e. core and coil material and tanks are arranged and transformers are taken for production on shop floor and a few assembly have been completed, the firm shall intimate the purchaser in this regard, so that an officer for carrying out such inspection could be deputed, as far as possible within seven days from the date of intimation. During the stage inspection a few assembled core shall be dismantled (only in case of CRGO material) to ensure that the CRGO laminations used are of good quality. Further, as and when the transformers are ready for

despatch, an offer intimating about the readiness of transformers, for final inspection for carrying out tests as per relevant IS shall be sent by the firm along with Routine Test Certificates. The inspection shall normally be arranged by the purchaser at the earliest after receipt of offer for pre-delivery inspection. The proforma for pre delivery inspection of Distribution transformers is placed at **Annex- III**.

39.5 In case of any defect/defective workmanship observed at any stage by the purchaser's Inspecting Officer, the same shall be pointed out to the firm in writing for taking remedial measures. Further processing should only be done after clearance from the Inspecting Officer/ purchaser.

39.6 All tests and inspection shall be carried out at the place of manufacture unless otherwise specifically agreed upon by the manufacturer and purchaser at the time of purchase. The manufacturer shall offer the Inspector representing the Purchaser all reasonable facilities, without charges, to satisfy him that the material is being supplied in accordance with this specification. This will include Stage Inspection during manufacturing stage as well as Active Part Inspection during Acceptance Tests.

39.7 The manufacturer shall provide all services to establish and maintain quality of workman ship in his works and that of his sub-contractors to ensure the mechanical /electrical performance of components, compliance with drawings, identification and acceptability of all materials, parts and equipment as per latest quality standards of ISO 9000.

39.8 Purchaser shall have every right to appoint a third party inspection to carryout the inspection process.

39.9 The purchaser has the right to have the test carried out at his own cost by an independent agency wherever there is a dispute regarding the quality supplied. Purchaser has right to test 1% of the supply selected either from the stores or field to check the quality of the product. In case of any deviation purchaser have every right to reject the entire lot or penalize the manufacturer, which may lead to blacklisting, among other things.

40 QUALITY ASSURANCE PLAN:

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

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

40.3 Information and copies of test certificates as above in respect of bought out accessories.

40.4 List of manufacturing facilities available.

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

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

40.7 List of testing equipment available with the bidder for final testing of equipment along with valid calibration reports. These shall be furnished with the bid. Manufacturer shall posses 0.1 accuracy class instruments for measurement of losses.

40.8 Quality Assurance Plan (QAP) with hold points for purchaser's inspection.

40.9 The successful bidder shall within 30 days of placement of order, submit following information to the purchaser :

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

40.9.2 Type test certificates of the raw materials and bought out accessories.

40.9.3 The successful bidder shall submit the routine test certificates of bought out accessories and central excise passes for raw material at the time of routine testing.

41 DOCUMENTATION:

41.1 The bidder shall furnish along with the bid the dimensional drawings of the items offered indicating all the fittings.

41.2 Dimensional tolerances.

41.3 Weight of individual components and total weight.

41.4 An outline drawing front (both primary and secondary sides) and end-elevation and plan of the tank and terminal gear, wherein the principal dimensions shall be given.

41.5 Typical general arrangement drawings of the windings with the details of the insulation at each point and core construction of transformer.

41.6 Typical general arrangement drawing showing both primary and secondary sides and end-elevation and plan of the transformer.

42 PACKING AND FORWARDING:

42.1 The packing shall be done as per the manufacturer's standard practice.

However, it should be ensured that the packing is such that, the material would not get damaged during transit by Rail / Road / Sea.

42.2 The marking on each package shall be as per the relevant IS.

43 MANADATORY SPARES:

43.1 Mandatory spares shall be supplied as per the purchaser's requirement.

44 GUARANTEE

44.1 The manufacturers of the transformer shall provide a guarantee of 24 months from the date of receipt at the stores of the Utility or 18 months from the date of commissioning, whichever is earlier. In case the distribution transformer fails within the guarantee period the purchaser will immediately inform the supplier who shall take back the failed DT within 15 days from the date of the intimation at his own cost and replace/repair the transformer within forty five days of date of intimation with a roll over guarantee.

44.2 The outage period i.e. period from the date of failure till unit is repaired/ replaced shall not be counted for arriving at the guarantee period.

44.3 In the event of the supplier's inability to adhere to the aforesaid provisions, suitable penal action will be taken against the supplier which may inter alia include blacklisting of the firm for future business with the purchaser for a certain period.

45 SCHEDULES:

45.1 The bidder shall fill in the following schedule which will be part of the offer. If the schedule are not submitted duly filled in with the offer, the offer shall be liable for rejection.

Schedule-A : Guaranteed Technical Particulars

Schedule-B : Schedule of Deviations

46 DEVIATIONS :

46.1 The bidders are not allowed to deviate from the principal requirements of the Specifications. However, the bidder is required to submit with his bid in the relevant schedule a detailed list of all deviations without any ambiguity. In the absence of a deviation list in the deviation schedules, it is understood that such bid conforms to the bid specifications and no post-bid negotiations shall take place in this regard.

46.2 The discrepancies, if any, between the specification and the catalogues and / or literatures submitted as part of the offer by the bidders, shall not be considered and representations in this regard shall not be entertained.

46.3 If it is observed that there are deviations in the offer in guaranteed technical particulars other than those specified in the deviation schedules then such deviations shall be treated as deviations.

46.4 All the schedules shall be prepared by vendor and are to be enclosed with the bid.

TECHNICAL SPECIFICATIONS FOR STATION SERVICE TRANSFORMER

1. SCOPE This specification covers oil-immersed, naturally cooled, three-phase, 50 Hz, double-wound outdoor type transformers of 100 KVA ratings for use in system with a nominal voltage of 11 KV.

2. APPLICABLE STANDARDS Unless otherwise stipulated in this specification, the transformers shall comply with the latest version of IS: 1180 (Pt.I) and IS: 2026.

3. STANDARD RATINGS **T**he standard ratings shall be 100 KVA.

4. NO LOAD VOLTAGE RATIO The no load voltage ratio shall be as follows: 33000/415-240 V for 100 KVA

5. TAPS No taps are to be provided in these transformers.

6. WINDINGS

6.1 For 100 KVA transformer ratings, thermo-mechanically treated NML – PM2 designation copper wires should be used for HV windings for better short circuit capability and longer life. The technical properties of these wires shall be as follows:

i)	Electrical Conductivity (Percentage IACS at 20^{o}C.)	61-62
ii)	Ultimate Tensile Strength (Kg/mm^2)	10-13
iii)	Percentage elongation at 250 mm gauge length	27-35

NOTE: The supplier shall furnish requisite data in support of the above properties as guaranteed technical particulars and shall also satisfy the inspecting officer in this regard.

Alternatively, The Government of India, Minisitry of Industry, New Delhi vide its letter No.19/(53)/93-E1. India dated 13.4.94 has allowed the use of copper windings.

6.2 Unless otherwise specified, DPC insulation shall be used for HV and LV winding wires and Electrical Grade plain insulation kraft paper shall be used for inter-layer insulation of the HV and LV coils. In case PVA enamelled conductor is used for HV/LV winding, electrical grade epoxy dotted, thermally upgraded kraft paper shall be used for inter-layer insulation. Use of single coil design for HV winding shall be preferred due to its better short-circuit behaviour.

6.3 Corrugated cylinder made from pre-compressed insulation board should be used between HV and LV windings.

6.4 Angle shaped End Rings made from pre-compressed board should be used between the end coil and core (with this provisions, the purchaser should not specify any minimum clearance between end coil and core).

6.5 The primary winding shall be connected in delta and the secondary winding in star (Vector Symbol Dy 11) so as to produce a positive displacement of 30 degrees from the primary to the secondary vectors of the same phase (Vector rotation assumed counter clockwise). The neutral of the secondary winding shall be connected to a separate insulated terminal.

7. FITTINGS

The following standard fittings shall be provided:-

a)	Two earthing terminals
b)	Oil level gauge indicating three positions of oil marked as follows:- Minimum (-5^0C) 30^0C Maximum (98^0C)
c)	Lifting lugs
d)	Plain breathing device comprising an inverted U-pipe with wire gauze at the open end or Silica gel breather, as required by the purchaser.
e)	Drain-cum-Sampling Valve (Steel) of the type shown in Fig.1 welded to the tank. The special tool for operating this valve shall be supplied with the transformer.
f)	Thermometer pocket for 100 KVA units.
g)	Filling hole having P 1¼ thread (with cover) on the transformer body/conservator

8. CONSERVATOR.

8.1 On transformer of 100 KVA, provision of conservator is obligatory.

8.2 The conservator shall be provided with a drain plug and a filling hole with cover. In addition, the cover of main tank shall be provided with an air release plug to enable trapped air to be released unless the conservator is so located as to eliminate the possibility of air being trapped within the main tank.

8.3 The inside diameter of the pipe connecting the conservator to the main tank shall be within 20 to 50 mm and it should project into the conservator in such a way that its end is approximately 20 mm above the bottom of the conservator so as to create a sump for collection of impurities. The minimum oil level (corresponding to -5^0C) should be above the sump level.

9. RATING AND TERMINAL MARKING PLATE (S) Each transformer shall be provided with non-detachable rating and terminal marking plate(s) of weather-proof material, fitted in a visible position and showing complete information as given in IS:1180 (Pt.I).

10. LIMITS OF TEMPERATURE RISE. The temperature rise shall not exceed the limit of 55^0C (measured by resistance) for transformer windings and 45^0C. (Measured by thermometer) in top oil when tested in accordance with IS: 2026.

11. LOSSES AND IMPEDANCE VALUES.

11.1 The no-load and load-losses shall not exceed the values given in the following table:

KVA Rating	No–load losses (Fixed loss) Watts	Load losses at 75^0C Watts
100	260	1760

The above losses are maximum allowable and there will not be any plus tolerance. The capitalization of losses will be allowed for lower losses offered.

11.2 The percentage impedance at 75^0C shall be 4.5% subject to tolerance as per IS: 2026.

12. PERMISSIBLE FLUX DENSITY AND OVERFLUXING The flux density at rated voltage and frequency shall not exceed 1.69 Tesla. The no-load current at Rated Voltage and at 112.5 percent Rated Voltage shall not exceed values given below:-

KVA Rating	**Percentage of Rated full Load Current**	
	At 100% Rated Voltage	**At 112.5% Rated Voltage**
100	2.5	5

13. BUSHING TERMINALS.

13.1 To avoid bimetallic action at the point of connection to the aluminium windings and to the external aluminium cables/conductors, both HV & LV bushing stems shall be made of aluminium alloy conforming to the requirement of IS: 3347.

13.2 The busing terminals shall be of clamp type to directly receive aluminium conductors/cables without requiring use of lugs. The terminal shall be directly screwed on to the stem to secure effective sealing of the bushing. Details of the terminals are given in Appendix-II.

14. SEALING GASKETS All sealing washers/gaskets shall be made of oil and heat resistant nitrile rubber. Gaskets made of natural rubber or cork sheet are not permissible.

15. TRANSFORMER OIL The transformer oil shall comply with REC Specification No. 39/1985(R-1993) (Appendix–I).

16. TESTS AND INSPECTION.

16.1 ***Routine Tests:*** All transformers shall be subjected to the following routine tests at the manufacturer's work in accordance with IS: 2026 and IS: 1180 (Pt.I).

a)	Measurement of winding resistance
b)	Measurement of voltage ratio and check of voltage vector relationship
c)	Measurement of impedance voltage/short circuit impedance and load loss
d)	Measurement of no-load loss and no-load current
e)	Measurement of insulation resistance
f)	Induced over-voltage withstand test
g)	Separate-source voltage withstand test

16.2 ***Type Tests:*** The following type tests shall be made on the transformers as per details given in IS: 2026:

a) to g) as indicated under routine tests:	
h)	Lightning impulse test
i)	Temperature-rise test
j)	Short circuit test
k)	Air Pressure test (IS: 1180 Part-I-1989).
l)	Unbalance current test: The value of unbalance current indicated by the ammeter as shown in the test arrangement in Fig.2 shall not be more than 2% of the full load current. If records of a type test on a transformer which, in essential details, is representative of the one being purchased are furnished, the purchaser may accept this as evidence of the type test instead of the actual test

16.3 The supplier shall furnish calculations in accordance with IS: 2026 to demonstrate the thermal ability of the transformer to withstand short-circuit.

16.4. Inspection.

16.4.1 All tests and inspection shall be made at the place of manufacture unless otherwise especially agreed upon by the manufacturer and purchaser at the time of purchase. The manufacturer shall afford the inspector representing the purchaser all reasonable facilities without charge to satisfy him that the material is being furnished in accordance with this specification.

16.4.2 The purchaser has the right to have the tests carried out at his own cost by an independent agency whenever there is dispute regarding the quality of supply.

17. WARRANTY The supplier shall guarantee satisfactory performance of transformers and all the associated components for a period of 2 years from the date of receipt by the purchaser or 18 months from the date of commissioning, whichever is earlier. During the warranty period, all repairs/replacements shall be carried out free of cost and the warranty shall cover all failures except those caused by deliberate interference.

18. MOUNTING ARRANGEMENT The under-base of all transformers shall be provided with two 75 x 40 mm M.S. Channels 460 mm long with holes to make them suitable for fixing on a platform or plinth.

TECHNICAL SPECIFICATIONS FOR AAC/ACSR CONDUCTORS

FOR OVERHEAD POWER LINES

1. SCOPE This Specification covers the details of the conductors for use on 33 KV, 11 KV and LT overhead lines in rural electric distribution systems. The sizes of conductors standardised for lines of different voltages are indicated below:

33KV Lines

i) ACSR 7/3.35mm (50mm^2 aluminium area)

ii) ACSR 7/4.09 mm (80mm^2 aluminium area)

iii) ACSR 6/4.72 mm + 7/1.57 mm (100mm^2 aluminium area)

11 KV Lines

i) ACSR 7/2.11 mm (20mm^2 aluminium area)
ii) ACSR 7/2.59 mm (30mm^2 aluminium area)
iii) ACSR 7/3.35 mm (50mm^2 aluminium area)

LT Lines

i) ACSR 7/2.11 mm (20mm^2 aluminium area)
ii) ACSR 7/2.59 mm (30mm^2 aluminium area)
iii) ACSR 7/3.35 mm (50mm^2 aluminium area)
iv) AAC 7/2.21 mm (25mm^2 aluminium area)
v) AAC 7/3.10 mm (50mm^2 aluminium area)

2. APPLICABLE STANDARDS Except when they do not comply with the specific requirements in this specification, the conductors shall comply with the Indian Standard Specification IS:398 (Pt.I)-1976 and IS:398 (Pt.II)-1976 or the latest version thereof.

3. SIZES The sizes and properties of Stranded Aluminium and Steel cored Aluminium Conductors shall be as under:

TABLE – I : STANDARD ALUMINIUM STRANDED CONDUCTORS

Nominal Aluminium Area	**Stranding and Wire Diameter**	**Sectional Area**	**Approx. Overall Diameter**	**Approx. Mass**	**Calculated Resistance at 20^0 C Max.**	**Approx. Calculated Breaking load**
mm.sq.	***mm***	***mm.sq.***	***Mm***	***Kg./Km***	***Ohm./Km***	***KN***
25	7/2.21	26.85	6.63	74	1.086	4.52
50	7/3.10	52.83	9.30	145	0.5525	8.25

TABLE – II : STRANDED STEEL CORED ALUMINIUM CONDUCTORS

Nominal Aluminium Area	Stranding & Wire Diameter		Sectional Area of Aluminium	Total Sectional Area	Approx. Overall Diameter	Approx. Mass	Calculated Resistance at 20^0C Max.	Approx. Calculated Breaking Load
	Al.	Steel						
mm.sq	*Mm*	*mm*	*mm.sq.*	*Mm.sq.*	*mm*	*Kg./Km.*	*Ohm./Km*	*KN*
20	6/2.11	1/ 2.11	20.98	24.48	6.33	85	1.394	7.61
30	6/2.59	1/ 2.59	31.61	36.88	7.77	128	0.9289	11.12
50	6/3.35	1/ 3.35	52.88	61.70	10.05	214	0.5524	18.25
80	6/4.09	1/ 4.09	78.83	91.97	12.27	319	0.3712	26.91
100	6/4.72	7/ 1.57	105.00	118.50	14.15	394	0.2792	32.41

4. ALUMINIUM WIRES The properties of aluminium wires to be used in the construction of the stranded conductors shall be as under

TABLE – III : SOLID ALUMINIUM WIRES USED IN THE CONSTRUCTION OF STRANDED ACSR CONDUCTORS

Diameter			Cross Sectional Area of Nominal Diameter Wire	Mass	Resistance At 20^0 C	Breaking Load Min.	
Nominal	Min.	Max.				Before Stranding	After Stranding
Mm	*Mm*	*mm*	*mm.sq.*	*Kg./Km*	*Ohm./Km.*	*KN*	*KN*
2.11	2.09	2.13	3.497	9.45	8.237	0.63	0.60
2.21	2.19	2.23	3.836	10.37	7.503	0.68	0.65
2.59	2.56	2.62	5.269	14.24	5.490	0.89	0.85
3.10	3.07	3.13	7.548	20.40	3.818	1.24	1.18
3.35	3.32	3.38	8.814	23.82	3.265	1.43	1.36
4.09	4.05	4.13	13.140	35.51	2.194	2.08	1.98
4.72	4.67	4.77	17.500	47.30	1.650	2.78	2.64

5. STEEL WIRES The properties of steel wires to be used in the construction of the stranded ACSR conductors shall be as under

TABLE – IV

SOLID STEEL WIRES USED IN THE CONSTRUCTION OF STRANDED ACSR CONDUCTORS

Diameter			**Cross Sectional Area of Nominal Diameter Wire**	**Mass**	**Breaking Load Min.**	
Nominal	**Min.**	**Max.**			**Before Stranding**	**After Stranding**
Mm	***Mm***	***mm***	***mm.sq.***	***Kg./Km***	***KN***	***KN***
1.57	1.54	1.60	1.936	15.10	2.70	2.57
2.11	2.07	2.15	3.497	27.27	4.60	4.37
2.59	2.54	2.64	5.269	41.09	6.92	6.57
3.35	3.28	3.42	8.814	68.75	11.58	11.00
4.09	4.01	417	13.140	102.48	17.27	16.41

6. FREEDOM FROM DEFECTS The wires shall be smooth and free from all imperfections, such as spills & splits.

7. JOINTS IN WIRES & CONDUCTORS

All aluminium conductors: No joints shall be permitted in any wire.

Aluminium Conductor Steel Reinforced:

Aluminium Wires: No two joints shall occur in the aluminium wires closer together than 15 metres.

Steel Wires: No joints shall be permitted in steel wires used for ACSR of Sizes 20mm^2 aluminium area (7/2.11mm), 30mm^2 aluminium area (7/2.59mm), 50mm^2 aluminium area (7/3.35mm) and 80mm^2 aluminium area (7/4.09 mm). In the case of ACSR of 100mm^2 aluminium area (6/4.72mm + 7/1.57 mm) having seven galvanised steel wires, joints, in individual wires shall be permitted but no two such joints shall be less than 15 metres apart in the complete steel core.

8. STRANDING The wires used in construction of a stranded conductor shall, before stranding satisfy all the requirements of this standard for solid wires.

Lay Ratio:

(i) The lay ratio for aluminium wires in case of AAC shall be within limits given below:

No. of wires in conductors	Lay Ratio	
	Min.	**Max.**
7	10	14

(ii) The lay ratio for aluminium and steel wire in case of ACSR shall be within limits given below:

No. of wires		Ratio Aluminium wire dia to steel wire dia	Lay ratio for Steel wire (6 wire layer)		Lay Ratio for Aluminium wire	
Al.	**Steel**		**Min.**	**Max.**	**Min.**	**Max.**
6	1	1.000	-	-	10	14
6	7	3.000	13	28	10	14

9. TESTS The samples of individual wires for the tests shall normally be taken before stranding. The manufacturer shall carry out test on samples taken out at least from 10% of aluminium wire spools and 10% of steel wire coils. However, when desired by the purchaser, the test sample may be taken from the stranded wires.

a) The wires used for all aluminium conductors shall comply with the following tests as per IS: 398 (Pt.I)-1976.

i) Breaking load test
ii) Wrapping test
iii) Resistance test

b) The wires used for aluminium conductors, steel reinforced shall comply with the following tests as per IS: 398 (Pt.II)-1976

i) Breaking load test
ii) Ductility test
iii) Wrapping test
iv) Resistance test
v) Galvanizing test

10. PACKING & MARKING The conductors shall be wound in reels or drums conforming to IS: 1778-1980 ‘Specification for Reels and Drums for bare wire’ or the latest version thereof.

Packing The gross mass for various conductors shall not exceed by more than 10% of the values given in the following table:

Conductor Size	**Gross Mass**
AAC	
25mm^2 Al. area (7/2.21 mm)	500 Kg.
50mm^2 Al. area (7/3.10 mm)	500 Kg.
ACSR	
20mm^2 Al. area (7/2.11 mm)	1000 Kg.
30mm^2 Al. area (7/2.59 mm)	1000 Kg.
50mm^2 Al. area (7/3.35 mm)	1500 Kg.
80mm^2 Al. area (7/4.09 mm)	1500 Kg.
100mm^2 Al. area (6/4.72mm + 7/1.57mm)	2000 Kg.

The normal length of various conductors shall be as given in the following table:

Conductor Size	**Normal Conductor Length**
AAC	
25mm^2 Al. area (7/2.21mm)	1.0 Km.
50mm^2 Al. area (7/3.10mm)	1.0 Km.
ACSR	
20mm^2 Al. area (7/2.11 mm)	2.0 Km.
30mm^2 Al. area (7/2.59 mm)	2.0 Km.
50mm^2 Al. area (7/3.35 mm)	2.0 Km.
80mm^2 Al. area (7/4.09 mm)	1.5 Km.
100mm^2 Al. area (6/4.72mm + 7/1.57mm)	2.0 Km.

Longer lengths shall be acceptable. Short lengths, not less than 50% of the standard lengths, shall be acceptable to the maximum extent of 10% of the quantity ordered.

Marking: The following information shall be marked on each package:

a)	Manufacturers' name	b)	Trade mark, if any
c)	Drum or identification number	d)	Size of conductor
e)	Number and lengths of conductor	f)	Gross mass of the package
g)	Net mass of conductor	h)	I.S.I certification mark, if any

11. INSPECTION All tests and inspection shall be made at the place of manufacture unless otherwise especially agreed upon by the manufacturer and purchaser at the time of purchase. The manufacturer shall afford the inspector representing the purchaser all reasonable facilities without charge, to satisfy him that the material is being furnished in accordance with this Specification.

TECHNICAL SPECIFICATIONS FOR

TUBULAR STEEL POLES FOR OVERHEAD LINES

1.0 SCOPE This specification covers the general requirements towards design, manufacture, testing at manufacturers works, supply and delivery for Tubular Steel Poles of circular cross section (swaged type) for overhead lines.

2.0 STANDARD The Tubular Steel Poles shall conform to the latest edition of Indian Standard Specification IS: 2713 (Part-I, III)-1980 or any other authoritative standards (as amended up-to-date) except where specified otherwise in this specification.

3.0 TOPOGRAPHY AND CLIMATIC CONDITION The materials offered shall be suitable for operation in tropical climate and will be subjected to the sun and inclement weather and shall be able to withstand wide range of temperature variation. For the purpose of design, average atmospheric temperature may be considered to be 50ºC with humidity nearing saturation.

4.0 MATERIALS

4.1 The materials used in construction of Tubular Steel Poles shall be of the tested quality of steels of minimum tensile strength 540 MPa (55 Kgf/mm²).

4.2 The materials, when analysed in accordance with IS: 228 (Part-III)-1972 and IS: 228 (Part-IX) shall not show sulphur and phosphorus contents of more than 0.060% each.

5.0 TYPES, SIZE AND CONSTRUCTION Tubular Steel Poles shall be swaged type. Swaged poles shall be made of seamless or welded tubes of suitable lengths swaged and jointed together. No circumferential joints shall be permitted in the individual tube lengths of the poles. If welded tubes are used they shall have one longitudinal weld seam only and the longitudinal welds shall be staggered at each swaged joint.

Swaging may be done by any mechanical process. The upper edge of each joint shall be chamfered if at an angle of about 45º. The upper edge need not be chamfered if a circumferential weld is to be deposited in accordance with clause no. 5.32 of IS: 2713 (Part-I)-1980.

The length of joints on swaged poles shall be in accordance with clause no. 5.4 of IS: 2713 (Part-I)-1980.

Poles shall be well finished, clean and free from harmful surface defects. Ends of the poles shall be cut square. Poles shall be straight, smooth and cylindrical. The weld joints, if any shall be of good quality, free from scale, surface defects, cracks, etc.

Tolerances for outside diameter, thickness, length, weight and straightness shall be in accordance with IS: 2713 (Part-I)-1980.

The poles shall be coated with black bituminous paint conforming to IS: 158-1968 throughout, internally and externally up to the level which goes inside the earth. The

remaining portion of the exterior shall be painted with one coat of red oxide primer as specified in IS: 2074-1979.

6.0 EARTHING ARRANGEMENTS For earthing arrangement a through hole of 14 mm diameter shall be provided in each pole at a height of 300 mm above the planting depth.

7.0 TESTS AND TEST CERTIFICATES The following tests shall be conducted on finished poles:

Tensile test and chemical analysis for sulphur and phosphorus, Defalcation test, Permanent set test and Drop test.

In addition to above verification of dimensions as per IS: 2713 (Part-III)-1980 shall be carried out during acceptance lots. Number of poles selected for conducting different tests shall be in accordance to clause no. 10.1.1 and no. 10.1.12 of IS: 2713 (Part-I)-1980.

Tests shall be carried out before supply of each consignment at the manufacturer's works and test certificates should be submitted to the purchaser for approval prior to delivery.

Re-tests, if any, shall be made in accordance with IS: 2713 (Part-I)-1980.

Purchaser reserves the right to inspect during manufacturing and depute his representative to inspect/ test at the works. If any extra cost is required for carrying out the above specified tests, the same shall be borne by the contractor.

8.0 MARKING The poles shall be marked with designation, manufacturer's identification, year of manufacture and name of the Purchaser: P&E DEPARTMENT, GOVT OF MIZORAM.

The poles may also be marked with the ISI certification mark, if applicable.

9.0 GUARANTEED TECHNICAL PARTICULARS The contractor shall furnish all necessary guaranteed technical particulars.

10.0 SCHEDULE OF REQUIREMENT The schedule of requirement given in the AQS is tentative and may vary.

11.0 PERFORMANCE The contractor shall furnish a list of the major supplies effected during the last 3 (three) years indicating the volume of supply and actual delivery dates along with the Contracts.

12.0 DEVIATION

12.1 Any deviation in Technical Specification shall be clearly indicated with sufficient reasons thereof. Purchaser shall however reserve the right to accept and/ or reject the same without assigning any reasons whatsoever.

TECHNICAL SPECIFICATION OF MILD STEEL CHANNEL, ANGLE AND FLAT

1) APPLICABLE STANDARDS:

The mild steel shall conform to IS: 2062 grade 'a' modified upto date or equivalent international standard for steel materials, documents for which shall be made available at the time of inspection to the owner's representative.

2) GENERAL REQUIREMENTS:

Material shall be supplied as per the following sizes:

100x50 ISMC channel conforming to IS: 2062 grade 'a' modified upto date or its equivalent International Standard having length ranging from 5.5 to 13.5 meters. 75x40 ISMC channel conforming to IS: 2062 grade 'a' modified upto date or its equivalent International Standard having length ranging from 5.5 to 135 meters.

50x50x8 mm or 6 mm ISA angles conforming to IS: 2062 grade 'a' modified upto date or its equivalent international standard having length ranging from 5.5 to 13.5 meters.

45X45X5 mm ISA angles conforming to IS: 2062 grade 'a' modified upto date or its equivalent international standard having length ranging from 5.5 to 13.5 meters.

60x65x6 mm ISA angles conforming to IS: 2062 grade 'a' modified upto date or its equivalent international standard having length ranging from 5.5 to 13.5 meters.

25X3mm, 50X6mm, 50x8mm, 75X8mm and 80X8 flats conforming to IS: 2062 grade 'a' modified upto date or its equivalent international standard having length ranging from 5.5 to 9.5 meters.

3) <u>GALVANISATION</u>:

All above steel members shall be fabricated as per approved drawing having smooth edge, drilled circular/elliptical holes of suitable measurements.

All structural steel members and bolts shall be galvanized as per IS:4759 and zinc coating shall not be less than 610gm/sq. meter for all structural steel members. All weld shall be 6mm filled weld unless specified otherwise. All nuts and bolt shall be of property class 5.6 of IS 1367. Plain washers shall be as per IS 2016 and spring washers shall be IS:3063

4) INSPECTION:

All inspection/test will be carried out by representative of owner.

All tests and inspection shall be made at the place of manufacturer unless otherwise specially agreed upon by the manufacturer and the owner. The manufacturer shall provide all reasonable facilities, without charge to satisfy him that the material is being supplied in accordance with the specification.

TECHNICAL SPECIFICATION OF LT (UPTO 1100 V) XLPE INSULATED

1.0 SCOPE:

1.1 The scope of this specification covers the design, manufacture inspection and testing the finished ISI marked LT (1100 volts, 31/2 x25 Sq.mm to 400 Sq.mm stranded, compact aluminum conductor, with XLPE insulated, PVC inner sheathed, galvanized steel strip armored/unarmoured and overall PVC sheathed Black colour cable conforming to IS:7098 /88 with latest amendments and as per specification detailed.

2.0 RATED VOLTAGE:

2.1 The rated voltage of the cable shall be 1100 Volts AC with the highest system voltage of 1100 Volts between phases of the effectively earthed three-phase transmission system.

2.2 The cables shall be capable of operating continuously under the system frequency variation of ± 3 Hz, voltage variation of ± 10% and a combine d frequency – voltage variation of ± 10%.

3.0 APPLICABLE STANDARDS:

i) Unless otherwise stipulated in the specifications, the latest version of the following Standards shall be applicable:

IS 7098 (Part 2)-Cross-linked Polyethylene insulation for Cables.
IS 8130-Conductors for insulated electrical cables and flexible cords.
IS 10810(series)-Methods of tests for cables.
IS 10418-Drums for electric cables.
IS 3975-Specification for mild steel wires, strips and tapes for armouring of cables.
IS 5831-Specification for PVC insulation sheath for electric cables.
IS 10462-Fictitious calculation method for determination of dimensions of protective coverings of cables Part 1 - Elastomeric and thermoplastic insulated cables.

ii) The cables manufactured to any other International Standards like BSS, IEC or equivalent standards not less stringent than Indian Standards are also acceptable. In such cases the Manufacturer shall enclose a copy of the equivalent international standard, in English language.

4.0 CONSTRUCTION:

4.1 **Conductor:** - The cable conductor shall be made from stranded aluminum to form compact sector shaped conductor having resistance within the limits specified in IS:8130/1984 and any amendment thereof. The wires shall be laid up together with a suitable right hand lay. Stranded Class 2 – as per the IS:8 130 / IEC 60228/ BS 6360 standards.

4.2 Insulation: - The insulation shall be cross linked polyethylene applied by extrusion and shall be steam (wet) cured as pre IS:7098(1)1988 and curing in hot water tank/bath is not accepted.:

Sl.No.	Properties	Requirements
1.	Tensile Strength	12.5N/mm², Min.
2.	Elongation to break	200 percent, Min

3.	Aging in air oven: a) Treatment: Temperature: Duration: b) Tensile Strength variation: c) Elongation variation:	 135±3°C 7 days ±25 percent, Max ±25 percent, Max
4.	Hot set: a) Treatment: Temperature: Time under load Mechanical stress b) Elongation under load c) Permanent elongation (set) after cooling	 200±3°C 15 min 20N/cm^2 175 percent, Max 15 percent, Max
5.	Shrinkage: a) Treatment: Temperature Duration b) Shrinkage	 130±3°C 1 hour 4 percent, Max
6.	Water absorption (Gravimetric): a) Treatment: Temperature: Duration b) Water absorbed	 85±2°C 14 days 1 mg/cm^2, Max
7.	Volume Resistivity a) at 27°C b) at 70°C	1x10^{14} ohm-cm, Min 1x10^{13} ohm-cm, Min
8	Thermal Resistivity	350 degrees C cm/W
9	Power factor at maximum conductor Temperature	0.008
10	Dielectric strength	22 kV/mm

4.3.1 The XLPE insulation should be suitable for specified 1.1 KV system voltage.

4.3.2 The manufacturing process shall ensure that insulations shall be free from voids.

4.3.3 The insulation shall withstand mechanical and thermal stresses under steady state and transient operating conditions.

4.3.4 The insulation of the cable shall be high stranded quality, specified in IS:7098 (Part-II/1985). Withstand continuous conductor temperature of 90 deg C, which means higher continuous rated current carrying capacity.

4.3.5 The cables can operate even at conductor temperature of 130 deg C continuously and 250 deg C during a Short Circuit condition

4.4 SHEATH :

The sheath shall be suitable to withstand the site conditions and the desired temperature. It should be of adequate thickness, consistent quality and free from all defects. The PVC sheath shall be extruded as per IS:7098 (Part – I/1988). IEC:60502 Part– I,BS:6622, LSOH to BS:7835.

4.5 ARMOUR :

Armoring shall be applied over the inner sheath with single galvanized steel complying with the requirements of IS:3975/1979. The dimensions of the galvanized strip shall be as specified in table 4 of the IS:7098/Part-I/1988. The armour wire shall be applied as closely as

practicable. The direction of the lay of the armour shall be left hand. The joints in armour wire shall be made by brazing or welding and the surface irregularities shall be removed. A joint in any wire shall be atleast 300mm from the nearest joint in any other armour wire in the complete cable and shall be as per IS:7098 Part 1, IS: 3975.

The cable without armouring shall also be accepted of type detailed in price schedule.

4.6 OUTER SHEATH : Extruded PVC ST2, outer sheath as per IS:5831/1984, IS:7098

Part 1, IEC:60502 Part – 1, BS:6622, LSOH to BS:78 35. shall be applied over armoring with suitable additives to prevent attack by rodents and termites. Outer sheathing shall be designed to offer high degree of mechanical protection and shall also be heat, oils, chemicals, abrasion and weather resistant. Common acids, alkalis, saline solutions etc., shall not have adverse effects on the PVC sheathing material used.

4.7 The cables should be suitable for use in solidly earthed system.

4.8 The power cables shall be manufactured to the highest quality, best workmanship with scientific material management and quality control. The Manufacturer shall furnish the quality plan, giving in detail the quality control procedure / management system.

4.9 The cable shall be suitable for laying in covered trenches and/or buried underground to meet the outdoor application purposes.

4.10 **The parameters of the LT power cables to be supplied shall be as specified below**

Nom. cross sectional area (Sq.mm)	**Nom. Thickness of XLPE Insulation mm main core**	**Armoured**			**Max.DC**	**AC current rating**	
		Nom. Steel Armour size (mm)	**Approx. Overall dia. (mm)**	**Approx, Weight (kg/km)**	**Conductor Resistance at 20°C (ohm/km)**	**In air (amps)**	**In Ground (amps)**
25	0.90	4 X 0.8	22.8	821.0	1.200	95	97
35	0.90	4 X 0.8	24.9	961.0	0.868	117	116
50	1.00	4 X 0.8	28.1	1195.0	0.641	140	134
70	1.10	4 X 0.8	33.0	1569.0	0.443	176	167
95	1.10	4 X 0.8	35.8	1903.0	0.320	221	199
120	1.20	4 X 0.8	39.0	2303.0	0.253	258	227
150	1.40	4 X 0.8	42.9	2720.0	0.206	294	255
185	1.60	4 X 0.8	47.5	3276.0	0.164	339	287
240	1.70	4 X 0.8	52.7	4048.0	0.125	402	333
300	1.80	4 X 0.8	58.4	4872.0	0.100	461	375
400	2.00	4 X 0.8	65.6	6101.0	0.0778	542	426

4.11 The short circuit current of the LT cable to be as specified below

Sq.mm of LT Cable	Short Circuit Current(KA)
25	2.420
35	3.370
50	4.790
70	6.680
95	9.030
120	11.400
150	14.200
185	17.500
240	22.600
300	28.200
400	37.600

5.0 SYSTEM DETAILS:

General Technical particulars

Nominal system voltage (rms) (U)	0.44KV
Highest system voltage (rms) (U_m)	1.1 KV
Number of Phase	3
Frequency	50Hz
Variation in Frequency	+/- 3%
Type of Earthing	Solidly Earthed
Total relay & circuit breaker Operating time	15 – 20 cycles

6.0 CLIMATIC CONDITIONS:

(a)	Maximum ambient air temperature (in shade)	45^0 C
(b)	Maximum ambient air temperature (under sun)	50^0 C
(c)	Maximum daily average ambient air temperature	35^0 C
(d)	Maximum yearly average ambient air temperature	30^0 C
(e)	Maximum humidity	100%
(f)	Altitude above M.S.L.	Up to 1000M
(g)	Average No. of thunder storm days per annum	50
(h)	Average No. of dust storm days per annum	Occasional
(i)	Average No. of rainy days / annum	90
(j)	Average Annual Rain fall	925mm
(k)	Normal tropical monsoon period	4 months
(l)	Maximum wind pressure	150 kg/Sq.M

7.0 DESIGN CRITERIA:

i. The cables that are covered in these specifications are intended for use outdoor , under the climatic conditions and installation conditions described in the technical specification.

ii. For continuous operation of the cables, at specified rating, the maximum conductor temperature shall be limited to the permissible value as per the relevant standard, generally

not exceeding 90°C under normal operation and 250°C under short – circuit conditions.

iii. The cables in service will be subject to daily load cycles, of two peaks during a day; morning peak and evening peak, with around 25% to 50% loading during the nights.

iv. The materials used for outer sheaths shall be resistant to oils, acids and alkalis.

v. The cables shall have the mechanical strength required, during handling and laying.

vi. The cables shall be designed to withstand the thermo-mechanical forces and electrical stresses during normal operation and transient conditions.

vii. The cables shall be designed to have a minimum useful life span of Thirty-five years.

viii. The detailed design drawings shall be submitted along with Purchase order.

8.0 MANUFACTURE PROCESS:

Cross-linking of the insulation materials (pre compounded polyethylene) shall be conforming to IS: 7098 (Part – II) and the proof of purchase of the above insulating material shall be submitted and is to be offered for stage inspection..

9.0 MATERIALS:

9.1 **Conductor:** -The conductor shall be of stranded construction. The material for conductor shall consist of the plain aluminum of H2 or H4 grade as per clause – 3 of IS 8130/ 1984.

9.2 The minimum number of wires shall be 53 for circular compacted 400 sq. mm aluminum conductor as per table – 2 of IS 8130/ 1984.

10.0 CORE IDENTIFICATION:

10.1. The core identification for 31/2 core cables shall be provided, by suitable means, like, byapplication of individual colour or colored stripes, or by numerals or by printing on the cores as per clause 13 of IS: 7098 - Part 2

10.2. For identification of different coloring of XLPE Insulation, or by using colored strips, red,yellow and blue colors respectively shall be used to identify the phase conductors.

11.0 LAYING UP OF CORES:

The cores shall be laid together with a suitable right hand lay. The interstices at the center shall be filled with a non- hygroscopic material.

12.0 INNER SHEATH (COMMON COVERING):

12.1 The laid up cores shall be provided with inner sheath applied either by extrusion. It shall be ensured that the shape is as circular as possible. The inner sheath shall be so applied that it fits closely on the laid up cores and it shall be possible to remove it without damage to the insulation.

12.2 The thickness of the inner sheath (common covering) shall be given as follows**:**

CALCULATED DIAMETER IN MM OVER LAID UP CORES [REF IS 10462 (PART 1)]		**THICKNESS OF INNER SHEATH (Min) mm**
Over	Up to and including	
_	25	0.3
25	35	0.4
35	45	0.5
45	55	0.6
55	-	0.7

12.3 When one or more layers of binder tapes are applied over the laid up cores, the thickness ofsuch tapes shall not be construed as a part of inner sheath.

13.0 ARMOURING:

13.1 Armouring shall be single strip steel wire applied over the inner sheath as closely aspracticable. The direction of the lay of the armour shall be left hand.

13.2 The armour shall consist of galvanized strip steel The dimensions of the galvanized steelwires shall be 4 X 0.8 mm (Nominal)

13.3 The joints in the armour strip shall be made by brazing or welding and the surface irregularities shall be removed. A joint in the wire shall be at least 300-mm from the nearest joint in any other wire in the complete cable.

13.4 Manufacturers shall furnish the calculation / data sheet for the short circuit carrying capability of the Armour.

14.0 UTER SHEATH:

14.1 The outer sheath shall be applied by extrusion. It shall be applied over the armouring shall consist of poly-vinyl chloride (PVC) compound, conforming to the requirements of type ST-2 of IS 5831. Suitable additives shall be added to give anti termite protection.

14.2 The minimum thickness of the PVC outer sheath shall be as per IS:10462 and as detailed.

Calculated diameter under the outer sheath [IS 10462 Part 1] – mm		**Nominal thickness of the outer sheath (ts) - mm**
Over	**Up to and including**	
_	15	1.24
15	25	1.40
25	35	1.56
35	40	1.72
40	45	1.88
45	50	2.04

50	55	2.20
55	60	2.36
60	65	2.52
65	70	2.68
70	75	2.84
75	_	3.0

14.3 **IDENTIFICATION**:

The outer sheath shall have the following information embossed or indented on it; ISI marking, the manufacturer's name or trade mark, the voltage grade, the year of manufacture and the letters "IPDS, Name of Employer" The identification shall repeat every 300/350mm along the length of the cable. Outer sheath of cable shall be black in permanent colour**.**

15.0 INSPECTION AND QUALITY CONTROL:

The Manufacturer shall furnish a complete and detailed quality plan for the manufacturing process of the cable. All raw materials shall conform to relevant applicable standards and tested for compliance to quality and requirement. During the manufacturing process, at all stages, inspections shall be made to check the physical and dimensional parameters, for verification to compliance to the standards. The Manufacturer shall arrange, for inspection by the purchaser, during manufacture with one month advance notice for verifying the various stage inspections as specified in the quality assurance plan enclosed to verify the quality control process of the Manufacturer.

16.0 TYPE TESTS:

Type test certificates from Accredited NABL Testing Laboratories for 1.1 kV XLPE, shall be submitted along with Purchase order. The Type Tests should have been conducted not later than 5 years as on the date of supply.

16.1 Stage wise Inspection: The Manufacturer shall offer the stage wise inspection as detailed in the in the quality assurance plan

16.2 All acceptance tests shall be conducted in the presence of the Employer's representative.

16.3 The supplier shall give 10 days advance notice for inspections, and witnessing of tests by the Employer representative.

16.4 The following type tests shall be conducted on the cable.

Sl. No.	Test	Requirement	Test method Ref Part no of IS: 10810
a)	Tests on conductor		
	i) Tensile test	IS:8130	2
	ii) Wrapping test	IS:8130	3
	iii) Resistance test	IS:8130	4
b)	Tests for armoured wires and strips	Clause 15.2 & IS:3975	36 to 42

c)	Test for thickness of insulation and sheath	Clause 4.3, 14.2 & 16.2	6
d)	Physical tests for insulation: i) Tensile strength and elongation at break ii) Aging in air oven iii) Hot test iv) Shrinkage test v) Water absorption (gravimetric)	Clause 4.2	 7 11 30 12 33
e)	Physical tests for outer sheath i) Tensile strength and elongation at break ii) Aging in air oven iii) Shrinkage test iv) Hot deformation	IS: 5831	 7 11 12 15
f)	High voltage test	Clause 22.7	45
g)	Flammability test	Clause 22.8	53

17.0 ACCEPTANCE TEST:

17.1 The sampling plan for acceptance test shall be as per IS 7098 part -II, Appendix 'A'.

17.2 The following shall constitute the acceptance test.

a. Tensile test for aluminum.
b. Wrapping test for aluminum.
c. Conductor resistance test.
d. Test for thickness of insulation.
(i) Test for thickness of inner and outer sheath.
(ii) Hot-set test for insulation.
(iii) Tensile strength and elongation at break test for insulation and outer sheath.
(iv) High voltage test.
(v) Insulation resistance (volume resistivity) test.

18.0 ROUTINE TEST:

The following shall constitute routine tests:

- Conductor resistance test.
- High voltage test.

19.0 DETAILS OF TESTS:

19.1 Unless otherwise mentioned in this specification, the tests shall be carried out in accordance with appropriate part of IS: 10810.

19.2 High Voltage Test at room temperature:
The cables shall withstand a voltage of 3KV AC (rms) at a frequency of 40 to 60 Hz or an AC voltage of 7.2KV , between conductors and between conductors and ECC (if any) for a

period of 5 minutes each test connection.

19.3 Flammability test: Period of burning after removal of the flame shall not exceed 60 seconds and the unaffected (uncharred) portion from the lower edge of the top clamp shall be at least 50-mm.

Employer reserves the right to select a random sample of 1.1 kV UG cable from the Manufacturer's end which are ready to dispatch and also ongoing cable laying works and the same samples will be sent to any testing laboratory as desired by Employer. If the testing results are found to be not satisfactory Employer reserves the right to reject the entire batch of cable received and insists for replacement of material free of cost. The decision of Employer in this regard is final.

20.0 PACKING:

20.1 The cables, as per specified delivery lengths, shall be securely wound /packed in non-returnable wooden drums, capable of withstanding rough handling during transport by Rail, Road, etc. The packing should withstand storage conditions in open yards. The cable drums shall conform to IS 10418-1982 or equivalent standard. The dimensional drawings of wooden drums shall be furnished with the Purchase order. The drum shall be provided with circumferential lagging of strong wooden planks. The end of the cable shall be sealed with good quality heat shrink sealing caps. The sufficiently required additional sealing caps shall be supplied for use of testing during laying and jointing at site and to seal spare lengths of cable. The packing should be able to withstand the rigorous of transport. The following information in bold letters in English shall be painted on the flanges.

a. Name & Address of the manufacturer, Trade name/Trade mark/Brand
b. ISI Marking
c. Size of cable (Cross section) rated voltage, standard, insulation, cable code, drum No., and year of manufacture.
d. Length of cables (Meters)
e. Direction of rolling
i) Net weight (in Kg)
ii) Gross weight (in Kg)
iii) Owners purchase order reference.

21.0 SEALING OF CABLE ENDS ON DRUMS:

21.1 The cable ends shall be sealed properly so that ingress of moisture is completely prevented. The individual core endings shall be sealed effectively with water resistant compound applied over the core and provided with a heat shrinkable or push-on or Tapex or cold shrinkable type cap of sufficient length with adequate cushion space so that the conductor does not puncture the cap in case of movement of the core during unwinding or laying. Before sealing, the semi conducting layer on the cores may be removed for about 2 mm at each end, to facilitate checking the insulation resistance from one end, without removing the sealing cap at the other end.

21.2 The three cores should have an overall heat shrinkable or push-on or Tapex or cold shrinkable type cap with adequate end clearance, and sufficient cushioning to prevent puncturing of the overall sealing cap due to stretching of the cores. The sealing cap shall have sufficient

mechanical strength and shall prevent ingress of moisture into the cable. The ends of single core cables shall also be sealed on the same lines to prevent entry of moisture.

22.0 CABLE LENGTHS:

The cables shall be supplied in continuous lengths of 500 m or more with 5% tolerance and cable shall on the wooden drums only.

23.0 QUANTITY TOLERANCE:

A +3% tolerance shall be allowed on the ordered quantity including 300-m cable as spare.

24.0 MARKING:

24.1 The packed cable drum shall carry the following information, clearly painted or stenciled.

a. The letters 'IPDS, Name of Employer'
b. Reference to Standard and ISI mark.
c. Manufacturer's Name or trade mark.
d. Type of cable & voltage grade.
e. Number of cores.
f. Nominal cross- sectional area of conductor.
g. Cable code.
h. Length of cable on the drum.
i. Direction of rotation.
j. Gross weight.
k. Country of Manufacture.
l. Year of Manufacture.
m. Purchase order and date.
n. Address of consignee.

25.0 GUARANTEED TECHNICAL PARTICULARS:

The manufacturer, shall furnish the guaranteed technical particulars of the cable offered in the GTP format provided.

26.0 DRAWING & LITERATURE:

(i) The following shall be furnished along with the tender
Cross sectional drawings of the cables, giving dimensional details.
An illustrated literature on the cable, giving technical information, on current ratings, cable constants, short circuit ratings, de rating factors for different types of installation, packing date, weights and other relevant information**.**

27.0 GUARANTEE: The cable manufactured shall be guaranteed for the period of 18 months from the date of receipt at stores.

28.0 The Manufacturer shall furnish a copy of valid BIS licence for ISI marking without which the cable shall not be accepted.

TECHNICAL SPECIFICATION for DT LT METERING CUBICLE

1.0 SCOPE

1.1 This specification covers the design, engineering, manufacture, assembly, inspection, testing at manufacturers works before dispatch, packing, fabrication, painting and supply and delivery at destination of DT LT Metering Cubicle made of metal cabinet incorporating 0.5S accuracy class fully static 3 phase-4 wire CT operated Tri-vector energy meter and MCCB. The metering cubicle shall be suitable for indoor/outdoor application and shall be suitable for measurement of different electrical parameters as per the energy and power demand requirement in an AC balanced/unbalanced system over a power factor range of zero lag to unity to zero lead. The Trivector meters should have communication port to interface for remote meter reading (AMR Compatible).

1.2 It is not the intent to specify completely herein all details of the design and construction of equipments. However, the equipment shall conform in all respects to high standards of engineering, design and workmanship mentioned in clause 4.0 and shall be capable of performing in continuous commercial operation up to the supplier's guarantee in a manner acceptable to the purchaser, who will interpret the meanings of drawings and specification and shall have the power to reject any work or material which in this judgment, is not in accordance therewith. The equipments shall be complete with all components necessary for their effective and trouble free operation.

2.0 SERVICE CONDITIONS-

i)	Location - Anywhere in the state of Mizoram	
ii)	Maximum altitude above mean sea level	- 1000 meters
iii)	Maximum ambient average temp.	- 50 Degree C.
iv)	Maximum temperature in shade	- 45 Degree C.
v)	Minimum air temperature in shade	- 3.5 Degree C.
vi)	Relative humidity (%)	- 10 to 100%
vii)	Maximum annual rainfall (mm)	- 2500 mm
viii)	Maximum wind pressure (kg/sq.mm)	- 150 (kg/sq.mm)
ix)	Seismic level (Horizontal acceleration)	- Zone-V
x)	Isoceraunic level (days/year)	- 60 (days/year)
xi)	Climate — Moderately hot, humid, tropical, conducive to rust and fungus growth.	
xii)	The highest temperature in the cubicle may go up to 85 deg.c	

3.0 STANDARD

Unless otherwise specified elsewhere in this specification, the rating , performance and testing of the metering cubicle and accessories shall conform to the latest revisions from time to time of all relevant standards.

4.0 GENERAL TECHNICAL REQUIREMENTS:

4.1 GENERAL ARRANGEMENT

The metering cubicle shall be installed electrically in between the LT side of Distribution Transformer and outgoing feeder. The general arrangement of the cabinet shall be as per the enclosed drawing and the LT DT metering cubicle shall be provided with the following components suitably mounted:

1. 4 Nos. LT current transformer (CTs) (50/5A for 25kVA, 100/5A for 63kVA, 200/5A for 100kVA, 400/5A for 250kVA 800/5A for 500 & 1000kVA)
2. 1 No. Trivector Energy Meter
3. 1 No. MCCB (40A for 25kVA, 100A for 63kVA, 160A for 100kVA, 400A for 250kVA, 800A for 500kVA and 1600A for 1000kVA)
4. Copper Busbar arrangement for outgoing LT Feeder
5. Adequate space in the bottom for incoming and/or outgoing cables.

4.2 CONSTRUCTIONAL FEATURES OF THE CABINET

The metering cubicle shall consist of two metal enclosed compartments as follows:

l. Metering & Control Compartment
2. Busbar Compartment

4.2.1 Metering & Control Compartment : 4 nos. of C.T's, 1 no. of MCCB and a Trivector Energy Meter shall be mounted in this compartment. All CTs, cables and its interconnection shall be made in the back side of the compartment so that only Display Panel of Meter and front side of MCCB can be accessed from the front door of the metering cubicle. The compartment shall be able to housed different size of cables depending upon the capacity of DT.

4.2.2 Busbar Compartment : 4 nos. of Tinned Copper Busbars (for RYB & N) shall be connected from the MCCB output and fixed inside the busbar chamber. One or more LT outgoing feeder shall be connected from this busbar arrangement. Busbars and its interconnection shall be made in the back side of the compartment. The compartment shall be able to housed different size of cables depending upon the capacity of DT.

4.2.3 General Features:
The metering cubicle shall comprise of rigid welded structural frame enclosed completely by M.S sheets of not less than 2 mm thickness. Structural frame and supporting angles should be of M.S angle of size 50x50x6 mm minimum. All the compartments of the cubicle shall be welded from inside and detachable covers/components should be bolted. The fabrication of the cubicle should be such that there is no ingress of water.

4.2.3.1 All doors and removable covers shall be gasketed all around with neoprene gaskets and the metering cubicle shall meet the requirements of IP-55 protection as per IS-12063, if the air-vents are closed.

4.2.3.2 The DT metering cubicle shall be mounted on concrete plinth of 2 feet height so as to bring the meter window at normal eye level and providing space for cable entering and outgoing to and from the DT Cubicle.

4.2.3.3 There shall be 4 nos lifting hooks of suitable size at the top for lifting the cubicle.

4.2.3.4 The metering cubicle shall be painted by powder coating after proper cleaning. The colour shall be 'Light Gray'. Finished painted appearance of equipment shall present an aesthetically pleasing appearance, free from dents and uneven surfaces. The words 'P&E Department,

Mizoram.' shall be punched/embossed on front side door and name plate showing Meter/MCCB Sl. No., capacity of DT, rating of MCCB, etc..

4.2.3.5 Roof of the metering cubicle shall be slopping 5 to 10 degrees towards front side with canopy.

5.0 EARTHING

5.1 Appropriate numbers of G.I. earthling bolts of at least M 10 size should be provided on sides so that the inside and outside earthling can be done. It should be firmly welded to the sides.

5.2 All non-current carrying metal work of the switchboard and metal components of the cubicle shall be efficiently earthed.

5.3 Hinged doors shall be earthed through flexible earthing braid.

6.0 Energy Meter :

6.1 GENERAL TECHNICAL REQUIREMENT

6.1.l. AMR Compatible Static, 3 Ph, 4 Wire Tri-Vector Energy Meter for DTR.

6.1.2. FREQUENCY 50 Hz +/-5%

6.1.3. ACCURACY CLASS 0.5s

6.1.4. SECONDARY VOLTAGE 3x415V for DTR meters (LT)

6.1.5. BASIC CURRENT -/5 Amps.

6.1.6. MAXIMUM CONTINUOUS CURRENT 2.0 Ib Starting and Short time current shall be as per IS—l4697

6.1.7. POWER CONSUMPTION : The active and apparent power consumption, in each voltage circuit, at reference voltage, reference temperature and reference frequency shall not exceed l. 5 W and 8 VA. The apparent power taken by each current circuit, at basic current, reference frequency and reference temperature shall not exceed 1.0 VA

6.1.8 DESIGN : Meter shall be designed with application specific integrated circuit (asic) or micro controller, shall have no moving part; electronic components shall be assembled on printed circuit board using surface mounting technology; factory calibration using high accuracy software based test bench Assembly of electronic components shall be as per ANSI/IPC-A-610 standard

6.1.9 PERFORMANCE UNDER INFLUENCE QUANTITIES : The meters performance under influence quantities shall be governed by IS 14697-1999 (reaffirmed 2004). The meter should be designed and protected such that all external effects and influence shall not change its performance & shall work satisfactorily within guaranteed accuracy limits, as specified in IS l4697(latest version).

6.2.0 QUALITY : Overall the quality of the meter should be good and the service life of the meter shall be more than the guarantee period. The material, components used for manufacturing the meter shall be of premium quality. The LCD display shall not fade with time and the display

annunciators should be visible. Functionality of the meter shall not be affected by the harsh environmental conditions.

6.2.1 PERFORMANCE GUARANTEE : The meter shall have a design to operate satisfactory for 10 years under normal electrical condition and guaranteed life of 60 months from the date of commissioning against manufacturing and design defects. The meters found defective with in guaranteed period should be replaced/repaired by contractor free of cost within one month of intimation.

6.2.2 CONNECTION DIAGRAM : The connection diagram of the meter shall be clearly shown on inside portion of the terminal cover. The meter terminals shall also be marked and this marking should appear in the above diagram.

6.2.3 COMMUNICATION CAPABILITY: The meter shall be provided with two ports for communication of the measured/collected data as per the guideline document for DLMS/COSEM energy meters:

a) LOCAL COMMUNICATION PORT : The energy meter shall have a galvanically isolated optical communication port located in front of the meter and complying with the hardware specifications detailed in IEC-62056-21 for data transfer to or from a hand held DLMS compliant Data Collection Device (Common Meter Reading Instrument, Hand Held Units etc.) with proper security and without error.

b) REMOTE COMMUNICATION PORT : Meter shall have an additional communication port (RS 232/485) for periodic data transfer by remote access through suitable modem (GPRS/GSM/EDGE/CDMA/PSTN/LPR). Meter shall operate on open DLMS protocol and will be individually addressable. Meters with similar kind of RS 485 ports shall be possible to hook up in multi-drop arrangement for exporting data to the remote end server through suitable communication medium. Both ports shall support the default and minimum baud rate of 9600 bps.

6.2.4 DATA COLLECTION DEVICE : To enable local reading of meters data a DLMS compliant data collection device (HHU, CMRI, Laptop etc;) shall be used. It shall be compatible to the DLMS compliant energy meters that are to be procured /supplied on the basis of this specification. This device shall be supplied by the meter manufacturer along with the meter free of cost (one unit per 50 meters).

6.2.5 QUANTITIES TO BE MEASURED AND DISPLAYED : The meter shall be capable of measuring and displaying the following electrical quantities within specified accuracy limits for poly-phase balanced or unbalanced loads:

a) Instantaneous Parameters such as phase and line voltages, currents, power factors, overall kVA, kW, kVAr, power factor, frequency etc.

b) Block Load Profile Parameters such as kVAh, kWh, kVArh (lag, lead), Maximum Demand (MD) in kW & kVA, power factor, phase and line voltages, currents etc.

6.2.6. DISPLAY OF MEASURED VALUE : The measured value(s) shall be displayed on seven segments, seven digit (with i indication), parameter identifier, backlit Liquid Crystal Display (LCD) display unit/register, having minimum character height of l0 mm, wide viewing angle. LCD shall be suitable for temperature withstand of 70 degree centigrade.

The data should be stored in non-volatile memory. The non-volatile memory should retain data for a period of not less than 10 years under unpowered condition. Battery back-up memory will not be considered as NVM.

6.2.7. REAL TIME INTERNAL CLOCK (RTC) : RTC shall be pre-programmed for 30 Years day/date without any necessity for correction. The maximum drift shall not exceed +/- 180 Seconds per year. The uncertainty of setting initial time shall not exceed 130 Seconds with respect to Indian standard time (Ref. NPL New Delhi).

6.2.8 OTHER SALIENT FEATURES OF METERS

a) It should be possible to check the healthiness of phase voltages by displaying all the voltages on the meter display.

b) The meter must be readable in power off condition. For that a battery back-up of suitable capacity shall be provided. Push button for the normal display shall also be used for battery back-up display in power off condition for the manual mode reading of the auto display parameters. It must be possible to power up the battery by means of an external source or by the HHU itself for reading the meter in power off condition by the HHU. In case of an external source an inductive coupling arrangement shall be provided so that it should not be possible to damage the circuit of the meter by applying excess voltage directly in the meter. It must also be possible to trigger the battery to power up the meter in case of power failure from the remote server for reading the meter from remote location through the communication ports.

c) The meter should work accurately irrespective of phase sequence of the mains Supply

d) The meter should remain powered up and functional even when either of the two phases or one phase along with neutral is available to meter.

e) The meter should continue to record accurately as per prevailing electrical conditions even if the neutral of the potential supply gets disconnected.

7.0 Instrument Transformers:

7.1.1 The current transformers (CTs) shall conform to the requirement stipulated in relevant standards.

7.1.2 The CTs shall have polarity marks indelibly marked on each transformer and at the associated terminal block. CTs shall be of the single phase type Core lamination shall be of high grade steel or other equivalent alloy.

7.1.3 Name plate showing particulars and connection diagram shall be provided. They shall be made of non-corrosive material, shall be indelibly punched/painted and shall be firmly fixed on the body of instrument transformer.

8.0 MCCB : The following makes of MCCB shall only be accepted : Siemens/L&T/ABB/GE Power/ Schneider/Havells/C&S. MCCB shall conform to relevant IS Specifications. Contractor have to indicate makes and types of MCCB and submit complete type test report as per IS 13947/1993.

10.0 Tests & Test Certificate: All tests shall be carried out as Acceptance, Routine and Type Tests for CT, MCCB and Energy Meter as per relevant standard mentioned in the IS.

11.0 DRAWING:

The contractor will have to submit the drawings of DT Cubicle along with detail technical specifications of its components and get it approved from Nodal Officer before bulk manufacturing and supply.

12.0 Inspection:

The inspection may be carried out by the purchaser at any stage of manufacture. The contractor shall grant free access to the purchaser's representative at a reasonable time when the work is in progress. Inspection and acceptance of any equipment under this specification by the purchaser shall not relieve the contractor of his obligation of furnishing equipment in accordance with the specification and shall not prevent subsequent rejection if the equipment is found to be defective.

13.0 Packing & Forwarding:

The equipments shall be packed in crates suitable for vertical/horizontal transport, as the case may be, and suitable to withstand handling during transport and outdoor storage during transit.

The contractor shall be responsible for any damage to the equipment during transit due to improper and inadequate packing. The easily damageable material shall be carefully packed and marked with appropriate caution symbols. Wherever necessary, proper arrangement for lifting, such as lifting hooks etc. shall be provided.

Any material found short inside the packing cases shall be supplied by contractor without any extra cost.

13.1 Each consignment shall be accompanied by a detailed packing list containing the following information.

a) Name of the consignee
b) Details of consignment
c) Destination
d) Sign showing upper/lower side of the crate
e) Handling and unpacking instructions
f) Bill of material indicating contents of each package.

TECHNICAL SPECIFICATION OF GUY STRAIN INSULATORS

1. SCOPE

This Specification covers porcelain guy strain insulators for use in rural electrification system.

2. APPLICABLE STANDARDS

Unless otherwise modified in this specification, the insulators shall comply with IS: 5300-1969 or the latest version thereof.

3. GENERAL REQUIREMENTS

3.1 The porcelain insulator shall be sound, free from defects, thoroughly vitrified and smoothly glazed.

3.2 The design of the insulator shall be such that the stresses due to expansion and contraction in any part of the insulator shall not lead to its deterioration.

3.3 The glaze, unless otherwise specified, shall be brown in colour. The glaze shall cover the entire porcelain surface parts except those areas that serve as supports during firing.

4. TYPE OF INSULATORS

4.1 The standard guy strain insulators shall be of designations 'A' and 'C' as per IS:5300.

4.2 The recommended type of guy strain insulators for use on guy wires of overhead lines of different voltage levels are as follows :

Power Line Voltage	Designation of Insulators
415/240V	A
11000V	C
33000V	C (2 Insulators to be used in series)

5. DIMENSIONS

The dimensions of guy strain insulators shall be in accordance with Figs. 1 and 2.

6. BASIC INSULATION LEVELS

The test voltage of the insulators shall be as under :

Designation of Insulator	Dry one minute power Frequency withstand Voltage kV (rms)	Wet one minute power Frequency withstand voltage kV (rms)
A	18	8
C	27	13

7. MECHANICAL STRENGTH

The insulators shall be suitable for the minimum failing loads specified as under:

Designation of Insulator	Minimum failing load (KN)
A	44
	88

8. TESTS

The insulators shall comply with the following routine, type and acceptance tests as per IS:5300.

8.1 Routine Test

Visual examination

8.2 Type Tests

a) Visual examination
b) Verification of dimensions
c) Temperature cycle test
d) Dry one-minute power-frequency voltage withstand test
e) Wet one-minute power frequency voltage withstand test
f) Mechanical strength test
g) Porosity test

8.3 Acceptance Tests: (to be conducted in the following order)

a) Verification of dimensions
b) Temperature cycle test
c) Mechanical strength test
d) Porosity test

9. MARKING

9.1 Each insulator shall be legibly and indelibly marked to show the following:

a) Name or trade mark of the manufacturer
b) Year of manufacture
c) ISI certification mark, if any.

9.2 Marking on porcelain shall be applied before firing.

10. PACKING

All insulators shall be packed in wooden crates suitable for easy but rough handling and acceptable for rail transport. Wooden separators shall be fixed between the insulators to keep individual insulators in position without movement within the crate.

TECHNICAL SPECIFICATION OF HELICALLY FORMED FITTINGS FOR 11 KV AND LT LINES

1. SCOPE

This Standard specifies the requirements and tests for helically formed fittings for use on 11 KV and LT overhead lines.

The following types of fittings are covered:-

a) Conductor dead end fittings
b) Distribution ties, side ties and double ties
c) Conductor splices
d) Guy grip dead-ends
e) Tap connectors
f) Service grip dead-ends
g) Lashing rods

2. GENERAL REQUIREMENTS

2.1 Aluminium alloy, aluminium-clad steel and galvanised steel wires having required mechanical strength, corrosion resistance and formability, depending on the type of application shall be employed in the manufacture of the fittings. The material of the formed fittings shall be compatible with the conductors with which it is used.

2.2 In case of formed wires, no joints shall be permitted except those in the base rod or wire before final drawing.

2.3 Each formed set shall be marked with indelible and distinct colour to indicate starting/cross-over point of application to facilitate its application on the conductor.

2.4 The ends of the individual wires of the formed fittings shall be suitably debarred to provide a smooth finish so as to avoid any damage to the conductor due to sharp edges.

2.5 Suitable grit shall be applied to the gripping section of the formed fitting (except lashing rods) in order to enhance its gripping strength.

3. PROPERTIES OF WIRES

3.1 Materials of the wires used in the manufacture of the fittings covered by this specification shall have the mechanical and electrical properties as specified in Tables 1,2 and 3. Materials used for chloroprene pad shall have the properties specified in Table 4.

Table 1

Aluminium Alloy Wires

Test	Requirements
1. Visual	a) No scratches
	b) No pealing off
	c) No speed crack
	d) No cut mark
2. Dimensions after forming	a) Diameter Tolerance (+) .000 mm (-) .025 mm
	b) Flattening (+) .000 mm (-) .076 mm
3. Tensile strength of formed wires	35 Kg/mm^2
4. Elongation of finished wire	Min. 2% in a gauge length of 50 mm
5. Conductivity of finished wire	Min. 39% as per IACS
6. Wrap test Wire diameter mm Upto 3.07 From 3.08 to 3.45 From 3.46 to 3.71 From 3.72 to 4.24 From 4.25 and above	Min. number of twists on a mandrel of its own dia without fracture at a rate of 15 turn per minute 18 16 14 12 10

Table 2

Aluminium Clad Steel Wires

S.No.	Test	Requirements
1.	Visual	Free from splints, scale, inequalities, flaws and other irregularities :
2.	Dimentional	Roundness to (±) 0.013mm
3.	Tensile strength	As per table 2a below
4.	Weight of coating	As per table 2b below
5.	Wrap test (on a mandrel 2 times the dia of the sample and at the rate of 15 turns/minute)	After close helix, the sample should not fracture
6.	Adherence of coating (in a close helix not exceeding 15 turns/minute) around a cylindrical mandrel having a	No cracking or flacking to such an extent that the aluminium coating can be removed by rabbing with the bare fingers

	diameter prescribed in table 2c.	

Table 2a

Wire diameter (mm)	**Ultimate tensile strength minimum) MPa**	**Ultimate elongation (Min.) percent in 254 mm**
1.270 to 2.283 including	1280	3.0
2.286 to 3.045 including	1240	3.5
3.048 to 3.515 including	1210	4.0
3.518 to 3.782 including	1170	4.0
3.785 to 4.826 including	1140	4.0

Table 2b

Wire diameter (mm)	**Min. weight of aluminium coating on uncoated wire surface (gms/m^2)**
1.270 to 1.521 including	70
1.524 to 1.902 including	76
1.905 to 2.283 including	79
2.286 to 2.639 including	85
2.642 to 3.045 including	92
3.048 to 3.553 including	98
3.556 to 4.569 including	104
4.572 to 4.826 including	116

Table 2c

Wire diameter	**Min. ratio of mandrel diameter to wire diameter**
1.270 to 2.283 including	3
2.286 to 3.553 including	4
3.556 to 4.826 including	5

Table 3
Zinc coated steel wire

	Test	**Requirements**

1.	Visual	Free from splints, scale, inequalities and other irregularities :
2.	Dimentional	Roundness to (±) 0.013mm
3.	Tensile strength of finished wire	As per table 3a below
4.	Weight of zinc coating	As per table 3b below
5.	Wrap test (on a mandrel 2 times the dia of the sample and at the rate of 15 turns/minute)	After close helix of minimum 8 turns, the sample should not fracture.
6.	Adherence of coating (in a close helix not exceeding 15 turns/minute) around a cylindrical mandrel having a diameter prescribed in table 3c.	No cracking or flacking to such an extent that zinc coating can be removed by rabbing with the bare fingers

Table 3 a

Wire diameter mm	**Ulitimate tensile strength (Minimum) MPa**	**Elongation in 200 mm gauge length minimum (%) mm**
1.270 to 2.283 including	1450	3.0
2.286 to 3.045 including	1410	3.5
3.048 to 3.053 including	1410	4.0
3.556 to 4.022 including	1380	4.0

Table 3b

Wire diameter (mm)	**Minimum weight of zinc coating on uncoated wire surface (gms/m^2)**
1.270 to 1.521 including	183
1.524 to 1.902 including	198
1.905 to 2.283 including	214
2.286 to 2.639 including	229
2.642 to 3.045 including	244
3.048 to 3.553 including	259
3.556 to 4.69 including	274
4.572 to 4.822 including	305

Table 3c

Wire diameter (mm)	**Ratio of mandrel diameter to wire diameter**

1.270 to 2.283 including	3
2.286 to 3.553 including	4
3.556 to 4.822 including	5

Table 4
Properties for Chloroprene pad
Chloroprene cushion shall have following properties :

1a)	Tensile Strength	Minimum 100Kg/cm^2
b)	Tensile strenght (after ageing)	Loss of maximum 25% of the test value obtained in 1(a)
2a)	Elongation	250% minimum
b)	Elongation (after ageing)	Loss of maximum 25% of the test value obtained in 2(a)
3a)	Shore hardness 'A'	65 (±)5
b)	Shore hardness (after ageing)	(±)15% of test values obtained in 3(a)

Note : Ageing should be carried out for 70 hours at 100^{o}C.

4. REQUIREMENTS OF FORMED FITTINGS FOR VARIOUS APPLICATIONS

4.1 Conductor Dead-end fittings

4.1.1 Formed conductor dead-end fitting for 11 KV lines consists of the following parts for use with disc insulators of clevis and tongue type:

a) Cross arms strap for attaching the fittings to the pole on one side and the disc insulator on the other. These fittings shall conform to the REC Specifications of 11 KV Porcelain Insulators and Fitting.

b) Aluminium alloy die cast thimble clevis for attaching the fitting to the tongue of disc insulator on one end and for accomodating loop of the helically formed fitting at the other end in its smooth internal contour. The thimble clevis is attached to the insulator through a steel cotter pin used with a non-ferrous split pin of brass or stainless steel. The thimble clevis shall have clevis dimensions as per IS : 2486 (Part II) - 1989 and shall have the minimum failing load strength of 3000 kg.

c) Helically formed fitting acting as the dead-end grip.

4.1.2 The die-cast aluminium alloy thimble clevis shall be manufactured with alloy A6 Designation of IS : 617 - 1975.

4.1.3 Nuts and bolts used shall be of galvanised steel conforming to IS : 1364 - 1967 and cotter pins conforming to IS : 2004 -1978. Spring washers used shall be electro-galvanised.

4.1.4 The fitting for LT lines shall comprise of the helically formed fitting to suit the LT shackle insulator as per REC Specification of Porcelain Insulators and Insulator Fittings For 415/240V Overhead Power Lines

4.1.5 The fittings shall be made to suit the following conductor sizes for 11 KV/LT Lines conforming to REC Specification 1/1971(R-1993) and each fitting shall have a clear identification mark on PVC/metallic/plastic tag, indicating size of the conductor and voltage. The following colour code shall be used for the tag as also for the starting/cross-over marks for quick identification:

20 mm^2 ACSR(Squirrel)	Blue
30 mm^2 ACSR(Weasel)	Red
50 mm^2 ACSR (Rabbit)	Yellow
50 mm^2 ACSR (Rabbit)	Brown
50 mm^2 AAC (Ant)	Grey

4.2 Distribution ties side ties and double ties

4.2.1 Helically formed ties are used to hold the conductor to pin insulators or shackle insulators.]

4.2.2 Chloroprene pad shall be provided with the formed ties for use on 11 KV lines to avoid abrasion of the conductor

4.2.3 The conductor sizes and voltage class shall be clearly marked on each fitting and the fittings shall also be identified by color code as per clause 4.1.5.

4.2.4 To ensure proper fitting of 11 KV pin insulator ties, the purchaser shall furnish full-dimensions of the insulator top particularly the crown diameter, neck diameter etc. See REC specification 11KV porcelain insulators and fittings.

4.3 Conductor Splices

4.3.1 Conductor splices for ACSR conductors shall consist of (i) galvanised steel formed splice for steel core (ii) aluminium alloy formed filler rod (iii) aluminium alloy formed splice for the aluminium strands of the conductor. For AAC conductor, splice is formed with aluminium alloy only.

4.3.2 Repair Splice: Repair splices are non-tension splices and are used where some of the outer strands of the conductor are damaged.

4.4 Guy Grip Dead-End

4.4.1 Guy grip dead ends have one leg shorter than the other and are suitable for gripping the guy wire. These grips are applied on one side into the thimble eye of the stay rod and on the other side to the guy wire. These can also be used directly with guy insulators.

4.4.2 The fittings shall be made of two sizes to suit stay wires of 7/3.15mm(7/10SWG) and 7/2.5 mm(7/12SWG) having UTS values 3625 kg and 2300 kg respectively.

4.4.3 The fittings shall be clearly identified on a PVC/mettalic/plastic tag for the size of stay wire with which these are to be used and, in addition, the following colour codes for the tag as well as the corss-over marks shall be adopted for proper identification:

Guy grip for 7/3.15 mm stay wire - Green

Guy grip for 7/2.5 mm stay wire - Black

4.4.4 The guy grip shall be supplied complete with thimble to suit the fitting. Thimble shall be made of hot-dipped galvanized steel.

Note: The guy grips to be used with guy insulators shall take into account the standard sizes of insulators as per REC specification and the type and size of the guy insulator shall be clearly specified by the purchaser.

4.5 Tap Connectors: Tap connectors consist of helically formed aluminium alloy wires for non-tension tapping of conductors and cables from the main line. The sizes of conductors/cables for which these tap connectors are to be used have to be clearly specified by the purchaser.

4.6 Service Grip Dead End: Service grip dead-ends are used with metallic knob to hold one or more service bearer wires.

4.7 Lashing Rods: Lashing rods are helically formed wires to secure the bearer wire to the service cable. The number of lashing rods will depend on the length of service.

5. DIMENSIONAL REQUIREMENTS OF THE FINISHED FORMED FITTINGS

5.1 The lay of the helix shall be right hand.

5.2 The diameter and number of formed rods used per set of fittings to be used on various sizes of conductors shall be as per the approved drawings.

1.3 Tolerances of formed fittings: The various requirements of the helically formed fitting shall be within the following tolerances:

	Item	**Tolerances**
a)	Pitch length	+ 0.6 mm (-)0.12 mm
b)	Internal diameter	+ 1% (-) 3%
c)	Length of individual rod	(±) 1%
d)	Difference in length	(±) 1% between the longest and the shortest rod in an individual set

6. TESTS

6.1 **Type Tests:** The following tests shall constitute the type tests on the finished fittings:

Test	**Applicable to**
Visual examination	All fittings

Verification of dimension	All fittings
Tensile strength test	All fittings
Electrical resistance test	All aluminium alloy fittings
Wrapping test	All fittings
Slip strength test	Conductor dead-end, guy grip and splices
Resilence test	Conductor dead-end, guy grip and conductor splices
Unbalanced holding Strength Test	Ties only
Fatigue test	Conductor dead-end, ties and splices
Galvanising test	Hardwares and fittings using GI wire
Pull-off strength test	Ties only
Electrical & Mechanical Test	Tap Connectors

Acceptance Test: The following shall constitute the acceptance test:

1. Visual examination
2. Verification of dimension
3. Tensile Strength test
4. Electrical resistance test
5. Wrapping test
6. Slip Strength test
7. Resilience test
8. Unbalanced load
9. Galvanisation test
10. Pull-off strength
11. Electrical & Mechanical tests on tap connectors
12. The tests for other requirements as per Tables 1,2,3 & 4 on the individual wires used in making the helically formed fittings and chloroprene pad (where used).

6.2 **Routine Tests:** The following shall constitute the routine tests:

a) Visual examination
b) Verification of dimensions

7. TEST PROCEDURE

7.1 Visual Examination: All fittings and individual wires shall be checked visualy for good workmanship, smooth finish and other requirements indicated in Table 1, 2 and 3.

7.2 Verification of dimensions: The dimensins shall be checked as specified in the tables 1, 2, 3 and clause 5.

7.3 Tensile Strength Test:

7.3.1 Individual wire of the helically formed wires shall be straightened by light hammering and tested for tensile strength and elongation in accordance within the IS:398(Part II)-1976. The

tensile strength and the elongation of the formed wires shall not be less than the values specified in tables 1, 2 and 3.

7.3.2 For thimbles and hardwares other than formed fittings:

The dead-end clevis thimble and straps shall be tested for tensile strength in accordance with the requirements of mechanical failing load as per IS:2486(Part I)-1993.

7.4 Electrical Resistance Test: This test shall be done on straightened aluminium alloy formed wires only. The conductivity of the wires should not be less than 39% IACS.

7.5 Wrapping Test: The individual wires of the formed fittings shall be tested as specified in tables 1, 2 and 3. The wires should not break or show fracture when tested as above.

7.6 Slip Strength Test: For the conductor dead-end and guy grip dead-end, the test shall be made in accordance with IS:2486(Part I)-1993 and the value of slip/breaking strength shall not be less than 85% of the breaking strength of the conductor for conductor dead-end fitting and 100% for guy wires dead end fittings. In case of tension splices, the test shall be carried out as per IS:2121. No slippage or damage to the fitting shall occur at a value less than 100% of breaking load of the conductor. This test should be repeated after the resilence test.

7.7 Reslience Test: A set of helically formed fitting is wrapped and un-wrapped on a piece of conductor 3 times successively. The helical fitting should not lose its resilence even after three applications and should be able to pass the slip strength test requirements mentioned in 7.6 thereafter.

7.8 Unbalanced Holding test: Unbalanced holding strength is the ability of the formed ties to maintain a constant and uniform grip on the conductor when intermittent and repeated unbalanced loads impose a tension imbalance in the span. These imbalances occur due to wind induced motion, impacts, ice conditions and more so when the conductor is broken.

The test is intended to simulate the broken wire condition. A span of minimum 20 meters tensioned for 40% of UTS of the conductor shall be erected in the laboratory and a pin insulator alongwith the insulator tie under test shall be applied in the middle of span. The conductor used for this purpose shall be of the specific size with which the insulator tie is to be used. The test set up shall be such that it should be possible to apply a pull on one of the two dead ends of the conductor. For the purpose of this test, a steel replica of the insulator will be used. During the test, tension on one side of the pin insulator shall be suddenly released and effect observed. No slippage or damage to the fitting shall occur. After releasing tension from the other end, the fitting should retain the original form. This test will not only check the holding strength of the fitting but will also prove the resilence of the fitting in the event of broken wire.

The test shall be repeated. After releasing the conductor tension on one side, pulling force shall be slowly applied on the other dead-end to pull the conductor till slippage/damage occurs. This force shall not be less than 320 kg.

7.9 **Fatigue Test**: The fittings should be subjected to fatigue test alongwith the conductor by imparting 10 million cycles of peak to peak amplitude at a frequency above 30 cycles for minimum span length of 20 meters, at 40% of UTS of conductor. The amplitude of the vibrations at the antinodal points should be atleast 50% of the diameter of the conductor. The test should be carried out for 10 million cycles as continuously as possible after which the conductor fitting and insulator should be examined. There should be no damage to the conductor or the insulator where the fitting is attached. The fitting should also be able to withstand the test without any damage.

7.10 Galvanising Test: Galvanising test should be carried out in accordance with IS:4826-1979 for uniformity and IS:6745-1972 for weight of zinc coating and the fittings will meet the requirements of Table 3.

7.11 Pull-Off Strength Test: This test is intended to simulate the conductor pull-off conditions created by various factors including elevation difference of the supporting structures on the two sides of the tie. A span of minimum 20 metres tensioned for 40% of UTS of the conductor shall be erected in the laboratory with a conductor of the specified size with which the fitting is intended to be used. A steel replica of pin insulator alongwith the insulator tie under test shall be applied in the middle of span so that a suitable pull-off force can be applied on the pin by means of a machine. The pull-off strength of the tie shall not be less than 200 Kg. for all the three sizes of ACSR.

7.12 Electrical &Mechanical Test on Tap Connectors: The tap Connectorsshall conformto all the electrical and mechanical properties as per IS:5561.

8. PACKING AND MARKING

8.1 All helically formed items covered under this specification shall be carefully handled to prevent distortion and damage. These items shall be packed and stored in suitable cartons.

8.2 Different colour codes shall be adopted for different conductor sizes and catalogue number and range of outside diameter of the conductor shall be indicated on the packing.

8.3 Clevis thimbles and other hardwares for conductor dead-ends shall be packed in wooden crates with all necessary markings.

8.4 The packings of the fittings should carry the following informations.

a) Purchaser’s name

b) Manufacturer’s name and trade mark

c) Size of conductor, line voltage (when required) and numbers

d) Batch number, date, month and year of manufacture

e) Any other marking agreed to between manufacturer and user.

TECHNICAL SPECIFICATION OF 11 KV AND 33 kV AIR BREAK SWITCHES

1) SCOPE

This specification provides for manufacture, testing at works and supply of 11KV & 33KV AB switches. The 11KV and 33 KV AB switches shall conform to IS: 9920 (Part-I to IV)

2) AB SWITCHES

The 11KV & 33KV Air Break Switches are required with two poles in each phase. The AB Switches shall be supplied complete with phase coupling shaft, operating rod and operating handle. It shall be manually gang operated and vertically break and horizontal mounting type.

The equipment offered by the bidder shall be designed for a normal current rating of 200 Amps and for continuous service at the system voltage specified as under:

i) 11 KV AB Switch : 11KV + 10% continuous 50 C/s solidly grounded earthed neutral system

ii) 33KV AB Switch : 33 kV + 10% -do-

The length of break in the air shall not be less than 400 mm for 11KV AB Switches and 500 mm for 33 KV AB Switches.

The 11KV & 33KV AB Switches are required with post insulators. The AB switches should be suitable for mounting on the structure. The mounting structure will be arranged by the bidder. However, the AB Switches shall be supplied with base channel for mounting on the structure which will be provided by the owner. The phase to phase spacing shall be 750mm in case of 11KV AB Switches & 1200mm in case of 33KV AB Switches.

3) POST INSULATORS

The complete set of three phase AB Switches shall have stacks of post insulators.

11KV AB Switches : 3 No. 11KV Post Insulator per stack

33KV AB Switches : 3 No. 33KV Post Insulator per stack

The post insulators should conform to the latest applicable Indian standards IS: 2544 Specification for Porcelain Post insulator of compact solid core or long rod insulators are also acceptable. Creepage distance should be adequate for highly polluted outdoor atmosphere in open atmosphere. The porcelain used for manufacture of AB Switches should be homogeneous free from flaws or imperfections that might affect the mechanical dielectric quality. They shall be thoroughly vitrified, tough and impervious to moisture. The glazing of the porcelain shall be of uniform brown in colour, free from blisters, burns and other similar defects. Insulators of the same rating and type shall be interchangeable.

The porcelain and metal parts shall be assembled in such a manner that any thermal expansion differential between the metal and porcelain parts through the range of temperature variation shall not loose the parts or create undue internal stresses which may affect the electrical or mechanical strength. Cap and base of the insulators shall be interchangeable with each other.

The cap and base shall be properly cemented with insulators to give perfect grip. Excess cementing must be avoided.

Each 11KV & 33KV Post Insulators should have technical particulars as detailed below:

		11 kV	**33 kV**
i	Nominal system voltage kV (rms)	11	33
ii	Highest system voltage kV (rms.)	12	36
iii	Dry Power Frequency one kV minute withstand voltage (rms) in KV	35	75
iv	Wet Power frequency one minute withstand voltage (rms) in KV	35	75
v	Power Frequency puncture kV (rms) voltage	1.3 times the actual dry flashover voltage	
vi	Impulse withstand voltage kV (Peak)	75	170
vii	Visible discharge voltage kV (rms)	9	27
viii	Creepage distance in mm (minimum)	320	580

The rated insulation level of the AB Switches shall not be lower than the values specified below:-

Sl. No	Standard declared voltage KV/RMS	Rated Voltage of the AB Switches	Standard impulse with stand voltage (positive & negative polarity kV (Peak)		One Minute power frequency withstand voltage kV (rms)	
			Across the Isolating distance	To earth & between poles	Across the Isolating distance	To earth & between poles
i	11KV	12KV	85KV	75KV	32KV	28KV
ii	33KV	36KV	195KV	170KV	80KV	70KV

4) TEMPERATURE RISE

The maximum temperature attained by any part of the equipment when in service at site under continuous full load conditions and exposed to the direct rays of Sun shall not exceed 45 degree above ambient.

5) MAIN CONTACTS

AB Switches shall have heavy duty self-aligning type contacts made of hard drawn electrolytic copper/brass. The various parts should be accordingly finished to ensure interchangeability of similar components. The moving contacts of the switch shall be made from hard drawn electrolytic copper brass. This contact shall have dimensions as per drawing attached so as to withstand safely the highest short-circuit currents and over voltage that may be encountered during service. The surface of the contact shall be rounded smooth and silver-plated. In nut shell the male and female contact assemblies shall ensure.

1. Electro-dynamic withstands ability during short circuits without any risk of repulsion of contacts.
2. Thermal withstands ability during short circuits.
3. Constant contact pressure even when the lower parts of the insulator stacks are subjected to tensile stresses due to linear expansion of connected bus bar of flexible conductors either because of temperature variations or strong winds.
4. Wiping action during closing and opening.
5. Fault alignment assuring closing of the switch without minute adjustments.

6) CONNECTORS

The connectors shall be made of hard drawn electrolytic copper or brass suitable for Raccoon/Dog ACSR conductor for both 11KV & 33KV AB Switches. The connector should be 4 -bolt type.

7) OPERATING MECHANISM

All AB Switches shall have separate independent manual operation. They should be provided with ON/OFF indicators and padlocking arrangements for locking in both the end positions to avoid unintentional operation. The isolating distances should also be visible for the AB Switches.

The AB Switch will be supplied with following accessories:

Sl No	Item	Size of 11KV AB Switch	Size of 33KV AB Switch
i	Operating Rod (GI dia) ISI mark	Length 5.50 meter dia: 25MM	Length 5.50 mtrs dia: 40MM
ii	Phase coupling square rod (GI) ISI mark	Length 1800 mm Size 25x25 mm	Length 2700 mm Size 40 x 40 mm
iii	Hot dip galvanized Operating handle (GI)	1 No.	1 No.

The AB Switches shall be capable to resist any chance of opening out when in closed position. The operating Mechanism should be of robust constructions, easy to operate by single person and to be located conveniently for local operation in the switchyard. The GI pipe shall conform to('B' class or Medium class Blue strip) ISS: 1239-68 and ISI marked by embossing. The vertical down rod should be provided with adequate joint in the mid section to avoid bending or buckling. Additional leverage should be provided to maintain mechanical force with minimum efforts.

All iron parts should be hot dip galvanized as per IS 4759-1979 and zinc coating shall not be less than 610 gm/sq. meter. All brass parts should be silver plated and all nuts and bolts should be hot dip galvanized.

8) ARCING HORNS

It shall be simple and replaceable type. They should be capable of interrupting line-charging current. They shall be of first make and after break type.

9) BUSH

The design and construction of bush shall embody all the features required to withstand climatic conditions specified so as to ensure dependable and effective operations specified

even after long periods of inaction of these Air Break Switches. They shall be made from highly polished Bronze metal with adequate provision for periodic lubrication through nipples and vent.

10) DESIGN, MATERIALS AND WORKMANSHIP

All materials used in the construction of the equipment shall be of the appropriate class, well finished and of approved design and material. All similar parts should be accurately finished and interchangeable.

Special attention shall be paid to tropical treatment to all the equipment, as it will be subjected during service to extremely severe exposure to atmospheric moisture and to long period of high ambient temperature. All current carrying parts shall be of non-ferrous metal or alloys and shall be designed to limit sharp points/edges and similar sharp faces.

The firm should have the following type test certificate. The type test should be from CPRI or equivalent lab:-

1. Test to prove capability of rated peak short circuit current and the rated short time current. The rated short time current should correspond to minimum of 10K Amp and the peak short circuit current should correspond to minimum of 25K Amps.
2. Lightning impulse voltage test with positive & negative polarity.
3. Power Frequency voltage dry test and wet test
4. Temperature rise test
5. Mill volt drop tests

The above tests should be performed on the AB Switches, manufactured as per owner approved drawing with the specification. Along with the type test certificate, the certified copy of the drawing (from the testing lab) should also be kept for inspection of our officer. Also the test certificates should not be older than 5 years from the date of opening of tender.

Dimension of 11 & 33KV AB Switches in (Max.)Tolerance 5%.

Sl.	**Particulars**	**11KV AB Switch**	**33KV AB Switch**
i	MS Channel	450x75x40	675x100x50
ii	Creepage distance of Post Insulator	320mm (Min)	580mm (Min)
iii	Highest of Port shell	254 mm	368 mm
iv	Fixed contact assembly		
	i) Base	165x36x8	165x36x8
	Ii) Contact	70x30x6	70x30x6
	Iii) GI cover	110x44	140x44
	v) Spring	6 Nos.	6 Nos.

11) Moving Contact Assembly

i	Base Assembly	135x25x8	170x40x8
ii	Moving	180x25x9	290x25x14
iii	Bush	Bronze Metal	Bronze Metal
iv	Thickness of Grooves	7	11

12) Connectors

i	Connector	60x50x8 (Moving & fix both)	60x50x8 (Moving & fix both)

The bidder should provide AB Switches with terminal connectors, set of insulators, mechanical inter works and arcing horns sets. The base channel for the mounting of AB Switches shall also be included in the scope of AB Switches. The operating mechanisms together with down pipe operating handle etc. are also included in the scope of supply.

TECHNICAL SPECIFICATION OF 11 KV DROP OUT FUSE CUT OUTS

1. SCOPE

This specification covers outdoor, open, drop-out expulsion type Fuse Cutouts suitable for installation in 50 Hz, 11 KV distribution system.

2. APPLICATION

The distribution fuse cutouts are intended for use in distribution transformers and have no inherent load break capacity.

3. APPLICABLE STANDARD

Unless otherwise modified in this specification, the cutout shall conform to IS:9385 (Part-I to III) as amended from time to time.

4. RATED VOLTAGE

The rated voltage shall be 12 KV.

5. RATED CURRENT

The rated current shall be 100 A.

6. RATED LIGHTNING IMPULSE WITHSTAND VOLTAGE VALUES FOR THE FUSE BASE

The rated lightning impulse withstand voltages both for positive and negative polarities shall be as given below:

a) To earth and between poles 75 KV (Peak)
b) Across the isolating distance of fuse base 85 KV (Peak)

7. RATED ONE MINUTE POWER FREQUENCY WITHSTAND VOLTAGE (DRY & WET) VALUES FOR THE FUSE BASE

a) To earth and between poles 28 KV (rms)
b) Across the isolating distance 32 KV (rms)

8. TEMPERATURE RISE LIMIT (In Air)

a) Copper contacts silver faced $65^{o}C$
b) Terminals $50^{o}C$
c) Metal parts acting as springs. The temp. shall not reach such a value that elasticity of metal is changed

9. RATED BREAKING CAPACITY

The rated breaking capacity shall be 8 KA (Asymmetrical).

10. GENERAL REQUIREMENTS/CONSTRUCTIONAL DETAILS

10.1 The cutouts shall be of single vent type (downward) having a front connected fuse carrier suitable for angle mounting.

10.2 All ferrous parts shall be hot dip galvanised in accordance with the latest version of IS:2633. Nuts and bolts shall conform to IS:1364. Spring washers shall be electro-galvanised.

10.3 Typical constructional details of the fuse cutout are shown in Fig. 1

11. FUSE BASE TOP ASSEMBLY

11.1 The top current carrying parts shall be made of a highly conductive copper alloy and the contact portion shall be silver plated for corrosion resistance and efficient current flow. The contact shall have a socket cavity for latching and holding firmly the fuse carrier until the fault interruption is completed within the fuse.

11.2 The top contact shall be actuated by a strong steel spring which keeps it under sufficient pressure to maintain a firm contact with the fuse carrier during all operating conditions. The spring shall also provide flexibility and absorbs most of the stresses when the fuse carrier is pushed into the closing position.

11.3 The current carrying parts of the assembly shall be protected from water and dust formation by a stainless steel top cover.

11.4 The top contact assembly shall have a robust galvanised steel hook to align and guide the fuse carrier into the socket latch even when the fuse carrier is closed at an off-centre angle.

11.5 The top assembly shall have an aluminum alloy terminal connector (refer clause 19).

11.6 The top assembly shall be robust enough to absorb bulk of the forces during the fuse carrier closing and opening operations and shall not over-stress the spring contact. It shall also prohibit accidental opening of the fuse carrier due to vibrations or impact.

12. FUSE BASE BOTTOM ASSEMBLY

12.1 The conducting parts shall be made of high strength highly conductive copper alloy and the contact portion shall be silver plated for corrosion resistance and shall provide a low resistance current path from the bottom fuse carrier contacts to the bottom terminal connector.

12.2 The bottom assembly shall have hinge contacts made from highly conductive, anti-corrosive copper alloy and shall accommodate and make a firm contact with the fuse carrier bottom assembly. The fuse carrier shall be placed easily in or lifted from The hinges without any maneuvering. In addition, the bottom assembly shall perform the following functions :-

i) When opened manually or after fault interruption the fuse carrier shall swing through 180^{o} to the vertical and its further travel shall be prevented by the fuse base bottom assembly.

ii) The fuse carrier shall be prevented from slipping out of the self locking hinges during all operating conditions and only when the fuse carrier has reached its fully open position can it be removed from the hinge support.

12.3 The assembly shall have an aluminium alloy terminal connector (refer clause 19).

13. FUSE CARRIER TOP ASSEMBLY

13.1 The fuse carrier top contact shall have a solid replaceable cap made from highly conductive, anti-corrosive copper alloy and the contact portion shall be silver plated to provide a low resistance current path from the Fuse Base Top Contact to the Fuse Link. It shall make a firm contact with the button head of the fuse link and shall provide a protective enclosure to the fuse link to check spreading of arc during fault interruptions.

13.2 The fuse carrier shall be provided with a cast bronze opening eye (pull ring) suitable for operation with a hook stick from the ground level to pull-out or close-in the fuse carrier by manual operation.

14. FUSE CARRIER BOTTOM ASSEMBLY

14.1 The fuse carrier bottom assembly shall be made of bronze castings with silver plating at the contact points to efficiently transfer current to fuse base. It shall make smooth contact with the fuse base bottom assembly during closing operation.

14.2 The bottom assembly shall have a lifting eye for the hook stick for removing or replacing the fuse carrier.

14.3 The bottom assembly shall have a suitable ejector which shall perform the following functions :

i) It shall keep the fuse link in the centre of fuse tube and keep it tensioned under all operatingconditions.

ii) It shall be capable of absorbing the shock when the fuse carrier is pushed into the closed position and shall not allow the fuse link to be damaged. This is specially important when the fuse link is of low-ampere rating.

iii) The ejector at the instant of interruption shall retain the fuse carrier in the closed position long enough to ensure that the arc is extinguished within the fuse tube thereby excluding the possibility of arcing and subsequent damage at the contact surfaces.

iv) The ejector shall help the fuse link separation after fault interruption, allowing the fuse carrier to drop out and clearing the pigtail of the blown fuse link through the bore of fuse tube.

15. FUSE BASE (PORCELAIN)

The fuse base shall be a bird-proof, single unit porcelain insulator with a creepage distance (to earth) not less than 320mm. The top and bottom assemblies as also the middle clamping hardwares shall be either embedded in the porcelain insulator with sulphur cement or suitably clamped in position. For embedded components, the pull out strength should be such as to result in breaking of the porcelain before pull out occurs in a test. For porcelain insulators, the beam strength shall not be less than 1000 Kg.

16. FUSE TUBE

The fuse tube shall be made of fibre glass coated with ultraviolet inhibitor on the outer surface and having arc quenching bone fibre liner inside. The tube shall have high bursting strength to sustain high pressure of the gases during fault interruption. The inside diameter of the fuse tube shall be 17.5mm. The

solid cap of the fuse carrier shall clamp the button head of the fuse link, closing the top end of the fuse tube and allowing only the downward venting during fault interruption.

17. TYPE TESTS

The cutout shall be subjected to the following type tests :
i) Dielectric tests (rated impulse withstands and rated one minute power frequency with stand test voltages)

ii) Temperature rise test
The above tests shall be carried out in accordance with IS:9385 Part I & II.

For Porcelain Fuse Base only.

iii) Pull out test for embedded components of the fuse base

iv) Beam strength of porcelain base

18. MOUNTING ARRANGEMENT

18.1 The cutouts shall be provided with a suitable arrangement for mounting these on 75x40mm or 100x50mm channel cross arm in such a way that the centre line of the fuse base is at an angle of 15^{o} to 20^{o} from the vertical and shall provide the necessary clearances from the support. Mounting arrangement shall be made of high strength galvanised steel flat and shall be robust enough to sustain the various stresses encountered during all operating conditions of the cutout. For more details see enclosed figure 2.

18.2 Strength of the component marked 1 (see figure) shall be determined by clamping the member with the shorter leg at the top to a rigid support by M-10 carriage bolts. A downward force shall be applied along the axis of M-14 carriage bolt parallel to the longer leg and in the direction of longer leg of the member under test. A load of 50 Kg. shall be applied and then removed to take up any slack in the mounting arrangement before the measurement of position is taken, the permanent set

measured at the axis of the M-14 carriage bolt shall not exceed 1.6mm when a load of 425 Kg. is applied and removed.

18.3 The strength of the M-14 bolt shall in no case be less than1900 Kg. and the strength of M-10 bolts not less than 3500 Kg.

19. TERMINAL CONNECTIONS

The cut-out shall be provided with two aluminium alloy (alloy designation 2280 (A-11) as per IS:617-1975) terminal connectors at top and bottom of fuse base assemblies to receive aluminium conductors of diameters between 6.3mm to10.05mm. These terminals shall be easily accessible irrespective of the cut-out location with respect to the pole. The terminals shall meet the test requirements of REC Construction Standard.

20. INSPECTION

All tests and inspection shall be made at the place of manufacture unless otherwise especially agreed upon by the manufacturer and the purchaser at the time to purchase. The manufacturer shall afford the inspector representing the purchaser all reasonable facilities without charge, to satisfy him that the material is being furnished in accordance with this specification.

The purchaser has the right to have the tests carried out at his own cost by an independent agency whenever there is dispute regarding the quality of supply.

TECHNICAL SPECIFICATION OF 33&11 KV STATION CLASS LIGHTNING ARRESTOR & 11 KV DISTRIBUTION CLASS SURGE ARRESTORS

1. 33kV VOLTAGE CLASS SURGE ARRESTORS

Lightning Arrestors at Grid Substation shall be of Station class only in 33 & 11 KV System.

1.1. INTRODUCTION

The section covers the specification of 33kV voltage level, 10 kA, and Station class heavy duty, gapless metal (zinc) oxide Surge Arrestors complete with insulating base, terminal clamps, complete fittings & accessories for installation on outdoor type 33kV switchgear/transmission lines / transformers.

1.2. STANDARDS

The design, manufacture and performance of Surge Arrestors shall comply with IS: 3070 Part-3 and other specific requirements stipulated in the specification. Unless otherwise specified, the equipment, material and processes shall conform to the latest applicable Indian/International Standards as listed hereunder:

IS:2071-1993 (Part-1)	Methods of High Voltage Testing General Definitions & Test Requirements.
IS:2071-1974(Part-2)	Test Procedures
IS:2629-1985	Recommended Practice for hot dip galvanizing on Iron & Steel
IS:2633-1986	Method for Testing uniformity of coating of zinc coated Articles.
IS:3070-1993 (Part – 3)	Specification for surge arrestor for alternating current systems. Metal-Oxide lightening Arrestors without gaps
IS:4759-1996	Specification for hot dip zinc coating on Structural Steel and Other allied products.
IS:5621-1980	Hollow Insulators for use in Electrical Equipment.
IS:6209-1982	Methods of Partial discharge measurement.
IS:6745	Method for determination of mass of zinc coating on zinc coated iron and steel articles
ANSI/IEEE-C.62.11	Metal oxide, Surge Arrestor for AC Power Circuits.
IEC –60099-4	Surge Arrestors

The equipment complying with any other internationally accepted standards shall also be considered if it ensures performance equivalent to or superior to the Indian Standards.

1.3. GENERAL REQUIREMENT

1.3.1. The metal oxide gap less Surge Arrestor without any series or shunt gap shall be suitable for protection of 33kV switchgear, transformers, associated equipment and 33 kV lines from

voltage surges resulting from natural disturbance like lightning as well as system disturbances.

1.3.2. The surge arrestor shall draw negligible current at operating voltage and at the same time offer least resistance during the flow of surge current.

1.3.3. The surge arrestor shall consist of non-linear resistor elements placed in series and housed in electrical grade porcelain housing / silicon polymericof specified creepage distance.

1.3.4. The assembly shall be hermetically sealed with suitable rubber gaskets with effective sealing system arrangement to prevent ingress of moisture.

1.3.5. The surge arrestor shall be provided with line and earth terminals of suitable size. The ground side terminal of surge arrestor shall be connected with 25x6 mm galvanized strip, one end connected to the surge arrestor and second end to a separate ground electrode. The bidder shall also recommend the procedure which shall be followed in providing the earthing system to the Surge Arrestor.

1.3.6. The surge arrestor shall not operate under power frequency and temporary over voltage conditions but under surge conditions, the surge arrestor shall change over to the conducting mode.

1.3.7. The surge arrestor shall be suitable for circuit breaker performing 0-0.3sec.-CO-3 min-CO-duty in the system.

1.3.8. Surge arrestors shall have a suitable pressure relief system to avoid damage to the porcelain/silicon polymeric housing and providing path for flow of rated fault currents in the event of arrestor failure.

1.3.9. The reference current of the arrestor shall be high enough to eliminate the influence of grading and stray capacitance on the measured reference voltage.

1.3.10. The arrestors for 33 kV system shall be suitable for mounting on transformers, Bus, Line & structure as per scheme. The supplier shall furnish the drawing indicating the dimensions, weights etc. of the surge arrestors for the design of mounting Structure.

1.3.11. The arrestor shall be capable of handling terminal energy for high surges, external pollution and transient over voltage and have low losses at operating voltages.

1.4. ARRESTOR HOUSING

1.4.1. The arrestor housing shall be made up of porcelain/**silicon polymeric** housing and shall be homogenous, free from laminations, cavities and other flaws of imperfections that might affect the mechanical and dielectric quality. The housing shall be of uniform brown **(for porcelain**)/Grey **(for silicon polymeric)** colour, free from blisters, burrs and other similar defects.

Arrestors shall be complete with fasteners for stacking units together and terminal connectors.

1.4.2. The housing shall be so coordinated that external flashover shall not occur due to application of any impulse or switching surge voltage up to the maximum design value for arrestor. The arrestors shall not fail due to contamination. The 33 kV arrestors housing shall be designed for pressure relief class as given in Technical Parameters of the specification.

1.4.3. Sealed housings shall exhibit no measurable leakage.

1.5. FITTINGS & ACCESSORIES

1.5.1. The surge arrestor shall be complete with fasteners for stacking units together and terminal connectors.

1.5.2. The terminals shall be non-magnetic, corrosion proof, robust and of adequate size and shall be so located that incoming and outgoing connections are made with minimum possible bends. The top metal cap and base of surge arrestor shall be galvanized. The line terminal shall have a built in clamping device which can be adjusted for both horizontal and vertical take off.

1.6. TESTS

1.6.1. Test on Surge Arrestors

The Surge Arrestors offered shall be type tested and shall be subjected to routine and acceptance tests in accordance with IS : 3070 (Part-3)/IEC-60099-4. In addition, the suitability of the surge arresters shall also be established for the followings

i) **Acceptance tests**

a) Measurement of power frequency reference voltage of arrester units.
b) Lightning impulse residual voltage on arrester units (IEC clause 6.3.2)
c) Internal ionization or partial discharge test

ii) **Special Acceptance tests**

a) Thermal stability test (IEC **99-4**clause 7.2.2)
b) Watt loss test.

iii) **Routine tests**

a) Measurement of reference voltage
b) Residual voltage test of arrester unit
c) Internal ionization or partial discharge test
d) Sealing test
e) Verticality check on completely assembled surge arresters as a sample test on each lot if applicable.

iv) **Type Tests**

Following shall be type test as per IS 3070 (Part 3): 1993 or its latest amendment.

1.	Insulation Withstand test a) Lightning Impulse b) Power Frequency (Dry/Wet)
2.	Residual Voltage Test a) Steep current impulse residual voltage test b) Lightning impulse residual voltage test c) Switching Impulse Residual voltage test
3.	Long duration current impulse withstand test
4.	Switching surge operating duty test
5.	Power frequency voltage Vs. Time characteristics
6.	Accelerated Ageing test
7.	Pressure relief test High Current Low Current
8.	Artificial pollution test (for porcelain housing)
9.	Seismic Test
10.	Partial Discharge test
11.	Bending test
12.	a) Temperature cycle test (for porcelain housing) b) Porosity test (for porcelain housing)
13.	Galvanising test on metal parts
14.	Seal Leakage test (for porcelain housing)
15.	Seal leak test and operation tests (for surge monitor)
16.	Weather ageing test (for polymer housing)

1.6.2. The maximum residual voltages corresponding to nominal discharge current of 10 kA for steep current, impulse residual voltage test, lightning impulse protection level and switching impulse level shall generally conform to **Annex-K of IEC-99-4.**

1.6.3. The contractor shall furnish the copies of the type tests and the characteristics curves between the residual voltage and nominal discharge current of the offered surge arrestor and power frequency voltage v/s time characteristic of the surge arrestor subsequent to impulse energy consumption as per clause 6.6.**7** of IS:3070 (Part-3) offered along with the GTP/Drawing.

1.6.4. The surge arrestor housing shall also be type tested and shall be subjected to routine and acceptance tests in accordance with IS: 5621.

1.6.5. **Galvanization Test**

All Ferrous parts exposed to atmospheric condition shall have passed the type tests and be subjected to routine and acceptance tests in accordance with IS:2633 & IS 6745.

1.7. **NAME PLATE**

1.7.1. The name plate attached to the arrestor shall carry the following information:

- Rated Voltage

- Continuous Operation Voltage
- Normal discharge current
- Pressure relief rated current
- Manufacturers Trade Mark
- Name of Sub-station
- Year of Manufacturer
- Name of the manufacture
- Name of Client-“ “
- Purchase Order Number along with date

1.8. DRAWINGS AND INSTRUCTION MANUALS

Within 15 days of receipt of the order, the successful tenderer shall furnish to the purchaser the following drawings and literature for approval:

(i) Outline dimensional drawings of Surge Arrestor and all accessories.
(ii) Assembly drawings and weights of main component parts.
(iii) Drawings of terminal clamps.
(iv) Arrangement of earthing lead.
(v) Minimum air clearance to be maintained of line components to ground.
(vi) Name plate
(vii) Instructions manual
(viii) Drawing showing details of pressure relief valve
(ix) Volt-time characteristics of surge arrestors
(x) Detailed dimensional drawing of porcelain housing/Silicon polymeric i.e. internal diameter, external diameter, thickness, height, profile, creepage distance, dry arcing distance etc.

1.9. TECHNICAL PARTICULARS

1.9.1. The surge arrestors shall conform to the following standard technical requirements. The Insulation values shall be enhanced considering the altitude of operation & other atmospheric conditions.

System Parameters:

Nominal system voltage	:	33 kV
Highest system voltage	:	36 kV
System earthing	:	Solidly earthed system
Frequency (Hz)	:	50
Lightning Impulse withstand Voltage (kVP)	:	170
Power frequency withstand Voltage (kV rms)	:	70
Connection to system	:	Phase to earth

1.9.2. Surge Arrestors

Type of Surge Arrestor	:	Gapless Metal oxide outdoor
Arrestor rating (kV rms)	:	30
Continuous Operating voltage (kV rms)	:	25
Standard Nominal Discharge Current Rating (kA) (8x20 micro impulse shape)	:	10
Line discharge class	:	2
Degree of protection	:	IP-**67**
Lightning Impulse at 10 kA	:	85
Partial discharge at 1.05 COV not greater than	:	50 (PC)
Energy capability corresponding to		
a) Arrestor rating (kj/kV)	:	4.5
b) COV (kJ/kV)	:	4.9
Peak current for high current impulse operating duty of arrestor classification 10 kA	:	100

1.9.3. Insulator Housing

Power frequency withstand test voltage (wet) (kV rms)	:	70
Lightning impulse withstand/tests voltage (kVP)	:	170
Pressure Relief Class	:	40
Creepage distance not less than	:	900 mm

1.9.4. Galvanisation

Fabricated Steel Aticles		
-- 5 mm thick cover	:	610 g/m^2
-- Under 5 mm but not less than 2 mm thickness	:	460 g/m^2
-- Under 2 mm but not less than 1.2 mm thickness	:	340 g/m^2
Castings		
-- Grey Iron, malleable iron	:	610 g/m^2
Threaded works other than tubes & tube fittings		
-- Under 10 mm dia		270 g/m^2
-- 10 mm dia & above		300m^2

2. 11kV VOLTAGE CLASS SURGE ARRESTORS

2.1. INTRODUCTION

This section covers the specification of 11kV voltage station Surge Arrestors for installation on outdoor type 11kV switchgear, transmission lines, transformers etc. 11kV side of which is not enclosed in a cable box. Station class surge arrestors shall be complete with fasteners for stacking units.

2.2. STANDARDS

The design, manufacture and performance of Surge Arrestors shall comply with IS: 3070 Part-3 and other specific requirements stipulated in the specification. Unless otherwise specified, the equipment, material & processes shall conform to the latest amendments of the following:

IS:2071-1993 (Part-1)	Methods of High Voltage Testing General Definitions & Test Requirements.
IS:2071-1974 (Part-2)	Test Procedures.
IS: 2629-1985	Recommended Practice for hot dip galvanizing on Iron & Steel.
IS: 2633-1986	Method for Testing uniformity of coating of zinc coated Articles.
IS:3070-1993 (Part – 3)	Specification for surge arrestor for alternating current systems. Metal-Oxide lightening Arrestors without gaps.
IS: 4759-1996	Specification for hot dip zinc coating on structural steel and other allied products.
IS: 5621-1980	Hollow Insulators for use in Electrical Equipment.
IS: 6209-1982	Methods of Partial discharge measurement.
IS: 6745	Method for determination of mass of zinc coating on zinc coated iron and steel articles.
ANSI/IEEE-C.62.11	Metal oxide, Surge Arrestor for AC Power Circuits.
IEC –60099-4	Surge Arrestors.

The equipment complying with any other internationally accepted standards shall also be considered if it ensures performance equivalent to or superior to the Indian Standards.

2.3. GENERAL REQUIREMENT

2.3.1. The metal oxide gap less Surge Arrestor without any series or shunt gap shall be suitable for protection of 11 kV side of power transformers, associated equipment and 11kV lines from voltage surges resulting from natural disturbance like lightning as well as system disturbances.

2.3.2. The surge arrestor shall draw negligible current at operating voltage and at the same time offer least resistance during the flow of surge current.

2.3.3. The surge arrestor shall consist of non-linear resistor elements placed in series and housed in electrical grade porcelain housing / silicon polymeric of specified Creepage distance.

2.3.4. The assembly shall be hermetically sealed with suitable rubber gaskets with effective sealing system arrangement to prevent ingress of moisture.

2.3.5. The surge arrestor shall be provided with line and earth terminals of suitable size. The ground side terminal of surge arrestor shall be connected with 25x6 mm galvanized strip, one end connected to the surge arrestor and second end to a separate ground electrode. The bidder shall also recommend the procedure which shall be followed in providing the earthing system to the Surge Arrestor.

2.3.6. The surge arrestor shall not operate under power frequency and temporary over voltage conditions but under surge conditions, the surge arrestor shall change over to the conducting mode.

2.3.7. The surge arrestor shall be suitable for circuit breaker performing 0-0.3 min-CO-3 min-CO-duty in the system.

2.3.8. Surge arrestors shall have a suitable pressure relief system to avoid damage to the porcelain/ silicon polymeric housing and providing path for flow of rated fault currents in the event of arrestor failure.

2.3.9. The reference current of the arrestor shall be high enough to eliminate the influence of grading and stray capacitance on the measured reference voltage.

2.3.10. The Surge Arrestor shall be thermally stable and the bidder shall furnish a copy of thermal stability test with the bid.

2.3.11. The arrestor shall be capable of handling terminal energy for high surges, external pollution and transient over voltage and have low losses at operating voltages.

2.3.12. The surge arrestor shall be provided with line and earth terminals of suitable size.

2.4. ARRESTOR HOUSING

2.4.1. The arrestor housing shall be made up of porcelain/**silicon polymeric** housing and shall be homogenous, free from laminations, cavities and other flaws of imperfections that might affect the mechanical and dielectric quality. The housing shall be of uniform **brown** (**for porcelain**)/**Grey** (**for silicon polymeric**) colour, free from blisters, burrs and other similar defects.

Arrestors shall be complete with fasteners for stacking units together and terminal connectors.

2.4.2. The housing shall be so coordinated that external flashover shall not occur due to application of any impulse or switching surge voltage upto the maximum design value for arrestor. The arrestors shall not fail due to contamination. The 11kV arrestors housing shall be designed for pressure relief class as given in Technical Parameters of the specification.

2.4.3. Sealed housings shall exhibit no measurable leakage.

2.5. ARRESTOR MOUNTING

The arrestors shall be suitable for mounting on 4 pole/2 pole structure used for pole/plinth mounted transformer and for incoming and outgoing lines. Arrestor may also be required to be mounted on a bracket provided in the Transformers.

2.6. FITTINGS & ACCESSORIES

2.6.1. The surge arrestor shall be complete with fasteners and terminal connectors.

2.6.2. The terminals shall be non-magnetic, corrosion proof, robust and of adequate size and shall be so located that incoming and outgoing connections are made with minimum possible bends. The top metal cap and base of surge arrestor shall be galvanized. The line terminal shall have a built in clamping device which can be adjusted for both horizontal and vertical take off.

2.7. TESTS

2.7.1. Test on Surge Arrestors

The Surge Arrestors offered shall be type tested and shall be subjected to routine and acceptance tests in accordance with IS : 3070 (Part-3)-/IEC:600994. In addition, the suitability of the surge arresters shall also be established for the followings.

i) **Acceptance tests**

a) Measurement of power frequency reference voltage of arrester units.
b) Lightning impulse residual voltage on arrester units (IEC clause 6.3.2)
c) Internal ionization or partial discharge test

ii) **Special Acceptance tests:**

a) Thermal stability test (IEC clause 7.2.2)
b) Watt loss test.

iii) **Routine tests**

a) Measurement of reference voltage
b) Residual voltage test of arrester unit
c) Internal ionization or partial discharge test
d) Sealing test
e) Verticality check on completely assembled surge arresters as a sample test on each lot ifapplicable.

iv) **Type Tests**

Following shall be type test as per IS 3070 (Part 3): 1993 or its latest amendment

1.	Insulation Withstand test a) Lightning Impulse b) Power Frequency (Dry/Wet)
2.	Residual Voltage Test a) Steep current impulse residual voltage test b) Lightning impulse residual voltage test c) Switching Impulse Residual voltage test

3.	Long duration current impulse withstand test
4.	Switching surge operating duty test
5.	Power frequency voltage Vs. Time characteristics
6.	Accelerated Ageing test
7.	Pressure relief test High Current Low Current
8.	Artificial pollution test (for porcelain housing)
9.	Seismic Test
10.	Partial Discharge test
11.	Bending test
12.	a) Temperature cycle test (for porcelain housing) b) Porosity test (for porcelain housing)
13.	Galvanising test on metal parts
14.	Seal Leakage test (for porcelain housing)
15.	Seal leak test and operation tests (for surge monitor)
16.	Weather ageing test (for polymer housing)

2.7.2. The maximum residual voltages corresponding to nominal discharge current of 10 kA for steep current, impulse residual voltage test, lightning impulse protection level and switching impulse level shall generally conform to Annex-K of IEC-99-4.

2.7.3. The contractor shall furnish the copies of the type tests and the characteristics curves between the residual voltage and nominal discharge current of the offered surge arrestor and power frequency voltage v/s time characteristic of the surge arrestor subsequent to impulse energy consumption as per clause 6.6 of IS:3070 (Part-3) offered alongwith the bid.

2.7.4. The surge arrestor housing shall also be type tested and shall be subjected to routine and acceptance tests in accordance with IS :5621.

2.7.5. **Galvanization Test**

All Ferrous parts exposed to atmospheric condition shall have passed the type tests and be subjected to routine and acceptance tests in accordance with IS:2633 & IS 6745.

2.8. **NAME PLATE**

2.8.1. The name plate attached to the arrestor shall carry the following information:

- Rated Voltage
- Continuous Operation Voltage

- Normal discharge current
- Pressure relief rated current
- Manufacturers Trade Mark

- Name of Sub-station
- Year of Manufacturer
- Name of the manufacture
- Name of Client-
- Purchase Order Number along with date

2.9. DRAWINGS AND INSTRUCTION MANUALS

Within 15 days of receipt of the order, the successful tenderer shall furnish to the purchaser, the following drawings and literature for approval:

(i) Outline dimensional drawings of Surge Arrestor and all accessories.
(ii) Assembly drawings and weights of main component parts.
(iii) Drawings of terminal clamps.
(iv) Arrangement of earthing lead.
(v) Minimum air clearance to be maintained of line components to ground.
(vi) Name plate
(vii) Surge monitor, if applicable.
(viii) Instructions manual
(ix) Drawing showing details of pressure relief valve
(x) Volt-time characteristics of surge arrestors
(xi) Detailed dimensional drawing of porcelain housing/Silicon polymeric i.e. internal diameter, external diameter, thickness, height, profile, creepage distance, dry arcing distance etc.

2.10. TECHNICAL PARTICULARS

2.10.1. The surge arrestors shall conform to the following standard technical requirements. The Insulation values shall be enhanced considering the altitude of operation & other atmospheric conditions.

System Parameters

i)	Nominal system voltage	11kV
ii)	Highest system voltage	12 kV
iii)	System earthing	Effectively earthed system
iv)	Frequency (Hz)	50
v)	Lightning Impulse withstand	75 Voltage (kVP)
vi)	Power frequency withstand	28 Voltage (kV rms)
vii)	Arrestor duty	
	-- Connection to system	Phase to earth
	-- Type of equipment to be protected	transformers & switchgear

2.10.2. Surge Arrestors

i)	Type	Gapless Metal oxide outdoor
ii)	Arrestor rating (kV rms)	9
iii)	Continuous Operating voltage	7.65 (kV rms)

iv)	Standard Nominal Discharge Current	10 Rating (kA) (8x20 micro impulse shape)
v)	Degree of protection	IP **67**
vi)	Line discharge Class	2
vii)	Steep current at 10 kA	45
viii)	Lightning Impulse at 10 kA	40
ix)	Energy capability corresponding to	
	a) Arrestor rating (kj/kV)	4.5
	b) COV (kj/kV)	4.9
x)	Peak current for high current impulse operating duty of Standard TS for arrestor classification10 kA	100

2.10.3. Insulator Housing

i)	Power frequency withstand test voltage (Wet) (kV rms)	28
ii)	Lightning impulse withstand/tests voltage (kVP)	75

2.10.4. Galvanisation

i)	Fabricated Steel Aticles	
	a) 5 mm thick cover	610 g/m^2
	b) Under 5 mm but not less than 2 mm thickness	460 g/m^2
	c) Under 2 mm but not less than 1.2 mm thickness	340 g/m^2
ii)	Castings	
	Grey Iron, malleable iron	610 g/m^2
iii)	Threaded works other than tubes & tube fittings	
	a) Under 10 mm dia	270 g/m^2
	b) 10 mm dia & above	300 g/m^2

NOTE- Surge Monitor shall have to be provided if coverded in BPS.

3. DISTRIBUTION CLASS SURGE ARRESTORS

To be used in distribution Transformer Substations only.

3.1. INTRODUCTION

This section covers the specification of Distribution class Surge Arrestor for 11kV transmission lines, transformers etc.

3.2. STANDARDS

The design, manufacture and performance of Surge Arrestors shall comply with IS: 3070 Part-3 and other specific requirements stipulated in the specification. Unless otherwise specified, the equipment, material and processes shall conform to the latest applicable Indian/International Standards as listed hereunder:

IS:2071- 1993 (Part-1)	:	Methods of High Voltage Testing General Definitions & Test
IS:2071-1974 (part-2)	:	Test Procedures

IS:2629-1985	:	Recommended Practice for hot dip galvanizing on Iron & Steel
IS:2633-1986	:	Method for Testing uniformity of coating of zinc coated Articles.
IS3070-1993 (Part–3)	:	Specification for surge arrestor for alternating current systems. Metal-Oxide lightening Arrestors without gaps
IS:4759-1996	:	Specification for hot dip zinc coating on Structural Steel and Other allied products.
IS:5621-1980		Hollow Insulators for use in Electrical Equipment.
IS:6209-1982		Methods of Partial discharge measurement.
IS:6745		Method for determination of mass of zinc coating on zinc coated iron and steel articles
ANSI/IEEE-C.62.11 :		Metal oxide, Surge Arrestor for AC Power (1982) Circuits.
IEC –60099-4		Surge Arrestors

3.2.1. The equipment complying with any other internationally accepted standards shall also be considered if it ensures performance equivalent to or superior to the Indian Standards.

3.3. GENERAL REQUIREMENT

3.3.1. The metal oxide gap less Surge Arrestor without any series or shunt gap shall be suitable for protection of 11 kV side of Distribution Transformers, associated equipment and 11 kV lines from voltage surges resulting from natural disturbance like lightning as well as system disturbances.

3.3.2. The surge arrestor shall draw negligible current at operating voltage and at the same time offer least resistance during the flow of surge current.

3.3.3. The surge arrestor shall consist of non-linear metal oxide resistor elements placed in series and housed in electrical grade porcelain housing / silicon polymericof specified Creepage distance.

3.3.4. The assembly shall be hermetically sealed with suitable rubber gaskets with effective sealing system arrangement to prevent ingress of moisture.

3.3.5. The surge arrestor shall be provided with line and earth terminals of suitable size. The ground side terminal of surge arrestor shall be connected with 25x6 mm galvanized strip, one end connected to the surge arrestor and second end to a separate ground electrode. The contractor shall also recommend the procedure which shall be followed in providing the earthing/system to the Surge Arrestor.

3.3.6. The surge arrestor shall not operate under power frequency and temporary over voltage conditions but under surge conditions, the surge arrestor shall change over to the conducting mode.

3.3.7. The surge arrestor shall be suitable for circuit breaker performing 0-0.3 min-CO-3 min-CO-duty in the system.

3.3.8. The reference current of the arrestor shall be high enough to eliminate the influence of grading and stray capacitance on the measured reference voltage.

3.3.9. The Surge Arrestor shall be thermally stable and the contractor shall furnish a copy of thermal stability test with the bid.

3.3.10. The arrestor shall be capable of handling terminal energy for high surges, external pollution and transient over voltage and have low losses at operating voltages.

3.4. ARRESTOR HOUSING

3.4.1. The arrestor housing shall be made up of porcelain/***silicon polymeric*** housing and shall be homogenous, free from laminations, cavities and other flaws of imperfections that might affect the mechanical and dielectric quality. The housing shall be of uniform **brown (for porcelain)/ Grey (for silicon polymeric)** colour, free from blisters, burrs and other similar defects.

3.4.2. The housing shall be so coordinated that external flashover shall not occur due to application of any impulse or switching surge voltage upto the maximum design value for arrestor. The arrestors shall not fail due to contamination.

3.4.3. Sealed housings shall exhibit no measurable leakage.

3.5. ARRESTOR MOUNTING

The arrestors shall be suitable for mounting on 4 pole/2 pole structure used for pole mounted transformer and for incoming and outgoing lines.

3.6. FITTINGS & ACCESSORIES

3.6.1. The surge arrestor shall be complete with disconnector and terminal connectors and all other accessories.

3.6.2. The terminals shall be non-magnetic, corrosion proof, robust and of adequate size and shall be so located that incoming and outgoing connections are made with minimum possible bends. The top metal cap and base of surge arrestor shall be galvanized. The line terminal shall have a built in clamping device which can be adjusted for both horizontal and vertical take off.

3.7. TESTS

3.7.1. Test on Surge Arrestors

The Surge Arrestors offered shall be type tested and shall be subjected to routine and acceptance tests in accordance with IS : 3070 (Part-3)-1993. In addition, the suitability of the surge arresters shall also be established for the followings

a) **Acceptance tests:**

i) Measurement of power frequency reference voltage of arrester units.

ii) Lightning impulse residual voltage on arrester units (IEC clause 6.3.2)

iii) Internal ionization or partial discharge test

b) **Special Acceptance tests:**

i) Thermal stability test (IEC clause 7.2.2)

c) **Routine tests:**

Measurement of reference voltage

i) Residual voltage test of arrester unit
ii) Internal ionization or partial discharge test
iii) Sealing test
iv) Verticality check on completely assembled surge arresters as a sample test on each lot if applicable.

d) **Type tests:** Following shall be type test As per IS 3070 (Part 3)-/IEC;60094 or its latest amendment

1.	Insulation Withstand test Lightning Impulse voltage test Power Frequency (Dry & Wet)
2.	Residual Voltage Test Steep current impulse residual voltage test Lightning Impulse Residual Voltage Test
3.	Long duration current impulse withstand test
4.	High current impulse operating duty test
5.	Power frequency voltage Vs. Time characteristics
6.	Accelerated Ageing test
7.	Artificial pollution test (for porcelain housing)
8.	Partial discharge test
9.	Visual Examination (for porcelain housing)
10.	a) Temperature cycle test (for porcelain housing)
11.	Mechanical Failing Load test (Bending Strength test)
12.	Uniformity of Zinc coating, Mass of zinc coating
13.	Time versus current curve (for disconnector)
14.	Weather ageing test (for polymer housing)

3.7.2. The maximum residual voltages corresponding to nominal discharge current of 5 kA for steep current, impulse residual voltage test, lightning impulse protection level and switching impulse level shall generally conform to Annex-K of IEC-99-4.

3.7.3. The contractor shall furnish the copies of the type tests and the characteristics curves between the residual voltage and nominal discharge current of the offered surge arrestor and power frequency voltage v/s time characteristic of the surge arrestor subsequent to impulse energy consumption as per clause 6.6.7 of IS:3070 (Part-3) offered alongwith the GTP.

3.7.4. The surge arrestor housing shall also be type tested and shall be subjected to routine and acceptance tests in accordance with IS: 5621

3.7.5. GALVANIZATION TEST

All Ferrous parts exposed to atmospheric condition shall have passed the type tests and be subjected to routine and acceptance tests in accordance with IS:2633 & IS 6745.

3.7.6. TEST ON SURGE ARRESTOR DISCONNECTORS

The test shall be performed on surge arrestors which are fitted with arrestor disconnector or on the disconnector assembly alone if its design is such as to be un-affected by the heating of adjacent parts of the arrestor in its normally installed portion in accordance with IS:3070 (Part-3)

3.8. NAME PLATE

3.8.1. The name plate attached to the arrestor shall carry the following information:

- Rated Voltage
- Continuous Operation Voltage
- Normal discharge current
- Manufacturers Trade Mark
- Year of Manufacturer
- Name of the manufacture
- Name of Client-
- Purchase Order Number along with date

3.9. DRAWINGS AND INSTRUCTION MANUALS

The successful bidder shall furnish to the purchaser the following drawings and literature for approval:

(i) Outline dimensional drawings of Surge Arrestor and all accessories.
(ii) Assembly drawings and weights of main component parts.
(iii) Drawings of terminal clamps.
(iv) Arrangement of earthing lead.
(v) Minimum air clearance to be maintained of line components to ground.
(vi) Name plate
(vii) Instructions manual
(viii) Drawing showing details of pressure relief valve
(ix) Volt-time characteristics of surge arrestors
(x) Detailed dimensional drawing of porcelain housing/Silicon polymeric i.e. internal diameter, external diameter, thickness, height, profile, creepage distance, dry arcing distance etc.

3.10. TECHNICAL PARTICULARS

3.10.1. The surge arrestors shall conform to the following standard technical requirements. The Insulation values shall be enhanced considering the altitude of operation & other atmospheric conditions.

System Parameters

i)	Nominal system voltage	11kV
ii)	Highest system voltage	12 kV
iii)	System earthing	Solidly earthed system
iv)	Frequency (Hz)	50
vii)	Lightning Impulse withstand	75 Voltage (kVP)
viii)	Power frequency withstand	28 Voltage (kV rms)
vii)	Arrestor duty	
	-- Connection to system	Phase to earth
	-- Type of equipment to be protected	11 kV transformers & switchgear

3.10.2. Surge Arrestors

i)	Type	Gapless Metal oxide outdoor
ii)	Arrestor rating (kV rms)	9
iii)	Continuous Operating voltage (kV rms)	7.65
v)	Nominal Discharge Current	5 Rating (kA) (8x20 micro impulse shape)
v)	Long Duration discharge class	Distribution class
vi)	Maximum residual voltage (kV peak)	
	a) at 5 kA	27
vii)	Partial discharge at 1.05 COV not greater than	50 (PC)
viii)	High current impulse withstand voltage at 5 kA (kVp)	65

3.11. INSULATOR HOUSING

i)	Power frequency withstand test voltage (Wet) (kV rms)	28
ii)	Lightning impulse withstand/tests voltage (kVP)	75
iii)	Creepage distance not less than (mm)	300

3.12. GALVANISATION

i)	Fabricated Steel Aticles	
	a) 5 mm thick cover	610 g/m^2
	b) Under 5 mm but not less than 2 mm thickness	460 g/m^2
	c) Under 2 mm but not less than 1.2 mm thickness	340 g/m^2
ii)	Castings	
	Grey Iron, malleable iron	610 g/m^2
iii)	Threaded works other than tubes & tube fittings	
	a) Under 10 mm dia	270 g/m^2
	b) 10 mm dia & above	300 g/m^2

TECHNICAL SPECIFICATION OF EARTHING COIL

Earthing Coils shall be fabricated from soft GI Wire Hot Dip Galvanized. The Hot Dip galvanized wire shall have clean surface and shall be free from paint enamel or any other poor conducting material. The coil shall be made as per REC constructions standard (Refer tender drawing No. REC-XI Plan-Gen-005). The Hot Dip galvanizing shall conform to IS:2629/1966, 2633/1972 and 4826/1969 with latest amendments. Galvanizing should be heavily coated and should stand for the following tests.

Galvanizing Tests

i) Minimum Mass of Zinc

   a) ON GI Wire used 280 cm/m^2
   b) After Coiling – 266 gm/m^2. The certificate from recognized laboratory shall be submitted towards mass of zinc.

ii) Dip Test shall stand 3 dips of 1 minute and one dip of ½ minute before coiling and 43 dips of 1 minute after coiling as per IS : 4826/1979.

THE DIMENSIONAL REQUIREMENT SHALL BE AS FOLLOWS

a) Nominal dia of GI Wire 4 mm (Tolerance $\pm$ 2.5%)
b) Minimum no. of turns – 115 Nos.
c) External dia of Coil (Min) – 50 mm
d) Length of Coil (Min) – 460 mm
e) Free length of GI Wire at one end coil (Min.) – 2500 mm

The turns should be closely bound. Weight of one finished Earthing Coils (min.) – 1.850 Kg.

Adhesion test – As per ISS 4826 – 1979.

Earthing Conductor All conductors burred in earth and concrete and above ground level shall be galvanised steel. Galvanised steel shall be subject to four one minute dips in copper sulphate solution as per IS:2633.

Earthing (AS PER IS 3043-1987)

Earthing shall generally be carried out in accordance with the requirements of Indian Electricity Rules 2003 amended from time to time and relevant regulations under Electricity Supply Authority concerned.

In case of high and extra high voltages, the neutral points shall be earthed by not less than two separate distinct connections with earth, each having its own electrodes sub-station and will be earthed at any other point provided no interference is caused by such earthing. If necessary, the neutral may be earthed through suitable impedance.

As far as possible, all earth connections should be visible for inspection. Each earthing system shall be so designed, that, the testing of individual earth electrodes is possible. It is recommended that the value of any earth system resistance shall be such as to conform to the degree of shock protection desired.

It is recommended, that a drawing showing the main earth connections and earth electrodes be prepared for each installation and submitted to Employer.

No addition to the current carrying system, either temporary or permanent, shall be made which will increase the maximum available fault current on its duration until it has been ascertained that the existing arrangement of earth electrodes, earth bus-bar etc., are capable of carrying the new value of earth fault current which may be obtained by this addition.

All materials, fittings etc., used in earthing shall conform to Indian Standard Specifications, wherever they exist.

GENERAL REQUIREMENTS AND PROCEDURES FOR EARTHING AT SUB-STATIONS.

The ground resistance for sub-stations should not exceed a value 2(two) ohms. The joints/connections in the earthling, system shall be welded only, except the connections, which require opening for testing/maintenance. Such connections should be bolted tightly, using spring and ring washers for proper contact pressure. The G.S. flats to be provided for the horizontally laid earth grid should have overlap welded joints, with length of welding at least twice the width of the flat, e.g., 100 MM for 50x6 MM G.S. flats. There should not be any dirt, grease, oil, enamel, paint or any such non-conductive coatings on the surfaces being joined/ connected. Only the finished joints/connections above ground may be provided with red-oxide or any other protective coating. Underground earth electrodes and earth grid elements, when laid, should have a clean metallic surface, free from paint, enamel, grease or any such non-conductive coatings.

As far as possible, all earth connections should be accessible for visual inspection. No cut-outs, links or switches, other than linked switches arranged to operate simultaneously on the earthed or earthed neutral conductor and the live wire shall be inserted in the supply system. Earth electrodes or mate should not be installed in close proximity to metal fence to avoid possibility of fence becoming live. Separate earth electrodes, isolated from the earth grid, are to be provided for grounding the fence wires.

Pipes or rods used as electrodes should be in one piece, as far as possible, with a minimum allowable length of 3 mtrs. Except where rock or hard stratum is encountered, the pipe/rod electrodes should be driven into the ground to a minimum depth of 3 mtrs. The strip electrodes, forming the horizontal gild, should be buried underground to a minimum depth of 0.5 mtrs. The path of earth wire should be out of normal reach of any person, as far as possible.

For high resistivity soils, above 100 Ohm-mtrs., attempts should be made to bring the soil resistivity in the range of 50 to 60 Ohm-mtrs. By digging and treating the soil mass around the earth grid/electrodes with a mixture of salt and charcoal.

In case of rocky top soil and sub-stratum, having very high resistivity, with no scope of improvement by other means, the procedure given below should be followed:

1. At least two bores of diameter little less than 40 mm, with a minimum distance of 10 mtrs. between them, should be made in the ground at suitable locations inside the S/S yard. The boring should be done until soil sub-stratum rich in moisture and low in resistivity is encountered. G.I. pipes of 40 MM dia. should be descended in each bore, such that, the soil mass around the pipes grips them tightly, Back – filling of bores, if required, with wet soil/clay may be done to ensure this condition. The G.I. pipes in these deep bores should be interconnected with the main earthing grid of the S/S through 50x6 mm G.S. flat, with all the joints/connections and terminations being either fully welded, or clamped/bolted and welded simultaneously. The G.I. pipes in the bores should also be interconnected with each other. In extreme cases, the bores may have to be made at remote locations i.e. outside the S/S yard, with inter-connections, through 50x6 MM flats, as explained before.

2. The procedures to be observed stringently for making connections and joints between various elements of the earthing system are as follows:

a. G.S. flat to Structure/flat - The G.S. flat should be welded to the metallic portion (leg) of the structure after thoroughly cleaning the surfaces to be welded. The length of the welding should be at least twice the width of the G.S. flat, e.g.-minimum 100 mm for 50x6 mm G.S. flat. Exactly similar procedure is to be adopted for joints between two G.S. flats.

b. G.I. wire to structure. The G.I. wire should be bolted to the structure after making an eye formation and kept tight with the help of spring and ring washer. Then, the entire arrangement should be welded.

c. G.I. wire to G.S. flat- The G.I. wire should be bolted and then welded to G.S. flat, as explained above.

d. G.I. rod to G.S. flat- The G.I. rod should be securely clamped to the G.S. flat with the help of bolts and washers and the entire arrangement should then be welded.

e. G.I. wire to G.I. pipe – GI wire should be bolted to the G.I. pipe and then welded, keeping in view the relevant precautions, mentioned before.

f. G.I. flat to G.I pipe – The GI flat should be bolted tightly to the G.I. pipe and then the connection should be welded.

Before making connections and joints, it should be ensured that, the elements to be joined have a clean metallic contact surface without any non-conductive coating.

EARTH GRID SYSTEM

Grid system of interconnected conductors forming a closed loop mesh is to be installed using 75x8 mm MS flat for peripheral and branch conductors. Interconnections are made by welding them. This earth grid will be laid at a depth of about 0.5 mtr. bonded to general mass of the earth by 3 mtrs. long earth electrode of solid MS rod (or pipe) of dia 25mm. The G.I. pipe 40 mm. dia 3 mtrs. long in the earthing pits, driven vertically.

It is to this earth grid that the transformer neutral, apparatus, frame work and other non-current carrying metal work associated like transformer tank, switchgear frame etc. are to be

connected. All these connections should be made in such a way that reliable and good electrical connection is ensured. Aluminum/ other paint, enamel, grease and scale should be removed from the point of contact before connections are made. No part of the ground connection leads should be embedded in concrete.

Arrangement of connection of earth connection shall be as follow:

1. STRUCTURES:

Structures including frames, metal supports within the substation grid at least two legs, preferably diagonally opposite (where more than two legs are provided) on each metal structure shall be connected to earth grid with GI wire of 4mm dia or 6 mm dia.

2. ISOLATORS/ SWITCHES:

The operating handle shall be connected to earth grid independent of the structure earthing or through the steel mounting structure, through 4 mm dia G.I. wire.

3. LIGHTNING ARRESTOR:

The bases of lightning arrestors shall be directly connected to the earth electrodes by 4 or 6 SWG G.I. wires as short and as straight as practicable, to ensure minimum impedance. Separate earth leads should be used for L.A. in each phase. In addition there shall be as direct connections as practicable from the earthed side of the lightning arrestors to the frame of the apparatus being protected. Surge counters, could also be inserted in the circuit where lightning incidences are high, but in such cases, the lightning arrestor should be mounted on insulated base. Invariably, earth connections for lightning arrestors should be separate, and in no case should they be joined looped or meshed with other conductors. For lightning arrestors mounted near transformers, earthing connections shall be done with the earthing pits and earthing leads shall be laid clear of the tank and collars in order to avoid possible oil leakage caused by arcing. The earth connection should not pass through iron pipes, as it would increase the reactive impedance of the connection.

4. POWER TRANSFORMER:

- The tank of the transformer shall be directly connected to the main earth grid. In addition there shall be a separate and as direct a connection as practicable from the tank to the earth side of protecting LA using 4 or 6 SWG GI wire.

- The earthing of the neutral shall be by two separate, distinct and direct connections of 50x6 mm GS flat to earth pits, which form a part of the earth grid, and shall be run clear of the tank and collars.

- The transformer track rails shall be connected to earth

5. OUT DOOR VCB:

At least two legs, preferably diagonally opposite of the supporting structure frame work of each circuit breaker unit shall be connected to the earth grid, through 50x6 mm G.S. flats.

6. FENCING:

Fencing and gate should be earthed separately.

7. CURRENT TRANSFORMERS / POTENTIAL TRANSFORMERS:

The bases of the current transformers should be directly connected to the earth grid through 4 or 6 SWG G.I. wires. The base (neural side) of the P.Ts. should be directly connected to the earth grid through 4 or 6 SWG G.I. wires. Separate earth leads should be used for P.Ts. in each phase. The termination of leads on the P.T. neutral should be bolted/clamped and not welded, to facilitate opening of the earth connection for testing purposes. In addition, all bolted cover plates to which bushings are attached, should be connected to the earth grid, both in case of C.Ts. and P.Ts.

8. Armoring of armored metal-sheathed cables within the station grid area shall be connected to the earth grid.

9. Substation L.T. Supply Transformer: Same as above except that the neutral earthing conductor used shall be 4 or 6 SWG G.I. wire.

GI Earthing Pipe

Earthing pipe should be made of 40 mm diameter ISI marked B class GI Pipe. 12 mm dia suitable holes on its circumference shall be made as per approved drawing. The pipe should be in one piece. No joints or welding would be allowed on its length. Clamps made of 50x6mm GI flat duly drilled with 12 mm size holes should be welded at the top end for connection of earth conductor.

Pipe used shall be 40mm NB diameter, ISI marked Galvanized Mild Steel Tubes continuously welded Electric Resistance Welded ERW/High Frequency Induction welded (HFIW)/Hot finished welded (HFW) type, conforming to IS-554-1985 with latest amendment of MEDIUM quality (Class B).

1. MANUFACTURE:

GI earth pipe (40 mm diameter & 3 metre long) shall be made of tubes which shall be made from tested quality steel manufactured by any approved process as follows:

a) Electric Resistance Welded (ERW).
b) High Frequency Induction Welded (HFIW) and
c) Hot finished Welded (HFW).

Tubes made by manual welding are not acceptable.

2. DIMENSIONS:

The dimensions and weights of tubes shall be in accordance with Table-I and Table-II of IS: 1239 (Part-I)/1990 with latest amendments, subject to tolerance permitted therein. Necessary 12 mm diameter holes across the circumference shall be provided as per approved drawing. Drawings shall be approved by the owner before start of the manufacturing work. The tube, earthing pipe shall be provided with 50x6mm GS clamps on one end, one clamp is to be welded with the pipe and another is removable to enable measurement of earth resistance of the pit. Other end of the earth pipe should be cut half in slop to make it a sharp.

3. GALVANIZING:

Tubes shall be galvanized in accordance with IS-4736-1986 with latest amendment for not dip zinc coating of Mild Steel Tubes. The minimum mass of zinc coating on the tubes shall be in accordance with clause 5.1 of IS-4736-1986 (specification for hot dip zinc) and when determined on a 100mm long test piece in accordance with IS: 6745:1972 shall be 400 g/m^2. The zinc coating shall be uniform adherent reasonably smooth and free from such imperfections as flux, ash and dross

inclusions, bare patches, black spots, pimples, lumpiness, rust, stains, bulky white deposits and blisters.

4. HYDRAULIC TEST:

(Before applying holes) Each tube shall withstand a test pressure of 5 M Pa maintained for at least 3 seconds without showing defects of any kind. The pressure shall be applied by approved means and maintained sufficiently long for proof and inspection. The testing apparatus shall be fitted with an accurate pressure indicator

5. TEST ON FINISHED TUBES AND SOCKETS:

The following tests shall be conducted by the manufacturer of finished tubes and sockets.

a) The tensile strength of length of strip cut from selected tubes when tested in accordance with IS-1894-1972, (Method for tensile testing of steel tubes), shall be at least 320N/mm^2.

b) The elongation percentage on a gauge length of 5.65/so (where so is the original cross-sectional area of test specimen) shall not be less than 20%.

c) When tested in accordance with IS-2329-1985 (Method for Bend test on Metallic tubes) the finished tube shall be capable of with standing the bend test without showing any sign of fracture or failure. Welded tubes shall be bent with the weld at 90 degree to the plane of bending. The tubes shall not be filled for this test.

d) Galvanized tubes shall be capable of being bent cold without cracking of the steel, through 90 degree round a former having a radius at the bottom of the groove equal to 8 times the outside diameter of tube.

e) Flattening Test on Tubes above 50 mm Nominal Bore: Rings not less than 40 mm in length cut from the ends of selected tubes shall be flattered between parallel plates with the weld, if any, at 90 degree (point of maximum bending) in accordance with IS-2328-1983. No opening should occur by fracture in the weld unless the distance between the plate is less than 75 percent of the original outside diameter of the pipe and no cracks or breaks in the metal elsewhere than in the weld shall occur, unless the distance between the plates is less than 60% of the original outside diameter. The test rings may have the inner and outer edges rounded.

f) GALVANISHING TEST:

- Weight of zinc Coating: For tubes thickness upto 6 mm the minimum weight of zinc coating, when determined on a 100 mm long test piece in accordance with IS-4736-1986 shall be 400 grm/m^2.

- The weight of the coating expressed in gram/m^2 shall be calculated by dividing the total weight of the zinc (inside plus outside) by the total area (inside plus outside) of the coated surface.

- Test specimen for this test shall be cut approximately 100 mm in length from opposite ends of the length of tubes selected for testing. Before cutting the test specimen, 50 mm from both ends of the samples shall be discarded.

g) Free Bore Test: A rod 230mm long and of appropriate diameter shall be passed through relevant nominal bore of the sample tubes to ensure a free bore.

h) Uniformity of Galvanized Coating: The galvanized coating when determined on a 100 mm long test piece [see V (a) (iii)] in accordance with IS-2633-1986 (Method for testing uniformity of coating on zinc coated articles) shall with stand 4 one minute dips.

6. WORKMANSHIP:

The tubes shall be cleanly finished and reasonably free from injurious defects. They shall be reasonably straight, free from cracks, surface flaws, laminations, and other defects, both internally and externally. The screw tubes and sockets shall be clean and well-cut. The ends shall be cut cleanly and square with the axis of tube.

7. MARKING:

The medium class of tubes shall be distinguished by Blue colour bands which shall be applied before the tubes leaves the manufacturers' works. Tubes shall be marked with the standard mark.

TECHNICAL SPECIFICATION OF GI STAY SETS

1. 16MM DIA STAY SETS (GALVANIZED)

The stay sets (Line Guy set) will consist of the following components:-

a) **ANCHOR ROD WITH ONE WASHER AND NUT**: Overall length of rod should be 1800 mm to be made out of 16 mm dia GS Rod, one end threaded upto 40mm length with a pitch of 5 threads per cm and provided with one square GS washer of size 40x40x1.6mm and one GS hexagonal nut conforming to IS:1367:1967 & IS:1363:1967. Both washer and nut to suit threaded rod of 16mm dia. The other end of the rod to be made into a round eye having an inner dia of 40mm with best quality welding.

b) **ANCHOR PLATE SIZE 200x200x6MM**: To be made out of GS plate of 6mm thickness. The anchor plate should have at its centre 18mm dia hole.

c) **TURN BUCKLE & EYE BOLT WITH 2 NUTS**: To be made of 16mm dia GS Rod having an overall length of 450 mm, one end of the rod to be threaded upto 300 mm length with a pitch of 5 threads per cm and provided with two GS Hexagonal nuts of suitable size conforming to IS:1363:1967 & IS:1367:1967. The other end of rod shall be rounded into a circular eye of 40mm inner dia with proper and good quality welding.

d) **BOW WITH WELDED ANGLE**: To be made out of 16mm dia GS rod. The finished bow shall have an overall length of 995mm and height of 450 mm, the apex or top of the bow shall be bent at an angle of 10 R. The other end shall be welded with proper and good quality welding to a GS angle 180mm long having a dimension of 50x50x6mm. The angle shall have 3 holes of 18mm dia each.

e) **THIMBLE**: To be made on 1.5 mm thick GS sheet into a size of 75x22x40mm and shape as per standard shall be supplied.

f) **Galvanizing**: The complete assembly shall be hot dip galvanized.

g) **WELDING:** The minimum strength of welding provided on various components of 16mm dia stay sets shall be 3100 kg. Minimum 6 mm fillet weld or its equivalent weld area should be deposited in all positions of the job i.e. at any point of the weld length. The welding shall be conforming to relevant IS: 823/1964 or its latest amendment. Minimum length of weld to be provided at various places in the stay sets shall be indicated by the bidder. Welding if, found short in lengths as per final approved drawings shall be rejected.

h) **THREADING:** The threads on the Anchor Rod, Eye Bolt & Nuts shall be as per specification IS: 4218:1967 (ISO Metric Screw Threads). The nuts shall be conforming to the requirement of IS: 1367:1967 & have dimensions as per IS; 163:1967. The mechanical property requirement of fasteners shall conform to property clause 4.6 each for anchor rod & Eye bolt and property clause 4 for nuts as per IS: 1367:1967.

AVERAGE WEIGHT OF FINISHED 16MM STAY SETS 7.702 KG. (MINIMUM) (EXCLUDING NUTS THIMBLES AND WASHERS) 8.445 KG. (MAXIMUM)

2. 20 MM DIA STAYS SETS FOR 33KV LINES (GALVANIZED)

THE STAY SET (LINE GUY SET) WILL CONSIST OF THE FOLLOWING COMPONENTS:

a) **ANCHOR ROD WITH ONE WASHER AND NUT**: Overall length of Rod should be 1800mm to be made out of 20mm dia GS Rod, one end threaded upto 40mm length with a pitch of a threads per cm. And provided with one square G.S. Washer of Size 50x50x1.6mm and one GS Hexagonal nut conforming to IS:1367:1967 & IS:1363:1967. Both washer & nut to suit the threaded rod of 20mm. The other end of the rod to be made into a round eye having an inner dia of 40mm with best quality welding. Dimensional and other details are indicated and submitted by bidders for owner's approval before start of manufacturing.

b) **ANCHOR PLATE**: Size 300x300x8mm: To be made out of G.S. Plate of8mm thickness. The anchor plate to have at its centre 22mm dia hole.

c) **TURN BUCKLE, EYE BOLT WITH 2 NUTS:** To be made of 20mm dia G.S. Rod having an overall length of 450 mm. One end of the rod to be threaded upto 300mm length with a pitch of 4 threads per cm. The 20mm dia bolt so made shall be provided with two G.S. Hexagonal nuts of suitable size conforming to IS:1637/1967 & IS:1363/1967.

The other end of the rod shall be rounded into a circular eye of 40mm inner dia with proper and good quality of welding. Welding details are to be indicated by the bidder separately for approval.

d) **BOW WITH WELDED CHANNEL:** To be made out of 16mm dia G.S. Rod. The finished bow shall have and overall length of 995 mm ad height of 450 mm. The apex or top of the bow shall be bent at an angle of 10R. The other end shall be welded with proper and good quality welding to a G.S. Channel 200mm long having a dimension of 100x50x4.7 mm. The Channel shall have 2 holes of 18 mm dia and 22 dia hole at its centre.

e) **THIMBLE 2 Nos.**: To be made of 1.5mm thick G.S. sheet into a size of 75x22x40mm and shape as per standard.

f) **GALVANISING**: The complete assembly shall be hot dip galvanised.

g) **WELDING**: The minimum strength of welding provided on various components of 20mm dia stay sets shall be 4900 kg. Minimum 6mm filet weld or its equivalent weld area should be deposited in all positions of the job i.e. at any point of the weld length. The welding shall be conforming to relevant IS: 823/1964 or its latest amendment.

h) **THREADING:** The threads on the Anchor Rods, Eye Bolts and Nuts shall be as per specification IS: 4218:1967 (ISO Metric Screw Threads). The Nuts shall be conforming to the requirements of IS: 1367:1967 and have dimension as per IS 1363:1967. The mechanical property requirement of fasteners shall confirm to the properly clause 4.6 each for anchor rods and Eye bolt and property clause 4 for nuts as per IS: 1367:1967.

AVERAGE WEIGHT OF FINISHED 20MM STAYS SET: 14.523 KG. (MIN.) (EXCLUDING NUTS THIMBLE & WASHER): 15.569 KG. (MAX.)

3. TEST CERTIFICATE: The contractor shall be required to conduct testing of materials at Govt./Recognized testing laboratory during pre – dispatch inspection for Tensile Load of 3100 Kg/4900 Kg. applied for one minute on the welding & maintained for one minute for 16 mm and 20 mm dia stay sets respectively.

4. IDENTIFICATION MARK: All stay sets should carry the identification mark of word IPDS and size of the stay set. This should be engraved on the stay plate and on stay rods to ensure proper identification of the materials.

The nuts should be of a size compatible with threaded portion of rods and there should be no play or slippage of nuts.

Welding wherever required should be perfect and should not give way after erection.

5. TOLERANCES: The tolerances for various components of the stay sets are indicated below subject to the condition that the average weight of finished stay sets of 16mm dia excluding nuts, thimbles and washers shall not be less than the weight specified above :-

No. Item	Section Tolerances	Fabrication Tolerances	Material
1 Anchor Plate	6mm thick + 12.5% - 5%	200x200mm + 1%	GS plate 6mm thick
	8mm thick + 12.5% - 5%	300x300mm + 1%	GS plate 8mm thick
2 Anchor Rod	16mm dia + 5%- 3%	Length 1800mm + 0.5%	GS Round 16mm dia
		Rounded Eye 40 mm inside dia + 3%. Threading 40mm+11% - 5	GS Round 16mm dia
	20mm dia + 3%- 2%	Length 1800mm + 0.5%	GS Round 20mm dia
		Round Eye 40mm inside dia + 3%. Threading 40mm +11% - 5%	GS Found 20mm dia
3 Turn Buckle Bow	16 mm dia + 5%- 3%	Length 995mm + 1% 16mm dia	GS Round 16mm dia
		Length 180mm + 1% 50x50x6mm	GS Angle
		Channel length 200mm + 1%	GS Channel 100x50x4.7mm
4 Eye Bolt Rod	16mm dia + 5%- 3%	Length 450mm + 1% Threading 300mm + 1% Round Eye 40mm inside dia + 3%	GS Round 16mm dia
	20mm dia + 3%- 2%	Length 450mm + 1% Threading 300mm + 1% Round Eye 40mm inside dia + 3%	GS Round 20mm dia

TECHNICAL SPECIFICATION OF GI STAY WIRES

1. SCOPE

This Specification covers details of G.I. stranded stay wires for use in rural distribution system.

2. APPLICABLE STANDARDS

Except when they conflict with the specific requirements of this specification, the G.I. Stranded Wires shall comply with the specific requirements of IS:2141-1979. IS:4826-1979 & IS:6594-1974 or the latest versions thereof.

3. APPLICATION AND SIZES

3.1 The G.I. stranded wires covered in this Specification are intended for use on the verhead power line poles, distribution transformer structures etc.

3.2 The G.I. stranded wires shall be of 7/2.5mm, 7/3.15mm and 7/4.0mm standard sizes.

4. MATERIAL

The wires shall be drawn from steel made by the open hearth basic oxygen or electric furnace process and of such quality that when drawn to the size of wire specified and coated with zinc, the finished strand and the individual wires shall be of uniform quality and have the properties and characteristics as specified in this specification. The wires shall not contain sulphur and phosphorus exceeding 0.060% each.

5. TENSILE GRADE

The wires shall be of tensile grade 4, having minimum tensile strength of 700 N/mm2 conforming to IS:2141.

6. GENERAL REQUIREMENTS

6.1 The outer wire of strands shall have a right-hand lay.

6.2 The lay length of wire strands shall be 12 to 18 times the strand diameter.

7. MINIMUM BREAKING LOAD

The minimum breaking load of the wires before and after stranding shall be as follows :

No. of wires & const.	Wire dia (mm)	Min. breaking load of Single wire before stranding (KN)	Min. breaking load of the standard wire (KN)
7(6/1)	2.5	3.44	22.86
7(6/1)	3.15	5.45	36.26
7(6/1)	4.0	8.79	58.45

8. CONSTRUCTION

8.1 The galvanised stay wire shall be of 7-wire construction. The wires shall be so stranded together that when an evenly distributed pull is applied at the ends of completed strand, each wire shall take an equal share of the pull.

8.2 Joints are permitted in the individual wires during stranding but such joints shall not be less than 15 metres apart in the finished strands.

8.3 The wire shall be circular and free from scale, irregularities, imperfection, flaws, splits and other defects.

9. TOLERANCES

A tolerance of (±)2.5% on the diameter of wires before stranding shall be permitted.

10. SAMPLING CRITERIA

The sampling criteria shall be in accordance with IS:2141.

11. TESTS ON WIRES BEFORE MANUFACTURE

The wires shall be subjected to the following tests in accordance with IS:2141.

i) Ductility Test

ii) Tolerance on Wire Diameter

12. TESTS ON COMPLETED STRAND

The completed strand shall be tested for the following tests in accordance with IS:2141.

a) Tensile and Elongation Test : The percentage elongation of the stranded wire shall not be less than 6%.

b) Chemical analysis

c) Galvanising Test : The Zinc Coating shall conform to "Heavy Coating" as laid down in IS:4826

13. MARKING

Each coil shall carry a metallic tag, securely attached to the inner part of the coil, bearing the following information:

a) Manufacturers' name or trade mark
b) Lot number and coil number
c) Size
d) Construction
e) Tensile Designation
f) Lay
g) Coating
h) Length
i) Mass
j) ISI certification mark, if any

14. PACKING

The wires shall be supplied in 75-100 Kg. coils. The packing should be done in accordance with the provisions of IS:6594.

TECHNICAL SPECIFICATION OF MCCB

The MCCBs provided in these boxes shall conform in all respects to the relevant IS: 2516 (Pt-I&II)/1977 or its latest revision as applicable.

REQUIREMENT OF MCCBs:

The moulded case circuit breakers should comprise of a switching mechanism, an effective extinguishing device and a tripping unit contained in a compact moulded case cover made of high strength, heat resistance and flame retardant thermo-insulating materials. They should comprise of a spring assisted quick make/quick break type independent manual trip free mechanism rendering it easy to manually operate the MCCBs and capable of clearly indicating "TRIPPED", "ON" AND "OFF" positions from the position of the operating handle. The contact tips should be made of a suitable alloy having high arc resistance and a long electrical and mechanical life needing no replacement. The breakers should be designed with a common trip bar to break and make all the three phase together even when fault occurs on any of the phases. The breakers should provide protection against sustained overloads and short circuits through thermal-magnetic/fully magnetic releases. These MCCBs along with terminal blocks are intended to be housed in the distribution boxes made out of sheet steel of 2mm gauge. The assembly of the MCCBs and the terminal blocks should be compact, reliable from operation point of view and safe to the operating personnel. As already mentioned earlier, the MCCBs should be fully maintenance free.

TECHNICAL PARTICULARS OF MCCBs:

The LT MCCBs should have inverse current/time characteristics suitable for protection of 63KVA, 100KVA, 200KVA & 315KVA 11.0.4KV Distribution Transformers against sustained over-loads and short circuits for following operating conditions:-

i	Rated Operating Voltage	3 Phase 415 Volts AC 50 cycles with neutral solidly grounded system
ii	Standard rated current ratings for MCCBs to be used with different sizes of transformers will be as follows:-	
a)	For 63KVA 11/0.4KV Dist. Transformer	90 Amps
b)	For 100KVA 11/0.4KV Dist. Transformer	140 Amps
c)	For 200KVA 11/0.4KV Dist. Transformer	300 Amps
d)	For 315KVA 11/0.4KV Dist. Transformer	450 Amps
iii	No. of Poles	3
iv	Duty	Un-interrupted
v	Maximum ambient temperature	47^{o}C in shade
vi	Minimum ambient temperature	4^{o}C in shade

vii	Average altitude	A maximum of 1000 meter
viii	Maximum humidity	Frequently approaches saturation point

TIME/CURRENT CHARACTERISTICS:

The circuit breakers shall have time/current characteristics suitable for following operating conditions

Multiple of normal current rating	Tripping time
1.1 times	After 4 hours
1.2 times	Less than 50 minutes
1.3 times	Less than 30 minutes
1.4 times	Less than 10 minutes
2.5 times	Less than 1 minute
6 times	Less than 40 mili-seconds
12 times	Less than 40 mili-seconds

Time/Current characteristic of the Circuit Breaker (MCCB) shall be tested in accordance with Clause-7.7.2.3 (b) (2) of IS:2516-(Pt-I&II) Sec.I/1977 and the test shall be made with all the three phases loaded.

For time/current characteristic, the reference calibration temperature of the MCCBs shall be 40^{o}C and durance, if any, upto 50^{o}C operating temperature in the enclosure shall not exceed 10% of the value indicated above in Clause (I) above.

The MCCBs shall be calibrated and adjusted in the factory itself for the desired time/current characteristic.

The MCCB should have the following maximum resetting time under overload & short circuit conditions :-

Overload conditions - 3 minutes

Short Circuit conditions - Instantaneous

RATED SHORT CIRCUIT BREAKING CAPACITY:

The rated short circuit breaking capacity of the MCCBs shall be as follows: -

Transformer rating(KVA)	Rated short circuit breaking capacity of the breaker in Kilo-Amps
63 KVA	A minimum of 3 Kilo-Amps
100 KVA	A minimum of 5 Kilo-Amps
200KVA	A minimum of 10 Kilo-Amps
315KVA	A minimum of 15 Kilo-Amps

The short circuit breaking capacity test as specified above shall be based on short circuit tests carried out at 0.4 Power Factor (lagging). For the purpose of these tests, the following operating sequence shall be followed: -

Break-3 minutes interval-Make-Break-3 minutes interval-Make-Break.

TECHNICAL SPECIFICATION OF H.R.C. FUSE

The H.R.C. fuse links of 100 Amp, 200 Amp, 300 Amp ratings, should be ISI marked & conforming to ISS: 9224-1979 with latest amendment and to be supplied with suitable base of bakelite on DMC. The knife contact should be made of tinned/silver plated copper complete with extension strips. The extension strips should be made of copper. The thickness of the cooper strips should be 2mm for 100 Amp and 200 Amp, 3.0mm for 300 Amp. The strips should be in one piece. The HRC Fuse units should also be supplied with suitable lugs for 3 core 95 sq.mm, 120 sqmm and 300 sq.mm. cables for 100, 200 and 300 Amps ratings respectively. The dimension of the lugs should be as under

S.No	Ratings of HRC Fuse unit	Cable sizes	Minimum thickness of lugs Flat (mm) / Rounded (mm)	Minimum total length of lugs (mm)
1	100 Amp	95 sq.mm	4.2 / 2.1	64
2	200 Amp	120 sq.mm	4.6 / 2.3	73
3	300 Amp	300 sq.mm	7.0 / 3.5	15

The knife contact should have pressure springs to hold the fuse links. The extension strips shall be provided with GI nut & bolts and plain and spring washer to both the end. The DMC or bakelite base should be provided with suitable fixing alignment.

The following test certificates should invariably to be performed on the HRC Fuse Units.

1. Test for temperature rise at rated current
2. Current time characteristics
3. Determination of minimum fusing current and minimum non-fusing current
4. Test for duty

The breaking capacity of HRC Fuse Units should not be less than 80 KA.

The following tests shall be performed during pre-despatch inspection at manufacturer's works: -

1. Insulation resistance test
2. Temperature rise test
3. High Voltage test

Marking on the fuse base and on the fuse links :

1. Name of the manufacturer
2. Rated current
3. Rated voltage
4. ISI marking and reference of 185 No. (only on fuse links)
5. Rated Power loss
6. Name of the Employer

Technical Specification of Triple Pole Switch Fuse Units with Neutral Links (200A, 320A & 400A/415 VOLTS RATINGS)

This specification covers manufacture, testing before dispatch and delivery of Triple Pole Switch Fuse Units with neutral Link and HRC cartridge type fuses suitable for AC 3 Phase 4 wire 415 V with neutral solidly grounded system. The working conditions and technical requirements are as under:-

TECHNICAL REQUIREMENTS

a)	Rated Current	:	200 Amps, 320 Amps & 400 Amps
b)	I) Rated Operational Voltage	:	3 Phase 4 Wire, 415 Volts AC 50 Hz with solidly earthed neutral
	II) Highest System Voltage	:	415V + 10%

c) Type of Fuse to be used : Non-deteriorating quick arcing type ISI marked HRC Cartridge fuse Links suitable for Class-1 category of duty of IS: 13703(Part-I). The temperature rise shall be in accordance with IS:13703 (Part-I) (with latest amendments) over and above the ambient temperature of 45^{o}C. It shall be used for protecting the distribution circuits and distribution transformers and shall be capable of carrying continuously the above stated rated current safely.

d)	Number of Poles	:	Three
e)	Neutral Link	:	One
f)	Duty	:	Un-interrupted duty
g)	Rated fused short circuit	:	40KA for 1 second. Withstands current capacity at 415V
h)	Utilization category as	:	AC-23 (B) as defined in IS: 13947 (Pt-III)/ 1993

GENERAL

1. CONTACTS AND BLADES & OPERATING MECHANISM

The switch shall be a combination of double beak per pole AB switch with HRC fuses in all the three phases. The switch shall be spring assisted, quick make and quick break type having operating mechanism independent of he speed of the operator to minimize the acing. If required, additional contact springs shall be provided to maintain correct contact pressures throughout operating life of the switches. The switch shall be so constructed that the alignment of its contacts & blades, which will be made of silver plated electrolytic copper/tinned copper, is maintained under asymmetrical fault conditions also. The tenders should furnish in their offers about the details of switching mechanism and the contacts. The switch shall have positive break feature such that it is

possible to make it OFF even if the quick action spring fails due to ageing or other causes. The switch fuse unit shall be provided with double break per pole to ensure complete isolation of HRC Fuses from both incoming and outgoing circuits when the switch is in OFF position, in order to minimize the damage to the maintenance personnel. Ample flash over distances shall be provided so as to make the unit suitable for controlling highly inductive loads.

2. ENCLOSURES

The Triple Pole Switch fuse units shall be totally enclosed in robust enclosures made out of 16 guage/1.5 mm pressed steel sheet (conforming to relevant ISS for M.S. sheet) designed to withstand humid and hot weather conditions. The enclosures should have adequate strength and rigidity to withstand rough usage without fracture or permanent distortion. Suitable mounting arrangement shall be provided on the enclosures for mounting the units on a supporting structure.

3. INTER LOCK

It should not be possible to open the switch cover when the switch is in 'ON' position and also it should not be possible to operate the switch 'ON' when the switch cover is open.

4. PAINTING

The inside and outside of the enclosure should be painted with a grey paint. Before painting the surface, the same should be chemically cleaned for removing rust, grease etc. Then it should be given phosphate coating, followed by two coats of anti-rust primer (i.e. Red zinc Chrome Primer), after which two coats of synthetic paint of light grey colour shall be applied on internal and external surfaces of the enclosures with a spray gun. The enclosures shall then be baked in oven so as to give an elegant and durable finish.

5. EARTHING

The enclosure shall be provided with earthing arrangements at two places.

6. TERMINAL CONNECTIONS

The switch shall be provided with aluminium lugs for termination of PVC coated aluminium cables of following sizes: -

S.N	Capacity of TPN Switches	Size of Cable	No. of cable sockets required
1	200 Amps	150 sq.mm. 3.5 Core stranded aluminium cable	8 Nos. (3 Nos. phase leads and 1 natural lead for incoming and also 3 Nos. phase leads and 1 neutral for outgoing connections)
2	320 Amps	300 sq.mm. 3.5 Core stranded aluminium cable	-do-
3	400 Amps	300 sq.mm. 3.5 Core stranded aluminium cable	-do-

7. All the surface contacts (e.g. lugs, connectors, fixed contacts, moving contacts etc.) should be fitted with GI nuts & bolts having yellowish OR whitish passivation with good finish.

8. TESTING & TEST CETIFICATES FOR SWITCHES

The performance of the switch should conform to IS:10027/1981 with latest amendments. Accordingly, certificates from reputed laboratories such as CPRI, ERDA, IITs, for the type tests in accordance with IS:10027/1981 with latest amendment would necessarily be furnished by the tenderers along with offer.

9. USE OF ISI MARK HRC FUSES

The HRC Fuses with ISI mark only should be used. These HRC fuses should conform to IS:13703 (Part-I)/1993 or as per its latest revision. The rated current of HRC fuses must be 200 Amps for 200 Amps Switches, 315 Amps for 320 Amps Switches and 400 Amps for 400 Amps Switches.

10. IMPORTANT NOTE

The firms must consider supply of 'ISI' certificate (valid on date) products on their offer in the tender, Other certification such as ISO:9001 & 9002 shall be given due weightage while considering their offer, however, the attested photo copies of such certification must be enclosed with the offer.

11. INSULATION FOR LIVE PARTS

All live parts shall be fully shielded with bakelite shrouds.

Technical Specification of Clamps & Connectors

CLAMPS & CONNECTORS: Clamps & connectors shall conform to IS: 5561. The clamps and connectors shall be made of materials listed below:

For connecting ACSR conductors	Aluminium alloy casting, conforming to designation A6 of IS: 617 and shall be tested for all tests as per IS: 617
For connecting equipment terminals made of copper with ACSR conductor	Bimetallic connectors made from aluminium alloy casting conforming to designation A6 of IS:617 with 2mm thick Bimetallic liner and shall be tested as per IS:617
For connecting GS shield wire	Galvanised mild steel
Bolts, Nuts & plain washers	Hot dip galvanised mild steel for sizes M12 and above, and electro-galvanised for sizes below M12
Spring washers for items ‘a’ to ‘c’	Electro-galvanised mild steel suitable for at least service condition 4 as per IS:1573

All castings shall be free from blow holes, surface blisters, cracks and cavities. All sharp edges and corners shall be blurred and rounded off.

No current carrying part of a clamp or connector shall be less than 10 mm thick. They shall be designed and manufactured to have minimum contact resistance.

For Bimetallic clamps or connectors, copper alloy liner of minimum 2 mm thickness shall be provided.

Flexible connectors, braids or laminated strips made up of copper/ aluminium for the terminal clamps for equipment shall be suitable for both expansion or through (fixed/ sliding) type connection of IPS Aluminium tube as required. In both the cases the clamp height (top of the mounting pad to center line of the tube) should be same.

Size of the terminal/conductor for which the clamp/connector is suitable shall be embossed/punched (i.e. indelibly marked) on each components of the clamp/ connector, except on the hardware.

Clamp shall be designed to carry the same current as the conductor and the temperature rise shall be equal or less than that of the conductor at the specified ambient temperature. The rated current for which the clamp/ connector is designed with respect to the specified reference ambient temperature, shall also be indelibly marked on each component of the clamp/connector, except on the hardware.

Clamps and connector shall be designed corona controlled. Clamps & connectors shall conform to type tests and shall be subjected to routine and acceptance tests on minimum 3 samples per lot as per IS: 5561. Type tests report for all clamps and connectors for temperature rise test, tensile test, shall be furnished by the Contractor.

TECHNICAL SPECIFICATION OF EPOXY BASED PROTECTIVE PAINT

1. SCOPE

This specification covers the requirement of self-priming epoxy-based protective paint both for new and old steel structures such as poles, sub-station structures etc.

2. COMPOSITION

The paint shall be epoxy-based with metallic zinc as an essential component. The paint shall be supplied in two components and shall be suitable for a single coat application. It shall have such composition as to satisfy the requirements of this standard. The mixing ratio (base-to-accelerator) shall be specified by the manufacturer.

3. REQUIREMENTS

3.1	Volume Solids	85% (±)3%
3.2	Theoretical covering Capacity	6.5 sq. mtrs. per litre at 125 microns dry film thickness
3.3	Weight per 10 litres of mixed paint	14 to 15 Kg. (±) 0.3 kg
3.4	Drying time (at 30 OC) dry	Surface : Not more than 4 hours Hard Dry : 16-18 hours Recoating Time: 16-18 hours Curing time : 7 days
3.5	Scratch hardness (with 1.5 kg. load)	No such scratch as to show the base metal
3.6	Finish	Smooth and semi-glossy
3.7	Colour	Ash Grey or Aluminium (as required)
3.8	Dry Film Thickness	The paint shall develop a dry film of minimum 100-125 microns in a single coat (measured by Elcometer)
3.9	Flash point	Not below 40 OC
3.10	Flexibility and adhesion	The paint shall not show damage, detachment or cracking.
3.11	Resistance to humidity	Shall pass 1000 hours (minimum) at 125 microns D.F.T
3.12	Resistance to lubricating oil petroleum, hydrocarbon solvent,petrol and heat	Shall show no sign of permanent injury

4. STORAGE LIFE & POT LIFE

4.1	Storage life	Minimum 6 months from the date of manufacture in original sealed container under normal covered storage conditions
4.2	Pot life (at 30OC)	Not less than 4 hours

5. DURABILITY

Under severe surface conditions, paint shall protect the substrate at least for 5 years, if it is wire-brushed/power tool cleaned and 7 years for commercially grit-blasted steel sub-strate.

6. SURFACE PREPARATION

If possible, the surface on which the paint has to be applied shall be cleaned by grit blasting, otherwise manual wire brushing or power tool cleaning process may be used as convenient.

7. METHOD OF APPLICATION

Brushing, rollers or spraying.

8. TESTS

The following tests shall be carried out in accordance with the procedure given in the Indian Standard quoted against each, except requirements stipulated in clauses 3.1 and 3.2 which shall be tested in accordance with the procedure indicated in Annexure-II; preparation of painted panels for conducting different tests shall be done as given in Annexure-I.

8.1 Requirement stipulated in clauses 3.3 to 3.12 - **IS:101**

8.2 **Resistance to Salt Spray**

Shall pass 1000 hours (minimum with 200 microns D.F.T.) - **IS:2074**

8.3 **Chemical Resistance**

Shall be resistant to acid/alkaline chemicals or solvents - **IS:8662**

9. PACKAGE

Unless otherwise specified by the purchaser, the paint shall be normally supplied in 2 litre packs.

TECHNICAL SPECIFICATION OF MID SPAN COMPRESSION JOINT AND REPAIR SLEEVE

1.0 Mid Span Compression Joint

1.1 Mid Span Compression Joint shall be used for joining two lengths of conductor. The joint shall have a resistivity less than 75% of the resistivity of equivalent length of conductor. The joint shall not permit slipping off, damage to or failure of the complete conductor or any part thereof at a load less than 95% of the ultimate tensile strength of the conductor.

1.2 In ACSR conductors, the joint shall be made of steel and Aluminium for jointing the steel core and Aluminium respectively. The steel sleeve should not crack or fail during compression. The Brinnel Hardness of steel sleeve shall not exceed 200. The steel sleeve shall be hot dip galvanised. The Aluminium shall have Aluminium/alloy. Aluminium plugs shall also be provided on the line of demarcation between compression and non compression zone.

2.0 Repair Sleeve

Repair Sleeve of compression type shall be used to repair conductor with not more than two strands broken in the outer layer. The sleeve shall be manufactured from Aluminium and shall have a smooth surface. The repair sleeve shall comprise of two pieces with a provision of seat for sliding of the keeper piece. The edges of the seat as well as the keeper piece shall be so rounded that the conductor strands are not damaged during **installation.**

3.0 Material and Workmanship

3.1 All the equipment shall be of the latest proven design and conform to the best modern practices adopted in the power line field. The Supplier shall offer only such equipment as guaranteed by him to be satisfactory and suitable for 11/33 kV transmission line application and will give continued good performance.

3.2 The design, manufacturing process and quality control of all the materials shall be such as to achieve requisite factor of safety for maximum working load, highest mobility, elimination of sharp edges and corners, best resistance to corrosion and a good finish.

3.3 All ferrous parts shall be hot dip galvanised, after all machining has been completed. Nuts may, however, be tapped (threaded) after galvanising and the threads oiled. Spring washers shall be electro galvanized as per grade 4 of IS-1573-1970. The bolt threads shall be undercut to take care of increase in diameter due to galvanising. Galvanising shall be done in accordance with IS:2629-1985 / IS-1367 (Part-13) and satisfy the tests mentioned in IS-2633-1986. Fasteners shall withstand four dips while spring washers shall withstand three dips. Other galvanised materials shall have a minimum over range coating of Zinc equivalent to 600 gm/sq.m and shall be guaranteed to withstand at least six dips each lasting one minute under the standard Peerce test for galvanising unless otherwise specified.

3.4 The zinc coating shall be perfectly adherent, of uniform thickness, smooth, reasonably bright, continuous and free from imperfections such as flux, ash, rust stains, bulky white deposits and blisters. The zinc used for galvanising shall be of grade Zn.99.95 as per IS:209.

3.5 In case of castings, the same shall be free from all internal defects like shrinkage, inclusion, blow holes. cracks etc.

3.6 All current carrying parts shall be so designed and manufactured that contact resistance is reduced to minimum and localised heating phenomenon is averted.

3.7 No equipment shall have sharp ends or edges, abrasions or projections and shall not cause any damage to the conductor in any way during erection or during continuous operation which would produce high electrical and mechanical stresses in normal working. The design of adjacent metal parts and mating surfaces shall be such as to prevent corrosion of the contact surface and to maintain good electrical contact under all service conditions.

3.8 Particular care shall be taken during manufacture and subsequent handling to ensure smooth surface free from abrasion or cuts.

3.9 The fasteners shall conform to the requirements of IS:6639-1972. All fasteners and clamps shall have corona free locking arrangement to guard against vibration loosening.

4.0 Compression Markings

Die compression areas shall be clearly marked on each equipment designed for continuous die compressions and shall bear the words 'COMPRESS FIRST' 'suitably inscribed on each equipment where the compression begins. If the equipment is designed for intermittent die compressions, it shall bear the identification marks 'COMPRESSION ZONE' and 'NON-COMPRESSION ZONE' distinctly with arrow marks showing the direction of compression and knurling marks showing the end of the zones. The letters, number and other markings on finished equipment shall be distinct and legible.

5.0 Drawings

5.1 The Supplier shall furnish detailed dimensioned drawings of the equipments and all component parts. Each drawing shall be identified by a drawing number and Contract number. All drawings shall be neatly arranged. All drafting and lettering shall be legible. The minimum size of lettering shall be 3 mm. All dimensions and dimensional tolerances shall be mentioned in mm.

5.2 The drawings shall include

(i) Dimensions and dimensional tolerances

(ii) Material. Fabrication details including any weld details and any specified finishes and coatings. Regarding material, designations and reference of standards are to be indicated.

(iii) Catalogue No.

(iv) Marking

(v) Weight of assembly

(vi) Installation instructions

(vii) Design installation torque for the bolt or cap screw

(viii) Withstand torque that may be applied to the bolt or cap screw without failure of component parts

(ix) The compression die number with recommended compression pressure.

(x) All other relevant technical details

5.3 The above drawings shall be submitted in 3 copies with all the details as stated above along with the bid document. After the placement of award, The Contractor shall again submit the drawings in four copies to the Owner for approval. After

Owner's approval and successful completion of all type tests, 10 more sets of drawings shall be submitted to Owner for further distribution and field use at Owner's end.

6.0 Tests

6.1 Type Tests

6.1.1 Mid Span Compression Joint for Conductor

(a) Chemical analysis of materials (as per Annexure – A)

(b) Electrical resistance test

(c) Heating cycle test

(d) Slip strength test

6.1.2 Repair Sleeve for Conductor

(a) Chemical analysis of materials

6.1.3 Flexible Copper Bond

(a) Slip Strength Test (as per Annexure – A)

6.2 Acceptance Tests

6.2.1 Mid Span Comprression Joint for Conductor and Earthwire

(a) Visual examination and dimensional verification

(b) Galvanising test

(c) Hardness test

6.2.2 Repair Sleeve for Conductor

(a) Visual examination and dimensional verification

6.2.3 Flexible Copper Bond

(a) Visual examination and dimensional verification

(b) Slip strength test

6.3 Routine Tests

(a) Visual examination and dimensional verification

6.4 Tests During Manufacture

On all components as applicable

(a)	Chemical analysis of Zinc used for galvanising	))	
(b)	Chemical analysis mechanical metallo-graphic test and magnetic particle inspection for malleable castings	)))	As per Annexure-A

(c) Chemical analysis, hardness tests and)
magnetic particle inspection for forgings)

7.0 Tests and Standards

7.1 Testing Expenses

7.1.1 Supplier shall indicate the laboratories in which they proposes to conduct the type tests. They shall ensure that adequate facilities for conducting the tests are available in the laboratory and the tests can be completed in these laboratories within the time schedule guaranteed by them in the appropriate schedule.

7.1.2 The Contractor shall intimate the Owner about carrying out of the type tests alongwith detailed testing programme at least 3 weeks in advance of the scheduled date of testing during which the Owner will arrange to depute his representative to be present at the time of carrying out the tests.

8.0 Sample Batch For Type Testing

8.1 The Contractor shall offer material for sample selection for type testing only after getting Quality Assurance Programme approved by the Owner. The Contractor shall offer at least three times the quantity of materials required for conducting all the type tests for sample selection. The sample for type testing will be manufactured strictly in accordance with the Quality Assurance Programme approved by the Owner.

8.2 Before sample selection for type testing the Contractor shall be required to conduct all the acceptance tests successfully in presence of Owner's representative.

9.0 Schedule of Testing and Additional Tests

9.1 The Supplier has to indicate the schedule of following activities

(a) Submission of drawing for approval.

(b) Submission of Quality Assurance programme for approval.

(c) Offering of material for sample selection for type tests.

(d) Type testing.

9.2 The Owner reserves the right of having at his own expense any other test(s) of reasonable nature carried out at Contractor's premises, at site, or in any other place in addition to the aforesaid type, acceptance and routine tests to satisfy himself that the material comply with the specifications.

9.3 The Owner also reserves the right to conduct all the tests mentioned in this specification at his own expense on the samples drawn from the site at Contractor's premises or at any other test centre. In case of evidence of non compliance, it shall be binding on the part of Contractor to prove the compliance of the items to the technical specifications by repeat tests, or correction of deficiencies, or replacement of defective items, all without any extra cost to the Owner.

10 Test Reports

10.1 Copies of type test reports shall be furnished in atleast six copies alongwith one original. One copy shall be returned duly certified by the Owner, only after which the commercial production of the concerned material shall start.

10.2 Copies of acceptance test report shall be furnished in atleast six copies. One copy shall be returned, duly certified by the Owner, only after which the materials will be despatched.

10.3 Record of routine test report shall be maintained by the Contractor at his works for periodic inspection by the Owner's representative.

10.4 Test certificates of tests during manufacture shall be maintained by the Contractor. These shall be produced for verification as and when desired by the Owner.

11.0 Inspection

11.1 The Owner's representative shall at all times be entitled to have access to the works and all places of manufacture, where the material and/or its component parts shall be manufactured and the representatives shall have full facilities for unrestricted inspection of the Contractor's, sub-Contractor's works raw materials. manufacturer's of all the material and for conducting necessary tests as detailed herein.

11.2 The material for final inspection shall be offered by the Contractor only under packed condition. The engineer shall select samples at random from the packed lot for carrying out acceptance tests.

11.3 The Contractor shall keep the Owner informed in advance of the time of starting and of the progress of manufacture of material in its various stages so that arrangements could be made for inspection.

11.4 Material shall not be despatched from its point of manufacture before it has been satisfactorily inspected and tested unless the inspection is waived off by the Owner in writing. In the latter case also the material shall be despatched only after all tests specified herein have been satisfactorily completed.

11.5 The acceptance of any quantity of material shall in no way relieve the Contractor of his responsibility for meeting all the requirements of the Specification, and shall not prevent subsequent rejection, if such material are later found to be defective.

12.0 Packing and Marking

12.1 All material shall be packed in strong and weather resistant wooden cases/crates. The gross weight of the packing shall not normally exceed 50 Kg to avoid handling problems.

12.2 The packing shall be of sufficient strength to withstand rough handling during transit, storage at site and subsequent handling in the field.

12.3 Suitable cushioning, protective padding, dunnage or spacers shall be provided to prevent damage or deformation during transit and handling.

12.4 Bolts, nuts, washers, cotter pins, security clips and split pins etc. shall be packed duly installed and assembled with the respective parts and suitable measures shall be used to prevent their loss.

12.5 Each component part shall be legibly and indelibly marked with trade mark of the manufacturer and year of manufacture.

12.6 All the packing cases shall be marked legibly and correctly so as to ensure safe arrival at their destination and to avoid the possibility of goods being lost or wrongly despatched on account of faulty packing and faulty or illegible markings. Each wooden case/crate shall have all the markings stencilled on it in indelible ink.

13.0 Standards

13.1 The Hardware fittings, conductor and earthwire accessories shall conform Indian/International Standards which shall mean latest revisions, with amendments/changes adopted and published, unless specifically stated otherwise in the Specification.

ANNEXURE – A

1.0 TESTS ON HARDWARE FITTINGS

1.1 Galvanising/Electroplating Test

The test shall be carried out as per Clause no. 5.9 of IS:2486-(Part-1) - 1972 except that both uniformity of zinc coating and standard preecee test shall be carried out and the results obtained shall satisfy the requirements of this specification.

1.2 Mechanical Strength Test of Each Component

Each component shall be subjected to a load equal to the specified minimum ultimate tensile strength (UTS) which shall be increased at a steady rate to 67% of the minimum UTS specified. The load shall be held for five minutes and then removed. The component shall then again be loaded to 50% of UTS and the load shall be further increased at a steady rate till the specified UTS and held for one minute. No fracture should occur. The applied load shall then be increased until the failing load is reached and the value recorded.

1.3 Mechanical Strength Test of Welded Joint

The welded portion of the component shall be subjected to a Load of 2000 kgs for one minute. Thereafter, it shall be subjected to die-penetration/ ultrasonic test. There shall not be any crack at the welded portion.

1.4 Clamp Slip Strength Vs Torque Test for Suspension Clamp

The suspension assembly shall be vertically suspended by means of a flexible attachment. A suitable length of Conductor shall be fixed in the clamp. The clamp slip strength at various tightening torques shall be obtained by gradually applying the load at one end of the conductor. The Clamp slip strength vs torque curve shall be drawn. The clamp slip strength at the recommended tightening torque shall be more than 12.5% but less than 20% of conductor rated strength.

2.0 TESTS ON CONDUCTOR AND EARTHWIRE ACCESSORIES

2.1 Mid Span Compression Joint for Conductor and Earthwire

(a)Slip Strength Test

The fitting compressed on conductor/earthwire shall not be less than one metre in length. The test shall be carried out as per IS:2121 (Part-II)- clause 6.4 except that the load shall be steadily increased to 95% of minimum ultimate tensile strength of conductor/earthwire and retained for one minute at this load. There shall be no movement of the conductor/ earthwire relative to the fittings and no failure of the fittings during this one minute period.

(b) Hardness Test

The Brinnel hardness at various points on the steel sleeve of conductor core and of the earthwire compression joint and tension clamp shall be measured.

2.2 Flexible Copper Bond

a)Slip Strength Test

On applying a load of 3 kN between the two ends, stranded flexible copper cable shall not come out of the connecting lugs and none of its strands shall be damaged. After the test, the lugs shall be cut open to ascertain that the gripping of cable has not been affected.

2.3 Chemical Analysis Test

Chemical analysis of the material used for manufacture of items shall be conducted to check the conformity of the same with Technical Specification and approved drawing.

3.0 TESTS ON ALL COMPONENTS (AS APPLICABLE)

3.1Chemical Analysis of Zinc used for Galvanizing

Samples taken from the zinc ingot shall be chemically analysed as per IS-209. The purity of zinc shall not be less than 99.95%.

3.2Tests for Forgings

The chemical analysis hardness tests and magnetic particle inspection for forgings, will be as per the internationally recognised procedures for these tests. The, sampling will be based on heat number and heat treatment batch. The details regarding test will be as discussed and mutually agreed to by the Contractor and Owner in Quality Assurance Programme.

3.3 Tests on Castings

The chemical analysis, mechanical and metallographic tests and magnetic particle inspection for castings will be as per the internationally recognised procedures for these tests. The samplings will be based on heat number and heat treatment batch. The details regarding test will be as discussed and mutually agreed to by the Contractor and Owner in Quality Assurance Pro

TECHNICAL SPECIFICATION OF DANGER NOTICE PLATES

1. **SCOPE** This Specification covers Danger Notice Plates to be displayed in accordance with rule No. 35 of Indian Electricity Rules, 2003.

2. **APPLICABLE STANDARDS** Unless otherwise modified in this specification, the Danger Notice Plates shall comply with IS:2551-1982 or the latest version thereof.

3. DIMENSIONS

3.1 Two sizes of Danger Notice Plates as follows are recommended:

a) For display at 415 V installations - 200x150mm

b) For display at 11 KV (or higher voltages) installations - 250x200mm

3.2 The corners of the plate shall be rounded off.

3.3 The location of fixing holes as shown in Figs. 1 to 4 is provisional and can be modified to suit the requirements of the purchaser.

4. LETTERINGS

All letterings shall be centrally spaced. The dimensions of the letters, figures and their respective position shall be as shown in figs. 1 to 4. The size of letters in the words in each language and spacing between them shall be so chosen that these are uniformly written in the space earmarked for them.

5. LANGUAGES

5.1 Under Rule No. 35 of Indian Electricity Rules, 2003, the owner of every medium, high and extra high voltage installation is required to affix permanently in a conspicuous position a danger notice in Hindi or English and, in addition, in the local language, with the sign of skull and bones.

5.2 The type and size of lettering to be done in Hindi is indicated in the specimen danger notice plates shown in Fig. 2 and 4 and those in English are shown in Figs. 1 and 3.

5.3 Adequate space has been provided in the specimen danger notice plates for having the letterings in local language for the equivalent of' Danger',' 415' '11000' and 'Volts'.

6. MATERIAL AND FINISH

The plate shall be made from mild steel sheet of at least 1.6mm thick and vitreous enameled white, with letters, figures and the conventional skull and cross-bones in signal red colour (refer IS:5-1978) on the front side. The rear side of the plate shall also be enamelled.

7. TESTS

The following tests shall be carried out :

i) Visual examination as per IS:2551-1982

ii) Dimensional check as per IS:2551-1982

iii) Test for weather proofness as per IS:8709-1977 (or its latest version)

8. MARKING

Maker's name and trade mark and the purchaser's name shall be marked in such a manner and position on the plates that it does not interfere with the other information.

9. PACKING

The plates shall be packed in wooden crates suitable for rough handling and acceptable for rail/road transport.

TECHNICAL SPECIFICATION OF CABLE GLANDS AND LUGS

Cable glands shall be Double compression type, tinned/Nickel plated (coating thickness not less than 20 microns in case of tin and 10 to 15 microns in case of nickel) brass cable glands for all power and control cables. They shall provide dust and weather proof terminations. They shall comprise of heavy duty brass casting, machine finished and tinned to avoid corrosion and oxidation. Rubber components used in cable glands shall be neoprene and of tested quality. Required number of packing glands to close unused openings in gland plates shall also be provided.

The cable glands shall be tested as per BS: 6121. The cable glands shall also be duly tested for dust proof and weather proof termination.

Cables lugs shall be tinned copper solder less crimping type conforming to IS: 8309 and 8394 suitable for aluminum or copper conductor (as applicable). The cable lugs shall suit the type of terminals provided. The cable lugs shall be of Dowell make or equivalent.

TECHNICAL SPECIFICATION OF EARTH KNOBS FOR LT LINES

1. SCOPE

This standard covers the requirements of knobs for supporting the neutral-cum-earth wire used for earthing of metal parts of supporting structures of overhead power lines with a nominal voltage upto 1000V (refer Construction Standard B-3 & B-4).

2. APPLICABLE STANDARDS

Except when they conflict with the specific requirements of this specification, the earth knobs shall conform to the latest version of IS:9511-1980.

3. MATERIALS

Earth knobs shall be made of cast iron.

4. GENERAL REQUIREMENTS

Earth knobs shall not have blow holes, shrinkage and other casting defects. The top and bottom flat portion of earth knob shall be smooth and plain.

5. SHAPE AND DIMENSIONS

The shape and dimensions of earth knob shall conform to Fig. 1.

6. ACCEPTANCE TESTS

The following acceptance tests shall be carried out atleast on one knob for every 1000 nos.

6.1 Electrical Resistance

6.1.1 The electrical resistance of the earth knob shall be measured using a Kelvin bridge. Adequate electrical contact shall be ensured against the two surfaces of the knob preferably by using brass washers, soldered to the leads going to the bridge circuit. The washers shall be of adequate size to ensure sufficient area of contact.

6.1.2 The electrical resistance of the earth knob, measured as given in 6.1.1 between the two flat portions, shall not exceed 200 m ohms.

6.2 Mechanical Strength

The breaking strength at the neck of the earth knob shall not be less than 11,500 kg. when force is applied in the direction shown in Fig. 2.

7. MARKING

Each earth knob shall be marked with the name of the manufacturer or his trade mark.

TECHNICAL SPECIFICATION OF GI WIRES

1. SCOPE

This specification covers details of solid G.I. Wires for use in rural distribution system.

2. APPLICABLE STANDARDS

Except when they conflict with the specific requirements of this specification, the G.I. wires shall comply with the provisions of IS:280-1978 and IS:7887-1975 or the latest version thereof.

3. APPLICATION & SIZES

G.I. wires covered in this Specification are intended for the following applications :

Application	Sizes (nominal dia)
Bearer wire for service	3.15mm (for single phase cables services) 4 mm (for three phase services)
Earthing of Transformers, poles & Fittings.	4 mm
Continuous Earthwire for. 11 KV lines	4 mm
Protective guarding at the crossing of over-head power lines with roads, railway tracts and telecommunication lines	3.15, 4 and 5 mm

4. MATERIAL

4.1 The wires shall be drawn from the wire rods conforming to IS:7887-1975 or the latest version thereof.

4.2 The requirements for chemical composition for the wires shall conform to IS:7887.

4.3 The wires shall be sound, free from split surface flaws, rough jagged and imperfect edges and other detrimental defects on the surface of the wires.

5. GALVANISING

The wires shall be galvanised with 'Heavy Coating' as per IS:4826-1979 or the latest version thereof.

6. GRADES

GI wires shall be classified into two grades based on their tensile strength :

Grade	Tensile Strength (MPa)
Annealed	300-550
Hard	550-900

7. TOLERANCE IN DIAMETER

The tolerance on nominal diameter at any section of wire shall not exceed (±)2.5%. Further, the maximum difference between the diameters at any two cross-sections of wires shall not exceed 2.5%.

8. TESTS

The following tests shall be carried out in accordance with IS:280-1978 or the latest version thereof as per sampling criteria stipulated therein :

i) Dimensional check (dia) - refer clause 7 above.
ii) Visual inspection regarding freedom from defects refer clause 4.3 above.
iii) Tensile test
iv) Wrapping test (for wire diameters smaller than 5mm)
v) Bend test (for wire diameters 5mm only)
vi) Coating test - refer clause 5 above
vii) Chemical composition

9. PACKING

The wires shall be supplied in 50-70 kg. coils, each coil having single continuous length. Each coil of wire shall be suitably bound and fastened compactly and shall be protected by suitable wrapping.

10. MARKING

Each coil shall be provided with a label fixed firmly on the inner part of the coil bearing the following information:

a) Manufacturer's name or trade mark
b) Lot number and coil number
c) Size
d) Grade (Annealed or Hard)
e) Mass
f) Length
g) ISI Certification mark, if any

TECHNICAL SPECIFICATIONS FOR 33 KV DROP OUT FUSE CUT OUTS

1. **SCOPE** This specification covers outdoor, open, drop-out expulsion type Fuse Cutouts suitable for installation in 50 Hz, 33 KV distribution systems.

2. **APPLICATION** The distribution fuse cutouts are intended for use in distribution transformers and have no inherent load break capacity.

1. **APPLICABLE STANDARD** Unless otherwise modified in this specification, the cutout shall conform to IS: 9385 (Part-I to III) as amended from time to time.

2. **RATED VOLTAGE** The rated voltage shall be 36 KV.

3. **RATED CURRENT** The rated current shall be 200 A.

4. **6.RATED LIGHTNING IMPULSE WITHSTAND VOLTAGE VALUES FOR THE FUSE BASE**

The rated lightning impulse withstands voltages both for positive and negative polarities shall be as given below:

a) To earth and between poles 175 KV (Peak)

b) Across the isolating distance of fuse base 195 KV (Peak)

7. **RATED ONE MINUTE POWER FREQUENCY WITHSTAND VOLTAGE (DRY & WET) VALUES FOR THE FUSE BASE**

a) To earth and between poles 70 KV (rms)

b) Across the isolating distance 80 KV (rms)

8. **TEMPERATURE RISE LIMIT (In Air)**

a) Copper contacts silver faced $65^{o}C$

b) Terminals $50^{o}C$

c) Metal parts acting as springs. The temperature shall not reach such a value that elasticity of the metal is changed.

9. **RATED BREAKING CAPACITY**

The rated breaking capacity shall be 16 KA (Asymmetrical).

10. **GENERAL REQUIREMENTS/ CONSTRUCTIONAL DETAILS** The cutouts shall be of single vent type (downward) having a front connected fuse carrier suitable for angle mounting.

All ferrous parts shall be hot dip galvanized in accordance with the latest version of IS: 2633. Nuts and bolts shall conform to IS: 1364. Spring washers shall be electro-galvanized.

11. FUSE BASE TOP ASSEMBLY The top current carrying parts shall be made of a highly conductive copper alloy and the contact portion shall be silver plated for corrosion resistance and efficient current flow. The contact shall have a socket cavity for latching and holding firmly the fuse carrier until the fault interruption is completed within the fuse.

The top contact shall be actuated by a strong steel spring which keeps it under sufficient pressure to maintain a firm contact with the fuse carrier during all operating conditions. The spring shall also provide flexibility and absorbs most of the stresses when the fuse carrier is pushed into the closing position.

The current carrying parts of the assembly shall be protected from water and dust formation by a stainless steel top cover. The top contact assembly shall have a robust galvanized steel hook to align and guide the fuse carrier into the socket latch even when the fuse carrier is closed at an off-centre angle. The top assembly shall have an aluminum alloy terminal connector (refer clause 19).

The top assembly shall be robust enough to absorb bulk of the forces during the fuse carrier closing and opening operations and shall not over-stress the spring contact. It shall also prohibit accidental opening of the fuse carrier due to vibrations or impact.

11. FUSE BASE BOTTOM ASSEMBLY The conducting parts shall be made of high strength highly conductive copper alloy and the contact portion shall be silver plated for corrosion resistance and shall provide a low resistance current path from the bottom fuse carrier contacts to the bottom terminal connector.

The bottom assembly shall have hinge contacts made from highly conductive, anti-corrosive copper alloy and shall accommodate and make a firm contact with the fuse carrier bottom assembly. The fuse carrier shall be placed easily in or lifted from the hinges without any maneuvering. In addition, the bottom assembly shall perform the following functions:-

When opened manually or after fault interruption the fuse carrier shall swing through 180^{o} to the vertical and its further travel shall be prevented by the fuse base bottom assembly.

The fuse carrier shall be prevented from slipping out of the self locking hinges during all operating conditions and only when the fuse carrier has reached its fully open position can it be removed from the hinge support.

The assembly shall have an aluminium alloy terminal connector (refer clause 19).

13. FUSE CARRIER TOP ASSEMBLY The fuse carrier top contact shall have a solid replaceable cap made from highly conductive, anti-corrosive copper alloy and the contact portion shall be silver plated to provide a low resistance current path from the Fuse Base Top Contact to the Fuse Link. It shall make a firm contact with the button head of the fuse link and shall provide a protective enclosure to the fuse link to check spreading of arc during fault interruptions.

The fuse carrier shall be provided with a cast bronze opening eye (pull ring) suitable for operation with a hook stick from the ground level to pull-out or close-in the fuse carrier by manual operation.

1. **FUSE CARRIER BOTTOM ASSEMBLY** The fuse carrier bottom assembly shall be made of bronze castings with silver plating at the contact points to efficiently transfer current to fuse base. It shall make smooth contact with the fuse base bottom assembly during closing operation.

   The bottom assembly shall have a lifting eye for the hook stick for removing or replacing the fuse carrier. The bottom assembly shall have a suitable ejector which shall perform the following functions:

   i) It shall keep the fuse link in the centre of fuse tube and keep it tensioned under all operating conditions.

   ii) It shall be capable of absorbing the shock when the fuse carrier is pushed into the closed position and shall not allow the fuse link to be damaged. This is especially important when the fuse link is of low-ampere rating.

   iii) The ejector at the instant of interruption shall retain the fuse carrier in the closed position long enough to ensure that the arc is extinguished within the fuse tube thereby excluding the possibility of arcing and subsequent damage at the contact surfaces.

   i) The ejector shall help the fuse link separation after fault interruption, allowing the fuse carrier to drop out and clearing the pigtail of the blown fuse link through the bore of fuse tube.

15. FUSE BASE (PORCELAIN) The fuse base shall be a bird-proof, single unit porcelain insulator with a creepage distance (to earth) not less than 840mm. The top and bottom assemblies as also the middle clamping hardwares shall be either embedded in the porcelain insulator with sulphur cement or suitably clamped in position. For embedded components, the pull out strength should be such as to result in breaking of the porcelain before pull out occurs in a test. For porcelain insulators, the beam strength shall not be less than 1000 Kg.

2. **FUSE TUBE** The fuse tube shall be made of fibre glass coated with ultraviolet inhibitor on the outer surface and having arc quenching bone fibre liner inside. The tube shall have high bursting strength to sustain high pressure of the gases during fault interruption. The inside diameter of the fuse tube shall be 17.5mm. The solid cap of the fuse carrier shall clamp the button head of the fuse link, closing the top end of the fuse tube and allowing only the downward venting during fault interruption.

3. **TYPE TESTS** The cutout shall be subjected to the following type tests:

   i) Dielectric tests (rated impulse withstands and rated one minute power frequency with stand test voltages)

i) Temperature rise test

The above tests shall be carried out in accordance with IS: 9385 Part I & II. For Porcelain Fuse Base only.

iii) Pull out test for embedded components of the fuse base

iv) Beam strength of porcelain base

4. **MOUNTING ARRANGEMENT** The cutouts shall be provided with a suitable arrangement for mounting these on 75x40mm or 100x50mm channel cross arm in such a way that the centre line of the fuse base is at an angle of 15^o to 20^o from the vertical and shall provide the necessary clearances from the support. Mounting arrangement shall be made of high strength galvanized steel flat and shall be robust enough to sustain the various stresses encountered during all operating conditions of the cutout. For more details see enclosed figure 2.

   Strength of the component marked 1 (see figure) shall be determined by clamping the member with the shorter leg at the top to a rigid support by M-10 carriage bolts. A downward force shall be applied along the axis of M-14 carriage bolt parallel to the longer leg and in the direction of longer leg of the member under test. A load of 50 Kg. shall be applied and then removed to take up any slack in the mounting arrangement before the measurement of position is taken, the permanent set measured at the axis of the M-14 carriage bolt shall not exceed 1.6mm when a load of 425 Kg. is applied and removed.

   The strength of the M-14 bolt shall in no case be less than1900 Kg. and the strength of M-10 bolts not less than 3500 Kg.

5. **TERMINAL CONNECTIONS** The cutout shall be provided with two aluminium alloy (alloy designation 2280 (A-11) as per IS: 617-1975) terminal connectors at top and bottom of fuse base assemblies to receive aluminium conductors of diameters between 6.3mm to 10.05mm. These terminals shall be easily accessible irrespective of the cutout location with respect to the pole. The terminals shall meet the test requirements of REC Construction Standard E-30.

6. **INSPECTION** All tests and inspection shall be made at the place of manufacture unless otherwise especially agreed upon by the manufacturer and the purchaser at the time to purchase. The manufacturer shall afford the inspector representing the purchaser all reasonable facilities without charge, to satisfy him that the material is being furnished in accordance with this specification.

   The purchaser has the right to have the tests carried out at his own cost by an independent agency whenever there is dispute regarding the quality of supply.

TECHNICAL SPECIFICATION FOR 33/11KV, 3-PHASE POWER TRANSFORMERS

1. SCOPE This specification covers oil-immersed, naturally air-cooled (type ON) outdoor type, three-phase, 50Hz, 33/11KV step down power transformers of capacities up to and including 6300 KVA.

2. APPLICABLE STANDARDS Unless otherwise modified in this Specification, the transformers shall comply with the latest version of Indian Standard Specification IS:2026 (Part I-Part IV).

3. STANDARD RATINGS The standard ratings shall be 630 KVA, 1600 KVA, 2500 kVA and 3150 KVA for transformers with off-circuit taps and 3150 KVA, 5000 KVA and 6300KVA for transformers with on-load taps.

4. CONTINUOUS MAXIMUM RATING AND TEMPERATURE RISE As regards rating and temperature rise, all transformers shall comply with the appropriate requirements of IS: 2026.

5. NO-LOAD VOLTAGE RATIO The no-load voltage ratio corresponding to the principal tapping shall be 33,000/ 11,000 V.

6. TAPS

6.1 **Off-circuit taps**: Transformers with off-circuit taps shall have taps ranging from (+) 2.5% to (-) 10% in steps of 2.5% each on HV winding for HV variation.

6.1.1 The tap changing switch shall be located in a convenient position so that it can be operated from ground level. The switch handle will be provided with a locking arrangement along-with tap position indication, thus enabling the switch to be locked in position.

6.2 **On-load taps**: Transformers with on-load taps shall have taps ranging from (+) 5% to (-) 15% in steps of 2.5% each on HV winding for HV variation.

6.2.1 Equipment for only local electrical and local hand operation shall be provided.

6.2.2 The circuit arrangement shall be flexible to provide for addition of a transformer at a later date.

6.2.3 An out-of-step device shall be provided for each transformer which shall be arranged to prevent fur-ther tap changing when transformers in a group, operating in 'parallel control' are one tap out-of-step.

7. WINDING CONNECTIONS AND VECTORS

7.1 The primary winding shall be connected delta and secondary winding star as per vector symbol Dy11 (IS: 2026) so as to produce a positive displacement of 30 deg. from the primary to the secondary vectors of the same phase (vector rotation assumed counter-clock-wise).

7.2 The neutral point of the secondary (L.V.) winding shall be solidly earthed and should be brought out to a separate insulated terminal, enabling a current transformer for an earth leakage relay to be connected wherever required.

8. IMPEDANCE VALUES The percentage impedance at 75°C shall be 6.25% for 1600 KVA 2500 KVA and 6300 KVA transformers. The impedance values refer to the principal tapping and are subject to a tolerance of (±) 10%. The impedance values measured on any other tapping shall not exceed the value measured on the principal tapping by more than (±) 10%.

9. LOSSES

9.1 The losses shall not exceed by more than 10% the values given below:

KVA Rating	No Load Losses (KW)	Load Losses (KW)
630	1.45	7.5
1600	3.00	15.0
2500	As per IS	As per IS
3150	4.5	23
6300	6.5	34

9.2 No weightage in prices for offers with lower losses would be given for these sizes of transformers.

10. TERMINAL ARRANGEMENT

10.1 Transformers shall preferably be provided with bushing insulators on 33 KV and 11 KV sides, 33 KV and 11 KV bushings shall be located on opposite sides. However, cable box may be provided on the 11KV side if specially desired by the purchaser.

10.2 The electrical characteristics of bushing insulators shall be in accordance with IS: 2099 as amended from time to time. All type and routine tests shall be carried out in accordance with IS: 2099. The test voltages for various tests as stipulated in IS: 2099-1986 are reproduced below:-

Nominal System Voltage	Rated Voltage of the bushing	One minute wet and dry power frequency voltage withstand test	Lightning impulse withstand test 1.2/50 μ s KV peak
KV	KV	KV	KV
11	12	28	75
33	36	70	170

10.3 Dimensions of the 12 KV bushings (11 KV side) shall conform to IS: 3347 (Part-III) and those of 36 KV bushings (33 KV side) shall conform to IS: 3347 (Part V).

11. GUARANTEE

The manufacturer shall among other things guarantee the following:

i)	Quality & strength of materials used.
ii)	Satisfactory operation during the guarantee period of one year from the date of commissioning or 24 months from date of receipt at site, whichever earlier
iii)	Performance figures and all other details as required in IS:2026 are to be supplied by tenderer in the schedule of Guaranteed Particulars

12. TOLERANCES The tolerances of guaranteed performance figures shall be as specified in the latest version of IS: 2026.

13. AXLES AND WHEELS Transformers shall be provided with bidirectional flat rollers suitable for use on a 1000mm gauge track.

14. FITTINGS Unless otherwise specified in the order, the following standard fittings shall be provided. The fittings shall be in accordance with the details to the extent these specified in IS: 2026:

a)	Inspection Cover (1600 KVA and above)
b)	Rating Plate
c)	Diagram Plate
d)	Two Earthing Terminals
e)	Lifting Lugs
f)	Jacking Pads (3150 KVA and 6300 KVA)
g)	Conservator
h)	Dehydrating Breather
i)	Thermometer (dial type) with one Contact for Alarm
j)	Thermometer Pocket
k)	Oil level gauge indicating three positions of oil marked as follows:
	Minimum ($-5^{o}C$)
	$30^{o}C$
	Maximum ($98^{o}C$)
l)	Oil filling Hole and Cap
m)	Air Release Device
n)	Pressure Relief Device
o)	Gas and Oil actuated Relay (1600 KVA and above)
p)	Filter Valves (lower valves to be also used as drain valve)

15. TESTS AND INSPECTION The following tests shall be carried out in accordance with the details specified in IS: 2026 or as agreed upon between the purchaser and manufacturer.

15.1 Type Tests

a)	Measurement of winding resistance
b)	Measurement of voltage ratio and check of voltage vector relationship
c)	Measurement of impedance voltage
d)	Measurement of no-load loss and current
e)	Measurement of insulation resistance
f)	Lightning impulse test
g)	Temperature rise test
h)	Tests on on-load tap changers, where appropriate
i)	**Vacuum test:** Whereas the tank of the power transformer of 1600and 2500 KVA capacity (excluding tap changing compartment, radiators and coolers) shall be able to withstand 34.7 KN/m^2 vacuum gauge pressure (250 mm of Hg).The permanent deflection of the flat plate after subjecting the transformer tank of each size to the above vacuum for one hour shall not exceed the following values, and shall not affect the performance of the transformer :
j)	Short-circuit Test

Horizontal length of flat plate (mm)	**Permanent deflection (mm)**
Upto and including 750	5
751 to 1250	6.5
1251 to 1750	8
1751 to 2000	9.5
2001 to 2250	11
2251 to 2500	12.5
2501 to 3000	16
Above 3000	19

Note: In view of the high cost and delay involved in carrying out short circuit test and the cost of transportation etc., the purchaser may insist upon this test only if such a test has not been made earlier by the transformer manufacturer on a transformer of identical design.

15.2 Routine Tests The following shall constitute the routine tests:

a)	Measurement of winding resistance
b)	Measurement of voltage ratio and check of voltage vector relationship
c)	Measurement of impedance voltage/short-circuit impedance (Principal tapping) and

	load loss
d)	Measurement of no-load loss and current
e)	Measurement of insulation resistance
f)	Dielectric tests
g)	Tests on on-load tap changers, wherever appropriate

15.3 INSPECTION

15.3.1 All tests and inspection shall be made at the place of manufacture unless otherwise especially agreed upon by the manufacturer and purchaser at the time of purchase. The manufacturer shall afford the inspector representing the purchaser all reasonable facilities, without charge, to satisfy him that the material is being furnished in accordance with this specification.

15.3.2 The purchaser has the right to have the tests carried out at his own cost by an independent agency whenever there is dispute regarding the quality of supply.

TECHNICAL SPECIFICATIONS FOR D.C. DISTRIBUTION BOARD

1.0 SCOPE This section of the specification covers the design, manufacture, testing at works, transport to site, insurance, erection and commissioning of D.C. Distribution Board complete with all equipments and accessories as described below.

2.0 CONSTRUCTIONAL FEATURES

2.1 The D.C. Distribution Boards shall be indoor, floor mounting of self supporting type, sheet metal clad, cubicle type with channel base. The panels / boards shall be totally enclosed, dust tight and vermin proof. The boards shall have double leaf hinged doors at the back. All doors and covers shall be filled with rubber gaskets. The doors shall be provided with locks and duplicated keys. The boards shall be made of 2.0 mm cold rolled sheet steel.

2.2 All incoming and outgoing cables shall enter from bottom. Suitable cable terminal boards with cable lugs shall be provided inside each panel for incoming and outgoing cables. Suitable compression type cable glands shall provided to hold the cable so as to avoid any pressure or tension at the terminal board connection. The terminal boards shall be easily accessible for inspection and checking.

3.0 MCCB / MCB All MCCB / MCB shall be of Two / Three pole type. The MCCB / MCB shall be suitable for rated voltage of 415 V/230 Volts A.C., 50 Hz. Icu = 35kA, Ics = 50% of Icu. The rated current of each unit shall be as specified later.

4.0 BUS BAR The bus bars shall be of electrolytic copper of ample cross section. The bus bars shall be insulated from the structure by means of durable non-hygroscopic, non-combustible and non-tracking material.

5.0 The 110 Volts, D.C. Distribution Board shall have following circuits and equipments:

a) ***INCOMING:*** One no. 415 Volts, 63 Amps 3 Pole MCCB from Battery Charger

b) ***OUTGOING:***

i) One no. 230 Volts, 32 Amps 2 Pole MCB for 11 kV VCB Panel DC Bus.
ii) One no.230 Volts, 6 Amps 2 Pole MCB for Emergency Lighting
iii) One no. 230 Volts, 32 Amps 2 Pole MCB for Spare.
iv) One no. 230 Volts, 6 Amps 2 Pole MCB for Spare

c) ***OTHER EQUIPMENTS:***

i) One Mains Failure alarm relay.
ii) One Earth Fault alarm relay.
iii) One 110 volts D.C. Bell to be operated by the Mains Failure alarm relay.
iv) One 110 volts D.C. Buzzer to be operated by the Earth Fault alarm relay.
v) One 0-150 volts D.C. moving coil voltmeter to measure the bus bar voltage.
vi) One pilot lamp to indicate D.C. ON conditions.
vii) One terminal board/ block for all feeder outlets including cable glands.
viii) One number A.C. operated Contactor rated for 230V shall be provided inside DCDB with one number self reset N/C contact for connecting 4 nos. 230V, 40W Incandescent Emergency Lamps placed at identified locations inside Control Room building & Battery Room.

6.0 Name Plate The equipments shall be provided with name plate covering, rating and other technical data and also name of the project shall be clearly mentioned "Under IPDS, Power & Electricity Department, Govt. of Mizoram".

TECHNICAL SPICIFICATION FOR LATTICE, RAIL AND PIPE STRUCTURES

1.0 GENERAL The scope of specification covers design, fabrication, proto-assembly, supply and erection of galvanised steel structures for towers, girders, and equipment support structures. Towers, girders and equipment support structure shall be lattice type structure like ISMB; ISLC T-section etc fabricated from structural steel conforming to IS 2062 (latest) and IS: 800. Support structure for substation equipment shall be designed by the Contractor/supplier, got it approved by the owner and shall be supplied with equipment.

The scope shall include supply and erection of all types of structures including bolts, nuts, washers, hangers, shackles, clamps anticlimbing devices, bird guards, step bolts, inserts in concrete, gusset plates, equipment mounting bolts, structure earthing bolts, foundation bolts, spring washers, fixing plates, ground mounted marshalling boxes (AC/DC Marshalling box & equipment control cabinets), structure mounted marshalling boxes and any other items as required to complete the job.

The connection of all structures to their foundations shall be by base plates and embedded anchor/foundation bolts. All steel structures and anchor/foundation bolts shall be fully galvanized. The weight of the zinc coating shall be at least 0.610 kg/m2 for anchor bolts / foundation bolts and for structural members. One additional nut shall be provided below the base plate which may be used for the purpose of leveling.

Similar type of structures shall be adopted in R&M of existing substation extension. Contractor must furnish the design, drawings, proto corrected drawings etc. in support of activities that are to be carried out at site. Contractor should also visit site to ascertain the amount of activities involved at site before quoting.

2.0 DESIGN REQUIREMENTS FOR STRUCTURES

2.1 For design of steel structures loads such as dead loads, live loads, wind loads etc. shall be based on IS: 875,Parts I to V.

2.2 For materials and permissible stresses IS: 802,Part-I, Section-2 for angle section and for other types (like ISMB, ISLC T-section etc.) IS: 800 shall be followed in general. However, additional requirements given in following paragraphs shall be also considered.

2.3 Minimum thickness of galvanized tower member shall be as follows:

Members	**Minimum thickness (mm)**
Leg members, Ground wire Peak members/Main members	5
Other members	4
Redundant members	4

2.4 Maximum slenderness ratios for leg members, other stressed members and redundant members for compression force shall be as per IS-802 for angle sections otherwise IS: 800 shall be adopted for ISMB, ISLC, T-Section etc.

2.5.1 Minimum distance from hole center to edge shall be 1.5 x bolt diameter. Minimum distance between center to center of holes shall be 2.5-x bolt diameter.

2.5.2 The minimum bolt diameter shall be 12 mm. and welding shall be as per IS: 816.

2.7 **Step Bolts** In order to facilitate inspection and maintenance, the structures shall be provided with climbing devices. Each tower shall be provided with step bolts not less than 16mm diameter & 175mm long spaced not more than 450mm apart, staggered on faces on one leg extending from about 0.5 meters above ground level to the top of the tower. The step bolt shall conform to IS: 10238. Ladders on towers with lighting appliances shall be provided with safety guards.

2.8 **Design Criteria**

a) All structures shall be designed for the worst combination of dead loads, superimpose equipment load, live loads, wind loads as per code IS: 875, seismic forces as per code IS: 1893 (latest), Importance factor of 1.5, loads due to deviation of conductor, load due to unbalanced tension in conductor, torsional load due to unbalanced vertical and horizontal forces, erection loads, short circuit forces. Short circuit forces shall be calculated considering a fault level of 25.0 kA. IEC-865 may be followed for evaluation of short circuit forces.

b) Switchyard gantry structures shall be designed for the two conditions i.e. normal condition and short circuit condition. In both conditions the design of all structures shall be based on the assumption that stringing is done only on one side i.e. all the three (phase) conductors broken on the other side.

Factor of safety of 2.0 under normal conditions and 1.5 under short circuit condition shall be considered on all external loads for the design of switchyard structures which are of lattice i.e. type using angle section. If different types of sections are used other than angle section then FOS shall be as per relevant IS code.

c) Vertical load of half the span of conductors/string and the earth wires on either side of the beam shall be taken into account for the purpose of design. Weight of man with tools shall be considered as 150 kgs. for the design of structures.

d) Terminal/line take off gantries shall be designed for a minimum conductor tension of 0.75 tonne per phase for 132 kV or as per requirements whichever is higher. The distance between terminal gantry and dead end tower shall be taken as 150 metres. The design of these terminal gantries shall also be checked considering +/- 15 deg deviation of conductor in both vertical and horizontal planes. For other gantries the structural layout requirements shall be adopted in design.

e) The girders/portals shall be connected with lattice columns by bolted joints as far as possible.

f) All Pipe support used for supporting equipments shall be designed for the worst combination of dead loads, erection load. Wind load/seismic forces, short circuit forces and operating forces acting on the equipment and associated bus bars as per IS: 806. The material specification shall be as per IS: 1161 read in conjunction with IS: 806.

g) If luminaries are proposed to be fixed on gantries/towers, then the proper loading for the same shall be considered while designing. Also holes for fixing the brackets for luminaries should be provided wherever required.

h) Foundation bolts shall be designed for the loads for which the structures are designed.

3.0 DESIGN DRAWINGS, BILL OF MATETRIALS AND DOCUMENTS

3.1 The Contractor shall furnish design, drawing and BOMs and shop manufacturing drawings for every member to the Purchaser after award of the Contract. However, Contractor shall have to prepare and submit any other drawings, bill of materials (BOM) additionally required during design and construction stage which the Purchaser feels necessary. In case Purchaser feels that any design drawing, BOM are to be modified even after its approval, Contractor shall modify the designs & drawings and resubmit the design drawing, BOM as required in the specification.

3.2 The fabrication drawings to be prepared and furnished by the Contractor shall be based on the design approved by the Purchaser or standard drawing provided. These fabrication drawings shall indicate complete details of fabrication and erection including all erection splicing details and typical fabrication splicing details, lacing details, weld sizes and lengths. Bolt details and all customary details in accordance with standard structural engineering practice whether or not given by the Purchaser. The fabrication drawings shall be submitted to the Purchaser. Proto shall be made only after approval of fabrication drawings.

3.3 The fabrication work shall start only after the final approval to the Fabrication drawing is accorded by the Purchaser. The design drawing should indicate not only profile, but section, numbers and sizes of bolts and details of typical joints.

3.4 Such approval shall, however, not relieve the Contractor of his responsibility for the safety of the structure and good connections and any loss or damage occurring due to defective fabrication, design or workmanship shall be borne by the Contractor.

4.0 FABRICATION OF STEEL MEMBERS The fabrication and erection works shall be carried out generally in accordance with IS 802. A reference however may be made to IS 800 in case of non-stipulation of some particular provision in IS 802. All materials shall be completely shop fabricated and finished with proper connection material and erection marks for ready assembly in the field.

5.0 PROTO-ASSEMBLY The component parts shall be assembled in such a manner that they are neither twisted nor otherwise damaged and shall be so prepared that the specified camber, if any, is provided. In order to minimize distortion in member the component parts shall be positioned by using the clamps, clips, dogs, jigs and other suitable means and fasteners (bolts and welds) shall be placed in a balanced pattern. If the individual components are to be bolted, paralleled and tapered drifts shall be used to align the part so that the bolts can be accurately positioned.

ii) Sample towers and equipment support structures shall be trial assembled in the fabrication shop and shall be inspected and cleared by Contractor based on the approved fabrication drawing before mass fabrication.

Pursuant to above the BOMs along with proto-corrected fabrication drawings and shop manufacturing drawings for every member shall be prepared and submitted by the main vendor to Purchaser as document for information. Such BOM, which shall be duly certified

by the main vendor for its conformity to the approved design, shall be the basis for Purchaser to carry out inspection.

6.0 BOLTING

i) Every bolt shall be provided with a washer under the nut so that no part of the threaded portion of the bolt is within the thickness of the parts bolted together.
ii) All steel items, bolts, nuts and washers shall be hot dip galvanised.
iii) 2.0% extra nuts and bolts shall be supplied for erection.

7.0 WELDING The work shall be done as per approved fabrication drawings which clearly indicate various details of joints to be welded, type of weld, length and size of weld, whether shop or site weld etc. A symbol for welding on erection and shop drawings shall be according to IS: 813. Efforts shall be made to reduce site welding so as to avoid improper joints due to constructional difficulties. Welding shall be done as per IS: 816.

8.0 FOUNDATION BOLTS

8.1 Foundation bolts for the towers and equipment supporting structures and elsewhere shall be embedded in first stage concrete while the foundation is cast. The Contractor shall ensure the proper alignment of these bolts to match the holes in the base plate.

8.2 The Contractor shall be responsible for the correct alignment and leveling of all steel work on site to ensure that the towers/structures are plumb.

8.3 All foundation bolts for steel structures, pipe structures are to be supplied by the Contractor.

8.4 All foundation bolts shall be fully galvanised so as to achieve 0.61 kg. per Sq.m. of Zinc Coating as per specifications.

8.5 All foundation bolts shall conform to IS 5624 but the material, however shall be MS conforming to IS: 2062.

9.0 STABILITY OF STRUCTURE The Supplier shall be responsible for the stability of the structure at all stages of its erection at site and shall take all necessary measures by the additions of temporary bracings and guying to ensure adequate resistance to wind and also to loads due to erection equipment and their operations.

10.0 GROUTING The method of grouting the column bases shall be subject to approval of Purchaser and shall be such as to ensure a complete uniformity of contact over the whole area of the steel base. The Contractor will be fully responsible for the grouting operations.

11.0 GALVANISING

11.1 All structural steel works and pipe supports shall be galvanised after fabrication.

11.2 Zinc required for galvanizing shall have to be arranged by the manufacturer. Purity of zinc to be used shall be 99.95% as per IS: 209.

11.3 The Contractor shall be required to make arrangement for frequent inspection by the

Purchaser as well as continuous inspection by a resident representative of the Purchaser, if so desired for fabrication work.

12.0 TOUCH-UP PAINTING The touch up primers and paints shall consist of Red Oxide / Zinc chromate conforming to the requirements of IS: 2074 with a pigment to be specified by the Purchaser.

13.0 INSPECTION BEFORE DISPATCH Each part of the fabricated steel work shall be inspected as per approved quality plans and certified by the Purchaser or his authorized representative as satisfactory before it is dispatched to the erection site. Such certification shall not relieve the Contractor of his responsibility regarding adequacy and completeness of fabrication.

14.0 TEST CERTIFICATE Copies of all test certificates relating to material procured by the Contractor for the works shall be forwarded to the Purchaser.

15.0 ERECTION The Contractor should arrange on his own all plant and equipment, welding set, tools and tackles, scaffolding, trestles equipments and all other accessories and ancillaries required for carrying out erection without causing any stresses in the members which may cause deformation and permanent damage.

16.0 SAFETY PRECAUTIONS The Contractor shall strictly follow at all stages of fabrication, transportation and erection of steel structures, raw materials and other tools and tackles, the stipulations contained in Indian Standard Code for Safety during erection of structural steel work-IS: 7205.

17.0 GANTRY/PORTAL AND EQUIPMENT SUPPORT STRUCTURES Structures are to be designed, supplied and erected, as described in preceding paragraphs, without any extra financial implication to the Purchaser.

18.0 All tests mentioned in standard field quality plans have to be carried out and conformity of materials and workmanship shall be ascertained.

TECHNICAL SPECIFICATION FOR P.G. CLAMP

1.0 SCOPE

1.1 The scope covers design, manufacturing, testing preferably at manufacturer's work before supply and delivery of Aluminium P.G. Clamp suitable for Conductor size Dog, Rabbit & Weasel ACSR Conductor used in overhead line having an average span of 80 mtr to 110 mtr.

1.2 The materials offered shall be complete with all components which are necessary or usual for their efficient performance and satisfactory maintenance. Such parts shall be deemed to be within the scope of contract.

2.0 STANDARDS The materials offered shall conform to the provisions of the following broad relevant Indian Standards as amended up to date except where specified otherwise.

i) IS 5561, 1970 : Electric Power Connectors
ii) IS 2629, 1985 : Recommended Practice for Hot Dip Galvanizing of Iron and Steel (Reaffirmed in 1990)
iii) IS 2633, 1986 : Method of Testing Uniformity of Coating of Zinc for Zinc (Reaffirmed in 1990) Coated Articles
iv) IS 1285, 1975 : Aluminium and Aluminium Alloy

3.0 INSPECTION & TESTING All inspection shall be carried out at the manufacturer's works only. If acceptance test could not be carried out at the works in absence of requisite testing facilities, the details of the acceptance test to be carried out (through the agency) and the name of the concerned agency shall be intimated along with the particulars of the proposed agency.

4.0 PACKING

4.1 The materials are to be packed in gunny bags.

4.2 The quantity to be packed in gunny bags should be 50 sets for the PG Clamps suitable for 50 sq. mm Rabbit/ 30 sq.mm Weasel and 25 sets for 100 sq.mm DOG.

5.0 DRAWING SUBMISSION Submission of drawing is not needed.

6.0 ALUMINIUM PG CLAMPS

6.1 The PG clamps shall be of best quality and workmanship, free from blow holes, cavities and other defects such as cracks etc. The clamps shall consist of two halves of Aluminum secured by two numbers galvanized bolts, nuts, flat washer, spring washer etc.

6.2 The PG clamps shall be of extruded Aluminum alloy, conforming to IS 1285 (latest amendment) and shall be suitable for use with ACSR conductors (100/50/30 sq.mm) and AAC Conductors (50/25 sq. mm.).The thickness and contact surface should be maintained in such a way that the clamp should conform to IS 5561 (latest amendment).

6.3 The PG clamps shall be used for heavy duty services and shall be so designed, manufactured and finished that any sharp radii of curvature, ridges which may lead to localized pressure or may cause damage to conductor in service, should be avoided.

6.4 All metal parts like bolts, nuts and washers shall be made of forged steel and shall be hot dip galvanized conforming to IS 2633 (latest amendment) except spring washer which shall be electro galvanized. All sharp edges shall be rounded off.

6.5 The PG clamp shall be resistant to atmospheric corrosion both during storage and in service. All current carrying parts shall be so designed and manufactured that contact resistance is reduced to a minimum. The clamps shall be designed to avoid corona, visible discharge etc.

6.6 The grooves in the clamps shall be smooth to give a firm and complete grip to the conductor and to provide maximum contact area. The grooves of the clamps should suit the size of the respective conductors. The bolts and nuts shall have hexagonal head.

6.7 Each PG clamp shall be legibly and indelibly marked with NAME or TRADE MARK of manufacturer and property marking as "Power & Electricity Department, Govt. of Mizoram". The size of the clamps for which it is suited shall also be marked on the PG clamps.

6.8 The following tests shall be carried out as per IS 5561 and IS 2633:

A. **Type Test**

a)	Tensile test	b)	Resistance test
c)	Temperature rise test	d)	Short time current test
e)	Verification of dimension	f)	Galvanizing test

The above tests shall be made and to be certified by the manufacturer or any Govt. recognized authority.

B. **Acceptance Test**

a)	Tensile test	b)	Resistance test
c)	Verification of dimension	d)	Galvanizing test

C. **Routine Test**

a)	Visual examination	b)	Verification of dimension

6.9 All the PG clamps of the same type and design manufactured under similar conditions of production and offered for acceptance, a lot may consist of whole or part of the quantity offered. A lot shall consist of only one type of fittings manufactured essentially from the same raw material under identical condition.

TECHNICAL SPECIFICATIONS FOR PVC INSULATED LT CABLES

1. SCOPE This specification covers details of PVC Insulated LT cables for use on Service Connections and Distribution Transformers in rural electrification system.

2. APPLICABLE STANDARDS Except when it conflicts with the specific requirements of this specification, PVC insulated LT cables shall comply with the latest versions of the following Indian Standards.

A	Service cables	IS:694 (Part-II)(PVC Insulated Cables for working voltages upto and including 1100 V with aluminium conductors)
B	Transformer Cables i) Three-core, solid sector-shaped, aluminium armored cables	IS: 4288 (PVC Insulated and PVC sheathed solid aluminium conductor cables of voltage rating not exceeding 1100 Volts).
	OR	
	ii) Single-core and four-core unarmored aluminium cables	IS: 1554 (Part-I) (PVC Insulated Heavy Duty Electric Cables for working voltages upto and including 1100 V).

3. SIZE AND TYPE The size and type of PVC insulated LT cables for different applications shall be as in Table-I below:

Table-I

Sl. No.	Size	Type	Use
A	*Service Cables*		
I	2.5mm^2	Twin-core (unarmored) as per IS: 694-Pt-II	i) Single-phase service connections upto 2KW connected load ii) Three –phase Agrl. / Indl. Service connections upto 2.2KW (3-HP) connected load (2 runs to be used)
II	4.0mm^2	Twin-core (unarmored) as per IS: 694-Pt-II	i) Single-phase service connections above 2KW & upto 4KW connected load. ii) Three –phase Agrl. / Indl. Service connections above 2.2KW (3-HP) and upto 3.7KW (5-HP) connected load (2 runs to be used)
III	6.0mm^2	Four-core (unarmored) as per IS: 694-Pt-II	i) Three –phase Agrl./Indl. Service connections above 3.7 KW (5-HP) and upto 7.5 KW (10-HP) connected load.
IV	10.0mm^2	Four-core (unarmored) as per IS: 694-Pt-II	i) Three –phase Agrl. /Indl. Service connections above 7.5KW (10-HP) and upto 11KW (15-

Sl. No.	Size	Type	Use
			HP) connected load.
B	*Transformers cables*		
1(a)	16.0mm^2	Four-core (unarmoured) as per IS: 1554-Pt-I	25 KVA distribution transformers
(b)	10.0mm^2	Single-core (unarmoured) as per IS: 1554-Pt-I	
2(a)	70.0mm^2	Three - core solid sector-shaped aluminium (armoured) cable as per IS: 4288 OR Four- core (unarmoured) with reduced neutral of 35mm^2 as per IS: 1554 Pt.-I.	63 KVA distribution transformers
2(b)	50.0mm^2	Single-core (unarmoured) as per IS:1554-PT-I	
(a)	120.0mm^2	Three - core solid sector-shaped aluminium (armoured) cable as per IS: 4288 OR Four core (unarmoured) with reduced neutral of 70mm^2 as per IS: 1554 Pt.-I.	100 KVA distribution transformers
3(b)	95.0mm^2	Single-core (unarmoured) as per IS: 1554-Pt-I	

4. SHAPE OF CABLE All twin-core cables shall be of flat shape and single 3 or 4-core cables of circular shape.

5 CONDUCTORS Aluminium conductor complying with IS: 8130-1976 shall be used. The conductors of service cables (2.5mm^2 to 10mm^2) shall be either solid or stranded, as required by the purchaser.

6. TESTS All the type tests, acceptance tests and routine tests shall be carried out as per the relevant I.S. indicated in clause 2 above.

7. PACKING Service cables of 2.5, 4, 6 and 10mm^2 size shall be packed in coils of 100 metres length each. Each coil shall be protected against damage by polythene wrapping. Transformer cables shall be supplied in wooden drums with 100 or 250 metres length, as required by the purchaser. The cable reels/drums shall comply with IS: 10418-1982 (Specification on 'Drums for Electric Cables').

8. MARKING The following information shall be marked on the reel/ drum carrying transformer cables or contained in a label attached to the coils in case of service cables:

a) Manufacturer's name, brand name or trade mark
b) Type of cable and voltage grade
c) Number of cores
d) Nominal cross-sectional area of conductor
e) Length of cable on reel/drum or coil
f) Direction of rotation of drums (by means of an arrow)
g) Approximate gross weight
h) Country of manufacture
i) Year of manufacture and
j) Name of the purchaser

9. INSPECTION All tests and inspection shall be made at the place of manufacture unless otherwise agreed to especially by the manufacturer and purchaser at the time of purchase. The manufacturer shall afford the inspector, representing the purchaser, all necessary facilities (without charge) to satisfy him that the material is being supplied in accordance with the Specification.

TECHNICAL SPECIFICATIONS FOR H.T.(11KV) AERIAL BUNCHED CABLES

1. SCOPE : The specification covers design, manufacture, testing before dispatch, transportation, supply and delivery of ISI marked 11 KV Grade XL PE insulated screened armoured all aluminium conductor and PVC sheathed Power Cables suitable for effectively earthed 11KV Overhead Lines.

2. LOCATION : 11KV Aerial Bunched Cables are composite Cable especially intended for overhead line use in forest areas where tree clearance poses a series problem and in other cases where it is difficult to get clearance for bare conductor lines. These Cables comprise of 3 XLPE insulated Single Phase Cables twisted around a bare messenger wire, which will carry the weight of composite Cable.

3. SERVICE CONDITIONS: Equipment to be supplied against the specification shall be suitable for satisfactory continuous operation under the following tropical conditions.

Maximum ambient temperature (Degree C)	50
Maximum temperature in shade (Degree C)	45
Minimum temperature of Air in Shade (Degree C)	3.5
Relative Humidity (Percent)	10 to 100
Maximum annual rain fall (mm)	1450
Maximum wind pressure (Kg/sq.mm.)	150
Maximum altitude above mean sea level (Metres)	1000
Isoceraunic level (day per year)	50
Seismic level (Horizontal Acceleration)	0.3 g
General nature of the Climate	Moderate

4. APPLICABLE STANDARDS : Unless otherwise stipulated in this specification, the following standard with up to date amendment shall be applicable.

IS 7098 (Part-II)-1985	Cross linked polyethylene insulated PVC sheathed Cables.
IS : 8130-1984	Conductors for Insulated Cables.
IS : 398 (Part-II)-1976	Galvanised Steel Wires.
IS : 398 (Part-IV)-1979	Aluminium Alloy Conductors.
IEC- 60502 (Part-II) 2005	Polyethylene Outer Sheath

5. RATED VOLTAGE : The rated Voltage of the Cables shall be 11KV and the maximum operating Voltage shall be 12KV.

6. CONDUCTORS : The Aluminium Conductors shall comply with the requirements as specified in IS-8130-1984 with up to date amendments. The stranded conductor shall be clean & reasonably uniform in size and shape and its surface shall be free from sharp edges. Not more than two joints shall be allowed in any of the wires forming every complete length of conductor and no joint shall be within 300 mm. of any other joint in the same layer. Joints shall be brassed, silver soldered or electric or gas welded. No joint shall be made in the conductor once, it has been stranded.

7. INSULATION : The insulation shall be chemically cross linked polyethylene conforming to the physical, electrical and ageing properties as required in the specification. Cross-linking may be done by exposure to peroxide with nitrogen curing CCV line, method with intention to ensure lowest tree formation. Only natural unfilled compound shall be used for insulation. Thickness when measured in accordance with relevant Clause of the Specification, shall not be less than the standard thickness value specified.

8. SCREENING : The screening of insulated Cables shall consist of conductor screening and insulation screening.

Screening Materials : Two types of materials may be used for screening of Cables : non-metallic & metallic.

Conductor Screening : Conductor screening shall be non- metallic and shall consist of a layer of extruded-semi-conducting cross linked polyethylene compound of thickness no less than 0.5 mm.

Insulating Screening : The insulation screening shall consist of non-metallic semi-conducting part in combination with a metallic part. Non-metallic part shall be applied either directly over the insulation of each core and shall consist of either a semi-conducting tape or a layer of extruded semi-conducting compound or a combination of these materials. The metallic part shall be applied over the individual core. Metallic screening shall consist of either tape or braid or concentric serving of wires or a sheath and shall be non-magnetic.

9. OUTER SHEATH : Over the armouring/metallic screen the Cable shall be provided with extruded PVC outer sheath. The composition of the PVC compound for outer sheath shall be Type ST2 of IS-5831-1984. The colour of the outer sheath shall be black. The average thickness of the sheath shall not be less than the standard values specified in the IS when measured as laid in IS-7098(Part-II)/1985. The smallest thickness of the measured values of sheath shall not fall below the standard value(s) specified with tolerance. Outer surface of the Cable shall be ultra-violet Ray resistant.

10. CORE IDENTIFICATION : The Core identification shall be done by Ridges one, two and three on PVC covering over core.

11. BARE MESSENGER WIRE : Bare messenger wire shall consist of combination of galvanised steel wires and aluminium alloy wires. Central layer(s) shall be of galvanized steel wires and outer layer(s) shall be of Aluminium Alloy Wires. Galvanised Steel Wires shall be tested as per IS:398(Part-II)/1978 and **Aluminium Alloy Wires shall be tested as per IS:398(Part-IV) /1979.** The number of strands and diameter of strand for Steel Wire & Aluminium Alloy Wire for Bare Messenger Wire shall be calculated considering 100 mtrs. Span Length on Steel Pole Support and Breaking Load of Messenger Wire.

12. LAYING UP : Three Power Cores having Ridges one, two and three shall be twisted over bare messenger wire with right hand direction of lay. This will from the Aerial Bunched Cable.

13. TESTS : Copies of the type test certificates in respect of all the type tests as per IS:7098 (Part-II) 1985 for similar type of XLPE Cables from any Government recognized Testing Labs, shall be submitted.

LIST OF TYPE TESTS :

a) i) Annealing test (for Copper)
   ii) Tensile Test (for Aluminium)
   iii) Wrapping Test (for Aluminium)
   iv) Resistance Test.

b) Tests for armouring wires/strips.

c) Test for thickness of insulation and sheath.

d) Physical tests for insulation.
   i) Tensile strength and elongation at break.
   ii) Ageing in air oven.
   iii) Hot test.
   iv) Shrinkage test.
   v) Water absorption (Gravimetric)

e) Physical Test for outer sheath :
   i) Tensile Strength and elongation at break.
   ii) Ageing in on even.

iii) Shrinkage Test.
iv) Hot deformation.

f) i) Bleeding and Blooming test (for outer sheath)
ii) Loss of mass in air ever, heat shock and thermal stability tests will be carried out as per IS:7098, Part-II/1985.

g) Partial discharge test.
h) Bending test.
i) Dielectric Power Factor Test :
i) As a function of Voltage.
ii) As a function of temperature.
j) Insulation resistance (volume resistivity) test.
k) Heating cycle test.
l) Impulse withstand test.
m) High Voltage test.
n) Flammability test.
o) Cold Impact test.
p) List of type test for messenger wire :
i) Breaking load test on individual galvanised steel wire.
ii) Breaking load test on individual aluminium alloy wire.
iii) Elongation Test
iv) Resistance Test

14. ACEPTANCE TESTS :

The following tests shall be carried out as acceptance tests :

a) Annealing test (for copper) b) Tensile test (for aluminium)
c) Wrapping test (for aluminium) d) Conductor resistance test.
e) Test for thickness of insulation and sheath.
f) Partial discharge test (for screened cables only)
g) High Voltage test. h) Insulation resistance (volume resistivity) test

15. ROUTINE TEST ;

The following tests shall be carried out as routine tests :

a) Conductor resistance test (for aluminium and copper)
b) Partial discharge test (for screened cables only)
c) High Voltage Test.

Type test/acceptance test/Routine tests and any other tests required as per relevant Indian Standards shall also be got conducted.

16. INSPECTION : The Cable shall be inspected at manufacturer's works before despetch as per IS-7098 (Part-II)/1985 (with upto date amendments). All the acceptance tests embodied in the above shall be performed by the Inspecting Officer. The Manufacturer shall arrange without making any extra charges with all the necessary machinery, apparatus and labour requirement for the testing purpose. The cost requirement for testing shall be to Firm's Account.

17. SEQUENTIAL MARKING : Supplier shall provide non-erasable sequential marking of length on the Cable for each metre of length with sequential marking machine having automatic length measuring meter. The Cable supplied without sequential marking will not be accepted and no deviation shall be allowed under any circumstances.

18. PACKING & MARKING : The Cable shall be supplied in suitable non-returnable wooden drums of suitable size in standard lengths subject to a tolerance of +/-5% and conforming to IS:10418. The Cable shall be wrapped with polythene under wooden covering. Each metre length shall be embossed with the Trade Name of Manufacturer and the work 'PEDM IPDS'. ISI mark

Cable shall be preferred. The ends of the Cable shall be sealed by means of non-hygroscopic sealing material. Each drum shall carry the following information either stenciled on flange or label attached to it :

a) Manufacturer's Name
b) Trade Mark, if any.
c) A reference to ISS i.e. IS-7098 (Part-II)/1985.
d) Length of the Cable on the drum.
e) Voltage Grade and type of the Cable.
f) Colour of outer sheath.
g) Nominal cross-sectional area of the Cable Conductor.
h) Purchase Order No. & date.
i) Name and address of Consignee – P&E Deptt., Mizoram
j) Number of Cores.
k) Gross Weight of packed and net weight of the composite Cable.
l) Drum No. & its direction of rotation (with an arrow)
m) Year of Manufacture.

The standard Drum Length will be 250 mtrs. in each Drum for all sizes subject to a maximum tolerance of + 5%

DESCRIPTION OF 11 KV AERIAL BUNCHED CABLES :

Description	**S i z e**	
	Power Core	Messenger Wire
11KV (E) Grade Aerial Bunched Cable with 3(three) Power Cores Stranded, compacted Circular Aluminium Conductor screened with Black extruded semi - conducting Compound, natural coloured XLPE insulated core screened with Black extruded semi- conducting compound and one layer of copper tape and covered with Black extruded PVC (Core identification by ridges one, two and three over PVC covering) and one bare Messenger wire : combination of galvanized steel wire and Al. Alloy wires conforming to IS 3130/1984, IS-398(Part-II)/1976, IS-398 (Part-IV)/1979 and IS-7098(Part-II)/1985 with upto date amendments, if any.	1) 3x95 mm. + 2) 3x120 mm. +	1x80 mm. 1x100 mm.

ACCESSORIES REQUIRED FOR DRAWAL OF OVERHEAD LINE WITH HT (11KV) AERIAL BUNCHED CABLES

Sl. No. D e s c r i p t i o n

1. Anchor Clamp
2. Suspension clamp assembly.
3. Pole mounted support clamps.
4. Pole clamps.
5. Insulation piercing connectors with cover or P.G. connectors with insulation cover.
6. Facade hooks.
7. Cable Jointing Kit for straight through & end joints.

DIMENSIONAL AND ELECTRICAL PARAMETERS :

HT ABC : The standard sizes and technical characteristics for Single Core Cable.

Nominal Sectional Area of Conductors (sq.mm.)

Parameters	95	120
Nominal Conductor dia (mm) /No of wires in conductor	11.3/15	12.7/15
Max. DC resistance at 20C (ohm/km.)	0.320	0.253
Nominal thickness of insulation (mm)	3.6	3.6
Max. Short Circuit Current for 1 sec. (KA)	8.96	11.32
Max. continuous Load (Amps.)	230	265

Note : The resistance values given in the Table are the max. permissible one.

TECHNICAL CHARACTERISTIC OF MESSENGER WIRE FOR HT ABC :

Parameters	Nominal Area of Messenger (sq.mm.)	
Nominal Sectional Area (mm)	80	100
No. of wires	7	7
Nominal dia. of wires/compacted conductor (Approx.) mm	3.81/11.43	4.26/12.78
Breaking Load (KN)	23.41	29.26
DC resistance at 20° C Ohm/Km	0.425	0.339
Approx. mass Kg/Km	218.26	272.86

COMPLETE BUNCHED CABLE

Sr. No.	Designation	Overall dia. (approx.) mm	Total mass (approx.) Kg/Km
1	3 x 95 mm^2 + 80 mm^2	62.5	2250
2	3 x 120 mm^2+ 100 mm^2	67	2650

TECHNICAL SPECIFICATIONS FOR L.T. AERIAL BUNCHED CABLE FOR WORKING VOLTAGE UPTO 1100 VOLT

1. SCOPE : The specification covers design, manufacture, testing before despatch, transportation, supply and delivery of ISI marked 1100V Aerial Bunched Cable having XLPE insulated Cable (three Power Core) with stranded compact circular aluminium conductors twisted over an insulated aluminium alloy messenger wire for use as overhead distribution feeders, with/without one street lighting core with stranded compacted circular aluminium conductor XLPE insulated suitable for use on 3-Phase AC System conforming to IS-14255/1985 with up to date amendments.

2. LOCATION : Aerial bunched Cables for use in L.T. overhead lines are preferred than conventional L.T. overhead lines with bare conductors as those are not subjected to frequent faults as happens with the bare conductors and also to minimise problem of clearance, etc. ABC System is safer and eliminates use of insulators and associated hardwares required for bare conductors.

3. SERVICE CONDITIONS: Equipment to be supplied against the specification shall be suitable for satisfactory continuous operation under the following tropical conditions.

Maximum ambient temperature (Degree C)	50
Maximum temperature in shade (Degree C)	45
Minimum temperature of Air in Shade (Degree C)	3.5
Relative Humidity (Percent)	10 to 100
Maximum annual rain fall (mm)	1450
Maximum wind pressure (Kg/sq.mm.)	150
Maximum altitude above mean sea level (Metres)	1000
Isoceraunic level (day per year)	50
Seismic level (Horizontal Acceleration)	0.3 g
General nature of the Climate	Moderate

4. APPLICABLE STANDARDS : Unless otherwise stipulated in this specification, the following standard with up to date amendment shall be applicable.

IS 14255-1995	Specification for AERIAL Bunched Cables for working Voltage Up to & including 1100 Volts.
IS : 8130	Specification for Conductors for Insulated Cables.
IS : 398 (Part-IV)	Specification for Aluminium Alloy Conductor.

5. RATED VOLTAGE :

The rated Voltage of LT AB Cables shall be 1100 Volts.

6. CONDUCTORS : The Aluminium Conductors for phase/street lightning conductor shall be Tensile strength of H2 or H4 grade Aluminium complying with the requirements of IS-8130-1984 with up to date amendments. For messenger wire stranded All Aluminium Conductor shall be of heat treated Aluminium Magnesi um-Silicon Alloy Wires containing approximate 0.5% magnesium and 0.5% silicon conforming to IS-398 (Part-IV)/1984 with up to date amendments. The stranded conductor shall be clean & reasonably uniform in size and shape and its surface shall be free from sharp edges. Not more than two joints shall be allowed in any of the wires forming every complete length of conductor and no joint shall be within 300 mm. of any other joint in the same layer. The joint shall be brazed, silver soldered or electric or gas welded. No joint shall be made in the conductor, once it has been stranded.

7. INSULATION : The Conductor (with protective barrier, wherever applied) shall be provided with cross linked polyethylene applied by extrusion conforming to the standard Specification as per IS 14255/95. The average thickness of insulation when measured in accordance

with relevant clause of the specification, shall not be less than standard value specified. Upper surface of Cable insulation should be Ultra Violet Ray resistant Colour of insulation shall be black.

8. CORE IDENTIFICATION : The Phase Conductors shall be insulated with black weather resistant, XLPE suitable for 1100 Volt insulation. The Phase Conductor shall be provided with one, two and three ridges for quick identification. The individual cores thus formed shall then be laid up around insulated messenger wire. The insulated messenger wire shall have four ridges as per IS 14255:1995. The insulated street lighting conductor shall not have any identification mark.

9. MESSENGER-CUM-NEUTRAL WIRE : The insulated messenger wire shall be of aluminium alloy, generally conforming to IS 398 (Part-IV)/1994 and suitably compacted to have smooth round surface to avoid damage to the other insulating sheath of phase conductor twisted around the messenger.

10. LAYING UP : Three Power Cores having Ridges one, two and three and one street lighting without any ridge, if any should be twisted over insulated messenger wire with right hand direction of lay. This will form the Aerial Bunched Cable. Lay ratio shall be as specified in IS:14255/1995.

11. TESTS FOR CABLES : Type test reports not older than 5 years of at least two sizes of Aerial Bunched Cables with & without street lighting core being procured and as specified in relevant IS & IEE and detailed in Clause 5:1 got conducted from independent recognized Test House shall be furnished by the contractors along with the GTP.

TYPE TEST REPORTS SHALL CONTAIN DETAILS OF FOLLOWING TYPE TESTS AS PER IS 8130-1984 & IS 10810

1. Tests on Phase/Street Light Conductor :
   - i) Tensile Test
   - ii) Wrapping Test.
   - iii) Resistance Test.
2. Test on Messenger Conductor ;
   - i) Breaking Load.
   - ii) Elongation Test.
   - iii) Resistance Test.
3. Physical Test for XLPE insulation :
   - i) Tensile Strength and elongation at break.
   - ii) Ageing in on even.
   - iii) Hot Set Test.
   - iv) Shrinkage Test.
   - v) Water Absorption (Gavimetric)
4. Test for thickness insulation.
5. Insulation performance (Volume resistivity) Test.
6. High Voltage Test.

Report of above and any other type test provided in the relevant Indian Standards shall also be supplied.

ROUTINE TEST ;

The following routine tests shall be conducted :

1. Conductor Resistance Test.
2. High Voltage Test at room temperature.
3. Cold Bend Test (optional)

Any other routine test provided in the relevant Indian Standards shall also got conducted by the suppler.

ACCEPTANCE TEST : These tests as per relevant IS & IEC shall be carried out in the presence of the purchaser's representative if so desired by the purchaser. The following shall constitute the acceptance tests.

(a) Tensile Test (for phase/street light conductor)
(b) Wrapping Test (for phase/street light conductor)
(c) Breaking Load Test for messenger Conductor.
(d) Elongation test for messenger conductor.
(e) Conductor resistance test.
(f) Test for thickness of insulation.
(g) Tensile Strength and Elongation at Break Test.
(h) Hot Set Test for XLPE insulation.
(i) Insulation resistance test and
(j) High Voltage Test.

12. SEQUENTIAL MARKING : Supplier shall provide non-erasable sequential marking of length on the Cable for each metre of length with sequential marking machine having automatic length measuring meter.

13. PACKING & MARKING : The Cable shall be supplied on suitable sized wooden non-returnable drum of robust construction for each length of Cables as per I.S. 10418. A layor of water proof paper shall be applied to the surface of the drums and over the outer cable layer. A clear space at least 40 mm. shall be left between the Cable and Logging. Wood preservative shall be applied to the entire drum. Each metre length shall be embossed with the Trade Name of Manufacturer and the work 'PEDM IPDS'. Packing shall be sturdy to protect the Cable from any injury during transportation handling and storage. Both Cable ends shall be sealed with PVC/Rubber Caps to eliminate ingress of moisture. Each Cable Drum shall have following information stenciled on it.

a) Manufacturer's Name, Brand Name of Trade Mark.
b) Year of Manufacturre.
c) Nominal Cross-Sectional area of the Cable Conductor.
d) Type of Cable and Voltage Grade.
e) Length of the Cable.
f) Number of the Cores.
g) ISI Certification Mark, IS reference.
h) Colour of outer sheath.
i) No. of lengths in Drum (if more than one)
j) Cable Code.
k) Direction of rotation of drum (by means of an arrow)
l) Approximate gross weight in Kg./Km.

The standard Drum Length will be 500 mtrs. in each Drum for all sizes subject to a tolerance of +/- 5%.

14. INSPECTION : The Cable shall be inspected at manufacturer's works before despatch as per IS-7098 (Part-I)/1988 (with upto date amendments) & IS 14255/1995. All the acceptance tests embodied in the above shall be performed by the Inspecting Officer. The Manufacturer shall arrange without making any extra charges with all the necessary machinery, apparatus and labour requirement for the testing purpose. The Cable requirement for testing shall be to Firm's Account.

A. DESCRIPTION OF 1.1 KV AERIAL BUNCHED CABLES :

Description	Size
	Ph.Wire + St.Light Wire + Messenger- Cum- Neutral Wire
1100V Grade L.T. Aerial Bunched Cable having three Power Core & One Neutral-Cum-Messenger Core of stranded compacted circular Aluminium Black coloured XLPE insulated & Core identification by ridges, one, two and three & four respectively. One Street Lighting Core of stranded, compacted Circular (Provision for street light conductor is Aluminium Conductor, Black coloured XLPE insulated optional and as per requirement) without any identification mark. Messenger-Cum-Neutral Wire should be of stranded compacted circular Aluminium Alloy Conductor conforming to IS 8130/1984, IS-398(Part-IV)/1979 and IS-14255/1995 with upto date amendments, if any.	1) 3x50 + 1x16 + 1x35 sq.mm. 2) 3x70 + 1x16 + 1x50 sq.mm. 3) 3x95 + 1x16 + 1x70 sq.mm.

B. ACCESSORIES REQUIRED FOR DRAWAL OF L.T. OVERHEAD LINE WITH 1100V GRADE AERIAL BUNCHED CABLES

1. Anchor Clamp (3-Bolt and 2 Bolt Type)
2. Eye hook with Suspension Clamp Assembly.
3. PCC Pole Clamp.
4. Insulation Piercing Connectors with cover or P.G.Connectors with insulation cover.
5. Water Proof pre-insulated Hexagonal Compression Connectors & Lugs.

C. DIMENSIONAL AND ELECTRICAL PARAMETERS :

LTABC : The standard sizes and technical characteristics for Single Core Cable.

Sl. No.	Description	3 x 50 + 1 x 16 + 1 x 35	3 x 70 + 1 x 16 + 1 x 50	3 x 95 + 1 x 16 + 1 x 70
1	Power/Neutral Core :			
1.1	Conductors			
	Nom. Cross sectional area			
	(i) Power cores (mm2)	50	70	95
	(ii)Neutral cores (mm2)	16	16	16
	Max. D.C. resistance conductor at 20ºC			
	(i) Power cores (Ohm/Km)	0.641	0.443	0.32
	(ii)Neutral cores (Ohm/Km)	0.91	0.91	1.91
	Approx. diameter of conductor			

	(i)Power cores (mm)	7.9	9.6	11.3
	(ii)Neutral cores (mm)	4.4	4.4	4.4
1.2	Insulation:			
	Minimum thickness:			
	(i)Power cores (mm)	1.2	1.4	1.4
	(ii)Neutral cores (mm)	1	1	1
2	Messenger Wire(Bare):			
	(i) Nom. Cross sectional area (Sq. mm)	35	50	70
	(ii) Min. Breaking load (KN)	9.8	14.0	19.7
3	Current Rating:			
	Continuous current carrying capacity of cable in Air at Ambient temp. 40ºC (Amp.)	105	130	155

TECHNICAL SPECIFICATIONS FOR SINGLE PHASE ELECTRONIC ENERGY METER OF CLASS 1.0 ACCURACY

1.0 SCOPE This specification covers design, engineering, manufacture, testing, inspection & supply of A.C. Single phase, two wire solid state (static) fully electronic energy meters of accuracy class 1.0 & current rating 5-30 A, with backlit LCD display for 240 Volt systems as per requirement in this specification and pilfer proof meter box (PPMB) made of engineering plastic, FR grade with self extinguishing property suitable for single phase meter. The meter should be capable of recording & displaying energy in KWH, KVAH & demand in KW for single phase two wire A.C. loads respectively for power factor range of Zero lag - unity - Zero lead. Meters should have facility capability of recording tamper information. It is not the intent to specify completely herein all the details of the design and construction of meter.

However the meter shall conform in all respects to high standards of engineering, design and workmanship shall be capable of performing commercial operation continuously in a manner acceptable to P&E Department, Mizoram, who will interpret the meanings of drawings & specification and shall have the right to reject any work or material which in its judgment is not in accordance therewith. The supplied meter shall be complete with all components, accessories necessary for their effective and trouble free operation of the system for the purpose mentioned above. Such components shall be deemed to be within the scope of contractors supply irrespective of whether those are specifically brought out in this specification and / or the commercial order or not.

It is mandatory that in case of all manufacturers, the meter supplied shall be ISI marked and contractor shall have to furnish valid BIS certification.

2.0 STANDARDS APPLICABLE Unless specified elsewhere in this specification, the performance & testing of the meters should conform to the following Indian/International standards, to be read with up to date and latest amendments/revisions thereof.

S/No	Standard No.	Title
1	IS 13779, 1999 read with its latest amendments	Specification of AC Static Watt hour meters class 1.0 & 2.0
2	CBIP Report No.304 read with latest amendments	Specification for AC Static Electrical Energy Meters
3	IS 12346 (1988)	Specification for testing equipment for A.C. Static Electrical Energy Meter (latest amendment).
4	C.E.A. Regulation No. 502 / 70 / CEA/ DP&D dt 17/O3/2006	Central Electricity Authority (Installation & Operation of Meters) Regulation, 2006.
5	IS 14434 (1998)	Polycarbonate Moulding & Extrusion Materials.

3.0 CLIMATIC CONDITION The meters to be supplied against this specification should be suitable for satisfactory continuous operation under the following tropical conditions. Meters should be capable of maintaining required accuracy under hot, tropical and dusty climatic conditions.

i) Maximum Ambient Air Temperature in shade : 55^0 C
ii) Minimum Ambient Air Temperature : (-)10^0 C.

iii) Maximum Relative Humidity : 95%(non-condensing)
iv) Minimum Relative Humidity : 10%
v) Height above mean sea level : Up to 3000 meters
vi) Average number of tropical monsoon per annum : 5 months
vii) Annual Rainfall : 100 mm to 1500 mm

4.0 SUPPLY SYSTEM

System	1 Phase 2 Wire
Rated voltage (Vref)	240 V — Phase to Neutral
Rated Current	Basic current 5 Amps (Ib), Maximum current 30 Amps (Imax)
Rated Frequency	50 Hz

5.0 POWER FACTOR RANGE The meter should be suitable for full power factor range from zero (lagging) through to Unity to zero (leading).

6.0 POWER SUPPLY VARIATION

The meter should be suitable for working with following supply system variations.

System	1 Phase 2 Wire
Specified range of operation	70% to 120% of reference Voltage i.e. 240 Volt.
Frequency	50Hz +/-5%

7.0 ACCURACY

7.1 Class of accuracy of the meter should be 1.0. The accuracy should not drift with time.
7.2 Maximum error limit at 1% lb, UPF should preferably be within +/- 2%.
7.3 For voltage variation use of "between 70% to 50%" of Vref. allowable error limit is +/- 4%.

8.0 POWER CONSUMPTION

8.1 Voltage Circuit: The active and apparent power consumption in the voltage circuit including the power supply of meter at reference voltage. reference temperature and reference frequency should not exceed 1.0 Watt and 4 VA respectively.

8.2 Current Circuit: The apparent power taken by each current circuit at basic current, reference frequency and reference temperature should not exceed 1 VA.

9.0 STARTING CURRENT & RUNNING AT NO LOAD

The meter should start registering energy at 0.2 % of basic current at unity power factor and first pulse must appear within 10 minutes (i.e. time between two consecutive pulses).

Running at no load : When 70% & 120% voltage is applied and no current flows in the current circuit, the test output of the meter should not produce more than one pulse.

10.0 MAXIMUM CONTINUOUS CURRENT The maximum continuous current in meters should be the current at which the meter purports to meet the accuracy requirement of the specification. The same is indicated in table in clause 4 above.

11.0 GENERAL & CONSTRUCTIONAL REQUIREMENTS

11.1 Meters should be designed and constructed in such a way so as to avoid causing any danger during use and under normal conditions. However, the following should be ensured.

a) Personal safety against electric shock
b) Personal safety against effects of excessive temperature.
c) Protection against spread of fire
d) Protection against penetration of solid objects, dust & water.

11.2 The meter should be designed with ASIC (application specific integrated circuit) and should be manufactured using SMT (Surface Mount Technology) components. Power supply and voltage divider circuits may be of PTH (Pin Through Hole) technology.

11.3 The meter should be housed in a safe, high grade, unbreakable, fire resistant, UV stabilized, virgin Polycarbonate casing of projection mounting type. The meter cover should be transparent, for easy reading of displayed parameters, and observation of operation indicators. The meter base may not be transparent, but it should not be black in colour. The meter casing should not change in shape, colour, size, and dimensions when subjected to 200 hrs on UV test as per ASTMD 53. It should withstand 650 deg. C. glow wire test and heat deflection test as per ISO 75. The meter cover should be sealed to the meter base with at least 2 nos. seal by the Manufacturer.

11.4 The meter should be supplied with a transparent extended terminal block cover (ETBC). The ETBC should not be easily detachable from the base and be secured to the base using a hinging arrangement. ETBC should be closed at the bottom to prevent access for wires to terminal holes, but should have a slot of size 20mm X 20 mm on extreme right hand side of the bottom of the terminal cover as per enclosed Drawing No.-(1). The terminal block should be made of high grade non-hygroscopic, fire retardant, fire resistant, glass reinforced poly-carbonate with terminal holes of minimum dia 5.5 mm and should be suitable to accommodate the insulation of the conductors, meeting the requirement of IS 13779 / CBIP technical report-304. The minimum center-to-center distance clearance between adjacent terminals should be 13 mm. Terminal cover should have provision for sealing with at least one seal.

The polycarbonate material of only the following manufacturers shall be used :

a) G.E. Plastics/SABIC LEXAN 943A or equivalent for cover & Terminal cover/LEXAN 503R or equivalent for base.
b) BAYER Grade corresponding to above
c) DOW Chemicals - do -
d) MITSUBISHI - do -
e) TEJIN - do -
f) DUPONT - do –

11.5 All insulating material used in the construction of meters should be non-hygroscopic, non-ageing and of tested quality. All parts that are likely to develop corrosion should be effectively protected against corrosion during operating life by providing suitable protective coating.

11.6 The meter should conform to the degree of protection IP 51 for protection against ingress of dust, moisture and vermin.

11.7 The meter should be capable of providing phase to neutral protection up to 433 Volt for 4 hours.

11.8 The manner of fixing the cables to the terminal block should ensure adequate and durable contact such that there is no risk of loosening or undue heating. Meter should

have 2 screws in each terminal for effective clamping of cables. The screws shall not have pointed ends at the end of the thread. Screw connections transmitting contact force and screw fixing which may be loosened and tightened several times during the life of the meter should be such that the risk of corrosion resulting from contact with any other metal part is minimized. Electrical connections should be so designed that contact pressure is not transmitted through insulating material. All terminals and connecting screws and washers should be of tinned / nickel plated brass material.

The terminals should be capable of withstanding a current of 150% of Imax for two hours continuously.

11.9 The meter should be compact in design. The entire construction should be capable of withstanding stresses likely to occur in actual service and rough handling during transportation. The meter should be convenient to transport and immune to shock and vibration during transportation and handling.

11.10 The meter should have fixing holes, at least one at top and two at bottom. The top hole should be such that the holding screw is not accessible after fixing the meters. The lower fixing screws should be provided under the sealable terminal cover.

11.11 The meter should be fitted with SHUNT for measuring current in the phase element. The Neutral element may have either C.T. or SHUNT or HALL EFFECT SENSOR with proper isolation. The shunts, used in current circuit must be of high quality having high thermal stability and temperature co-efficient. The shunts should be E-Beam / Spot welded. In case of Hall Effect Sensor, meter should record as per requirement of technical specification in normal & tamper conditions and life of battery used for recording & recording & display during single wire operation as per clause 12 (IX) should be guaranteed for 10 years.

11.12 The meter cover should be permanently fixed to the meter base by using ultra sonic welding or any other technology which is either equally or more efficacious in such a way that the meter cover can‘t be opened without breaking the same. i.e. the meter should be break-to-open type. In case any attempt is made to separate the meter cover from the base by using any tools / implements /device, there should be visible evidence of tampering or attempt to open. The contractor will have to specify the type of technology used by him and will also indicate the tests / standard required for testing the same along with test certificates. However, sealing with commonly available adhesives will not be accepted.

11.13 Meter should have an indication in its display if top cover is removed and it should not disappear even if cover is fitted and indication will remove after commands from CMRI/Laptop.

11.14 **Sealing Arrangement**: The sealing screws used for the meter cover shall be fixed upside down so that these are tightened from the rear. A run through screw (stud) has to be provided from bottom side & sealing is to be done on the top side of the meter. Two independent sealing screws are to be provided at both sides of the meter casing. The sealing screws shall be Tinned Brass or Nickel plated steel. In addition to the sealing screws provided to the meter cover, the sealing screws of the terminal cover should be Tinned Brass or Nickel platted steel.

12.0 ANTI-TAMPER FEATURES The meter should have the following anti-tamper features and should record & register forward energy accurately under the following conditions :

i) Input phase and neutral connections are interchanged. Reverse power indication LED should

be provided.
ii) incoming mains is connected to outgoing terminals and load is connected to incoming terminals.
iii) A combination of conditions (i) and (ii) occurs.
iv) Load return is connected to a local earth and not returned to the meter as well as the phase and neutral at supply side are reversed.
v) A combination of '(ii) and (iv)' or (iii)' and (iv)' occurs.
vi) A part of the load is returned to a local earth and the other part is returned to the meter with "Earth load I Neutral load" indication. "Earth load indication" will appear if current measured in phase exceeds the current measured in neutral by more than 10% of the phase current. "Neutral load indication" will appear if current measured through Neutral exceeds the current measured through phase current by 10% or more.
vii) Meter should record energy with maximum error of +/- 4% on Injection of DC (+) ve & DC (-) ve in neutral having magnitude up to 350 V, injection of discontinuous DC (7-10 Hz) in neutral, injection of chopped AC in neutral. Tests in this respect will be conducted by using a device available with us for chopped AC injection (6OV to 300V) & steady/pulsating DC injection. DC voltage will be rectified from a three phase power supply. Single phase Circuit diagram of the device enclosed with the tender documents.
viii) Meter should record energy with maximum error of +/- 4% even in absence of neutral wire not connected at incoming & outgoing, i.e. single wire operation. in such condition Meter should start recording energy at 1.0 Amps. However, meters, which are immune or maintain better accuracy, will be preferred.
ix) The meter should be immune to Electro Static Discharge or sparks of 35 KVp. Approx generated from automobile ignition coil. Tests in this respect will be conducted by using commonly available devices and during spark discharge test, spark will be applied directly at all vulnerable points of the meter for a period of 10 to 20 minutes and meter should record under this condition. After application of spark discharge meter should record correctly within the specified limits of errors. Beyond 35 KVp meter should record as tamper if not immune.

Meters should offer compliance to requirements of CBIP-304 and its amendments for tampering using external magnets. The meter should be immune to tamper using external magnets. The meters should be immune to 0.2T of A.C. magnetic fields and 0.5 T of D.C. magnetic fields, beyond which it should record as tamper if not immune.

The meter should offer a link less design i.e. there is no isolation link provided between the current and voltage circuits and hence there would not be any possibility of tampering with the same. The meter should be capable of recording the following tamper events in memory (minimum 25 events) with date and time stamp preferably along with snapshots of V, I, PF, Kwh and KVAh. The logging will be on FIFO basis.

- Current reversal
- Neutral Disturbance
- Magnetic Tamper

13.0 DISPLAY

13.1 The measured value(s) should be displayed on a Liquid Crystal display (LCD) register. The height X width of the digit should be minimum 8.0 X 5 mm. The KWh energy registration should take place with 6 complete digits. The display should have backlit capability for easy reading. When the LCD is placed at a constant temperature

of 65^0C for a period of 30 minutes in operating condition and 80^0 C for 30 mins. Under de-energized / storage condition, it should not get deformed.

The LCD should be of TN (Twisted Pneumatic) type with display size area of at least 40 X 15 mm. The display should have wide viewing angle of at least 70 deg. Dot Matrix type LCD will not be acceptable. Display should have viewing angle 35 degree up & down from eye level.

13.2 The data should be stored in non-volatile memory (NVM). The non-volatile memory should retain data for a period of not less than 10 years under un-powered condition. Battery back-up memory will not be considered as NVM.

13.3 The register should be able to record and display starting from zero, for a minimum of 2500 hours, the energy corresponding to rated maximum current at reference voltage and unity power factor. The register should not roll over in between this duration.

13.4 In addition to provide serial number of the meter on the display plate, the meter serial number should also be programmed into meter memory for identification through communication port for CMRI / Laptop / meter reading print out.

13.5 It should be possible to read the meter during power —off condition. It should also be possible to read the meter with CMRI / Laptop in this condition. If battery is used for the same, it should be a separate battery and not the one used for RTC. The battery should be of high quality Lithium / Lithium-ion battery, with life of at least 10 years. In case of Lithium battery no of operations per day are to be restricted to maximum 5(five) operations so that battery life is not hampered during ten years.

14.0 DISPLAY SEQUENCE

The meter should display the required parameters in two different modes as per the sequence given below.

A Auto Display Mode : The following parameters hereinafter referred to as "Billing Parameters" (B.P) should be displayed in an auto-cycle mode, in the following sequence :

1. LCD Test
2. Real Time
3. Date
4. Cumulative Active energy (forwarded) reading (kWh)
5. Last Bill Maximum demand (kW)
6. Billing period counts

Each parameter should be on meter display for 10 seconds and the time gap between two auto-cycles should be 120 seconds

B Push Button Mode : In addition to the auto display mode parameters, the following parameters should be displayed on pressing the push button (All displays of auto mode and the following) :

1. Last Bill Active Forward energy
2. Reactive Energy
3. Instantaneous Load (KW)
4. Instantaneous voltage, current
5. Maximum demand kW for Current month
6. Supply Frequency
7. TOD Energy
8. Instantaneous Power Factor
9. Tamper Count

10. Meter Sl. No.

The meter should also be capable of offering a high resolution display which should enable conducting of dial testing by the user in the shortest possible time and as a minimum, the meter should be capable of offering a resolution of 4 digits after decimal & 2 digits before decimal for the high resolution KWh/KVAh display and 2 digits after decimal & 4 digits before decimal for the high resolution Wh/VAh display. Any other useful display will be acceptable. Accuracy test for low load will be measured by short dial test as well as pulse count test.

15.0 MAXIMUM DEMAND REGISTRATION & RESET

Meter should continuously monitor & calculate the average maximum demand for each demand interval time of 30 minutes and maximum of these in a calendar month should be stored along with date and time when it occurred. The maximum demand should automatically reset at 24:00 hrs. of the last date of each calendar month and the corresponding value along with date/time stamp shall be transferred to Billing(History) registers.

The integration period should be set as 30 minutes, on real-time basis.

The billing purpose parameters (active forwarded energy, reactive energy, maximum demand in kW) should be recorded and should be available in Bill (History) for a minimum period of last 12 months.

15.1 LOAD SURVEY: The meter should be capable of recording load survey for the following parameters for a period of minimum 90 days with 30 minutes integration period.

i) Demand in KW.

16.0 TIME OF USE / Time of Day MONITORING

The meter should offer the capability of time of use monitoring for energy. Minimum 2 registers should be capable of being configured for TOD monitoring for Peak / off peak hours. Time slots T1-23-00 Hrs. to 17-00 Hrs. of next day and T2-17-O0 Hrs. to 23-00 Hrs. In case of any change of Time slots in future as per directive of SERC, the same is to be incorporated by the supplier even after completion of the order as per instruction from the appropriate authority.

17.0 SELF- DIAGNOSTIC FEATURE

The meter should be capable of performing complete self diagnostic check to monitor integrity of data memory location at all time. The meter should have indication for unsatisfactory / nonfunctioning / malfunctioning of the following :

a) Time and date on meter display
b) All display segments on meter display
c) Real Time Clock (RTC) status in meter reading prints out at BCS end
d) Non-volatile Memory (NVM) status in meter reading prints out at BCS end

18.0 COMMUNICATION PORTS AND PROTOCOL:

The meter should have a galvanically isolated optical communication port for data communication with CMRI/Laptop. The port should be compatible with IEC 1107/PACT/ANSI. Adequate sealing provision should be provided.

19.0 DISPLAY POWER UP IN ABSENCE OF MAINS SUPPLY

The meter should have the provision of providing the display of billing parameters in absence of main supply. Press of push button should activate the display to facilitate hands free meter

reading with auto-off provision. It should be possible to read the meter using CMRI during power-off condition using this facility.

20.0 MARKING OF THE METER

The marking on the meter should be in accordance with relevant clauses of IS 13779.
The basic marking on the meter nameplate should be as follows (all other markings as per IS should also be there) :

a) Manufacturers name & trade mark
b) Type Designation
c) No. of phases & wires
d) Serial number (Size not less than 5mm)
e) Month & Year of manufacture
f) Reference Voltage
g) Rated Current
h) Operating Frequency
i) Principal unit(s) of measurement
j) Meter Constant (imp/kwh)
k) Class index of meter
l) "Property of P&E Deptt., Mizoram"
m) Purchase Order No. & Date
n) Guarantee (Guaranteed for a period of 5 1/2 Yrs. from the date of delivery)
0) BIS marking
p) Place of manufacture
q) Bar coded Sl no. of the meter along with manufacturing date.

21.0 CONNECTION DIAGRAM & TERMINAL MARKINGS:

The connection diagram of the meter should be clearly shown on terminal cover.

22.0 OUTPUT DEVICE

The meter should have a test output accessible from the front and capable of being monitored with suitable testing equipment while in operation at site. The test output device should be provided in the form of LED output, There should be adequate clearance of the test output from other outputs so that there is no interference of other outputs while performing accuracy test with standard scanners.
The relation between test output and the indication on display should comply with the marking on the name plate (imp per KWh)

23.0 ELECTRO-MAGNETIC-COMPATIBILITY & INTERFERENCE REQUIREMENT

The meter should meet EMI / EMC requirements as specified in the relevant standards described in Clause 2.0 of this specification.

24.0 PROCUREMENT OF SEALS :

The manufacturer of meter will be responsible for sealing of the meters at his works with his own two (2) nos. Polycarbonate seals with manufacturers logo & sequential numbers.
A Tracking & recording software (25 nos. or more as per our requirement) for all new seals shall be provided by the manufacturer of the meter so as to track total movements of the seals starting from manufacturing, procurement, storage, record keeping, installation, series of

inspections, removal & disposal.
Seal tracking software should be submitted and installed at PC/Laptop of the purchaser before commencement of supply of meters.

25.0 TESTS :

i) Type Testing of Meter : The meters should be type tested at any NABL accredited laboratory in accordance with IS 13779 with latest amendments, CBIP Report 304 with latest amendments. The type test report should not be more than 3 (three) years old. A copy of the Type Test results should be enclosed with the offer. If there is any modification in the design/parameters of the specifications or use of constituent materials in the offered meters submitted with the offer, from the meter which was submitted type tested, which may affect the characteristics as well as parameters of the meter, revised type test certificates as per the design, parameters and constituent material used in the offered meter, shall have to be submitted failing which the offer may be liable to be rejected. Type Test Certificate from any NABL accredited Lab. shall only be considered.
Type test certificate should contain the following information clearly :
1) Class of accuracy.
2) Meter constant

ii) Acceptance tests : The acceptance tests as stipulated in CBIP / IS (with latest amendments) and shall be carried out by the supplier in presence of purchaser's representative. Lot size, sampling and procedure to be followed for acceptance test will be as stated below The lot size of Meters is 10,000 nos. & no. of Sample Meters to be selected at random from the lot is 32 nos. The following tests shall be carried out on all the 32 nos. meters thus selected At random.

The P&E Department Engineers shall witness the various quality control measures adopted for verification of different components of meters and satisfy themselves about the same. They shall also inspect the protocol for maintaining the accuracy of the meter testing equipment with reference to the standard at manufacturer's meters testing station.

Physical examination of the meters.
Non-registration with Voltage along at 70% V ref and at 120% V ref.
Starting current at 0.2% I basic Upf
High voltage test.
Insulation resistance test.
Test of protection for withstanding 433 volt between phase & neutral for a period of at least 4 hours.
Test of endurance up to 150% I max

During the above tests, if no. of meter fails is less than or equal to 1 No., the lot shall be considered to be conforming to the above tests. If no. of meter fails is greater than 1 No. but less than 4 nos., further re-sampling will be done and the nos. of re-sampled meters shall be 32 nos. selected at random from the Lot of 10,000 nos.
The re-sampled meter will be subjected to the tests as mentioned above and if nos. of meters fail in two samples combined (64 nos.) is less than 4 nos. the lot shall be considered to be conforming to the above tests otherwise rejected. Further testing for 8 nos. meters selected from 32 nos. sample meters will be carried as follows :

Limits of error on all the sample meters at:

1% I basic	1.0 pf. (12% is preferable but should not exceed 13%)
2% I basic	1.0 pf.
5% I basic	1.0 pf., 0.5 pf. Lag & 0.8 lead
10% I basic	1.0 pf., 0.5 pf. Lag & 0.8 lead
50% I basic	1.0 pf., 0.5 pf. Lag & 0.8 lead
100% I basic	1.0 pf., 0.5 pf. Lag & 0.8 lead
200% I basic	1.0 pf., 0.5 pf. Lag
600% I basic	1.0 pf., 0.5 pf. Lag

Test of meter constant and meter dial for one unit at 200% I basic, 0.866 pf. Lag.
Power loss on voltage & current circuit.

Further testing for 3 Nos. sample meters will be carried as follows:

Repeatability of error test at 5% I basic Upf & 100% I basic Upf.
The maximum divergent should be less than 0.5%.
If anyone of the meter fails on any of the above tests, the lot will be rejected.
Further testing for 1 No. sample meter will be carried as follows:
Magnetic induction of external origin (AC & DC).
Electro Static Spark Discharge of 35KVp
Tamper & Fraud protection as per Clause 12 (I to vii) (Anti-tamper feature) of our specification.
Injection of DC pulse (low frequency) in the neutral.
Dry —heat test as per clause 12.6.1 of IS: 13779/99.
At least one sample selected from any lot of the meters offered for inspection will be sealed by us and handed over to the supplier for testing at NABL accredited laboratory. Presence of purchaser's representative during dry heat test at NABL accredited laboratory is not required. But in the test report meter SI. No. & meter body seal nos. are to be mentioned.

Shunt test by applying 100 Amps continuous load for minimum two hours for verification and conformation for quality of shunt & its E-beam welding.
Physical verification of internal components.

If the meter fails on any of the above test, the lot will be rejected.
Facilities/arrangement for conducting ageing test should be available with the manufacturer.

iii) Retesting after delivery

P&E Deptt., Mizoram will carry out re-testing of the supplied meters at their laboratory. Re-testing of the supplied meters will be conducted on sample meters collected from different stores of the consignees as per the procedure followed for acceptance test (except dry heat test & shunt test) during inspection & testing of the supplied meters at manufacturer's works. Re-testing of the supplied meters will be completed within one month from the date of receipt of meters at different stores. Date of re-testing of meters will be intimated to the supplier for witnessing testing of the meters.

In case the meters are not in order as per our observation during inspection and testing of the supplied meters, the lot will be declared defective and in that event meters supplied are to be replaced by the manufacturers free of cost including free transportation from the site to their works and back. The replaced meters are to be offered for inspection & testing and Acceptance test of will have to be carried out by the supplier in presence of purchaser’s representative.

iv) Routine Tests :

Each and every meter of the offered lot shall undergo the routine tests as well as functional tests as per IS: 13779/1999, CBIP Report-304 and after sealing of the meters, the manufacturers will submit the routine test report of all the meters as well as a statement showing seal Sl. Nos. against each meter.

v) TEST FACILITIES

The tests for equipment / instrument shall be carried out as per relevant Standards and test certificates shall be furnished for scrutiny. The Contractor shall indicate the details of the equipment available with him for carrying out the various tests as per relevant Standards. The contractor shall indicate the sources of all equipmentsl instruments.

NOTE : The standard meters used for conducting tests shall be calibrated periodically at any NABL Accredited Test Laboratories and test certificates shall be available at Works for verification by purchasers representative.

The manufacturer shall have the following testing facilities to ensure accurate calibration :

AC high voltage test
Insulation test
Test of no load condition
Test of Starting condition
Test on Limits of error
Power loss in voltage and current circuit
Test of Repeatability of error
Test of meter constant
Test of magnetic influence

26.0 INSPECTION :

The purchaser may carry out the inspection at any stage of manufacture. The manufacturer shall grant free access to the purchaser's representative at a reasonable time when the work is in progress. Inspection and acceptance of any equipment under this specification by the purchaser shall not relieve the supplier of his obligation of furnishing the equipment in accordance with the specification and shall not prevent subsequent rejection if the equipment is found to be defective.

All acceptance tests and inspection shall be made at the place of manufacturer unless otherwise especially agreed upon by the Contractor and purchaser at the time of purchase. The Contractor shall provide all reasonable facilities without charge to the inspector, to satisfy him that the equipment is being furnished in accordance with this specification.

The supplier shall keep the purchaser informed in advance, about the manufacturing programme for each lot so that arrangement can be made for inspection.

The purchaser reserves the right to insist for witnessing the acceptance / routine testing of the bought out items. The supplier shall give 15 days for local supply / 30 days in case of foreign supply advance intimation to enable the purchaser to depute his representative for witnessing the acceptance and routine tests.

The purchaser reserves the right for type testing of any meter & meter casing etc. from any of the offered lots, received at any destination stores.

27.0 QUALITY ASSURANCE PLAN :

The design life of the meter shall be minimum 20 years and to prove the design life the firm shall have at least the following quality Assurance Plan: -

>> The factory shall be completely dust proof.

>> The testing rooms shall be temp. and humidity controlled as per relevant standards.

> The testing and calibrating equipments should be automatic and all test equipment shall have their valid calibration certificates.

> Power supplies used in testing equipment shall be distortion free with sinusoidal wave- forms and maintaining constant voltage, current and frequency as per the relevant standards.

During the manufacturing of the meters the following checks shall be carried out.

i) Meter frame dimensions tolerances shall be minimum.

ii) The assembly of parts shall be done with the help of jigs and fixtures so that human errors are eliminated.

iii) The meters shall be batch tested on automatic, computerized test bench and the results shall be printed directly without any human errors.

28.0 GUARANTEE:

The meters should be guaranteed against any manufacturing defects arising out of faulty design or bad workmanship or component failure for a period of 5 1/2 years from the date of supply.

Life of battery used for the meter should be guaranteed for 10 years.

The meter/battery found defective within the above guarantee period shall be replaced by the supplier free of cost within 60 days of the receipt of intimation of failure/defect.

29.0 REPLACEMENT OF DEFECTIVE METERS :

The meters declared defective by the P&E Department shall be replaced by the supplier up to the full satisfaction of the P&E Department at the cost of supplier. Failure to do so within the time limit prescribe shall lead to imposition of penalty of twice the cost of meter. The same may lead to black listing even, as decided by P&E Department. In this connection the decision of P&E Department shall be final.

30.0 PACKING & FORWARDING :

The equipment shall be packed in cartons / crates suitable for vertical / horizontal transport as the case may be, and suitable to withstand handling during transport and outdoor storage during transit. The supplier shall be responsible for any damage to the equipment during transit, due to improper and inadequate packing. The easily damageable material shall be carefully packed and marked with the appropriate caution symbol. Wherever necessary, proper arrangement for lifting such as lifting hooks etc., shall be provided. Supplier without any extra cost shall supply any material found short inside the packing cases immediately.

The packing shall be done as per the standard practice as mentioned in IS 15707 : 2006. Each package shall clearly indicate the marking details (for e.g., manufacturer's name, SI. Nos. of meters in the package, quantity of meter, and other details as per supply order). However, he should ensure the packing is such that, the material should not get damaged during transit by Rail / Road.

TECHNICAL SPECIFICATION FOR 3-PHASE 4-WIRE STATIC WHOLE CURRENT ENERGY METER WITH LPR FACILITY OF 1.0 CLASS ACCURACY

1.0 SCOPE

(a) This specification covers design, engineering, manufacture, testing, inspection and supply of A.C. 3-phase, 4-wire solid state (Static) Whole Current lag only energy meter with LPR facility & backlit LCD. The meter should be capable of recording and display energy in KWh, KVAh and demand in KVA, power factor range of Zero lag-unity-Zero lead. Meter should have facility capability of recording tamper information & load survey in active, apparent & reactive energy and phase currents.

(b) It is not the intent to specify completely herein all the design and construction of meter however the meter shall conform in all respect to high standard of engineering, design and workmanship shall be capable of performing in continuous commercial operation in a manner acceptable to P&E Department, who will interpret the meanings of drawings and specification shall have the right to reject any work or material which in its judgment is not in accordance herewith. The meter shall be complete with all, accessories, hardware, software and components necessary for their effective and trouble free operation of the system. Such components shall be deemed to be within the scope of supply irrespective of whether those are specifically brought out in this specification or not.

(c) It is mandatory that meters shall be ISI marked and contractor shall have to furnish valid BIS certificate. The metering system should be flexible enough for changing requirements in future and designed for minimum maintenance. The meters will be installed with fully wired weatherproof, Polycarbonate pilfer proof Meter Box.

2.0 STANDARDS APPLICABLE:

Unless specified elsewhere in this specification, the performance & testing of the meters should conform to the following Indian / International standards, to be read with upto-date and latest amendments/revisions thereof.

Sl.No.	Standard No.	Title
1	IS3779, 1999 read with its latest amendments.	A.C. Static Watt-hour Meters, Class 1.0 &2.0
2	CBIP Technical Report 304	Specification for AC Static Electrical Energy meters of CBIP with its latest amendments.
3	IEC 687 - 1992	Alternating current static watt-hour meters for active energy (Class 1.0)
4	CBIP Technical Report III	Specification for Common Meter Reading Instrument
5	IS 13410-1992 with latest amendment	Specification for Pilfer Proof Meter box Suitable for 3-Ph static Energy Meter

Meters matching with requirements of other national or international standards that ensure equal or better performance than the above mentioned standards should also be considered. When the equipment conforms to standards other than those specified above, salient points of difference between standards adopted and the standards specified in this specification shall be

clearly brought out in the relevant schedule. A copy of such standards along with their English translation shall invariably be furnished.

3.0 CLIMATIC CONDITIONS :

The meters to be supplied against this specification should be suitable for satisfactory continuous operation under the following tropical conditions. Meters should be capable of maintaining required under hot, tropical and dusty climatic conditions.

i)	Maximum Ambient Air Temperature in shade	: 55°C
ii)	Minimum Ambient Air Temperature	: (-) 10°C
iii)	Maximum Relative Humidity	:95% (non-condensing)
iv)	Minimum Relative Humidity	: 10%
v)	Height above mean sea level	: Upto 1000 meters
vi)	Average number of tropical monsoon per Annum	: 5 months
vii)	Annual Rainfall	: 100 mm to 1500 mm
xi)	Max. Wind Pressure	: 150 Kg/sq.m.

4.0 TROPICAL TREATMENT :

The meters shall be suitably designed and treated for normal life and satisfactory operation under hot & hazardous tropical climate conditions and shall be dust and vermin proof. All the parts & surface, which are subject to corrosion, shall either be made of such material or shall be provided with such protective finish which provides suitable protection to them from any injurious effect of excessive humidity.

5.0 BRIEF ELECTRICAL SPECIFICATION:

Class of accuracy	:	1.0S (No drift in tolerance of accuracy with time) (Meter should record energy at 1% lb at UPF preferably with an error band +/-2%)
Supply Voltage	:	240V, (-40% to + 20%)
Frequency	:	50 Hz +/-5%
Current Range (basic)	:	10A for 10 - 60A
Maximum Current	:	60A
Starting Current	:	0.2% of Ib at UPF
Power factor range	:	Zero (lagging) - Unity - Zero (Leading)
Power Loss	:	Voltage Circuit Less than 1.5W/ 10VA per phase
Current Circuit Less than 4VA		
Resistance to impulse voltage	:	Minimum 10KV peak
Resistance to surge voltage	:	Minimum 8KV peak of 1.2/50 Micro sec.
Test Voltage at 50 Hz for 1min	:	4 KV rms - as per IS 13779
Clock time accuracy	:	+/-3 min/year - as per CBIP Tech Rep 88

6.0 MAXIMUM CONTINUOUS CURRENT:

The maximum continuous current in meters should be the current at which the meter purports to meet the accuracy requirement of the specification. The same is indicated in Clause 5.0 above.

7.0 CONSTRUCTION :

The case, winding, voltage circuit, sealing arrangements, registers, terminal block, terminal cover & name plate etc. shall be in accordance with the relevant standards. The meter should be compact & reliable in design, easy to transport & immune to vibration & shock involved in the transportation & handling. The construction of the meter should ensure consistence performance under all conditions especially during heavy rains / very hot weathers. The insulating materials used in the meter should be non-hygroscopic, non-ageing & have tested

quality. The meter should be sealed in such a way that the internal parts of the meter becomes inaccessible and attempts to open the meter shall result in viable damage to the meter cover. This is to be achieved by using continuous Ultrasonic welding on the Meter body or any other technology which is either equally
or more efficacious.

The meter should comply latest technology such as Microcircuit or Application Specific Integrated Circuit (ASIC) to ensure reliable performance. The mounting of the components on the PCB should compulsorily be Surface Mounted Technology (SMT) type. Power supply component may be of PTH type. The electronic components used in the meter should be of high quality and there should be no drift in the accuracy of the meter for at least ten years. The circuitry of the meter should be compatible with 16 Bit (or better) ASIC with compatible processor and meter should be based on Digital measuring and sampling technique.

The meter should be housed in a safe, high grade, unbreakable, fire resistant, UV stabilized, virgin Polycarbonate casing of projection mounting type. The meter cover should be transparent, for easy reading of displayed parameters, and observation of operation indicators. The meter base may not be transparent, but it should not be black in colour. The meter casing should not change shape colour, size, dimension when subjected to 200 hrs on UV test as per ASTMD 53. It should withstand 650 deg. C. glow wire test and heat deflection test as per ISO 75.

The meter cover should be sealed to the meter base with at least 2 nos. seal by the Manufacturer. The contractor shall submit relevant documents regarding the procurement of polycarbonate material. The polycarbonate material of only the following manufacturers shall be used.

a) GE Plastics (SABIC) LEXAN 943Aor equivalent for cover & Terminal cover /Lexan503R or equivalent base.

b) BAYER Grade corresponding to above
c) DOW Chemicals -Do-
d) MITSUBISHI -Do-
e) Tejin -Do-
f) DUPONT -Do-

8.0 METER CASE AND COVER:

The meter should have a case, which can be sealed in such a way that the internal parts of the meter are accessible only after breaking the seal and cover. This is to be achieved by used of Ultrasonic Welding (Ultrasonically continuously welded at three sides so that the cover cannot be separated from the basic without breaking/damaging the case & cover) or any other technology which is either equally or more efficacious. In case, ultrasonic welding using plate / strip is used the material of plate / strip should be same as that of cover and base and the strip. The manufacturers logo should be embossed on the strip/plate. The material of the meter body (case and cover) shall be of polycarbonate or Engineering Plastic.

The meter cover should be fixed to the meter base (case) with Unidirectional Screws, so that the same cannot be opened by use of screwdrivers. These unidirectional screws should be covered with transparent caps, ultrasonically welded with the meter body and the screw covers should be embedded in the meter body in a groove.

The meter shall withstand external magnetic influence as per latest amendments of CBIP Technical Report No.88.

9.0 TERMINAL BLOCK AND COVER :

The terminals may be grouped in a terminal block having adequate insulating properties and

mechanical strength. The terminal block should be made from best quality non- hygroscopic, flame retardant material (capable of passing the flammability tests) with nickel plated brass inserts / alloy inserts for connecting terminals.

The terminals in the terminal block shall be of adequate length in order to have proper grip of conductor with the help of screw adjustable metal plates to increase the surface of contact and reduce the contact resistance. The screws shall have thread size not less than M4 and head having 4-6mm. Diameters. The screws shall not have pointed ends at the end of threads. All terminals and connecting screws and washers should be of tinned / nickel plated brass material. The terminal should withstand glow wire test at 960 +/- 15 °C and the terminal should withstand at least 135 °C as per IS.

The internal diameter of terminal hole should be minimum 9.5 mm and center to center distance is 13 mm. The holes in the insulating material shall be of sufficient size to accommodate the insulation of conductor also.

The terminal cover shall be transparent re-inforced Polycarbonate, Engineering Plastic with minimum thickness 2.5 mm and the terminal cover shall be of extended type completely covering the terminal block and fixing holes. The space inside the terminal cover should be sufficient to accommodate adequate length of external cables.

10.0 MARKING OF THE METER :

The marking on the meter should be in accordance with relevant clauses of IS 13779. The basic marking on the meter nameplate should be as follows (all other markings as per IS should also be there):

a) Manufacturer's name & trade mark
b) Type Designation
c) No. of phases & wires
d) Serial number (Size not less than 5mm)
e) Year of manufacture
f) Reference Voltage
g) Rated Current
h) Operating Frequency
i) Principal unit(s) of measurement
j) Meter Constant (imp/kwh)
k) Class index of meter
l) “Property of P&E Deptt., Mizoram"
m) Purchase Order No. & Date
n) Guarantee (Guaranteed for a period of 5 1/2 Yrs. From date of delivery)
o) BIS marking
p) Place of manufacture
q) Meter Sl. No. in alpha numerical form, Dt. of Manufacture, Rating of the meter and P.O reference should be bar coded.

11.0 DISPLAY OF MEASURED VALUES :

The meter shall have Alphanumeric display with atleast 7 full digit with LCD backlit display, having minimum character height of 10 mm. The data should be stored in non-volatile memory. The non-volatile memory should retain data for a period of not less than 10 years under unpowered condition. Battery back-up memory will not be considered as NVM. It should be possible to easily identify the single or multiple displayed parameters through symbols / legend on the meter display itself or through display annunciator.

The register shall be able to record and display starting from zero, for a minimum of 2500 hours. The energy corresponding to rated maximum current at reference voltage and unity power factor. The register should not roll over in between this duration.

In addition to provide Serial Number of the meter on the display plate, the meter serial should also be programmed into meter memory for identification through communication port for CMRI / laptop / meter reading printout. Visibility of display in poor light conditions is an important criterion. STN or TN type of LCD to be used. Proper annunciation legends for the displayed parameters to be provided (programmable).

The meters should have auto-display mode for pre-selected parameters. Push-Button mode of display should display all parameters and it should have priority over auto mode. The meter should give clear message on display to indicate that the meter has experienced tampers and the nature of tamper with first occurrence and last restoration date & time.

The meter shall have a test output (blinking LED) accessible from the front and be capable of being monitored with suitable testing equipment. The operation indicator must be visible from the front. Test output device should be provided in the form of one common LED for active, reactive and apparent energies with the provision of selecting the parameter being tested (separate LED may also be used with proper separation).

Meters should have calibrating LED pulse output for Energy Vectors. The meter should also record values of Energies at present date & time (Programmable).

12.0 DISPLAY SEQUENCE :

The meter should display the required parameters in two different modes as follows :

Display sequence for both Auto & Push Button must be maintained, any interchange between the display parameters is not accepted.

A) Auto Display Mode : The following parameters should be display in auto cycle mode, in the following sequence.

- LED / LCD test
- Meter serial number
- Rising Apparent Demand with elapsed time
- Real Time & Date (dd mm yy)
- Power On Hours (Cumulative)
- Active Energy
- Maximum Demand in KW(Previous Month)
- Maximum Demand in KW(Present Month)
- Reactive Energy (Lag only)
- TOD Active Energies

Each parameter should be on meter display for 10 seconds And the time between two auto cycle should be at 120 seconds gap.

B) Push Button mode : In addition to the auto display mode parameters, the following parameters should be displayed on pressing the push button (all display of auto mode and the following).

- Last month Average Power Factor
- Instant Power Factor
- Avg. Load factor(Previous Month)
- Avg. Load factor(Present Month)
- Apparent Energy
- Apparent Max Demand (Lag only, Previous Month)
- Apparent Max Demand (Lag only, Present Month)

- TOD Apparent Demand
- MD reset count
- Inst. Phase Voltage
- Inst. Phase Current
- Inst. Load (Active & Apparent)
- Tamper Information
- Total Tamper Count
- Previous 3 months(at least) cumulative Kwh, KVAh and Maximum Demand in KW & KVA at 24.00 hrs. of last date of the month.
- Cumulative Power failure in days — hrs. from the date of manufacturing.

Any other useful display will be acceptable like Neutral Current at any instant.

13.0 ANTI TAMPER FEATURES :

The meter should have the following anti-tamper features:

i) The meter shall be capable of recording energy correctly even if the input and output terminals are interchanged.

ii) The meter shall work correctly irrespective of phase sequence of supply.

iii) The meter shall work correctly even in absence of neutral. The Meter should record accurate energy even if load is drawn partially or fully through a local earth.

iv) The meter shall work correctly if one, two and all three phase current direction is reversed.

v) The meter should work in absence of two phase and record relevant energy on any one phase & Neutral or any one phase & earth.

vi) The Potential link shall not be accepted.

vii) Meter should record energy with maximum error of +/-4% on injection of DC in neutral, injection of pulsating DC (7-10Hz) in neutral. DC voltage will be rectified from a three phase power supply.

viii) Meter should meet accuracy under magnetic influence as per CBIP 304 latest amendments . No abnormal behavior like flickering, switching on-off of display, abnormal heating etc should be observed during magnet test. Meter should record energy at Imax with Tamper logged, if it gets affected from magnetic influence.

ix) Meter should record energy with maximum error of 1 4% on injection of chopped AC in Neutral. However meters which are immune or maintain better accuracy, will be preferred. Maximum chopping for AC injection will be 25% to 30% at peak end.

x) The registration shall not be affected more than 1 4% if external A.C. or high frequency Voltage is applied to the meter neutral w.r.t. earth(up to 450 volt,1khz)

xi) The meter should be immune to Electro Static Discharge or Sparks of 35 KVp (approx) induced by using frequency-generating devices having very high output voltage. Tests in this respect will be conducted by using commonly available devices and during spark discharge test, spark will be applied directly at all vulnerable points of the meter for a period of 10 minutes and meter should record under this condition. After application of spark discharge meter should record correctly within the specified limits of errors. Beyond 35 KVp meter should record as tamper if not immune.

Circuit diagrams for test jig for chopped A.C. & pulsating D.C injection are enclosed. The meter shall be capable of recording occurrences and restoration with date and time the following tamper conditions:

Missing Potential for all phases.
Voltage unbalance (If Vmax-Vmin is greater than 30% of Vref)
Current reversal for all phases.
CT Open / CT Short! Load or Current imbalance etc
All potential missing or Power failure.
Magnetic Disturbances (IS 13779 & CBIP 304)
High voltage (35 KV apply if not immune)
Neutral Disturbance due to AC / DC abnormal signal (if not immune)

Snapshot values of phase Voltage, Phase Current & Phase wise Power Factor, Active Energy value during occurrence & restoration to be provided in the above mentioned for all tamper conditions (upto 300 events). The duration of tamper before it is logged should be a user programmable through authenticated commands. (But it should not be more than 10 min.) All authenticated commands should be Base Computer Software controlled.

All transactions with meter should be date & time logged (minimum last 5 transactions) Properly designed meter tamper logic should be provided and clearly explained in the bid. The tamper logic should be capable of discriminating the system abnormalities from source side and load side and it should not log/record tamper due to source side abnormalities. A minimum of 300 events (one event means either occurrence or restoration) of all types of tamper with date & time stamping should be available in meter memory. The logging will be on FIFO basis. Meter should have an indication in its display if top cover is removed/open and must be logged in BCS .

13.1 Measurement of Harmonics :

The meter should be capable of measuring fundamental energy as well total energy i.e, fundamental plus Harmonics energy. Total energy shall be made available on meter display and the same only shall be used for billing purpose. Provision for measuring of fundamental energy be kept for utilization in future.

The total energy & fundamental energy shall be logged in the meter memory and be capable of downloading to the BCS through the CMRI and be available for viewing at the BCS end.

14.0 RESETTING OF MAX. DEMAND :

The meter should be capable of recording the Apparent MD with integration period of 15 minutes (programmable). The meter should also record MD at preset date and time. MD reset should be through all of the three means : 1) Manually 2) Through authenticated MRI or Remote Communication Command, 3) Automatic resetting at 00:00 Hrs at fast day of the Month.

Facility to invoke any of the above through authenticated MRI command should be provided. By default the M.D. reset will be through push button on any date of the month. MD reset button should have proper sealing arrangement. Push button for scrolling display & MD reset should be separate.

15.0 LOAD SURVEY :

The meter should be capable of recording load survey for the following parameters for a period of minimum 45 days with 15 minutes integration period.

i) Demand in KW,
ii) Demand in KVA
iii) Current - phase-wise

iv) Voltage - Average Voltage.

The NVM shall not require any additional battery backup to retain the data in case of power failure, for upto 10 years and the data storage shall be independent of battery backup unit. The life of the RTC battery in circuit condition should be minimum 5 years in case of power failure. It should be possible to transfer this data to base computer software through MRI. The data so obtained should be displayed in both graphical & numeric form in the BCS. The BCS with all details is to be provided by the supplier at no extra cost.

16.0 METER READING DURING POWER OFF :

It should be possible to read the meter-display visually and with MRI in absence of input voltages with the help of internal or external battery backup. The interface preferred will be inductive coupling. If otherwise, proper sealing arrangement of coupling port to be provided. In case of internal battery the arrangements should be such that hands free operation is possible. Separate battery should be used for this purpose (Not RTC or processor battery).

17.0 SELF DIAGNOSTIC FEATURES :

The meter shall be capable of performing complete self-diagnostic check to monitor the circuits for any malfunctioning to ensure integrity of data memory location all the time. If possible, the details of malfunctioning should be recorded in the meter memory. The contractor should furnish the details of self-diagnostic capability feature.

18.0 IMMUNITY TO ELECTRO MAGNETIC & ELECTRO STATIC DISTURBANCE:

The meter should be designed in such a way so that external electromagnetic field or electrostatic discharges do not influence the performance of the meter. If it is influence it must be logged in Meter memory with proper stamping.

19.0 TECHNICAL SUPPORT, MANUALS & TRAINING :

Extensive technical support, detailed technical literature & training is to be provided by the manufacturer. Supply of External Battery Packs to be provided by the manufacturer.

20.0 INFLUENCE QUANTITIES :

The meter shall work satisfactorily with guaranteed accuracy as per limit as per limit or relevant IS under presence of the following quantities:

i) Electromagnetic field
ii) External magnetic field
iii) Radio frequency interference
iv) Vibration
v) Voltage fluctuation
vi) 35KV Electrostatic field
vii) Harmonics distortion as per relevant IS and IEC.

21.0 POWER CONSUMPTION BY METER :

Voltage Circuit : The active and apparent power consumption in the voltage circuits (all 3 phases) including the power supply of meter at reference voltage, reference temperature and reference frequency should not exceed 1.5 Watt and 10 VA respectively.

Current Circuit : The apparent power taken by each current circuits (all 3 phases) at basic current, reference frequency and reference temperature should not exceed 4 VA.

22.0 STARTING CURRENT :

The meter should start registering energy at 0.2 % of basic current at unity power factor and should be fully functional within five seconds after the rated voltage is applied.

23.0 RUNNING AT NO LOAD:

When 70% & 120% voltage is applied and no current flows in the current circuit, the test output of the meter should not produce more than one pulse.

24.0 COMMUNICATION CAPABILITY :

(a) Local Communication Mode:

The meter shall have a galvanically isolated optical communication port as per IEC 1107/ANSI/PACT so that it can be easily connected to a hand-held common meter reading instrument (CMRI) for data transfer. The billing data & the tamper data downloading time should be less than 2 minutes. The optical port should be provided with proper sealing arrangement so that the optical cover should not be opened without breaking the seal. A stored data in the meter should be available through CMRI even when the display of the meter is not available. The above ports suitable for interface of the meter with appropriate protocol to Common Meter Reading Instrument (CMRI) / LAPTOP / PC.

(b) Remote Communication Mode:

As the meters would be mounted at height & it is difficult to take manual meter readings at height therefore reading of the meter should be taken through Low Power Radio (LPR).

- The LPR should be able to read meter at a distance of 100 meter in open area (Line of sight) without obstructions.
- The data from the meter shall be retrieved at minimum 1200 — baud rate.
- The frequency range for LPR equipment shall be approved frequency range from the government of India i.e.2.4 G Hz.
- Meter shall use license free frequency band for communication so that license for using LPR equipment to read energy meter at site is not required.
- The LPR should be transceiver type and support Hand Held Unit (HHU) so that it should be able to retrieve meter reading data from meter and down load to base computer software at PC end.
- The Hand Held Unit shall be able to retrieve data directly from meter communication port and through LPR communication.

It should not be possible to alter date in the meter by-passing commands from the CMRI or Laptop. For alteration of RTC time, change of TOD timing, Billing parameters, etc. it should be possible to perform this functions through CMRI but only through authenticated commands sets by BCS after scheduling for particular meter sl nos. No alteration / change should be possible through authenticated commands sets by the BCS without scheduling the meters. Moreover, no alternation / change should be possible using CMRI only, i.e. the control has to be with the BCS.

The BCS shall have multi-level password for data protection & security.

25.0 BASE COMPUTER SYSTEM & SOFTWARE REQUIREMENTS :

The Common Meter reading Instrument (CMRI/Laptop) should be capable of being loaded with user-friendly software (MS-DOS 5.0 or higher version compatible) for reading / downloading meter data. Windows based Base Computer Software (BCS) should be provided for receiving data from CMRI / Laptop and downloading instructions from base computer software to CMRI / Laptop.

The data stored in the meters memory including defrauded energy should be available on the BCS. The contractor has to supply the Meter Reading protocol (API), free of cost. The protocol should not be complicated & should be easily understandable to introduced compatibility between meters, BCS and CMRI of other makes. The compatibility of transferring data from the meter to CMRI & then to the BCS should be easily established. Any change or upgradation of CMRI software of CMRI software or BCS in future, required for any reason, has to be done by the supplier at his own cost.

In BCS 12 months back-up data for KWH, KVAH, MD in KW & KVA (Total & TOD wise), Average Load Factor, Average Power Factor must be available.

26.0 ACCURACY :

There shall be no drift in accuracy, for a period of ten years from the date of supply. In case any drift is noticed which is beyond the permissible limits, the contractor shall re-calibrate/replace by a new meter without any extra cost.

27.0 TESTS :

Type Testing of Meter : The offered meters should be type tested at any NABL accredited laboratory in accordance with IS13779 with latest amendments, CBIP Report 304 with latest amendments. The type test report should not be more than 3(Three) years old. A copy of the Type Test results should be submitted by the contractor. If there is any modification in the design / parameters of the specifications or use of constituent materials in the offered meters submitted with the offer, from the meter which was submitted type tested, which may affect the characteristics as well as parameters of the meter, revised type test certificates as per the design, parameters and constituent material used in the supplied meter, shall have to be submitted failing which the supply may be liable to be rejected. Test Certificate from any NABL accredited Lab. Shall only be consider.

Type test certificate should contain the following information clearly:

1) Class of accuracy.
2) Meter constant

Acceptance tests :

A) The acceptance tests as stipulated in CBIP/IS (with latest amendments) shall be carried out by the supplier in presence of purchaser's representative.

B) Also the following additional tests are to be carried out on one meter randomly selected from each lot offered for inspection / acceptance testing.

i) Magnetic induction of external origin (AC & DC)
ii) Tamper & Fraud protection, as per Clause of 13 of this specification.
iii) Test of endurance upto 150% of lmax, for two hours, followed by verification of limits of error.
iv) Verification of internal components.
v) Dry Heat Test as per IS 13779 / 99, Clause 12.6.1, of one meter from the offered lot is to be arranged by the supplier at any NABL accredited laboratory, at his cost.

In case of failure of Meters as specified in Annexure - H of IS-13779 (For A above) the entire lot will be treated as rejected. In case of failure of any single meter (as per B above) the entire lot will be rejected.

Routine Tests : Each and every meter of the offered lot shall undergo the routine tests as well as functional tests as per IS: 13779/1999, CBIP Report 304 and after sealing the meters, the

manufacturers will submit the routine test report of all the meters as well as a statement showing seal SI. Nos. against each meter SI. No.

28.0 TEST FACILITIES

The tests for equipment / instrument shall be carried out as per relevant Standards and test certificates shall be furnished for scrutiny. The contractor shall indicate the details of the equipment available with him for carrying out the various tests as per relevant Standards. The contractor shall indicate the sources of all equipments / instruments. Sample Test will be carried out in fully automatic test bench with ICT facility

NOTE : The standard meters used for conducting tests shall be calibrated periodically at any NABL Accredited Test Laboratories and test certificates shall be available at Works for verification by purchasers representative.

The manufacturer shall have at least the following testing facilities to ensure accurate calibration:

AC high voltage test
Insulation test
Test of no load condition
Test of Starting condition
Test on Limits of error
Power loss in voltage and current circuit
Test of Repeatability of error
Test of meter constant
Test of magnetic influence

29.0 INSPECTION :

The P&E Deptt., Mizoram may carry out the inspection at any stage of manufacture. The manufacturer shall grant free access to the purchaser's representative at a reasonable time when the work is in progress. Inspection and acceptance of any equipment under this specification by the purchaser shall not relieve the supplier of his obligation of furnishing the equipment in accordance with the specification and shall not prevent subsequent rejection if the equipment is found to be defective.

All acceptance tests and inspection shall be made at the place of manufacturer, and testing will be done in Fully Automatic Test Bench, unless otherwise especially agreed upon by the contractor and P&E Deptt. at the time of purchase. The contractor shall provide all reasonable facilities without charge to the inspector, to satisfy him that the equipment is being furnished in accordance with this specification.

The supplier shall keep the P&E Deptt., Mizoram informed in advance, about the manufacturing programme for each lot so that arrangement can be made for inspection. The P&E Deptt., Mizoram reserves the right to insist for witnessing the acceptance / routine testing of the bought out items. The supplier shall give 15 days for local supply / 30 days in case of foreign supply advance intimation to enable the purchaser to depute his representative for witnessing the
acceptance and routine tests.

The P&E Deptt., Mizoram reserves the right to get type tested any meter or meter casing etc. from any of the offered lots, reserve at any destination stores.

30.0 QUALITY ASSURANCE PLAN :

The design life of the meter shall be minimum 20 years and to prove the design life the firm shall have at least the following quality Assurance Plan: -

- The factory shall be completely dust proof.
- The testing rooms shall be temp. and humidity controlled as per relevant standards.
- The testing and calibrating equipments should be automatic and all test equipment shall have their valid calibration certificates.
- Meter can't open / break for testing purpose, ICT facility must be available in Auto Test Bench.
- Power supplies used in testing equipment shall be distortion free with sinusoidal wave-

forms and maintaining constant voltage, current and frequency as per the relevant standards.

During the manufacturing of the meters the following checks shall be carried out.

i) Meter frame dimensions tolerances shall be minimum.

ii) The assembly of parts shall be done with the help of jigs and fixtures so that human errors are eliminated.

iii) The meters shall be batch tested on automatic, computerized test bench and the results shall be printed directly without any human errors.

31.0 MANUFACTURING ACTIVITIES:

All the materials, electronics and power components, ICs used in the manufacture of the meter shall be of highest quality and reputed make to ensure higher reliability, longer life and sustained accuracy. The manufacturer should use Application Specific Integrated Circuit (ASIC) or Micro controller for metering functions. The electronic components shall be mounted on the printed circuit board using latest Surface Mounted Technology (SMT) except power components by deploying automatic SMT pick and place machine and re flow solder process. The electronic components used in the meter shall be of high quality and there shall be no drift in the accuracy of the meter at least up to 10 years.

Further, the contractor should own or have assured access (through hire, lease or sub-contract) of the mentioned facilities. The PCB material should be of glass epoxy FR-4 grade conforming to relevant standards.

All insulating materials used in the construction of meters shall be non-hygroscopic, non-aging and tested quality. All parts that are likely to develop corrosion shall be effectively protected against corrosion by providing suitable protective coating.

32.0 GUARANTEE:

The meters of manufacturers shall be guaranteed against any manufacturing defect or bad workmanship or component failure for a period of 5 1/2 years from the date of supply. The contractor shall extend the guarantee of 5 years. The meter found defective within the above guarantee period shall be replaced by the supplier free of cost within one month of the receipt of intimation of failure / defect.

33.0 REPLACEMENT OF DEFECTIVE METERS :

The meters declared defective by the P&E Deptt., Mizoram shall be replaced by the supplier up to the full satisfaction of the P&E Deptt., Mizoram at the cost of supplier. Failure to do so within the time limit prescribe shall lead to imposition of penalty of twice the cost of meter. The same may lead to black listing even, as decided by P&E Deptt., Mizoram. In this connection the decision of P&E Deptt., Mizoram shall be final.

34.0 PACKING & FORWARDING :

The equipment shall be packed in cartons / crates suitable for vertical / horizontal transport as the case may be, and suitable to withstand handling during transport and outdoor storage during transit. The supplier shall be responsible for any damage to the equipment during transit, due to improper and inadequate packing. The easily damageable material shall be carefully packed and marked with the appropriate caution symbol. Wherever necessary, proper arrangement for lifting, such as lifting hooks etc., shall be provided. Supplier without any extra cost shall supply any material found short inside the packing cases immediately.

The packing shall be done as per the standard practice as mentioned in IS 15707: 2006. Each package shall clearly indicate the marking details (for e.g., manufacturer's name, Sl. Nos. of meters in the package, quantity of meter, and other details as per supply order). However, he should ensure the packing is such that, the material should not get damaged during transit by Rail / Road.

TECHNICAL SPECIFCATION FOR 3Ph 4 WIRE LT/HT CT OPERATED FULLY STATIC AMR COMPATIBLE TRI-VECTOR ENERGY METERS

1.0 SCOPE Design, manufacturing, testing, supply and delivery of AC, 3 Phase, 3/4 Wire, CT/PT operated & 3 Phase,4wire LT CT operated fully Static and AMR compatible Tri-Vector Energy Meters for measurement of different electrical parameters listed elsewhere in the document including Active Energy (kWh/MWh), Reactive Energy (kVArh/MVArh), Apparent Energy (kVAh/MVAh) etc.

2.0 STANDARDS TO WHICH METERS SHALL COMPLY

IS-14697:1999(2004)	Specification for AC Static Transformer operated Watt Hour & VAR-Hour meters (class 0.58);
IS-15959:2011	Data Exchange for Electricity Meter Reading Tariff & Load Control - Companion Specification
CBIP - 304 M	Manual on Standardization of AC Static Electrical Energy Meter
IEC 62052-11	Electricity metering equipment (AC) —General requirements, tests and test conditions -Part 11: Metering equipment;
IEC 62053-22	Electricity metering equipment (AC) —Particular requirements - Part-22: Static Meters for Active Energy (Class 0.58);
IEC 62053-23	Electricity metering equipment (AC) —Particular requirements - Part-23: Static Meters for Reactive Energy;
IS 15707	Specification for Testing, evaluation, installation & maintenance of AC Electricity Meters-Code of Practice. Guidelines on "Data Exchange for Electricity Meter Reading, Tariff and Load Control - Companion Specification"
IEC 62056-21	Electricity metering: Data exchange for meter reading, tariff and load control-Part 21: Direct local data exchange
IEC 62056-31	Electricity metering: Data exchange for meter reading, tariff and load control - Part 31: Local Area Network data exchange
IEC 62056-61	Electricity metering: Data exchange for meter reading, tariff and load control-Part 61: Object identification system (OBIS) The equipment meeting with the requirements of other authoritative standards, which ensure equal or better quality than the standard mentioned above, also shall be considered; in case of conflict the Guidelines on "Data Exchange for Electricity Meter Reading, Tariff and Load Control -Companion Specification"

3.0 GENERAL TECHNICAL REQUIREMENTS

1	TYPE	AMR Compatible Static, 3Ph,4Wire 240V (LTCT), 3 Ph,3 Wire(11KV) and 3 Ph, 4 Wire (33KV),CT/PT operated Tri- Vector Energy Meter for Bulk Consumers
2	FREQUENCY	50 Hz +/-5%
3	ACCURACY CLASS	0.5S
4	VOLTAGE RATING	Suitable for operation from 240v Ph-N, 240 v LT CT (3P, 4w)

		11KV/110V, Ph-Ph (3P,3W)
5	BASIC CURRENT (Ib) & CURRENT RATING	Ib- 5A, Ratio : 200/5 A for LT CT(3P, 4W) Ib- 5A, Ratio : 50/5A for CT/PT operated (3P,3W) Ib- 5A & 1A, Ratio: 100/5 A and 100/1A for (3P, 4W)
6	MAXIMUM CONTINUOUS CURRENT	As per IS 14697:1999(2004)
	STARTING CURRENT	0.1% of Ib at UPF
7	POWER CONSUMPTION	The active and apparent power consumption, in each voltage circuit, at reference voltage, reference temperature and reference frequency shall not exceed 1. 5 W and 8 VA. The apparent power taken by each current circuit, at basic current, reference frequency and reference temperature shall not exceed 1.0 VA.
8	POWER FACTOR	0 Lag — Unity — 0 Lead
9	DESIGN	Meter shall be designed with application specific integrated circuit (ASIC) or micro controller; shall have no moving part; electronic components shall be assembled on printed circuit board using surface mounting technology; factory calibration using high accuracy (0.05 class) software based test bench. Assembly of electronic components shall be as per ANSI /lPC- A-610 standard.
10	DLMS TEST	Manufacturer must have test certificate for conformance to CERTIFICATE DLMS

6.0 TEMPARATURE RISE: Under normal condition of use, winding and insulation shall not reach a temperature, which might adversely affect the operation of the meters. lS14697:1999(2004) should be followed.

7.0 CLIMATIC CONDITIONS:

Temperature	:	-10° C to 55° C (in shade)
Humidity	:	up to 95% RH non-condensing
Average annual rainfall	:	150 cm.
Max Wind Pressure	:	150 kg/sq.m.
Max. altitude	:	above MSL 3000 m.

8.0 TROPICAL TREATMENT: The meters shall be suitably designed and treated for normal life and satisfactory operation under hot & hazardous tropical climate conditions and shall be dust and vermin proof. All the parts & surface, which are subject to corrosion, shall either be made of such material or shall be provided with such protective finish which provides suitable protection to them from any injurious effect of excessive humidity.

9.0 CONSTRUCTIONAL REQUIREMENT – METER COVER & SEALING ARRANGEMENT

Wherever poly carbonate cover is specified, it shall conform to IS 11731 (FH-1category) besides meeting the test requirement of heat deflection test as per ISO 75, glow wire test as per the lS:11000 (part 2/SEC-1) 1984 OR IEC PUB,60695-2-12, Ball pressure test as per IEC--60695-10-2 and

Flammability Test As per UL 94 or As per IS 11731(Part-2) 1986.

10.0 CONSTRUCTION The case, winding, voltage circuit, sealing arrangements, registers, terminal block, terminal cover & name plate etc. shall be in accordance with the relevant standards. The meter should be compact & reliable in design, easy to transport & immune to vibration & shock involved in the transportation & handling. The construction of the meter should ensure consistence performance under all conditions especially during heavy rains / very hot weathers. The insulating materials used in the meter should be non-hygroscopic, non-ageing & have tested quality.

The meter should comply latest technology such as Microcontroller or Application Specific Integrated Circuit (ASIC) to ensure reliable performance. The mounting of the components on the PCB should compulsorily be Surface Mounted Technology (SMT) type. Power supply component may be of PTH type. The electronic components used in the meter should be of high quality and there should be no drift in the accuracy of the meter for at least ten years.

The circuitry of the meter should be compatible with 16 Bit (or better) ASIC with compatible processor and meter should be based on Digital measuring and sampling technique.

The meter should be housed in a safe, high grade, unbreakable, fire resistant, UV stabilized,virgin Polycarbonate High grade Engineering plastic/Thermosetting Plastic casing of projection mounting type. The meter cover should be transparent, for easy reading of displayed parameters, and observation of operation indicators. The meter base may or may not be transparent, but it should not be black in colour. The meter casing should not change shape, colour, size, and dimensions when subjected to 200 hrs on UV test as per ASTMD 53. It should withstand 650 deg. C. glow wire test and heat deflection test as per ISO 75.

Meters must be supplied with 2 (two) nos. manufacturers' seals between meter base and meter cover at both the sides. Both the communication port (Optical and RS232 port) should have proper sealing arrangement.

The polycarbonate material of only the following manufacturers shall be used.

a) G.E. Plastics/Sabic: LEXAN 943A or equivalent for cover & Terminal cover LEXAN 503R or equivalent base.
b) BAYER/SABIC : Grade corresponding to above
c) DOW Chemicals : -Do-
d) MITSUBISHI: -Do-
e) TEJIN : -Do-
f) DUPONT : -Do-

11.0 METER CASE AND COVER The meter should be sealed in such a way that the internal parts of the meter becomes inaccessible and attempts to open the meter shall result in viable damage to the meter cover. This is to be achieved by using continuous Ultrasonic welding on the Meter body, fully flushed between case and cover. In case, ultrasonic welding using plate/strip is used the material of plate/strip should be same as that of cover and base and the strip should flush with meter body. The manufacturer's logo should be embossed on the strip / plate. The meter cover should be fixed to the meter base (case) with Unidirectional Screws, so that the same cannot be opened by use of screwdrivers. These unidirectional screws should be covered with transparent caps, ultrasonically welded with the meter body and the screw covers should be embedded in the meter body in a groove.

The meter shall withstand external magnetic influence as per latest amendments of CBIP Technical Report No. 304.

12.0 TERMINAL BLOCK AND COVER: The terminals may be grouped in a terminal block having adequate insulating properties and mechanical strength. The terminal block should be made

from best quality non-hygroscopic, flame retardant material (capable of passing the flammability tests) with nickel plated brass inserts / alloy inserts for connecting terminals.

The terminals in the terminal block shall be of adequate length in order to have proper grip of conductor with the help of screw adjustable metal plates to increase the surface of contact and reduce the contact resistance. The screws shall have thread size not less than M 4 and head having 4-6mm. diameters. The screws shall not have pointed ends at the end of threads. All terminals and connecting screws should be of tinned/nickel plated brass material.

The internal diameter of terminal hole should be minimum 5.5 mm. The holes in the insulating material shall be of sufficient size to accommodate the insulation of conductor also. The terminal cover shall be transparent High grade Engineering Plastic/Polycarbonate/Thermosetting Plastic with minimum thickness 2.0 mm and the terminal cover shall be of extended type completely covering the terminal block and fixing holes. The space inside the terminal cover should be sufficient to accommodate adequate length of external cables.

13.0 WORKING ENVIRONMENT As per IS 14697:1999(2004). Meter to perform satisfactorily under Non-Air Conditioned environment (within stipulations of IS) IP51 housing for indoors. The meter shall be suitable designed for satisfactory operation under the hot and hazardous tropical climate conditions and shall be dust and vermin proof. All the parts and surface, which are subject to corrosion, shall either be made of such material or shall be provided with such protective finish, which provided suitable protection to them from any injurious effect of excessive humidity.

14.0 MANUFACTURING PROCESS, ASSEMBLY AND TESTING Meters shall be manufactured using latest and ‘state of the art‘ technology and methods prevalent in electronics industry. The meter shall be made from high accuracy and reliable surface mount technology (SMT) components. All inward flow of major components and sub assembly parts (CT, PT, RTCs / Crystal, LCDs, LEDs, power circuit electronic components etc.) shall have batch and source identification. Multilayer ‘PCB’ assembly with ‘PTH‘ using surface mounted component shall have adequate track clearance for power circuits. SMT component shall be assembled using automatic ‘pick-and-place’ machines, Reflow Soldering oven, for stabilized setting of the components on ‘PCB’. For soldered PCBs, cleaning and washing of cards, after wave soldering process is to be carried out as a standard practice.

Assembly line of the manufacturing system shall have provision for testing of sub-assembled cards. Manual placing of components and soldering, to be minimized to items, which cannot be handled by automatic machine. Handling of ‘PCB’ with lCs / C-MOS components, to be restricted to bare minimum and precautions to prevent ‘ESD' failure. Complete assembled and soldered PCB should undergo functional testing using Computerized Automatic Test Equipment.

Fully assembled and finished meter shall under go ‘burn-in’ test process for 24 Hours at 55 degree Celsius (Max. temperature to not exceed 60 degree Celsius) under base current (lb) load condition. Test points should be provided to check the performance of each block/stage of the meter circuitry.

RTC shall be synchronized with NPL time at the time of manufacture. Meters testing at intermediate and final stage shall be carried out with testing instruments, duly calibrated with reference standard, with traceability of source and date.

15.0 DISPLAY OF MEASURED VALUES The meter display shall have 7 digits(complete) for energy counter with alphanumeric digits for parameter identifier and tamper indication with backlit Liquid Crystal Display (LCD) of minimum 10 mm height, wide viewing angle suitable for temperature withstand of 70° C. LCD to be of ‘STN’ (super twisted numetic) type construction. The data stored in the meters shall not be lost in the event of power failure. The meter shall have Non

Volatile Memory (NVM), which does not need any battery backup. The NVM shall have a minimum retention period of 10 years.

Meter shall have Scroll Lock facility to display any one desired parameter continuously from display parameters. Auto display cycling of each parameter should be minimum 12 Seconds. The time between two auto display cycles shall be maximum 180 sec. It should be possible to easily identify the single or multiple displayed parameters through symbols/legend on the meter display itself or through display annunciation.

AUTO MODE:

i) LCD Test
ii) Rising Apparent Demand with elapsed time
iii) Real Time & Date (DD/MM/YYYY)
iv) Cumulative Power Off Hours
v) Cumulative Total Active Energy (with high resolution)
vi) Cumulative Total Reactive Energy Lag (with high resolution)
vii) Cumulative Total Reactive Energy Lead (with high resolution)
viii) Cumulative Apparent Energy (with high resolution) — Lag Only
ix) Apparent Max. Demand (with high resolution) — Lag Only
x) TOD Wise Total Active Energies
xi) TOD Wise Apparent Energies
xii) TOD Wise Apparent Max. Demand (MD)
xiii) Cumulative Apparent Maximum Demand
xiv) Cumulative Billing Count
xv) Cumulative Tamper Count
xvi) Phase Sequence
xvii) Connection Check
xviii) Self Diagnosis

PUSH BUTTON MODE:

i) LCD Test
ii) Rising Apparent Demand with elapsed time
iii) Real Time & Date (DD/MM/YYYY)
iv) Cumulative Power Off Hours
v) Cumulative Total Active Energy (with high resolution)
vi) Cumulative Total Reactive Energy Lag (with high resolution)
vii) Cumulative Total Reactive Energy Lead (with high resolution)
viii) Cumulative Apparent Energy (with high resolution) — Lag Only
ix) Apparent Max. Demand (with high resolution) — Lag Only
x) TOD Wise Total Active Energies
xi) TOD Wise Apparent Energies
xii) TOD Wise Apparent Max. Demand (MD)
xiii) Cumulative Apparent Maximum Demand
xiv) Cumulative Billing Count
xv) Cumulative Tamper Count
xvi) Cumulative Programming Count
xvii) Last Billing Date & Time

xviii) Inst. Secondary Voltages-Phase Wise (Ph-Ph for 3-Ph,3-Wire and P-N for 3-Ph,4-Wire)
xix) Inst. Secondary Currents — Phase Wise
xx) Signed Inst. Power Factor — Phase Wise
xxi) Three Phase Power Factor
xxii) Signed Inst. Active Power
xxiii) Inst. Apparent Power
xxiv) Inst. Frequency
xxv) Present Tamper Status (PT/CT/Other)
xxvi) First Occurrence with Date & Time
xxvii) Last Occurrence with Date & Time
xxviii) Last Restoration with Date & Time
xxix) Phase Sequence
xxx) Connection Check
xxxi) Self Diagnosis

The register shall be able to record and display starting from zero, for a minimum of 1500 hours, the energy corresponding to rated maximum current at reference voltage and unity power factor. The register should not roll over in between this duration.

High resolution registers required in display min 4 digits (for kW) and 6 digit (for MW) after decimal in case of Energy & Min 1/2 digits after decimal in case of Demand. Push button mechanism should be of high quality and should provide trouble free service for a long span of time. Up and Down scrolling facility should be there for Push Button Mode.

16.0 MAXIMUM DEMAND The meter should be capable of recording the Apparent/Active MD with integration period of 15 minutes.

MD RESET OPTION
i) Billing Date at 24:00 Hrs (Programmable)
ii) Push button
iii) By Authenticated Command from BCS through HHU or directly from PC/REMOTE
MD reset button should have proper sealing arrangement. Specific operation should be available in downloading data.

17.0 PERFORMANCE UNDER INFLUENCE QUANTITIES The meters performance under influence quantities shall be governed by IS 14697:1999 (2004). The accuracy of meter shall not exceed the permissible limits of accuracy as per standard IS 14697:1999(2004)

18.0 OUTPUT DEVICE **E**nergy Meter shall have test output, accessible from the front, and be capable of being monitored with suitable testing equipment while in operation at site. The operation indicator must be visible from the front and test output device shall be provided in the form of LED. Resolution of the test output device shall be sufficient to enable the starting current test in less than 10 minutes. Minimum gap should be maintained between Active & Reactive Test LED.

19.0 REAL TIME INTERNAL CLOCK (RTC) RTC shall be pre-programmed for 30 Years Day/date without any necessity for correction. The maximum drift shall not exceed +/- 300 Seconds per year. The clock day/date setting and synchronization shall only be possible through password/Key code command from one of the following:

a) Hand Held Unit (HHU) or directly through BCS and this shall authentication from BCS for individual meter.
b) From remote server through suitable communication network with authentication from BCS.

20.0 TIME OF DAY FACILITIES: The meter should have facilities to record Active, Apparent Energies and MD with a facility of 8 time zones. The time zones should be user programmable through authenticated command from BCS with the help of HHU.

21.0 METER READING DURING POWER OFF: It should be possible to read the meter-display visually and with MRI and in absence of input voltages with the help of internal battery for display in power off condition or external battery pack/PPU. The interface should be inductive coupling.

22.0 LOAD SURVEY: The meter should be capable of recording load survey data of Real Time, Phase wise Voltage, Phase wise current, Active Energy and Apparent Energy for a period of minimum 35 days for 15-minute integration period.

23.0 MEASUREMENT OF ENERGY The meter should be capable of measuring Fundamental Energy as well Total Energy i.e. Fundamental plus Harmonics energy. Total Energy shall be made available on meter-display and the same only shall be used for billing purpose.
The Fundamental Energy shall be logged in the meter memory and be capable of downloading to the BCS through the HHU and be available for viewing at the BCS end.

24.0 MARKING OF METERS Every meter shall have a nameplate clearly visible and indelible and distinctly marked in accordance with the relevant Standard. The following information should appear on an external plate attached to the meter cover.

i) Manufacturers Name or trademark and place of manufacture.
ii) Designation of type.
iii) Number of phases and wires.
iv) Serial number of meter.
v) Month and year of manufacture.
vi) Principal unit of measurement.
vii) P.T. Ratio.
viii) Basic Current and rated maximum current.
ix) C.T. Ratio.
x) Reference frequency in Hz.
xi) Meter constant (impulse/unit).
xii) Class index of meter.
xm) Reference temperature.
xiv) “Property of P&E Deptt., Mizoram"
xv) Purchaser's Order No. & Date.
xvi) Guarantee for 5 & 1/2 years from the date of commissioning.
xvii) Sign. of insulation.
xviii) Bar coding of Serial Number, month & year of manufacture.

The meter shall also store name plate details as given in the Table - 30 of IS 15959:2011

25.0 COMMUNICATION CAPABILITY The meter shall be provided with two ports for communication of the measured/collected data. The hardware port (with sealing facility) compatible

with RS 232 specifications which shall be used for remote access through suitable Modem and an Optical port complying with hardware specifications detailed in IEC-62056-21. This shall be used for local data downloading through a DLMS compliant HHU or direct through BCS. Both ports shall support the default and minimum baud rate of 9600 bps. Optical Cord (i.e. Optical Port of Meter to PC) must be USB type.
Data downloading time from meter to HHU/PC should be within 2 min for meter data (without load survey) and within 6 min for meter data with load survey.

27.0 TAMPER & FRAUD MONITORING FEATURES The meter shall work satisfactorily under presence of various influencing conditions like External Magnetic Field, Electromagnetic Field, Radio Frequency Interference, Vibrations, Harmonic Distortion, Voltage/Frequency Fluctuations, and Electromagnetic High Frequency Fields etc. The meter shall be immune to abnormal voltage/frequency generating devices and shall record the occurrence and restoration of all tampers and related snapshots as per Annexure — G of IS 15959:2011
The accuracy of meter should not be affected with the application of abnormal voltage frequency generating device such as spark discharge of approximately 35 kV.
The meters should work even in the presence of any two Potential wires.
Meter should work correctly irrespective of phase sequence.
Also, Meter should also be immune for tamper by application of remote induction device i.e. radiated spark through Jammer circuit.
Tamper details shall be stored in internal memory for retrieval by authorized personnel through either of the following:
a) DLMS compliant HHU.
b) Remote access through suitable communication network.
c) Direct by PC.

Minimum 400 numbers of events preferable (compartment wise) i.e. 200 no. events for occurrences & 200 no. events for restoration with date & time and snapshot should be available in the meter memory.
Default occurrence and restoration time shall be 5 minutes but it shall be programmable.
All the tamper information logged by the meter should be available in BCS with snapshot, Date & Time as per Table 39 of IS 1595922011 with occurrence and restoration.
Properly designed meter tamper logic with threshold value, should be provided and clearly explained in the bid. The tamper logic should be capable of discriminating the system abnormalities from source side and load side and it should not log / record tamper due to source side abnormalities. The meter should be able to distinguish between HT PT fuse blowing and Single Phasing and record the former.

28.0 TYPE TESTS Meters shall be fully type tested as per relevant Standard (latest version). The type test certificates should be submitted along with the offer. Offer without Type Test Report shall be liable for rejection. The type test certificate shall not be more than five years old.

29.0 ACCEPTANCE & ROUTINE TESTS: All acceptance tests as per relevant standards shall be carried out in the presence of utility representatives. Further Purchaser shall reserve the right to pick up energy meters at random from the lots offered and get the meter tested from NABL accredited lab. The supplier has no right to contest the test results NABL accredited lab or for additional test and has to replace/take corrective action at the cost of the supplier.

30.0 INSPECTION: The inspection shall be carried out at any stage of manufacture, by the P&E

Deptt., Mizoram authorized representatives, with prior intimation to the supplier. The manufacturer shall grant all reasonable facilities for testing free of charge for inspection and testing to satisfy the purchaser that the materials to be supplied are in accordance with their specification.
The supplier shall keep the P&E Deptt., Mizoram informed in advance, about the manufacturing program so that the arrangement can be made for inspection. The representative / Engineer of the P&E Deptt., Mizoram attending the above testing shall carry out testing as per relevant standards and issue test certificate approval to the manufacturer and give clearance for dispatch.

31.0 QUALITY ASSURANCE: The manufacturer shall have a comprehensive quality assurance program at all stages of manufacture for ensuring products giving reliable, trouble free performance. Details of the contractor's quality assurance and test set up shall be furnished to the Department.

32.0 TESTING FACILITIES: The Contractor shall have at least the following testing facilities to ensure accurate calibration and shall give a detailed list of bought out items with name of the manufacturer and details about quality control.

a) Insulation resistance measurement
b) Running at no load
c) Starting current test
d) Limits of error
e) Dial Test
f) Power loss in voltage and current ckt.
g) Repeatability of error
h) Transportation test
i) Tamper Test
j) Ageing Test

33.0 GUARANTEE Meter supplied shall be guaranteed for a period of 66 months from the date of supply or 60 months from the date of installation, whichever is earlier. Contractors shall guarantee to replace the meters, which are found to be defective/inoperative at the time of installation, or become in operative defective during guarantee period. Replacements shall be effected within 1 month from the date of intimation.

34.0 FIXING & SEALING ARRANGEMENT Every meter shall have three fixing holes one at the top and two at the bottom. The top hole shall be provided with a special clip at the back of the meter so that holding screw is not accessible to the consumer after the fixing of the meters. The lower fixing screws shall be provided under the sealed terminal cover. The requisite fixing screws shall be supplied with each meter.
Necessary provision may be kept for fixing the utility seal also. The manufacturers seal provided with the meter should be of high quality with tamper proof features.

VOLUME-III :

SECTION – II

GUARANTEED TECHNICAL PARTICULARS

GUARANATEED TECHNICAL PARTICULARS OF 33 kV VACUUM CIRCUIT BREAKERS

(To be filled up by the Bidders)

Sl. No	Description	Particulars
1	Name of Manufacturer & Address	
2	i) Type & Designation and	
	ii) Class of breaker- (C1-M2)	
3	Conforming Standard	
4	Service (Outdoor/Indoor)	
5	Rated Voltage kV (Nominal & Maximum)	
6	Frequency	
7	Insulation Level	
	a) 1.2/50 micro sec. L.I. withstand Voltage (KVp)	
	i) between line terminals and ground parts	
	ii) between terminals with Breaker contacts open	
	b) One minute power frequency withstand KV (rms) for dry & wet conditions	
	i) between line terminals and ground parts	
	ii) between terminals with Breaker contacts open	
8	Rated normal Current Amps. (cms.)	
9	Short time Current rating (KA) for 3 secs	
10	Temperature rise above ambient due to rated Current in main contacts in Deg.C.	
11	Rated operating duty	
12	Short Circuit breaking Current	
13	Asymmetrical breaking Current (including DC component) KA (Rms)	
14	Rated (TRV) for terminal fault	
15	Rated making capacity (KA peak)	
16	Data on Restriking Voltage for 100% 50% and 10% rated capacity	
	a) Amplitude factor	
	b) Phase factor	
	c) RRRV Volts/micro sec	
17	Breaking capacity under phase opposition condition in KA and the recovery voltage over poles in KV	
18	Short time Fault breaking capacity MVA	
19	Line charging current breaking capacity	
	a) line charging current AMP	
	b) Corresponding Over voltage (KV)	
	c) Whether Switching Resistor is provided	
	i) Value of Resistor	
	ii) Time of insertion	
	iii) Thermal Rating of Resistor	
20	Maximum Cable charging current breaking Capacity in Amps.	

	And corresponding over Voltage in kV as observed in Tests.	
21	Maximum shunt capacitor bank switching/breaking capacity in MVA and the over voltage factor	
22	Maximum over voltage in Kilovolts on switching OFF Transformer on low load	
23	Total breaking time in mili seconds measured from The instant of trip circuit energisation	
	a) At 10% breaking capacity	
	b) At 100% breaking capacity	
24	Arcing time (ms)	
	a) At 10% breaking capacity	
	b) At 100% breaking capacity	
25	i) Breaks per pole (No)	
	ii) Length of each break per pole (mm)	
	iii) Length of moving contact travel mm	
	iv) Rate of contact travel (m/sec)	
26	Make time (millisecs.)	
27	Minimum reclosing time at rated interrupting Capacity from the instant of the trip coil energisation (mili secs.)	
28	Minimum dead time for 1 phase & 3 phase reclosing with corresponding limits of adjustment of dead time, if any	
29	Maximum radio interference voltage between 0.5 MHz to 2 MHz with Voltage of 110% of rated rms voltage between phase & ground (Micro-Volt)	
30	Details of manually/motor operated spring charging mechanism	
31	i)Voltage and Power requirement for	
	a) closing coil	
	b) Tripping coil	
	ii) No of Tripping Coil	
32	Make, Country, Type, and other details(no. of operation at full short ckt level, rated current etc) of Vacuum Bottle used in VCB	
33	Weight of Vacuum Circuit Breaker	
34	No. of auxiliary contacts (Spring Charging LS) number of NO and NC shall be mentioned	
	No. of auxiliary spare contacts	
35	Power frequency withstand capability of breaker in open condition at	
	i) Atmospheric Pressure of Air/Zero Vacuum Pressure	
36	Actual opening time (from Trip Coil energisation to contact separation) (ms)	
37	Allowable time limit between breaker per pole (for multibreak type) and between poles (ms)	
38	Actual closing time (from Closing Coil energisation to contact touching (ms)	

39	Whether type tests report submitted in line with spec?	
40	Whether a)Dimensional GA Drawing Cross Sectional b)Drawing of interrupting Chamber and c)scheme diagram are furnished	a) b) c)
41	Whether brochure/ leaflet on Technical data for Vacuum bottle enclosed?	
42	Is there any Technical Deviation from present Specification. If so, have you furnished "Deviation Schedule"?	
43	The Equipment offered are suitable for tropical country like India	
44	Whether agreed to supply one no each of closing coil &tripping coil along with breaker without any extra price.	
45	All the 44 items are properly filled ?	

(Signature of Tenderer)

Name (In block letters)

Stamp.

Guaranteed Technical Particulars of Current Transformers

S/N	Particulars			
1.	Manufacturer's name and country of origin:			
2.	Manufacturer's type, designation and model:			
3.	Current transformers data:	Core-I	Core-II	Core-III
	a. Rated primary current (A):			
	b. Rated secondary current (A):			
	c. Transformation ratio:			
	d. Rated output at 0.9 lagging PF (VA):			
	e. Class of accuracy:			
	f. Accuracy limit factor:			
	g. Knee point voltage (V):			
	h. Excitation current at knee point voltage (mA):			
	i. Secondary limiting voltage:			
	j. Resistance of secondary winding at 75°C(Ω):			
4.	Nominal rated voltage (KV):			
5.	Maximum voltage of operation (KV):			
6.	One second over-current factor (times rated current):			
7.	Short time thermal rating for:			
	a) One second. kA(rms):			
	b) Three seconds kA (rms):			
8.	Rated dynamic current (Peak value):			
9.	Instrument security factor for the winding meant for measurement and metering:			
10.	Rated continuous thermal current and corresponding temperature rise (kA°C):			
11.	Creepage distance (mm):			
12.	One minute power frequency dry withstand test voltage-KV(rms):			
13.	One minute power frequency wet withstand test voltage-KV(rms):			
14.	1.2/50 micro second full wave Impulse withstand test voltage-KV(Peak):			
15.	Weigh to foil per CT (Kg):			
16.	Class of oil:			
17.	Whether p**ressure relief device provided (Yes/No):**			
18.	Total weight per C.T. (Kg):			
19.	Magnetisation curves of C.T. cores supplied with tender and total drawing Nos. attached:			
20.	Overall dimensions (mm x mm x mm):			
21.	Mounting details:			
22.	Shipping dimensions of largest package (mmxmmxmm) :			

23.	Shipping weight of heaviest package (Kg):			
24.	Enclosed copies of test reports etc:			

GUARANTEED TECHNICAL PARTICULARS for VOLTAGE TRANSFORMER/POTENTIAL TRANSFORMER

SN	Particulars	Value		Unit
1	Type			
2	Manufacturers type designation.			
3	Rated primary voltage.			Volts.
4	Number of secondary winding			
5	Rated secondary voltage	Wdg I	Wd II	Volts
6	Rated burden	Wdg I	Wd II	VA
7	Accuracy class	Wdg I	Wd II	
8	Temp rise at 1.2 times rated voltage and rated burden and frequency			^{0}C
9	Rated voltage factor at rated frequency, burden and time			
10	Temperature rise for item 9 above.			^{0}C
11	One minute power frequency withstand test (dry) voltage on primary winding			kV(Rms)
12	One minute power frequency withstand test (wet) voltage on primary winding			kV(Rms)
13	1.2/50 micro second impulse wave withstand test voltage			kV(Peak)
14	One minute power frequency withstands test voltage on secondary winding			kV(Rms)
15	Bushing creepage distance			(mm)
16	Variation in ration and phase angle error for variation in : a) Voltage by 1% b) Frequency by 1 Cycle			
17	Whether corona shield is provided or not			
18	(a) Weight of oil filling. (b) Total weight. (c) Overall dimension. (d) Mounting detail (e) Shipping dimension of largest package			Kg. Kg. mm Kg
19	Enclose copies of test reports etc.			

(Signature of Tenderer)
Name (In block letters)
Stamp.

Guaranteed Technical Particulars of SURGE ARRESTER

(This Schedule shall be filled in for each category of LA)

S.no	Description	Unit	Particulars
1	Name & Address of Supplier & Manufacturer		
	□ Surge Arrester		
	□ Surge Monitor		
	□ Line Dis-connector		
	□ Metal Oxide Block		
	□ Terminal Clamp		
2	Name & address of collaborator, if any		
3.	Standard to which surge arresters conforms		
4.	Surge Arrester		
4.1	Voltage rating (KV rms)		
4.2	Continuous Operating Voltagte (KV rms)		
	a) Continuous Operating Voltage (KV rms)		
	b) Leakage current at continuous operation voltage		
	c) Partial discharge at 1.05 COV (PC)		
	d) Permitted leakage current of arrester beyond which arrester is faulty :		
5.	Frequency (Hz)		
6.	Nominal discharge current (wave shape – 8 / 20 micro second) (KA)		
7.	Pressure relief rated current (KA rms)		
8.	Steep current protection level at 10 KA		
	a) Lighting impulse protection level at 5 KA and 10 KA (KVP)		
	b) Switching impulse protection level with 40 x 80 micro-sec. Wave at 500/1000 A		
9.	Long duration current impulse withstand capacity and virtual duration		
10.	Line discharge class		
11.	Thermal runaway limit of arrester		
12.	Energy capability (kJ/KV)		
13.	Pressure relief rating		
14.	Dry arcing distance		
15.	Reference current and reference voltage		
16.	Arrester housing		
16.1	Power frequency one minute wet withstand voltage (kV		
16.2	Lighting impulse dry withstand voltage (KVP)		
16.3	Creepage distance		
	a) Protected		
	b) Total		
16.4	Short circuit withstand capacity		

16.5	Bending moment (mm)		
17.	Dis-connector		
	a) Constructional Details		
	b) Other information as applicable to surge arrester		
18.	Surge monitor		
	a) Constructional details		
	b) Degree of protection		
19.	Suitable for hot line washing		
20.	Dimension & weight		
21.	G A drawing indicating height of complete unit from base to line, minimum recommended center to center spacing, clearance form ground equipment at various height of arrester, earthing arrester, earthing arrangement on earthed site of arrester etc.		
22.	Details of packing		
23.	Licence number and date for using ISI certification mark if any		
24.	Ammeter for discharge current		
	a) Type & Make		
	b) Accurancy		
	c) Range (mA)		
25.	Residual voltage		
26.	Follow current		
27.	Any other information		

Signature _____
NAME: _____
Designation: _____

Guaranteed Technical Particulars

ISOLATORS

(This Schedule shall be filled in for each category of Isolator)

S No.	Description	Unit	Particulars
1.0	Name of manufacturer and Address		
2.0	Manufacturer's type		
3.0	Standards to which the equipment conforms		
4.0	Frequency (Hz)		
5.0	Rated voltage KV rms)		
6.0	Maximum design voltage at which the isolator can operate (KV rms)		
7.0	Continuous current rating (Amp. Rms)		
8.0	Rated short time current		
	i) for 3 sec. (KV rms)		
	ii) rated peak short time current (KA peak)		
9.0	Current density at the min. cross section of (Amp./Sq.mm)		
	i) Moving blades		
	ii) Terminal pad		
	iii) Contacts		
	iv) Terminal connector		
10.0	Derating factor for specified site conditions		
11.0	Insulation levels		
	i) Dry impulse withstand voltage (KV peak)		
	a) Phase to earth		
	b) Isolating distance		
	ii) Wet power freq. Withstand voltage (KV rms)		
	a) Phase to earth		

	b) Isolating distance		
12.0	Min. clearance in air (mm)		
	i) Center to center distance between poles		
	ii) Between live parts & earth		
	iii) Between poles on one phase		
13.0	Design & construction		
	i) No. of insulators per pole		
	ii) No. of break per pole		
	a) Main switch		
	b) Earth switch		
	iii) Type of opening /closing mechanism		
	iv) Contacts		
	a) Materials & grade		
	b) Thickness of silver plating on contact surface		
	c) Effective cross sectional area (Sq.mm)		
	1) Main switch		
	2) Earth switch		
	d) No. of operations the isolator can make without deterioration of contacts		

Signed and stamped by the tenderer.

GTP OF CONTROL AND RELAYS PANEL
TO BE FILLED UP BY THE BIDDERS

1 Name of Manufacturer:
2 Country of Origin:
3 Manufacturer's Type and Designation:
4 Dimension:
5 Standards Applicable:
6 Mounted Devices

Sl.No.	Description	Make And Country Of Manufacture	Type (Catalogue to be enclosed)	Brief Description, with contact configuration, Input/Output details, characteristics, range, suitability etc. for clear perspective.
A	**SURFACE MOUNTING DEVICES**			
1	Circuit Level			
2	Mimic Diagram			
3	Circuit Breaker Control Switch Spring return lost motion type			
4	Digital Ammeter			
5	Digital Volt Meters			
6	Digital MW meter			
7	Digital Frequency meter			
8	Trivector Meters			
9	Digital PF meter			
10	Voltmeter Selector Switch 6 way & off position having break before make contact			
11	Test Terminal block suitable for 3 phase 4 wire system with wire rear connecting studs having provision of sealing arrangement			
12	Multi way micro processor based Electronic Annunciator with building-system watchdog first fault indications and red & yellow coloured windows with inscription for Trip & Non Trip Alarm functions			
13	Indicating Lamps led type 63.5 VAC for P.T. Supply indication with cover RED/YELLOW/ BLUE Colours			
14	Indicating Lamp LED type 230 VAC for Panel D.C. Fail Common Indication with cover			

15	Indicating Lamp LED type 110 VDC for CB ON/OFF Auto up Spring Charge Trip Circuit Healthy Gas Pressure Low Indication with RED/GREEN/ AMBER /BLUE/VIOLET Colours			
16	Push Button for Panel DC fail test			
17	Push Button for including AC fail test			
18	Push Button for non trip Panel DC fail Alarm Accept			
19	Push Button for Annunciator Alarm Test / Mute/Accept Reset			
20	Distance Relay			
21	Over current & Earth Fault Relay with instantaneous high set unit			
22	Transformer Protection Relay			
23	Single Element High Speed Tripping Relay with H/R Contact & H/R flag/indication with required numbers of contracts			
24	Two Element 110 V DC Voltage Actuated Auxiliary Relay with HR Contacts & HR/LED Flag/indication for Transformer Internal Trouble functions (a) Buchholz Trip & Winding Temp. Trip function			
	(b) Buchholz Non-Trip & Winding/ Oil Temp. Non-Trip Alarm function.			
25	Two Element 110 V DC Voltage Actuated Auxiliary Relay with HR Contacts & HR, Fag indication for (j) Transformer Low Oil Level Alarm function (ii) Pressure release Device Trip function			
26	Single Element 110 V DC Voltage Actuated Auxiliary Relay with self Reset Contact & Reverse Flag indication for Panel DC Supply fail function			
27	Single Element 230V AC Voltage Actuated Auxiliary Relay with self Reset Contacts & Reverse Flag indication for incoming AC Supply fail function			

28	110 V DC Voltage operated Relay for Trip Circuit supervision purpose with self reset contact			
29	Single Element 230V AC Voltage Actuated Auxiliary Relay with self Reset Contacts without Flag indication for panel DC fail Alarm, Accept			
30	Additional Involvement of Single Element 110 V DC Voltage Actuated Auxiliary Relay with self Reset Contacts without Flag for LV side breaker closing blocking function for Transformer‘s internal fault			
31	Extra Involvement of Auxiliary Relay for not having sufficient contacts to achieve required functions			
32	Common Electronic DC bell/Buzzer Trip & Non-Trip Alarm functions			
33	Common Electronic AC Bell for Panel DC fail Alarm functions			
B	**INSIDE MOUNTING DEVICE**			
1	230V AC Cubicle illuminating lamp with door operated Switch/Toggle Switch			
2	110 V DC Emergency Lamp with Toggle Switch			
3	230C AC 60W space heater with thermostat & Toggle Switch			
4	15A Double V AC Combined 2/3 pin plug and socket with Switch			
5	15A Double Pole MCB for Incoming AC Supply			
6	Fuse			
7	Links			
8	Board Terminals			
9	Earthing Arrangement			
10	Interposing P.T. for Directional Relay if required			
11	Interposing Universal type CT for Differential Relay if required			
12	Any additional devices that may be provided in the control & relay Panel			

Signed and stamped by the tenderer.

GUARANTEED AND OTHER PARTICULARS FOR DISTRIBUTION TRANSFORMERS
(To be furnished by the Bidder)

Sl.No.	Description
1.	Make
2.	Name of Manufacturer
3.	Place of Manufacture
4.	Voltage Ratio
5.	Rating in kVA
6.	Core Material used and Grade: a) Flux density b) Over fluxing without saturation (Curve to be furnished by the Manufacturer in support of his claim)
7.	Maximum temperature rise of : a) windings by resistance method b) Oil by thermometer
8.	Magnetising (no-load) current at: a) 90% Voltage b) 100% Voltage c) 110% Voltage
9.	Core loss in watts : a) Normal voltage b) Maximum voltage
10.	Resistance of windings at 20 ^{0}C (with 5% tolerance) : a. HV Winding (ohms) b. LV Winding (ohms)
11.	Full load losses (watts) at 75 ^{0}C
12.	Total Losses at 100% load at 75 ^{0}C
13.	Total Losses at 50% load at 75 ^{0}C
14.	Current density used for : (Amper/sq mm) a) HV Winding

b) LV Winding

15. Clearances : (mm)
    a) Core and LV
    b) LV and HV
    c) HV Phase to Phase
    d) End insulation clearance to earth
    e) Any point of winding to tank
16. Efficiency at 75 ^{0}C :
    a) Unity P.F. and
    b) 0.8 P.F.
    1) 125% load
    2) 100% load
    3) 75% load
    4) 50% load
    5) 25% load
17. Regulation at :
    a) Unity P.F.
    b) 0.8 P.F. at 75 ^{0}C
18. % Impedance at 75 ^{0}C
19. Flash Test :
    (i) HV 28 kV / 50 HZ for 1 minute
    (ii) LV 3 kV/50 Hz for 1 minute
20. Over potential Test (Double Voltage and Double frequency for 1 minute)
21. Impulse test
22. Mass of : (kg)
    a) Core lamination (minimum)
    b) Windings (minimum)
    c) Tank and fittings
    d) Oil
    e) Oil quantity (minimum) (litre)
    f) Total weight
23. Oil Data :

1. Quantity for first filling (minimum) (litre)
2. Grade of oil used
3. Maker's name
4. BDV at the time of filling (kV)

24. Transformer:

1) Overall length x breadth x height (mm x mm x mm)
2) Tank length x breadth x height
3) Thickness of plates for
   a) Side plate (min)
   b) Top and bottom plate (min)
4) Conservator Dimensions

25. Radiation:

1) Heat dissipation by tank walls excluding top and bottom
2) Heat dissipation by cooling tube
3) Diameter and thickness of cooling tube
4) Whether calculation sheet for selecting cooling area to ensure that the transformer is capable of giving continuous rated output without exceeding temperature rise is enclosed.

26. Inter layer insulation provided in design for :

1) Top and bottom layer
2) In between all layer
3) Details of end insulation
4) Whether wedges are provided at 50% turns of the HV coil

27. Insulation materials provided

a) For Conductors
   (1) HV
   (2) LV
b) For Core

28. Material and Size of the wire used

1) HV Dia (mm) (SWG)

2) **LV** a) Strip size

b) No. of Conductors in parallel

c) Total area of cross section (sq mm)

29. Whether the name plate gives all particulars as required in Tender

30. Particulars of bushings HV/LV

    1) Maker's name
    2) Type IS-3347/IS-2099/IS7421
    3) Rating as per IS
    4) Dry power frequency voltage withstand test
    5) Wet power frequency voltage withstand test

Note:

The following shall be specifically confirmed:

1) Whether the offer conforms to the limits of impedance mentioned in the specification
2) Whether the offer conforms to the limits of temperature rise mentioned in the specification.
3) Whether the losses of the transformers offered are within the limits specified.
4) Whether the transformer offered is already type tested for the design and test reports enclosed.

Signature _____
NAME: _____
Designation: _____

SCHEDULE IB
ADDITIONAL DETAILS

Sl.No.	Description	
1.	Core Grade	
2.	Core diameter	mm
3.	Gross core area	sq cm
4.	Net core area	sq cm
5.	Flux density	Tesla
6.	Mass of core	kg
7.	Loss per kg of core at the specified flux density	watt
8.	Core window height	mm
9.	Center to center distance of the core	mm
10.	No. of LV Turns	
11.	No. of H V turns	
12.	Size of LV conductor bare/covered	mm
13.	Size of HV conductor bare/covered	mm
14.	No. of parallels	
15.	Current density of LV winding	A/sq mm.
16.	Current density of HV winding	A/sq mm
17.	Wt. of the LV winding for Transformer	kg
18.	Wt. of the HV winding for Transformer	kg
19.	No. of LV Coils/phase	
20.	No. of HV coils / phase	
21.	Height of LV Windings	mm
22.	Height of HV winding	mm
23.	ID/OD of HV winding	mm
24.	ID/OD of LV winding	mm
25.	Size of the duct in LV winding	mm
26.	Size of the duct in HV winding	mm
27.	Size of the duct between HV and LV	mm
28.	HV winding to LV winding clearance	mm
29.	HV winding to tank clearance	mm
30.	Calculated impedance	%
31.	HV to earth creepage distance	mm
32.	LV to earth creepage distance	mm

G T P for Polymer Disc Insulator to be filled up by the Bidder

Name of the manufacturer :		
Address of works :		
	11 KV Disc	33 V Disc
1. Type of insulator 2. Reference Standard 3. Material of FRP Rod 4. Material of sheds 5. Type of metal end fittings 6. Material of end fittings 7. Material of sealing compound 8. Colour of sheds 9. Rated voltage 10. Highest voltage 11. Dry Power Frequency Withstand voltage 12. Wet Power Frequency Withstand voltage 13. Dry PF Flashover Voltage 14. Wet PF Flashover Voltage 15. Dry Lightning Impulse withstand Voltage - Positive Negative 16. Dry Lightning Impulse Flashover Voltage - Positive Negative 17. RIV at 1 MHz when energised at 10 KV / 30 KV (rms) under dry condition 18. Creepage distance (min) 19. Visible Discharge Voltage (PF) 20. Minimum Failing load 21. Dia of FRP Rod 22. Length of FRP Rod 23. Dia of weather sheds 24. Thickness of housing 25. Dry arc distance 26. Method of fixing sheds to housing 27. No of weather sheds 28. Type of sheds 29. Dia of bottom end fitting 30. Centre to centre distance between Tongue & Clevis 31. Weight of composite insulator 32. Type of packing 33. No of insulator in each pack 34. Weight of Insulator 35. Gross weight of package 36. Marking 37. Guarantee		

G T P for Polymer Pin Insulator to be filled up by the Bidder

Name of the manufacturer: Address of works:	11 kV Pin	33 kV Pin
Type of insulator		
Reference Standard		
Material of FRP Rod		
Material of sheds		
Material of end fittings		
Material of sealing compound		
Colour of sheds		
Rated voltage		
Highest voltage		
Dry Power Frequency Withstand voltage		
Wet Power Frequency Withstand voltage		
Dry Flashover Voltage		
Wet Flashover Voltage		
Dry Lightning Impulse withstand voltage		
Dry Lightning Impulse Flashover voltage		
RIV at 1 MHz when energised at 10 KV / 30 KV (rms) under dry condition		
Creepage distance (min)		
Visible Discharge Voltage (PF)		
Minimum Failing load		
Dia of FRP Rod		
Length of FRP Rod		
Dia of weather sheds		
Thickness of housing		
Dry arc distance		
Method of fixing sheds to housing		
No of weather sheds		
Type of sheds		
Dia of bottom end fitting		
Thread length of bottom end fitting		
Weight of composite insulator		
Type of packing		
No of insulator in each pack		
Gross weight of package		
Marking		
Guarantee		

GUARANTEED TECHNICAL PARTICULARS FOR 1.1 kV XLPE

	Manufacturer's Name		
	Class of Power Cable		
1	Name of the Manufacturer and country of origin		
2	Country of Manufacture		
3	Type of cable / cable code		
4	Applicable standard		
5	Voltage		
	a. Rated Nominal voltage		
	b) Rated Maximum voltage		
6	Suitability for :		
	a. Earthed system		
7	**Conductor**		
	a) Nominal cross section (sq.mm)		
	b) Material		
	c) Shape		
	d) Diameter of conductor (mm)		
	e) Number of wires per conductor (Nos.)		
	f) Nominal diameter of wire in conductor (mm)		
8	**Insulation XLPE**		
	a) Curing process (furnish details separately)		
	b) Material/Composition		
	c) Dia over insulation		
	i. Nominal (mm)		
	ii. Average (mm)		
	iii. Minimum (mm)		
9	**Inner sheath**		
	a) Type / composition		
	b) Material		
	d) Tolerance on thickness		
	e) Diameter of cable over sheath (mm)		
10	**Armouring**		
	a) Material		
	b) Dia of wire		
	Nom. (mm)		
	Min. (mm)		
11	**Outer sheath**		

	a) Type / composition		
	b) Material		
	c) Nominal thickness		
	d) Tolerance on thickness		
	e) Diameter of cable over sheath (mm)		
12	**Anti-thermite treatment to outer sheath**		
	a) Material		
	External overall dia of cable		
	Short circuit rating of conductor 90 deg. C operating temperature for 1 Sec.		
13	Minimum cable bending radius (in terms of cable dia)		
14	Permissible maximum tension		
15	Continuous current rating under specified insulation conditions at conductor temperature of 65 deg. C and 90 deg. C.		
16	Ground Temperature 30 deg. C		
17	Thermal resistivity of soil 150 deg. C CM/W		
18	Depth of laying 200 mm		
19	Ambient Air temperature 40 deg. C		
20	No. of circuits 1 OR 2		
21	Spacing between two circuits		
22	Formation		
23	Maximum permissible conductor temperature for continuous operation under specified installation conditions (deg. C)		
24	Conductor temperature at rated current (deg. C)		
25	Basic impulse level at conductor temperature of 90 deg. C (KV)		
26	Impulse wave shape		
27	Power frequency with stand voltage (KV)		
28	Tan Delta at 50 Hz (at U.KV and 90 (-5/+10) deg. C		
29	Sheath voltage at max. load		
30	Withstand voltage of sheath on spark test		
31	Permissible short circuit current ratings of conductor		
	i) 0.1 Sec KA		
	ii) o.2 Sec KA		
	iii) 0.5 Sec KA		
	iv) 1.0 Sec KA		
32	**Conductor resistance DC & AC**		
	a) at 20 deg. C (d.c)/A.C. ohm/KM		
	b) at 90 deg. C (d.c)/A.C. ohm/KM		
	c) at 105 deg. C (d.c)/A.C. ohm/KM over load temp) a.c.		

	(ohm)		
33	**Equivalent star resistance at 50 Hz of 3 phase current**		
	a) at 20 deg. C (d.c)/A.C. ohm/KM		
	b) at 90 deg. C (d.c)/A.C. ohm/KM		
	c) at 10% continuous overload temperature (ohm/KM)		
34	**Star reactance at 50 hz (ohm/KM)**		
	Approximate impedance at 50 hz per KM		
	a. at 20 deg. C ohm/KM		
	b. at 90 deg. C ohm/KM		
	c. at 10% continuous overload temperature (ohm/KM)		
35	Self electrostatic capacitance per phase (Micro farad/KM)		
36	Maximum power factor at charging KVA of cables when laid direct in ground at normal voltage & frequency		
	at ambient Temperature		
	at Maximum conductor Temperature		
37	**Impedance**		
	Positive and negative sequence impedance 37 (ohm/KM)		
	Zero sequence impedance (ohm/KM)		
	Zero sequence data		
38	**Series reactance / Resistance**		
	a) Series resistance (ohm/KM)		
	Series reactance (ohm/KM)		
	Shunt capacitive reactance (ohm/KM)		
39	Sheath resistance at 20 deg. C ohm/KM		
40	Surge impedance of cable (ohm/KM)		
41	IR value at amient temperature per KM		
	Maximum magnitude of partial discharge at 1.5 U.o		
	At High Temperature (Po)		
	Losses per Km.		
	NOTE : (i) Cable Conductor size 400 sq. mm		
	Total 3 phase dielectric loss		
	i. One circuit alive Kw/KM		
	ii. Both circuits alive KW/KM on each circuit		
	b) Total 3 phase resistive loss		
	i. One circuit alive Kw/KM		
	ii. Both circuits alive KW/KM on each circuit		
	c) Total 3 phase sheath / screen loss		
	i. One circuit alive Kw/KM		
	ii. Both circuits alive load KW/KM on each circuit		
42	d) Other losses due to reinforcement		
43	One circuit alive KW/KM		
44	Both circuits alive KW/KM on each circuit		

	Total losses		
	i. One circuit alive KW/KM		
	ii. Both circuits alive KW/KM		
	Charging current at rated voltage per Km (Amps)		
45	Short circuit capacity of conductor for one second at 90 deg. C prior to short circuit and 250 deg. C during short circuit (KA)		
46	Screening factor of cable for calculating interference on control and communication cables :		
	Approximate value of attenuation of carrier current signals operating over a frequency range		
	i. 50 KC/s- dB/KM		
	ii. 100 KC/s- dB/KM		
	iii. 150 KC/s- dB/KM		
	iv. 200 KC/s- dB/KM		
47	**Shipping weight and size of cale drum**		
	a) Size of Drum		
	i. Dia of Drum (M)		
	ii. Width of Drum (M)		
	iii. Gross Weight (Kgs)		
	iv. Length of cable per Drum(M)		
	v. Weight of Cable (Kg/M)		

Signature _____
NAME: _____
Designation: _____

SCHEDULE OF GUARANTEED TECHNICAL PARTICULARS FOR L.T. ABC CABLES

S/N	Description	Size-1	Size-2	Size-3
1.	Manufacturer's Name & Address			
2.	Lists of Standard applicable.			
3.	Power/Neutral-Cum-Messenger Core Conductors.			
3.1	Nominal cross sectional area, no. of standards and strand dia.			
	i) Power Cross(mm.)n/mm. ii) Neutral-Cum-Messenger Core(mm)/n/mm. iii) Street Lighting Core(mm.)/n/mm.			
	B. Max. DC resistance of conductor at 20 0C i) Power Cross (Ohm/Km.) ii) Neutral-Cum-Messenger Core (Ohm/Km.) iii) Street Lighting Core (Ohm/Km.)			
	C. Approximate diameter of Conductor. i) Power Cross (mm.) ii) Neutral-Cum-Messenger Core (mm.) iii) Street Lighting Core (mm.)			
	D. Approximate dia over insulation. i) Power Cores. ii) Neutral-Cum-Messenger Core. iii) Street Lighting Core.			
3.2	Insulation Minimum Thickness i) Power Cross (mm.) ii) Neutral-Cum-Messenger Core (mm.) iii) Street Lighting Core (mm.)			
4.	Messenger Wire (Insulated) i) Nom. Cross Sectional area (sq.mm.) ii) Approx. breaking load (KN)			
5.	Current ratings			
	Continuous current carrying capacity of Cable in Air at Ambient Temp. 400C (Amp.) i) Power Cores ii) Neutral-Cum-Messenger Core iii) Street Lighting Core			
6.	Approx. Weight (Kg./Km.)			

7.	No. of Cores i) Power Core (No.) ii) Street Lighting Core (No.) iii) Insulated Messenger (No.)			
8.	Derating factor			
	Derating factors for variation in Air Temp. Air Temp. 0C			
9.	Rating Factor.			
	Identification of Power Cores, Neutral-Cum- Messenger Core & Street Lighting Core.			
	Laying.			
10.	Details of Power/Neutral-Cum-Messenger Core Conductor :			
	a) Material			
	b) Flexibility Class as per IS : 8130/84			
	c) Form of Conductor.			
11.	Insulation a) Material. b) Form of Conductor			
12.	Voltage Grade of Cable. a) Service Voltage. b) Neutral Earthing.			
13.	Maximum Conductor Temperature.			
	a) Continuous (in Deg.C) b) Short time (in Deg.C)			
14.	Type of curing of XLPE Insulation Completed Cable.			

Signature _____
NAME: _____
Designation: _____

SCHEDULE OF GUARANTEED TECHNICAL PARTICULARS FOR 11KV AB CABLES

Sl.No.	Description	Size-1	Size-2	Size-3
1.	Manufacturer's Name & Address			
2.	Lists of Standard applicable.			
3.	Power/Messenger Core Conductors.			
	A. Nominal cross sectional area, no. of standards and strand dia.			
3.1	i) Power Cross(mm.)n/mm.			
	ii) Messenger Core(mm)/n/mm.			
	B. Max. DC resistance of conductor at 20 0C			
	i) Power Cross (Ohm/Km.)			
	ii) Messenger Core (Ohm/Km.)			
	C. Approximate diameter of Conductor.			
	i) Power Cross (mm.)			
	ii) Messenger Core (mm.)			
	D. Approximate dia over insulation.			
	i) Power Cores.			
3.2	Insulation			
	i) Power Cross (mm.)			
	a) Material.			
	b) Nominal thickness.			
	c) Method of application.			
3.3	Conductor Screening ;			
	a) Material.			
	b) Nominal thickness			
	c) Method of application.			
3.4	Insulation Screening :			
	a) Material			
	b) Nominal thickness.			
	c) Method application.			
3.5	Metallic Screening :			
	a) Material.			
	b) Nominal thickness.			
3.6	Outer Sheath :			
	a) Material.			
	b) Nominal thickness			
4.	Messenger Wire (Bare)			
	i) Nom. Cross Sectional area (sq.mm.)			
	ii) Approx. breaking load (KN)			
5.	Current ratings			
	i) Continuous current carrying capacity of Cable in Air at Ambient Temp. 400C (Amp.)			
6.	Approx. Weight (Kg./Km.)			
7.	No. of Cores			
	i) Power Core (No.)			
	ii) Bare Messenger (No.)			
8.	Derating factor			
	Derating factors for variation in Air Temp.			

Air Temp. 0C

9. Rating Factor.

9.1 Identification of Power Cores

9.2 Laying.

10. Details of Power/Messenger Core

10.1 Conductor :
- a) Material
- b) Flexibility Class as per IS : 8130/84
- c) Form of Conductor.

10.2 Insulation
- a) Material.
- b) Form of Conductor

11. Voltage Grade of Power Cable.
- a) Service Voltage.
- b) Neutral Earthing.

12. Maximum Conductor Temperature.
- a) Continuous (in Deg.C)
- b) Short time (in Deg.C)

13. Type of curing of XLPE Insulation

14. Completed Cable :
Approx. overall diameter.
Approx. Weight/KM

15. Cable Drums :
- a) Length/Drum/
- b) Dimension of Drum.
- c) Shipping Weight.
- d) Marking of Cable Drums as per IS

Signature _____
NAME: _____
Designation: _____

Guaranteed Technical Particulars of AAC/AAAC/ACSR
(To be filled in by the Tenderer)

1. Code Word
2. Maker's name and address
    a. Aluminium Rods
    b. Steel Rods
    c. Complete Conductor
3. Stranding and Wire diameter
    a. Aluminium
        i) Nominal
        ii) Minimum
        iii) Maximum
    b. Steel
        i) Nominal
        ii) Minimum
        iii) Maximum
4. Nominal Aluminium Area in sq. mm
5. Sectional Area of Aluminium in Sq. mm.
6. Total Sectional Area in Sq.mm.
7. Cross Sectional area of Nominal Diameter wire in sq.mm.
    a) Aluminium
    b) Steel
    c) Overall diameter of conductor in mm.
8. Breaking load of conductor in KN.
9. Minimum breaking load for
    a. Aluminium Wire ---
        i) Before stranding
        ii) After stranding
    b. Steel Wire ---
        i) Before stranding
        ii) After stranding
10. Zinc Coating of steel wire
    a. Uniformity of coating, number & duration of dips process test, withstood
        i) Before stranding
        ii) After stranding 1 Min x nos. ½ Min x nos
    b. Minimum Weight of coating gm/sq.m
        i) Before stranding
        ii) After stranding
11. Mass in kg. per Km.
    a. Aluminium
    b. Steel
    c. Conductor
12. Resistance in ohm per Km at 200 C
    i) Aluminium
    ii) Conductor
13. Continuous maximum current rating of conductor (Amps. in still air at 450 C ambient temperatures).
14. Modulus of elasticity of conductor

15. Co-efficient of linear expansion per degree centigrade of :
    a. Aluminium wire
    b. Steel Wire
    c. Conductor
16. Standard length of each piece in Km.
17. Approximate dimensions of the drum in mm.
18. Weight of the conductor in one drum in Kg.
19. Weight of the drum in Kg.
20. Gross weight of the drum including weight of the conductor.
21. Standard according to which the conductor will be manufactured and tested.
22. Other particulars if any.

Signature _____
NAME: _____
Designation: _____

GUARANTEED TECHNICAL PARTICULARS FOR 3 PHASE 4 WIRE CT PT OPERATED TRIVECTOR ENERGY METER

Sl. No.	Item	Bidder's data
1	Type of Meter	
2	Application	
3	Standard to which the meter confirm	
4	Rated Voltage	
5	Rated Current	
6	Frequency	
7	Overload capacity	
8	Minimum starting current in % of base current	
9	Power Factor Range	
10	Power loss in potential circuit	
11	Power loss in current circuit	
12	Change in error due to a. Variation in frequency b. Variation in temperature c. Variation in voltage	
13	Accuracy Class	
14	Type of Energy Registration Mechanism.	
15	MD Reset Mechanism	
16	Dynamic Working range a) Voltage b) Current	
17	Type of load (linear, non linear, balanced /unbalanced at any P.F.)	
18	Total Weight of meter	
19	Dimension of the meter	

20 Details of meter base & cover

21 Terminal Cover details

22 Capability for fraud Prevention & detection

23 Sealing and Locking Arrangement

24 Display details
i. Display Cycle (descriptive in order of display sequence) auto and manual
ii. Period of display of each parameter
iii. Display scroll-lock facility
iv. Backlit LCD
v. display off period between two cycles
vi. No of digits of display and height of character.

25 Memory Capacity

26 Non volatile memory retention capacity

27 Powering on facility in absence of mains

28 Tamper data preservation capacity :
a) on display
b) with meter data downloading provisions.

29 Tamper logic in detail

30 Load Survey details :
a) Parameter measured & Logged
b) Logging interval
c) No. of days of Load Survey

31 Type of communication:

32 a) Local-Optical port details with protocol
b) Additional Communication port for AMR compatibility with protocol Real Time Clock

33 Self Diagnostic Features (Provide Details)

34 Certification Marks

GTP of 33/11kV POWER TRANSFORMERS

ITEM NO.	DESCRIPTION	UNITS	BIDDERS OFFER
1	GENERAL		
	Transformer Nominal Capacity	MVA	
	Manufacturer		
	Cross-sectional area of conductors:	mm^2	
	- HV windings		
	- LV windings		
	Maximum current density in windings:	A/ mm^2	
	- HV windings		
	- LV windings		
	Zero sequence impedance, open circuit	Ohms	
	- HV windings		
	- LV windings		
	Zero sequence impedance, short circuit	Ohms	
	- HV windings		
	- LV windings		
	Magnetising current at rated voltage on principal tap	A	
	Winding capacitances:		
	HV winding – Core	µF/ph	
	LV winding – Core		
	HV winding - LV winding		
	Total volume of oil	Litres	
	Volume of oil above level of winding excluding conservator oil	Litres	
	Weight of core and windings	Kg	
	Total weight of complete transformer ready for service	Kg	
	Weight of transformer arranged for transport	Kg	
	Filling medium for transport		
	Type of material used for gasket joints		
	Vacuum withstand capability:	kPa	
	- main tank		
	- conservator		
	- tap-change compartment		
	- radiators		
	Dimensions of main transport package:	mm	
	- length		
	- width		
	- height		
	Dimensions as installed	mm	
	- length overall		
	- width overall		
	- height overall		
2	STANDARDS		
	In accordance with IEC 76 / IS 2026		
3	TYPE		

4	RATED POWER	MVA	
	Maximum continuous rating on all tap positions at specified service conditions.		
	Rating of windings:		
	- HV	MVA	
	- LV	MVA	
	Maximum winding hot spot temperature (ambient temperature 45°C)	°C	
	Maximum temperature rise in top oil	°C	
	Maximum winding temperature rise measured by resistance	°C	
5	VOLTAGE RATIO		
	No load voltage ratio:		
	- Tap 1	kV	
	- Tap 3	kV	
	- Tap 9	kV	
6	WINDING CONNECTIONS AND VECTOR GROUP		
	Winding connections:		
	- HV		
	- LV		
	Vector Group		
7	INSULATION LEVELS		
	Impulse withstand voltage:		
	- HV winding (1.2/50)	kV peak	
	- LV winding (1.2/50)	kV peak	
	- LV neutral	kV peak	
	- Waveshapes for LV neutral	µs	
	Power-frequency test voltage:		
	- HV winding	kV rms.	
	- LV winding	kV rms.	
	- LV neutral	kV rms.	
8	IMPEDANCE VOLTAGE		
	- Tap 1	%	
	- Tap 3	%	
	- Tap 9	%	
9	SHORT CIRCUIT PERFORMANCE		
	Short-circuit withstand capabilities	MVA 2 sec.	
10	REGULATION		
	Regulation at full load (75°C) and unity power factor	%	
	Regulation at full load (75°C) and 0.85 power factor lagging	%	
11	OVER-FLUXING		
	Maximum permissible overfluxing Volts/Hz in % of rated Volts/Hz:		
	- for 1 min.	%	
	- for 30 mins.	%	
	- Continuously	%	
	Flux density at rated voltage on principal tap	Tesla	

	Maximum flux. density in the transformer. State conditions under which it occurs	Tesla	
12	HARMONIC CURRENTS		
	3rd Harmonic as percentage of no load current	%	
	5th Harmonic as percentage of no load current	%	
	7th Harmonic as percentage of no load current	%	
13	PARTIAL DISCHARGE		
	Background level for partial discharge tests	pC	
14	ON-LOAD TAP-CHANGER		
	Tap Changer:		
	- Manufacturer & Type No.		
	- Located in HV winding	Yes/No	
	- Range as % of nominal voltage	%	
	- Number of steps	Step	
	- Impulse withstand level	kV	
	- 50Hz voltage withstand level (1 minute)	kV	
	- Tap-changer motor rating	W	
	Maximum Current Rating	A	
	Method of separating tap change selector switch from the main tank oil		
15	COOLING AND TEMPERATURE CONTROL		
	Cooling:		
	- radiators on main tank	Yes/No	
	Number of radiators		
	Surface area of each radiator	sq. m	
16	TANK AND ACCESSORIES		
16.1	SURFACE TREATMENT		
	Method of surface treatment:		
	- Tank		
	- Radiators etc.		
16.2	CONSERVATOR		
	Total volume of conservator	Litre	
17	TRANSFORMER OIL		
	Manufacture and type of transformer oil		
18	TERMINALS		
18.1	BUSHINGS		
	HV Bushings:		
	- Manufacturer		
	- Type		
	- Total creepage distances to earth	mm	
	- Protected creepage distance to earth		
	- Electrical clearance phase to phase	mm	
	- Electrical clearance to earth	mm	
	- Rated current	A	
	- Rated voltage	kV	
	- 1 min. 50Hz dry withstand voltage	kV	
	- 1 min. 50Hz wet withstand voltage	kV	
	- Impulse withstand voltage	kV	
	- Rated short-time current	kA	
	LV Bushings:		

	- Manufacturer		
	- Type		
	- Total creepage distances to earth	mm	
	- Protected creepage distance to earth	mm	
	- Electrical clearance phase to phase	mm	
	- Electrical clearance to earth	mm	
	- Rated current	A	
	- Rated voltage	kV	
	- 1 min. 50Hz dry withstand voltage	kV	
	- 1 min. 50Hz wet withstand voltage	kV	
	- Impulse withstand voltage	kV	
	- Rated short-time current (2 second)	kA	
18.2	NEUTRAL TERMINALS		
	11kV Neutral Bushing:		
	- Manufacturer		
	- Type		
	- Total creepage distances to earth	mm	
	- Protected creepage distance to eart	mm	
	- Electrical clearance to earth	Mm	
	- Rated current	A	
	- Rated voltage	kV	
	- 1 min. 50Hz dry withstand voltage	kV	
	- 1 min. 50Hz wet withstand voltage	kV	
	- Impulse withstand voltage	kV	
	- Rated short-time current (2 second)	kA	
19	NOISE LEVEL		
	Guaranteed noise level in dB (A) to IEC 551:	dB(A)	
20	INSTALLATION		
	Vibration characteristics of supports		
21	GUARANTEED LOSS		
	Guaranteed no-load loss:		
	- Tap 1	kW	
	- Tap 3	kW	
	- Tap 9	kW	
	Guaranteed load loss: (75ºC)		
	- Tap 1	kW	
	- Tap 3	kW	
	- Tap 9	kW	

Signature of Bidder