BIDDING DOCUMENT

FOR

"Turnkey Construction of 01 (one) no. of 33kV Feeder bay at 132 kV Ghoramari GSS, AEGCL for Solar Power Injection by Ajanta Pharma Ltd."

FUND: "Deposit Scheme"

(E-Tender)

(VOL – II)
Technical Specification

BID IDENTIFICATION NO:
AEGCL/MD/Tech-1226/Deposit/33kV Ajanta Pharma Bay/2026/BID

ASSAM ELECTRICITY GRID CORPORATION LIMITED

Rs.1000

Section - 4

Technical Specifications

(This Section contains the Technical Requirements and supplementary information that describe the Goods and Related Services)

4.1.0 SCOPE AND GENERAL TECHNICAL CONDITIONS

4.1.1 INTENT OF THE SPECIFICATION

This volume of the specification deals with the general technical information & criteria for design, manufacture and delivery of equipment/material.

The provisions of this section shall supplement all the detailed Technical Specifications and requirements brought out herein. The Supplier's proposal shall be based on the use of materials complying fully with the requirements specified herein.

4.1.1.1 SCOPE

The work involves design, engineering, manufacture, assembly, inspection, testing at manufacturer's works before dispatch, packing, supply, including insurance during transit, delivery at site of various equipment and materials including substation steel structures as specified in subsequent Clauses and Sections.

It is not the intent to specify completely herein all details of design and construction of the equipment and accessories. However, the equipment and accessories shall conform in all respects to high standards of engineering, design and workmanship and be capable of performing in continuous operation up to the bidder's guarantees in a manner acceptable to the Purchaser. The Purchaser will interpret the meaning of drawings and specifications and shall be entitled to reject any work or material, which in his judgment is not in full accordance therewith.

The major items of works included in the scope of this specification are listed below: -

i) Design & supply of all substation switchgears, control gears and protection equipment as per this bidding document.
ii) Supply of substation/ equipment mounting steel structure, power cables etc as specified.

The brief description of the scope covered under this bidding document is furnished below:

- Design, engineering, manufacture, assembly and testing at manufacturer's works of 33kV terminal equipment and different substation materials.
- Construction of outdoor cable trenches to link the existing cable trenches, kiosk etc. as per drawings and specification.
- Construction of drain as per drawing and specification.
- The price quoted shall include cost of all materials and labour to complete the job in all respect as per drawings and this Section.
- Loading at manufacturer's works, transportation and delivery at respective substation sites, including unloading at destination sites.
- Erection, Testing and commissioning of the supplied equipment and structures including construction of foundation, pile foundation and associated civil and electrical works needed for completion of the project and subsequent commissioning of the bay.

The various items of supply are described very briefly in the schedule of Bid Form, Prices & Other Schedules and annexure. The various items as defined in these schedules shall be read in conjunction with the corresponding section in the technical specifications including amendments and, additions if any.

The tentative Bill of Quantities is furnished in Section 3: Price Schedules. The BOQ is for indicative purpose only and the bidder is required to fill up the BOQ/price schedule as given in the e-tendering portal.

4.1.2 SUPPLIER TO INFORM HIMSELF FULLY

4.1.2.1 The Supplier should ensure that he has examined the General Conditions, qualifying criteria, Specifications and Schedules as brought out in Volume-1 and this Volume and has satisfied himself as to all the conditions and circumstances affecting the contract price and fixed his price according to his own views on these matters and acknowledge that no additional allowances except as otherwise provided therein will be levied.

4.1.2.2 The Purchaser shall not be responsible for any misunderstanding or incorrect information obtained by the Supplier other than information given to the Supplier in writing by the Purchaser

4.1.3 SERVICE CONDITIONS

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

A)	Peak ambient day temperature in still air	: 45^{O} C
B)	Minimum night temperatures	: 0^{O} C
C)	Reference ambient day temperature	: 45^{O} C
D)	Relative Humidity	
	a) Maximum b) Minimum	:100% : 10%
E)	Altitude	Below 1000M above MSL
F)	Maximum wind Pressure	As per IS: 802 latest code
G)	Other data	Refer meteorological date pertaining to the locations.
H)	Seismic intensity	Zone V as per IS 1893

4.1.4 CONFORMITY WITH INDIAN ELECTRICITY RULES & OTHER LOCAL REGULATIONS:

4.1.4.1 The Supplier shall note that all substation works shall comply with the latest provisions of Indian Electricity Rules and with any other regulations. Local authorities concerned in the administration of the rules and regulation relating to such works shall be consulted, if necessary, in regard to the rules and regulations that may be applicable.

4.1.5 STANDARDS

4.1.5.1.1 The equipment covered by this specification shall, unless otherwise stated be designed, constructed and tested in accordance with the latest revisions of relevant Indian Standards and shall conform to the regulations of local statutory authorities.

4.1.5.1.2 In case of any conflict between the standards and this specification, this specification shall govern.

4.1.5.1.3 Equipment conforming to other international or authoritative Standards which ensure equivalent or better performance than that specified under Clause 1.6.1 above shall also be accepted. In that case relevant extracts of the same shall be forwarded with the bid.

4.1.6 ENGINEERING DATA

4.1.6.1 The furnishing of engineering data by the Supplier shall be in. accordance with the Bidding Document. The review of these data by the Purchaser will cover only general conformance of the data to the specifications and not a thorough review of all dimensions, quantities and details of the materials, or items indicated or the accuracy of the information submitted. This review by the Purchaser shall not be considered by the Supplier, as limiting any of his responsibilities and liabilities for mistakes and deviations from the requirements, specified under these specifications.

4.1.6.2 All engineering data submitted by the Supplier after review by the Purchaser shall or part of the contract document.

4.1.7 DRAWINGS AND DOCUMENTS FOR APPROVAL

4.1.7.1 The supplier shall submit all drawings and documents of all equipment to be supplied, including drawings of foundation, steel structure and any other drawings that may be required for successful completion of the project and get it approved by the Purchaser (AEGCL).

4.1.7.2 In addition, the following sub clauses shall also apply in respect of Contract Drawings.

4.1.7.3 All drawings submitted by the Supplier including those submitted at the time of Bid shall be with sufficient detail to indicate the type, size, arrangement, dimensions, material description, Bill of Materials, weight of each component break-up for packing and shipment, fixing arrangement required, the dimensions required for installation and any other information specifically requested in these specifications.

4.1.7.4 Each drawing submitted by the Supplier shall be clearly marked with the name of the Purchaser, the specification title, the specification number and the name of the Project. All titles, noting, markings and writings on the drawing shall be in English. All the dimensions should be to the scale and in S.I. units.

4.1.7.5 The drawings submitted for approval to the Purchaser shall be in quadruplicate. One print of such drawings shall be returned to the Supplier by the Purchaser marked "approved/approved with corrections". The Supplier shall there upon furnish the Purchaser additional prints as may be required along with one reproducible in original of the drawings after incorporating all corrections.

4.1.8 INSPECTION & INSPECTION CERTIFICATE

4.1.8.1 The Purchaser, his duly authorized representative and/or outside inspection agency acting on behalf of the Purchaser shall have, at all reasonable times, access to the premises and works of the Supplier and their sub-Supplier(s)/sub-vendors and shall have the right, at the reasonable times, to inspect and examine the materials and workmanship of the product during its manufacture.

4.1.8.2 All routine and acceptance tests whether at the premises or work of, the Supplier or of any Sub-Supplier, the Supplier except where otherwise specified shall carry out such tests free of charge. Items such as labour, materials, electricity, fuel, water, stores apparatus and instruments as may be reasonably demanded by the Purchaser/inspector or his authorized representative to carry out effectively such tests in accordance with the Contract shall be provided by the Supplier free of charge.

4.1.8.3 If desired by the Purchaser, the Supplier shall also carry out type tests as per applicable Standards for which Purchaser shall bear the expenses except in cases where such tests have to be carried out in pursuance to ***Clause 1.18.3***. The Supplier is required to quote unit rates of type test charges in a separate Schedule (if such schedule is provided in the Bidding Document) in pursuance to this Clause. However, these type test charges shall not be taken into account in comparing Price Bid.

4.1.8.4 The inspection by Purchaser and issue of Inspection Certificate thereon shall in no way limit the liabilities and responsibilities of the Supplier in respect of the agreed Quality Assurance Programme forming a part of the Contract.

4.1.8.5 Tests

The type, acceptance and routine tests and tests during manufacture to be carried-out on the material and equipment shall mean as follows:

i) Type Tests shall mean those tests, which are to be carried out to prove the process of manufacture and general conformity of the material to this Specification. These tests shall be carried out on samples prior to Commencement of commercial production against the order. The Bidder shall indicate his schedule for carrying out these tests.

ii) Acceptance Tests shall mean those tests, which are to be carried out on samples taken from each lot offered for pre-dispatch inspection, for the purposes of acceptance of that lot.

iii) Routine Tests shall mean those tests, which are to be carried out on the material to check requirements, which are likely to vary during production.

iv) Tests during Manufacture shall mean those tests, which are to be carried out during the process of manufacture and end inspection by the Supplier to ensure the desired quality of the end product to be supplied by him.

v) The norms and procedure of sampling for these tests will be as per the Quality Assurance Programme to be mutually agreed to by the Supplier and the Purchaser.

4.1.8.6 The standards and norms to which these tests will be carried out are specified in subsequent Sections of this Specification. Where a particular test is a specific requirement of this Specification, the norms and procedure of the test shall be as specified or as mutually agreed to between the Supplier and the Purchaser in the Quality Assurance Programme.

4.1.8.7 For all type and acceptance tests, the acceptance values shall be the values specified in this Specification or guaranteed by the Bidder or applicable Standards, as applicable.

4.1.9 EMPLOYER'S SUPERVISION

4.1.9.1 To eliminate delays and avoid disputes and litigation it is agreed between the parties to the Contract that all matters and questions shall be resolved in accordance with the provisions of this document.

4.1.9.2 The manufacturing of the product shall be carried out in accordance with the specifications. The scope of the duties of the Employer, pursuant to the contract, will include but not be limited to the following.

(a) Interpretation of all the terms and conditions of these Documents and Specifications.

(b) Review and interpretation of all the Contractors drawings, engineering data etc.

(c) Witness or authorize his representative to witness tests at the manufacturer's works or at site, or at any place where work is performed under the contract.

(d) Inspect, accept or reject any equipment, material and work under the Contract, in accordance with the Specifications.

(e) Issue certificate of acceptance and/or progressive payment and final payment certificate.

2.1.10 GUARANTEED TECHNICAL PARTICULARS

2.1.10.1 The Guaranteed Technical Particulars of the various items shall be furnished by the Bidders. 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.

2.1.10.2 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 were stated otherwise.

2.1.11 PACKING

2.1.11.1 All the materials shall be suitably protected, coated, covered or boxed and crated to prevent damage or deterioration during transit, handling and storage at Site till the time of erection. The Supplier shall be responsible for any loss or damage during transportation, handling and storage due to improper packing.

2.1.11.2 The Supplier shall include and provide for securely protecting and packing the materials so as to avoid loss or damage during transport by air, sea, rail and road.

2.1.11.3 All packing shall allow for easy removal and checking at site. Wherever necessary, proper arrangement for attaching slings for lifting shall be provided. All packages shall be clearly marked for with signs showing 'up' and 'down' on the sides of boxes, and handling and unpacking instructions as considered necessary. Special precaution shall be taken to prevent rusting of steel and iron parts during transit by sea.

2.1.11.4 The cases containing easily damageable material shall be very carefully packed and marked with appropriate caution symbols, i.e., fragile, handle with care, use no hook etc. wherever applicable.

2.1.11.5 Each package shall be legibly marked by the-Supplier at his expenses showing the details such as description and quantity of contents, the name of the consignee and address, the gross and net weights of the package, the name of the Supplier etc.

2.1.12 CONSTRUCTION TOOLS, EQUIPMENTS ETC.

2.1.12.1 The Contractor shall provide all the construction equipment, tools, tackle and scaffoldings required for construction, erection, testing and commissioning of the works covered under the Contract including construction power water supply etc. He shall submit a list of all such materials to the Employer before the commencement of work at site. These tools and tackle shall not be removed from the site without the written permission of the Employer.

2.1.13 MATERIALS HANDLING AND STORAGE

2.1.13.1 All the supplies under the Contract as well as Employer supplied items (if any) arriving at site shall be promptly received, unloaded and transported and stored in the stores by the Contractor.

2.1.13.2 Contractor shall be responsible for examining all the shipment and notify the Employer immediately of any damage, shortage, discrepancy etc. for the purpose of Employer's information only. The Contractor shall submit to the Employer every week a report detailing all the receipts during the week. However, the Contractor shall be solely responsible for any shortages or damages in transit, handling and/or in storage and erection at site. Any demurrage, and other such charges claimed by the transporters, railways etc., shall be to the account of the Contractor.

2.1.13.3 The Contractor shall maintain an accurate and exhaustive record-detailing out the list of all items received by him for the purpose of erection and keep such record open for the inspection of the Employer.

2.1.13.4 All items shall be handled very carefully to prevent any damage or loss. The materials stored shall be properly protected to prevent damage. The materials from the store shall be moved to the actual location at the appropriate time to avoid damage of such materials at Site.

2.1.13.5 All the materials stored in the open or dusty location must be covered with suitable weatherproof and flameproof covering material wherever applicable.

2.1.13.6 The Contractor shall be responsible for making suitable indoor storage facilities, to store all items/materials, which require indoor storage.

2.1.13.7 The Contractor shall have total responsibility for all equipment and materials in his custody, stored, loose, semi-assembled and/or erected by him at site. The contractor shall make suitable security arrangements including employment of security personnel to ensure the protection of all materials, equipment and works from theft, fire, pilferage and any other damages and loss.

2.1.13.8 The Employer will verify the storage facilities arranged by the contractor and dispatch clearance will be provided only after Employer is satisfied.

2.1.14 CONTRACTOR'S MATERIALS BROUGHT ON TO SITE

2.1.14.1 The Contractor shall bring to Site all equipment, components, parts, materials, including construction equipment, tools and tackles for the purpose of the work under intimation to the Engineer. All such goods shall, from the time of their being brought vest in the Employer, but may be used for the purpose of the Works only and shall not on any account be removed or taken away by the Contractor without the written permission of the Engineer. The Contractor shall nevertheless be solely liable and responsible for any loss or destruction thereof and damage there to

2.1.14.2 The Employers shall have a lien on such goods for any sum or sums, which may at any time, be due or owing to him by the Contractor, under in respect of or by reasons of the Contract. After giving a fifteen (15) days' notice in writing of his intention to do so, the Employer shall be at liberty to sell and dispose of any such goods, in such manner, as he shall think fit including public auction or private treaty.

2.1.14.3 After the completion of the Works, the Contractor shall remove from the Site under the direction of the Engineer the materials such as construction equipment, erection tools and tackles, scaffolding etc. with the written permission of the Engineer. If the Contractor fails to remove such materials within fifteen (15) days of issue of a notice by the Engineer, the Engineer shall have the liberty to dispose of such materials as detailed under clause 1.24.2 above and credit the proceeds thereto to the account of the Contractor.

2.1.15 COMMISSIONING SPARES

1.24.1 It will be the responsibility of the Contractor to provide all commissioning spares required for initial operation till the Employer declares the equipment as ready for commissioning. All commissioning spares shall be deemed to be included in the scope of the Contract at no extra cost to the Employer.

1.24.2 These spares shall be received and stored by the Contractor at least 3 months prior to the schedule date of commencement of commissioning of the respective equipment and utilized as and when required. The unutilized spares and replaced parts, if any, at the end of successful completion of performance and guarantee test shall be the property of the Contractor and he will be allowed to take these parts back at his own cost with the permission of Employer's Representative.

4.2.0 SPECIFICATION FOR DESIGN AND FABRICATION OF SUBSTATION STEEL STRUCTURES

4.2.1 SCOPE

4.2.1.1 This section covers the design parameters and specification for fabrication and galvanizing, of steel structures, bolts & nuts, tower accessories etc. for Substations covered under this Bid Document.

4.2.2 MATERIALS

4.2.2.1 Structural Steel

The structures shall be of structural steel conforming to any of the grade, as appropriate, of IS 2062 (latest edition) Steel conforming IS 8500 may also be used.

Medium and high strength structural steels with known properties conforming to any other national or international standards may also be used.

4.2.2.2 Bolts

Bolts used shall conform to IS12427 or bolts of property class 4.6 conforming to IS 6639 may also be used.

High strength bolts, if used (only with steel conforming to IS 8500) shall conform to property class 8.8 of IS 3757.

Foundation Bolts shall conform to IS 5624.

Step bolts shall conform to IS 10238

4.2.2.3 Nuts

Nuts shall conform to IS 1363 (Part 3). The mechanical properties shall conform to property class 4 or 5 as the case may be as specified in IS 1367 (Part 6) except that the proof stress for nuts of property class 5 shall be as given in IS 12427.

Nuts to be used with high strength bolts shall conform to IS 6623.

4.2.2.4 Washers

Washers shall conform to IS 2016. Heavy washers shall conform to IS 6610. Spring washers shall conform to type B of IS 3663

Washers to be used with high strength bolts and nuts shall conform to IS 6649.

4.2.2.5 Galvanization

Structural members, plain and heavy washers shall be galvanized in accordance with the provisions of IS 4759.

Spring washers shall be hot dip galvanized as per service grade 4 of IS 4759 or IS 1537.

4.2.2.6 Other Materials

Other materials used in the construction of the supporting structures shall conform to appropriate Indian Standards wherever available.

4.2.3 DESIGN PARAMETERS

4.2.3.1 Switchyard structures such as columns, beams and equipment mounting structures shall be designed as per actual site requirement. The drawings are to be submitted for approval prior to supply/execution.

Note: Structures with earth peak shall assume to have four earth wires for design purpose in normal condition.

4.2.3.2 **Spans**

Following Spans shall be considered in design of all structures as applicable: -

a). Line gantries (structures to terminate lines):

(i) For 33 KV Switchyard: 50 Meter, wind & weight span.

b). All other Structures

(i) For 33 KV Switchyard: 20 Meter, wind & weight span.

4.2.4 Deviation Angle

The design of line gantries shall only be checked for a maximum deviation angle of 300 from normal at center of gantries to Dead End Tower.

4.2.5 Conductors and Shield Wires

a) The Conductor shall conform to IS: 398 (latest edition) except where otherwise specified herein.

The details of the ACSR Moose, ACSR Zebra and ACSR Panther conductors are tabulated below:

	DESCRIPTION	ACSR 'MOOSE'	ACSR 'ZEBRA'	ACSR 'PANTHER'
1	Code name	MOOSE	ZEBRA	PANTHER
2	Number of strands & size	Al: 54/ 3.53 mm	Al: 54/ 3.18 mm	Al: 30/ 3.00 mm
		St: 7/ 3.53 mm	St: 7/ 3.18 mm	St: 7/ 3.00 mm
3	Overall diameter	35.05 MM	28.62 mm	21.00 mm
4	Breaking load	136.38 KN	130.32 kN	130.32 kN
5	Weight of conductor	2004 Kg/KM	1621 kg / km	974 kg / km
6	Co-efficient Of Linear Expansion	23x10-6 /0C	19.35x10-6 /0C	19.35x10-6 /0C
7	Number of strands			
	Steel center	1	1	1
	1st Steel Layer	6	6	6
	1st Aluminium Layer	12	12	12
	2nd Aluminium Layer	18	18	18
	3rd Aluminium Layer	24	24	-
8	Sectional area of Aluminium	528.50 mm2	428.90 mm2	212.10 mm2
9	Total sectional area	597.00 mm2	484.50 mm2	261.50 mm2
10	Calculated d.c. resistance at 20 C	0.05552 ohm/km	0.06869 ohm/km	0.1400 ohm/km
11	Ultimate tensile strength	161.2 kN	130.32 kN	89.67

b) For protection against direct lightning G.I. wires of size 7/3.66 mm conforming to IS 2241 shall be considered for all switch yards.

4.2.6 DESIGN DRAWINGS

4.2.6.1 The relevant drawings for all the towers, beams and equipment mounting structures shall be furnished by the Supplier to the Purchaser which shall include structural/fabrication drawings, Bill of Materials including nuts and bolts.

4.2.6.2 The structural drawings, Bill of materials and shop fabrication drawings for all the structures shall be submitted in four copies and will be finally approved by the Purchaser.

The fabrication shall be taken up from the approved shop drawings.

The overall responsibility of fabricating structure members correctly lies with the Supplier only and the Supplier shall ensure that all the members can be fitted while erecting without any undue strain on them.

4.2.7 ACCESSORIES

4.2.7.1 **Step Bolts**

Each column/tower shall be provided with step bolts conforming to IS: 10238 of not less than 16mm diameter and 175mm long spaced not more than 450mm apart and extending from 2.5 meters above the ground level to the top. Each step bolt shall be provided with two nuts on one end to fasten the bolt securely to the tower and button head at the other end to prevent the feet from slipping away. The step bolts shall be capable of withstanding a vertical load not less than 1.5 KN.

4.2.7.2 **Insulator Strings and Conductor Clamps Attachments**

a) Single suspension and tension insulator string assemblies shall be used for stringing busbars for the attachment of Suspension Insulator string, a suitable strain plate of sufficient thickness for transferring the load to the tower body shall be provided. To achieve requisite clearances, if the design calls for providing extra D-shackles, link plate etc. before connecting the insulator string the insulator string the same shall be supplied by the Supplier.

b) At tension points strain plates of suitable dimensions placed on the beams, shall be provided for taking the hooks or D-shackles of the tension insulator strings. To achieve requisite clearances, if the design calls for providing extra D-shackles, link plate etc. before connecting the insulator string the same shall be supplied by the Supplier.

4.2.7.3 **Earth wire Clamps Attachment**

i. **Suspension Clamp**

The detailed drawing shall be submitted by the Supplier for Purchaser's approval. The Supplier shall also supply U-bolts, D-shackles wherever required.

a) **Tension Clamps**

Earth-wire peaks of tension towers shall be provided with suitable plates to accommodate the shackle of tension clamps. The Supplier shall also supply the U-bolts wherever required and take Purchaser's approval for details of the attachments before the mass fabrication.

4.2.8 FABRICATION

4.2.8.1 The fabrication of substation steel structures shall be in conformity with the following:

a. Except where hereinafter modified, details of fabrication shall conform to IS: 802 (Part-II) or the relevant international standards.

b. The tower structures shall be accurately fabricated to connect together easily at site without any undue strain on the bolts.

c. No angle member shall have the two leg flanges brought together by closing the angle.

d. The diameter of the hole shall be equal to the diameter of bolt plus 1.5mm.

e. The structure shall be designed so that all parts shall be accessible for inspection and cleaning. Drain holes shall be provided at all points where pockets of depression are likely to hold water.

f. All identical parts shall be made strictly inter-changeable. All steel sections before any work are done on them shall be carefully levelled, straightened and made true to detailed drawings by methods which will not injure the materials so that when assembled, the adjacent matching surfaces are in close contact throughout. No rough edges shall be permitted in the entire structure.

g. Minimum Thickness of Tower Members shall be as follows: -

ITEM	Minimum thickness (in mm)
Leg members & main chords of beams in compression	5
Other members	4

4.2.9 Drilling and Punching

4.2.9.1 Before any cutting work is started, all steel sections shall be carefully strengthened and trued by pressure and not by hammering. They shall again be trued after being punched and drilled.

4.2.9.2 Holes for bolts shall be' drilled or punched with a jig but drilled holes shall he preferred. The punching may be adopted for thickness up to 16mm. Tolerances regarding punch holes are as follows:

a) Holes must be perfectly circular and no tolerances in this respect are permissible.

b) The maximum allowable difference in diameter of the holes on the two sides of plates or angle is 0.8mm. I.e. the
allowable taper in a punched holes should not exceed 0.8 mm on diameter.

c) Holes must be square with the plates or angles and have their walls parallel.

4.2.9.3 All burrs left by drills or punch shall be removed completely. When the tower members are in position the holes shall be truly opposite to each other. Drilling or reaming to enlarge holes shall not be permitted.

4.2.10 Erection mark

4.2.10.1 Each individual member shall have erection mark conforming to the component number given to it in the fabrication drawings. The mark shall be marked with marking dies of 16mm size before galvanizing and shall be legible after galvanizing.

4.2.11 GALVANIZING AND PAINTING

4.2.11.1 Galvanizing of the various members of the structures shall be done only after all works of sawing, shearing, drilling, filling, bending and matching are completed. Galvanizing shall be done by the hot dip process as recommended in IS: 2629 or other such authoritative international standards and shall produce a smooth, clean and uniform coating of not less than 61 0 gm per square meter. The preparation for galvanizing and the galvanizing process itself must not affect adversely the mechanical properties of the treated materials. No manual Galvanization process will be accepted.

4.2.11.2 All assembly bolts shall be thoroughly hot dip galvanized after threading. Threads shall be of a depth sufficient to allow for the galvanized coating, which must not be excessive at the root of the threads, so that the nut shall turn easily on the completed bolts without excessive looseness. The nut threads shall not be galvanized, but oiled only.

4.2.11.3 The outside surface shall be galvanized. Sample of galvanized materials shall be supplied to the galvanized test set out in IS 729 or other such authorities international standards.

4.2.12 EARTHING

4.2.12.1 To keep provision in the structures for earthling, holes shall be drilled on two diagonals opposite legs of the towers/columns/mounting structures. The holes shall be suitable for bolting 65 mm X 1 2 mm GI strips and shall be such that the lower hole is about 350 mm above the ground level, clear of the concrete muffing, for connecting the earthling strip.

4.2.13 TEST AND TEST CERTFICATE

4.2.13.1 Each consignment ready for transportation shall be offered to ASEB for inspection before dispatch giving a minimum time of not less than 30 days. Samples of fabricated structure materials shall be subjected to following tests: -

a) Steel: The structural steel shall conform to IS 226 and IS 8500, BS 4360-1068 or ISO / R 630 other such authoritative international standards. Manufacturer's test certificate shall be submitted for all used steel.

b) Galvanising: The galvanising shall be as per IS 2633 or BS 729 other such authoritative international standards. Zinc coating over the galvanised surfaces shall not be less than 610 gm per square meter.

c) Bolts and nuts: Manufacturer's test certificate as per standard practice shall be submitted.

4.2.14 TEST AT SUPPLIER'S PREMISES

4.2.14.1 The Supplier shall fabricate one specimen structure of each type as soon as possible after placement of order and before starting the bulk fabrication of the structures ordered. It shall be assembled on a foundation as nearly similar as practicable to site and tested with suitable test loads as per specified broken wire condition, multiplied by the corresponding factor of safety to ensure that the design and fabrication complies with the requirements. Each structure shall be capable of withstanding the above-mentioned tests without any injury or any permanent deflection at any part. If any member is found to be weak or damaged the design should be suitably modified and the tower re-tested.

4.2.14.2 After the first lot of the structures manufactured, the members forming one structure of each type shall be selected at random from the lots of similar member and assembled in exactly the same manner as to be done at site. The structure then shall be set on foundation as nearly similar as practicable to site and tested with equivalent test load for which the structure has been designed.

4.2.14.3 No structure or any member thereof, which failed the test shall be supplied.

VACUUM CIRCUIT BREAKERS

SPECIFICATION OF 36 KV OUTDOOR TYPE PORCELAIN CLAD VACUUM CIRCUIT BREAKERS (PCVCB)

4.3 GENERAL TECHNICAL REQUIREMENTS

4.3.1 INTRODUCTION

The circuit breakers should be complete in all respects with insulators, bimetallic connectors, interrupting chamber, operating mechanism control cabinet, interlocks, auxiliary switches indicating devices, supporting structures, accessories, etc., described herein and briefly listed in the schedule of requirements. The scope of supply shall also include necessary special tools and plants required for erection as indicated, if any.

4.3.2 STANDARDS

The circuit breaker shall conform in all respects to the requirements of latest issue of IS/IEC specifications except for modifications specified herein. The equipment manufactured according to any other authoritative standards which ensure an equal or better quality than the provision of IS/IEC specifications shall also be acceptable. The salient point of difference between the proposed standard and provision of these specification shall be clearly brought out in the tender. A copy of English version of such specifications shall be enclosed with the tender.

The list of standards mentioned in this specification and to which the circuit conform is given below:

1.	IEC-62271-100	High Voltage A.C. Circuit Breakers
2.	IEC-60137	Bushing for alternating Voltages above 1000 volts
3.	IEC-60071	Insulation Co-ordination
4.	IEC-60694	Common clauses for high voltages switchgear and control gear standards
5.	IEC-60815	Specification for Creepage distances
6.	IS-13118	Specifications for high voltage alternating current circuit breakers
7.	IS-2099	High voltages porcelain bushings
8.	IS-4379	Identification of the contents of industrial gas cylinders
9.	IS-3072	Installation and maintenance of switchgear
10.	IEC-60267	Guide for testing of circuit breakers with respect to out of phase switching
11.	IS-802	Code of practice for use of structural steel in overhead transmission lines
12.	IEC-17A Study Group Dec.1981	Sealing of interrupters / breakers
13.	IS-1554	PVC insulated cables upto and including 1000 volts
14.	IS-5	Colors for ready mixed paints and channels
15.	Ref.Standard IES	Internal Electro-Technical Commission Bureau Central Data Commission, Elecro Technique International, 1, Ruede Verembe, Geneva, Switzerland
16.	IS	Indian Standard Bureau of India Standard, Manak Bhawan 9, Bahadurshah Zafar Marg, New Delhi – 110 002, India

4.3.3 SERVICE CONDITONS

CLIMATIC CONDITONS

The breakers and accessories to be supplied against this specification shall be suitable for satisfactory continuous operation as per section-I.

AUXILIARY POWER SUPPLY

Auxiliary electrical equipment shall be suitable for operation on the following supply system.

a)	Power Devices (like motors)	:	415 V, 3 phase 4 wire 50 hz, neutral grounded AC supply
b)	DC Alarm, Control and Protective Devices	:	220/110 V/30 V DC, ungrounded 2 wire (Substation wise exact details shall be furnished by the successful bidder after survey)
c)	Lighting	:	240 V, single phase 50 Hz AC supply

Bidder's scope includes supply of interconnecting cables, terminal boxes, etc. The above supply voltage may vary as indicated below and all devices shall be suitable for continuous operation over the entire range of voltages

i)	AC Supply	Voltage + 10% -15% Frequency $\pm$ 5%
ii)	DC Supply	-15% to + 10%

4.3.4 GENERAL REQUIREMENT OF 36 KV/OUTDOOR VACUUM CIRCUIT BREAKERS

The vacuum type circuit breaker shall have vacuum interrupters, designed to provide a long contact life at all currents upto rated making and breaking current during switching operation. The vacuum interrupters sealed for life shall be encapsulated by porcelain insulators for outdoor installation requirement of the circuit breakers. The offered breakers shall be suitable for outdoor operation under climatic conditions specified without any protection from sun, rain and dust storm.

The vacuum interrupters of each phase shall be housed in a separate porcelain insulator. The three identical poles shall be mounted on a common base frame and the contact system of three poles should be mechanically linked to provide three pole gang opening/closing for all type of faults.

i) The offered equipment shall be practically maintenance free over a long period.
ii) All mechanical parts and linkages shall be robust in construction and maintenance free, over at least 10,000 switching operations, except for lubrication of pins/articulated joints at interval of 5 years or 5000 operations.
iii) Similar parts shall be strictly interchangeable without special adjustment of individual fittings. Parts requiring maintenance shall be easily accessible, without requiring extensive dismantling of adjacent parts.
iv) The operating mechanism will be self maintained and of proper operation endurance not less than the mechanical life of circuit breaking unit. It shall be spring operated type described hereinafter.

v) The circuit breaker shall be supplied complete with all auxiliary equipment, meant necessary for the safe operation, routine and periodic maintenance. All internal wiring including those of spare auxiliary contacts shall be complete and wired upto terminal blocks.
vi) The breaker shall be totally re-strike free under all duty conditions. The details of any device incorporated to limit or control the rate of rise of re-striking voltage across the circuit breaker contacts shall be stated.
vii) The breaker shall be reasonably quiet in operation and the noise level shall not exceed 140 decibels.
viii) The breaker shall be suitable for three phase re-closing operation.
ix) An operation counter, visible from the ground level even with the mechanism housing closed shall be provided.

4.3.5 FIXED AND MOVING CONTACT

The fixed and moving contacts of the breaker have to ensure permanent full contact during closing. All making and breaking contacts shall be hermetically sealed and free from atmospheric effects.

The main contacts should have low contact resistance.

4.3.6 RECOVERY VOLTAGE AND POWER FACTOR

The circuit breaker shall be capable of interrupting rated power with recovery voltage equal to the rated maximum line to line service voltage at rated frequency and at a power factor equal to or exceeding 0.15. In case of multiple break circuit breaker, devices/method adopted for ensuring uniform voltage distribution across all the breaks shall be indicated and actual voltage distribution recorded during interruption tests shall be furnished with the bid.

4.3.7 RESTRIKING RECOVERY

The complete data for the phase factor, amplitude factor, etc., for rate of rise of re-striking voltage shall be furnished in the tender.

4.3.8 LINE CHARGING INTERRUPTING CAPACITY

The circuit breaker shall be designed so as to be capable of interrupting line charging currents without undue rise in the voltage on the supply side without re-strike and without showing sign of undue strains.

The maximum permissible switching over voltage shall not exceed 2.5 p.u. The guaranteed over voltage, which will not be exceeded while interrupting the rated line charging current for which the breaker is designed to interrupt shall also be stated. The results of the tests conducted along with the copies of the oscillographs to prove ability of the breakers to interrupt the rated as well as lower values of the line charging current shall be furnished with the tender.

4.3.9 TRANSFORMER CHARGING CURRENT BREAKING CAPACITY

The breaker shall be capable of interrupting inductive currents, such as those occurring while switching off unloaded transformers, without giving rise to undue over voltage and without re-strikes. The maximum over voltage value, which will not be exceeded under such conditions shall be stated in the tender.

4.3.10 BREAKING CAPACITY FOR SHORTLINE FAULTS

The interrupting capacity of the breaker for short line faults shall be stated in the tender. The details of the test conducted for proving the capability of the breaker under a short line fault occurring from one phase to earth conditions shall also be stated in the tender. The rated characteristics for short line faults shall be in accordance with stipulation contained in clause 4.105 of IEC 62271-100.

4.3.11 AUTOMATIC RAPID RECLOSING

36 kV circuit breaker shall be suitable for 3 pole rapid re-closing.

4.3.12 OUT OF PHASE SWITCHING

The circuit breaker shall be capable of satisfactory operation even under conditions of phase opposition that may arise due to faulty synchronization. The maximum power that the breaker can satisfactorily interrupt under "Phase Opposition" shall be stated in the bid".

4.3.13 TEMPERATURE RISE

The maximum temperature attained by any part of the equipment when in service at side and under continuous full load conditions and exposed to the direct rays of the sun shall not exceed the permissible limits fixed by IEC. When the standards specify the limits of temperature rise these shall not be exceeded when corrected for the difference between ambient temperature specified in the approved specification.

The limits of temperature rise shall also be corrected for altitude as per IEC and stated in the bid.

4.3.14 INSULATORS SUPPORTS AND HOUSING

The porcelain used shall be homogenous, free from cavities and other flaws. The insulators shall be designed to have ample insulation, mechanical strength and rigidity for satisfactory operation under conditions specified above.. The puncture strength of bushing shall be greater than the flash over value. The design of bushing shall be such that the complete bushing in a self-contained unit and no audible discharge shall be detected at a voltage upto a working voltage (Phase Voltage) plus 10%. The support insulator shall conform to IEC-60137. Minimum clearance between phases, between live parts and grounded objects shall be as per IS-3072-1975 and should conform to Indian Electricity Rules-1956. The minimum creepage distance for severely polluted atmosphere shall be 25 mm/KV as per IEC-815-1985.

The details for atmospheric pollution of various sub-stations where these breakers are to be installed shall be as per Clause 1.3.1 of this specification. The air clearance of bushing should be such that if the bushings were tested at an altitude of less than 1000 meters, air clearance would withstand the application of higher voltages (IS-2099-1973 para 6.1). In order to avoid breakdown at extremely low pressures the support insulators should not be covered by moisture and conducting dust. Insulators should therefore be extremely clean and should have antitracking properties. Sharp contours in conducting parts should be avoided for breakdown of insulation. The insulators shall be capable to withstand the seismic acceleration of 0.3 g in horizontal direction.

4.3.15 OPERATING MECHANISM GENERAL REQUIREMENTS

The operating mechanism shall be stored energy type and capable of giving specified duty of the breaker (sequence of opening and closing) as specified under O-0.3 sec-CO-3 min-CO. The breaker shall also pass

the operational test which ascertains the capabilities of operating mechanism. The operating mechanism shall be capable to perform the following functions efficiently.

i) To provide means where the circuit breaker can be closed rapidly, at all currents from zero to rated making current capacity.
ii) To hold the circuit breaker in closed position by toggles or latches till the tripping signal is received.
iii) To allow the circuit breaker to open without delay immediately on receiving tripping signal.
iv) To perform auto re-closure duty cycle.
v) To perform the related functions such as indication, contacts, etc.

Operating mechanism should also be suitable for three phase auto re-close duty. The closing spring shall be automatically charged by motor immediately after closing operation. In case of failure of supply to the spring charging motor, the spring shall be chargeable by hand-crank.

a) **TRIPPING/CLOSING COILS**

The circuit breakers shall be provided with two trip coils and one closing coil per breaker. First trip coil shall be utilized for tripping the breaker on main protection fault detection. Whereas second trip coil shall be used to trip the breaker when first trip coil fails to trip the breaker and backup protection comes into operation and shall also be used to trip the breaker on command. Provision shall be given for trip circuit supervision both in pre close and post close condition of the breaker. All the breakers shall have provision for independent electrical operation of trip coils from local as well as remote through local/remote selector switch.

b) **TRIP FREE FEATURES**

When the breaker has been instructed to close by manual instructions using push button, the operating mechanism will start operating for closing operations. If in the mean time a fault has taken place, the relay provision shall be such that it should close the trip circuit simultaneously interrupting the live circuit of closing coil which has been instructed for close command.

The trip free mechanism shall permit the circuit breaker to be tripped by the protective relay even if it is under the process of closing. An anti-pumping device to prevent the circuit breaker from reclosing after an automatic opening shall be provided to avoid the breaker from pumping i.e., anti pumping relay should interrupt the closing coil circuit.

c) **Controls**

The circuit breaker shall be controlled by a control switch located in the control cabinet . The control arrangement shall be such as to disconnect the remote control circuits of the breaker, when it is under test. Local control devices, selector switch and position indicator shall be located in weather and vermin-proof cabinet with degree of protection not less than IP-55. The circuit breaker control scheme shall incorporate trip circuit supervision arrangement. Local/remote selector switch shall be provided for all breakers for selection of “Local” control/remote control.

Provision shall be made for local manual, electrical and spring controls. Necessary equipment’s for local controls shall be housed in the circuit breaker cabinet of weather-proof construction. In addition to this, a hand closing device for facilitating maintenance shall also be provided.

Each circuit breaker shall have a mechanical open/closed and spring charge indicator in addition to facilities for provisions for semaphore indicators for breakers which are required for the mimic diagram in the control room. Lamps for indicating, `close/open' position of the breaker shall also be provided.

The contact pressure spring and tripping spring shall be chargeable during closing operation to ensure the breaker is ready to open. Mechanically ON/OFF indicator, spring charged indicator and operation counter shall be provided on the front of the control cubicle. For tripping, the spring provided shall ensure the trippings

Mechanical indicator, to show the 'open' and 'close' position of the breaker shall be provided in a position where it will be visible to a man standing on ground with mechanism housing open. An operation counter, visible from the ground even with the mechanism housing closed, shall be provided. Electrical tripping of the breaker shall be performed by shunt trip coils.

Closing coil shall operate correctly at all value of voltage between 85% and 110% of the rated voltage. Shunt trip coils shall operate correctly under all operating conditions of the circuit breaker upto the rated breaking capacity and at all values of supply voltage between 85% and 110% of rated voltage. The variation in A.C. supply voltage shall be –15%to +10% while variation in frequency shall be $\pm$3. Working parts of the mechanism shall be non-corrosive material. Bearings which require grease shall be equipped with pressure type fillings.

Bearing pins, bolts, nuts and other parts shall be adequately pinned or locked to prevent loosening or changing adjustment with repeated operation of the circuit breaker. It shall be possible to trip the circuit breaker even in the event of failure of power supply.

Operating mechanism and all accessories shall be enclosed in control cabinet. A common marshalling box for the three poles of the breaker shall be provided, along with supply of tubing, cables from individual pole operating boxes to the common marshalling box, local.

4.3.16 SPRING OPERATED MECHANISM

The motor compressed spring mechanism shall consists of a closing spring which is wound or compressed by an electric motor immediately after the breaker closes.

After the breaker has tripped, the tripping spring shall remain in the released position as long as the breaker is open, but the closing spring shall remain wound and ready for closing operation. The operating mechanism shall have all the necessary auxiliaries, apparatus for operation and supervision, like motor starter with thermal overload release, one closing coil, two trip coils, push button for local electrical operation, local/remote control selector switch, push button for direct mechanical tripping, auxiliary switches, anti puming contactors, operation counter, socket for inspection, lamp and heater with switch. Spring charging motor shall be standard single phase universal motor suitable for 220 volts supply.

i) Operating voltages for closing/tripping coils shall be 220/110/48/24 Volts DC **or as per actual DC voltage available at existing substations which is to be verified by supplier after award of contract.**

ii) Operating voltages for heater elements shall be 220V AC 50 HZ. Other features of the spring operated mechanism shall be as follows.

a) The spring operating mechanism shall have adequate energy stored in the operating to close and latch the circuit breaker against the rated making current and also to provide the required energy for tripping mechanism in case the tripping energy is derived from the operating mechanism.
b) The mechanism shall be capable of performing the rated operating duty cycle of O-0.3Sec-CO-3 Min-CO...
c) The spring charging motor shall be AC or DC operated and shall not take more than 30 sec., to fully charge the closing spring made for automatic charging. Charging of spring by the motor should not interfere with the operation of the breakers.
d) The motor shall be adequately rated to carry out a minimum of one duty cycle. Also provision shall be made to protect the motor against overloads.
e) In case of failure of power supply to spring charging motor, the mechanism shall be capable of performing one open-close-open operation.
f) Mechanical interlocks shall be provided in the operating mechanism to prevent discharging of the closing springs when the breaker is already in closed position. Provision shall be made to prevent a closing operation to be carried out with the spring partially charged.
g) Facility shall be provided for manual charging of closing springs.

4.3.17 CONTROL CABINET

The switchgear operating mechanism, the control equipment such switch for closing and tripping the breakers, various control relays, antipuming device, a set of terminal blocks for wiring connections, MCB's for disconnecting the control auxiliary power supplies including relays, etc., shall be enclosed in a cabinet to be mounted on a suitable structure at a convenient working height at the end of the breaker in the outdoor switchyard. The supporting structure and the enclosure shall be capable of withstanding the typical tropical climatic conditions, change of ambient temperature, severe dust-storms, very high relative humidity those are prevailing at the site of location of switchgear.

i) ENCLOSURE

The enclosure shall be made out of stretched level steel plates not less than 3 mm thick and of light section structural steel. It should be weather proof as well as vermin proof.

The enclosure shall provide protection against dust and foreign objects. Each cabinet section shall have full width and full-length hinged doors mounted on the front that swing fully open. The doors shall be provided with latches to securely hold it with the cabinet. Doors shall be of sturdy construction, with resilient material covering, fully perimeterically contacting the cabinet frame to provide dust protection and prevent metal to metal contact except at the latch points. Filtered ventilation shall be provided along with the rigid supports for control and other equipment, measuring instruments, mounting cabinet members and equipment shall not restrict easy access to terminal blocks for terminating and testing external connection or to equipment for maintenance.

All screws and bolts used for assembling and mounting wire and cable termination, supports, devices and other equipment shall be provided with lock washers or other locking devices. All metal parts shall be clean and free of weld splatter, rust and mill scale prior to application of double coat of zinc chromate primer which should be followed by an under coat to serve as base and binder for the finishing coat. The shade of exterior and interior shall be as per GTR. The mounting structure shall be galvanized and shall be as per IS-802-II-1978.

ii) HEATERS

Suitable heaters shall be mounted in the cabinet to prevent condensation. Heaters shall be controlled by thermostat and shall be provided with ON/OFF switches and fuses. Heaters shall be suitable for 240 V AC supply voltage.

iii) **LIGHTING**

At least one 13-watt CFL fixture and lamp working on 240 V 50 c/s AC supply shall be provided in each switchgear control cubicle section and shall be located suitably to provide adequate interior lighting of the cubicle. A single-pole 6 Amp. lighting switch shall be provided for each cubicle alongwth 5/15 amp.

The lighting and convenient outlet circuits shall be completely wired in conduit and terminated on cubicle terminal blocks.

iv) **WIRING AND CABLING**

a) Unless otherwise specified control wire shall be stranded tinned copper switchboard wire with 1.1 kV PVC insulation conforming to the requirements of IS-1554.
b) All the control circuit and secondary wiring shall be wired completely and brought out to terminal block ready for external connections in the control cabinet. The cross-section of control wire shall not be less than 2.5 mm2 copper (14 SWG).
c) All spare auxiliary contacts of the circuit breaker shall be supplied wired upto terminal block. Each terminal in terminal block shall be suitable for at least 2 x 2.5 mm^2 copper conductor.
d) All wiring termination on terminal blocks shall be made through lugs.
e) All wires shall be identified with non-metallic sleeve or tube type markers at each terminations.
f) Terminal blocks shall be made up of moulded non-inflammable plastic material with blocks and barriers moulded integrally have white marking strips for circuit identification and moulded plastic covers. Disconnecting type terminal blocks will be provided.

v) **GROUNDING**

A ground bus of copper bar not less than 6 mm by 25 mm shall be provided for grounding the cabnet.

4.3.18 ACCESSORIES

Each circuit breaker assembly shall be supplied with the following accessories.

i) Line and earthing terminals and terminal connectors.
ii) Control housing with:

a) One auxiliary switch with adequate number of auxiliary contacts, but not less than 20 nos. (10 NO + 10 NC) for each breaker. These shall be over and above the No. of contacts used for closing, tripping and re-closing and interlocking circuit of the circuit breaker. All auxiliary contacts shall be capable of use as “Normally closed” or “Normally open” contacts. Special auxiliary contacts required for the re-closing circuit if any, shall also be provided. There shall be provision, to add more auxiliary contacts at a later date, if required.
b) Operation counter
c) Position indicator (Close/Open)
d) Necessary cable glands
e) Fuses

f) Manual trip device and local test push buttons
g) Terminal blocks and wiring for all control equipment and
h) Adequate number of heaters for continuous operation to prevent moisture condensation in the housing of operating mechanism
i) Selector switch for local/remote control.

4.3.19 SUPPORTING STRUCTURE

The circuit breakers shall be supplied complete with necessary galvanized steel supporting structures, foundation and fixing bolts, etc., the galvanizing shall be as per IS. The mounting of the breaker shall be such as to ensure the safety of the operating staff and should conform to Indian Electricity Rules, 1956. Minimum ground clearance of live part from ground level shall be 3700 mm from finished ground level.

The bidder shall submit detailed design calculations and detailed design calculations and detailed drawings in respect of supporting structures suitable for the equipment offered.

All material for making connections between the circuit breaker and its control shall also be included in the scope of supply. Facility to earth the circuit breaker structure at two points shall be provided.

4.3.20 SURFACE FINISH

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

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

All ferrous hardware, exposed to atmosphere, shall be hot dip galvanized.

4.3.21 GALVANISING

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

4.3.22 CABLE TERMINATION

Suitable cable glands for terminating the multicore cable, shall be provided wherever required.

4.3.23 TERMINAL CONNECTIONS AND EARTH TERMINALS

Each circuit breaker connected with incoming and outgoing feeders shall be provided with solderless clamp type connectors suitable for ACSR conductor.

Each circuit breaker pole and control cabinet shall be provided with appropriate number of grounding terminals and clamps for receiving ground connections.

Each circuit breaker pole and control cabinet shall be provided with appropriate number of grounding terminals and clamps for receiving ground connections.

4.3.24 INTERLOCKS

Necessary interlocks to prevent closing or opening of the breaker under low pressure of the contact spring and devices for initiating alarm shall be provided. The detailed interlocking scheme based upon single line diagram as applicable for the substation shall be provided by the contractor

Requirement of interlock shall be as given below:

i) Isolator should not be operated unless the associated breaker is in open position.
ii) The circuit breaker shall close only after all isolators associated with it have been in closed position.

In case of double bus bar arrangement following additional requirement for interlocking shall be provided.

i) One bus bar selector isolator of any bay excepting the bus coupler bay shall close only when,
   a) The circuit breaker of corresponding bay is open and locked.
   b) The other bus isolator of that bay is open.

ii) When one bus isolator of any bay excepting the bus coupler bay is closed. The other shall close only when the bus coupler circuit breaker and both the bus isolators are closed.
iii) Bus isolator of bus coupler bay shall operate only when the bus coupler breaker is open.
iv) The bypass isolator of feeder shall close when the feeder circuit breaker and its adjoining isolators are closed.

4.3.25 EARTHING SYSTEM

All switchgear enclosures should be bolted metal to metal and should carry the full earth return current. Connection between phases at the earthing points shall be dimensioned for carrying full earth return current i.e., actual service current not rated current.

4.3.26 VACUUM INTERRUPTER ASSEMBLY

Each pole of the circuit breaker shall be provided with vacuum interrupter, one for each phase, hermetically sealed for life and encapsulated by ceramic insulators. The interrupter shall be provided with steel chromium are chamber to prevent vaporized contact material being deposited on the insulating body. A further shield giving protection to the metal bellows shall also follow the travel of the moving contacts to seal the interrupter against the surroundings atmosphere.

It shall have high and consistent dielectric strength of vacuum unaffected by environment and switching operations. Bronzed joints should ensure retention of vacuum for life time. It shall have low and stable contact resistance due to absence of oxidation effects and shall ensure low power loss. The arcing voltage shall be low and minimum contact erosion.

4.3.27 GUARANTEED TECHNCIAL PARTICULARS

Guaranteed and technical particulars as called for in Section-II shall be furnished along with the tender. Particulars which are subject to guarantee shall be clearly marked.

4.3.28 TESTS

TYPE TESTS

Each circuit breaker shall comply with requirements of type tests prescribed in IEC publication No. 62271-100

i) Short time and peak withstand current test .
ii) Short circuit breaking capacity and making capacity.
iii) Capacitive current switching test : Cable charging current breaking test(Ur less than or equal to 52 kV).
iv) Dielectric test i.e., power frequency withstand and impulse withstand test
v) Temperature rise test.
vi) Mechanical Endurance Test at ambient temperature.
vii) Measurement of resistance of the main circuit.

ROUTINE TESTS

Routine Tests as per IEC- 62271-100 shall be carried out on each breaker in presence of purchaser's representative at the manufacturer's expenses at his works except, where agreed to otherwise. All test reports should be submitted and should be got approved from the purchaser before despatch of the equipment.

SITE TESTS ON CONTROL AND AUXILIARY CIRCUIT

The following tests shall be conducted at site.

i) Voltage tests on control and auxiliary circuit.
ii) Measurements of resistance of the main circuit.
iii) Mechanical Operation Tests.

4.3.29 NAME PLATE

Equipment should be provided with name plate giving full details of manufacture, capacities and other details as specified in the relevant ISS or other specification stipulated.

4.3.30 TECHNICAL PARAMETERS

36 KV CIRCUIT BREAKERS

S. NO.	DESCRIPTION		VALUES
i)	Rate voltage (KV rms)	:	36 KV
ii)	Rated frequency (Hz)	:	50
iii)	System neutral earthing	:	Solidly grounded system
iv)	Type of arc quenching medium	:	Vacuum
v)	Rated normal current at site conditions (Amps)	:	1250 Amps
vi)	Number of poles	:	3
vii)	Installation	:	Outdoor type
viii)	Temperature rise	:	As per IEC 56 (Table-4) Page-19

S. NO.	DESCRIPTION		VALUES
ix)	Rated short circuit	:	
	a) Interrupting capacity at 36 KV	:	25 KA
	b) The percentage DC components	:	As per IEC-62271-100
	c) Duration of short circuit	:	3 Sec.
x)	Rated short circuit making	:	82 KA
xi)	First pole to clear factor	:	1.5
xii)	Rated short time current	:	26.3 KA
xiii)	Rated duration of short circuit	:	3 Seconds
xiv)	Total break time for any current upto the rated breaking current with limiting condition of operating and quenching media pressure (ms)	:	< 80 ms
xv)	Closing time (ms)	:	< 150 ms
xvi)	Mounting	:	Hot dip galvanized lattices steel support structured bolted type
xvii)	Phase to phase spacing in the switch yard i.e, interpole spacing for breaker (min) in mm	:	470±10
xviii)	Required ground clearance from the lowest line terminal if both the terminals are not in same horizontal plane (mm)	:	3700
xix)	Height of concrete plinth (mm)	:	150
xx)	Minimum height of the lowest part of the support insulator from ground liner (mm)	:	3194
xxi)	Minimum creepage distance of support insulator (mm)	:	1116 mm (31 mm/kV)
xxii)	Minimum corona extinction voltage (kv rms)	:	92
xxiii)	Standard value of rated transient recovery voltage for terminal fault	:	As per IEC-56
xxiv)	Standard value of rated line Characteristics for short line faults	:	
	RRRV	:	KV/ms=0.214
	Surge Peak Factor		K=1.6 A
	Impedance	:	450
xxv)	Rated operating duty cycle	:	O-0.3 Second - CO-3 Minutes-CO
	b) Auto reclosing	:	Suitable for three phase Auto reclosing duty
xxvi)	Rated insulation level under heavy pollution condition 1.2/50 micro second lightening Impulse withstand voltage (KV peak) to earth	:	170 KV
xxvii)	Power frequency withstand voltage KV (rms) to earth (KV rms)	:	70 KV
xxviii)	Rated characteristic for out of Phase breaking	:	
	a) Out of phase breaking capacity	:	25% of rated breaking capacity
	b) Standard values of transient recovery	:	As oper IEC-56
	c) Operating mechanism	:	Spring operated, Anti pumping and Trip free mechanism
	d) Power available for operating mechanism	:	Three phase 415 Volts 50 C/S or

S. NO.	DESCRIPTION		VALUES
			single phase 50 C/S 240 volts
xxix)	a) Rated supply voltage of closing and operating devices and auxiliary circuits	:	1)220 VDC/110 VDC 2)240 Volts AC 50 C/S single phase 3)415 volts 50 Hz three phase
	b) Permissible voltage variation	:	1)In case of DC Power supply voltage variation shall be between 85% to 110% of normal voltage. 2)In case of AC power supply voltage variation shall be of the normal voltage as per IS-15% to +10%.
	c) Permissible frequency	:	± 3% from normal 50 Hz as per IS 2026 part-I 1977 para 4.4
	d) Combined variation of frequency and voltage	:	± 10%
xxx)	Auxiliary contacts (number & rating)	:	12 NO and 12 NC on each pole having continuous current rating of 10 Amps. DC breaking rating capacity shall be 2 Amps with circuit time constant less than 20 ms at 220/30 volts DC
xxxi)	Number of trip coils	:	Two trip coils and 1 close coil with anti-pumping arrangement
xxxii)	Rated terminal load	:	100 kg. Static. The breaker shall be designed to withstand the rated terminal load, wind, load, earthquake load and short circuit forces
xxxiii)	Noise level of the equipment	:	Not exceeding 140 db
xxxiv)	ladder	:	Necessary platform with ladder shall be provided for local operation/maintenance to ease out accessible reach
xxxv)	Galvanisation Thickness of Supporting structure	:	125 microns

4.3.1 **DRAWINGS AND INSTRUCTION MANUALS**

Following drawings for each item are to be supplied as part of the contract.

i) General outline drawings, showing dimensions, front and side elevations and plan of the circuit breaker and its local control panel.
ii) Outline drawing of bushings showing dimensions and number of sheds and creepage distance.

iii) Assembly and sub-assembly drawings with numbered parts.
iv) Sectional views showing the general constructional features, operating mechanism and are extinguishing chamber, etc.
v) Dimension and assembly of important auxiliaries.
vi) Detailed drawings of operating mechanism. And inter-phase mechanism.
vii) Test certificates.
viii) Detailed drawings of mounting structure.
ix) Spare parts and catalogue
x) Wiring diagram showing the local and remote control scheme of breaker including alarms indication devices instruments relay and timer wiring.
xi) Write up on working of control schematic of breaker.
xii) Foundation plan including weights of various components and impact loadings for working foundation design. Three copies for each pkg. of the above drawings and instruction manuals covering instructions for installations, operation and maintenance shall be supplied by the contractor(s) without any extra cost.

4.4.0 TECHNICAL SPECIFICATION OF OUTDOOR CURRENT AND POTENTIAL TRANSFORMERS

4.4.1 SCOPE OF CONTRACT

4.4.1.1 This Section of the Specification covers general requirements for design, engineering, manufacture, assembly and testing at manufacturer's works of 33 kV outdoor Current and Potential Transformers.

4.4.2 STANDARDS

4.4.2.1 The equipment covered by this specification shall, unless otherwise stated be designed, constructed and tested in accordance with the latest revisions of relevant Indian Standards and shall conform to the regulations of local statutory authorities.

4.4.2.2 In case of any conflict between the Standards and this specification, this specification shall govern.

4.4.2.3 The current transformer shall comply also with the latest issue of the following Indian standard.

(i) IS: 2705(Part-I) Current transformers: General requirement.

(ii) IS: 2705(Part-II) Current transformers : Measuring Current transformers

(iii) IS: 2705(Part-III) Current transformers : Protective Current transformers

(iv) IS: 2705(Part-IV) Current transformers: Protective Current transformers for special purpose

application.

(v) IS: 3156(Part-I) Potential transformers: General requirement.

(vi) IS: 3156 (Part-II) Potential transformers : Measuring Potential transformers

(vii) IS: 3156 (Part-III) Potential transformers : Protective Potential transformers

4.4.3 GENERAL REQUIREMENTS

4.4.3.1 The cores of the instrument transformers shall be of high grade, non-aging CRC steel of low hysteresis loss and high permeability.

4.4.3.2 Instrument transformers shall be of Dead Tank design or Live Tank design.

4.4.3.3 The instrument transformers shall be truly hermetically sealed to completely prevent the oil inside the tank coming into contact with the outside temperature. To take care of oil volume variation the tenderer are requested to quote the current transformers with stainless steel diaphragm (bellow).

4.4.3.4 The instrument transformers shall be completely filled with oil.

4.4.3.5 A complete leak proof secondary terminal arrangement shall be provided with each instrument transformers, secondary terminal shall be brought into weather, dust and vermin proof terminal box. Secondary terminal boxes shall be provided with facilities for easy earthing, shorting, insulating and testing of secondary circuits. The terminal boxes shall be suitable for connection of control cable gland.

4.4.3.6 All instrument transformers shall be of single phase unit.

4.4.3.7 The instrument transformers shall be so designed to withstand the effects of temperature, wind load, short circuit conditions and other adverse conditions.

4.4.3.8 All similar parts, particularly removable ones, shall be interchangeable with one another.

4.4.3.9 All cable ferrules, lugs, tags, etc. required for identification and cabling shall be supplied complete for speedy erection and commissioning as per approved schematics.

4.4.3.10 The instrument transformers shall be designed to ensure that condensation of moisture is controlled by proper selection of organic insulating materials having low moisture absorbing characteristics.

4.4.3.11 All steel work shall be degreased, pickled and phosphated and then applied with two coats of Zinc Chromate primer and two coats of finishing synthetic enamel paint.

4.4.4 INSULATING OIL

4.4.4.1 The quantity of insulating oil for instrument transformers and complete specification of oil shall be stated in the tender. The insulating oil shall conform to the requirement of latest edition of IS: 335

4.4.5 COMMON MARSHALLING BOXES

4.4.5.1 The outdoor type common marshalling boxes shall conform to the latest edition of IS 5039 and other general requirements specified hereunder.

4.4.5.2 The common marshalling boxes shall be suitable for mounting on the steel mounting structures of the instrument transformers.

4.4.5.3 One common marshalling box shall be supplied with each set of instrument transformers. The marshalling box shall be made of sheet steel and weather proof. The thickness of sheet steel used shall be not less than 3.0 mm. It is intended to bring all the secondary terminals to the common marshalling.

4.4.5.4 The enclosures of the common marshalling boxes shall provide a degree of protection of not less than IP 55 (As per IS 2147).

4.4.5.5 The common marshalling boxes shall be provided with double hinged front doors with pad locking arrangement. All doors and removable covers and plates shall be sealed all around with neoprene gaskets or similar arrangement.

4.4.5.6 Each marshalling box shall be fitted with terminal blocks made out of moulded non-inflammable plastic materials and having adequate number of terminals with binding screws washers etc. Secondary terminals of the instrument transformers shall be connected to the respective common marshalling boxes. All out going terminals of each instrument transformer shall terminate on the terminal blocks of the common marshalling boxes. The terminal blocks shall be arranged to provide maximum accessibility to all conductor terminals.

4.4.5.7 Each terminal shall be suitably marked with identification numbers. Not more than two wires shall be connected to any one terminal. ***At least 20 % spare terminals shall be provided over and above the required number***.

4.4.5.8 All terminal strips shall be of isolating type terminals and they will be of minimum 10 A continuous current rating.

4.4.5.9 All cable entries shall be from bottom. Suitable removable gland plate shall be provided on the box for this purpose. Necessary number of cable glands shall be supplied fitted on to this gland plate. Cable glands shall be screw on type and made of brass.

4.4.5.10 Each common marshalling box shall be provided with two numbers of earthing terminals of galvanised bolt and nut type.

4.4.5.11 All steel, inside and outside work shall be degreased, pickled and phosphate and then applied with two coats of Zinc Chromate primer and two coats of finishing synthetic enamel paint. The colour of finishing paint shall be as follows: -

i) Inside: Glossy White

ii) Outside: Light Grey (Shade No. 697 of IS: 5)

4.4.6 BUSHINGS AND INSULATORS

4.4.6.1 Bushings and Insulators shall be of Porcelain, Solid core type. Porcelain used for the manufacture of bushings and insulators shall be homogeneous, free from defects, cavities and other flaws or imperfections that might affect the mechanical or dielectric quality and shall be thoroughly vitrified, tough and impervious to moisture.

4.4.6.2 Glazing of the porcelain shall be of uniform brown colour, free from blisters, burns and other similar defects. Bushings shall be designed to have sufficient mechanical strength and rigidity for the conditions under which they will be used. All bushings of identical ratings shall be interchangeable.

4.4.6.3 Puncture strength of bushings shall be greater than the dry flashover value. When operating at normal voltage, there shall be no electric discharge between the conductors and bushing which would cause corrosion or injury to conductors, insulators or supports by the formation of substances produced by chemical action. No radio interference shall be caused by the bushings when operating at the normal rated voltage.

4.4.6.4 The design of bushing shall be such that the complete bushing is a self-contained unit and no audible discharge shall be detected at a voltage up to a working voltage (Phase Voltage) plus 10%. The minimum creepage distance for severely polluted atmosphere shall be 25 mm/KV.

4.4.6.5 Sharp contours in conducting parts should be avoided for breakdown of insulation. The insulators shall be capable to withstand the seismic acceleration of 0.5 g in horizontal direction and 0.6g in vertical direction.

4.4.6.6 Bushings shall satisfactorily withstand the insulation level specified in data sheet.

4.4.7 TESTS

2.4.1.1 Routine/Acceptance Tests (all units)

2.4.1.2 **A**ll routine tests shall be carried out in accordance with relevant Standards. All routine/acceptance tests shall be witnessed by the Purchaser/his authorised representative.

2.4.1.3 **Type Tests:** The bidder shall furnish type test certificates and results for the all tests as per relevant Standards along with the bid for current and potential transformers of identical design.

2.4.1.4 Type test certificates so furnished shall not be older than 5 (five) years as on date of Bid opening.

4.4.8 NAME PLATES

4.4.8.1 All equipment shall have non-corrosive name plates fix at a suitable position indelibly mark with full particular there on in accordance with the standard adapted.

4.4.9 MOUNTING STRUCTURES

4.4.9.1 All the equipment covered under this specification shall be suitable for mounting on steel structures.

4.4.9.2 Supply of mounting structures is also in the scope of this tender.

4.4.9.3 Each equipment shall be furnished complete with base plates, clamps, and washers etc. and other hardware ready for mounting on existing steel structures.

4.4.10 SAFETY EARTHING

2.4.10.1.The non-current carrying metallic parts and equipment shall be connected to station earthing grid.
For this two terminals suitable for 40mm X 10mm GI strip shall be provided on each equipment.

4.4.11 TERMINAL CONNECTORS

4.4.11.1 The equipment shall be supplied with required number of terminal connectors of approved type suitable for ACSR. The type of terminal connector, size of connector, material, and type of installation shall be approved by the Purchaser, as per installation requirement while approving the equipment drawings.

4.4.12 TECHNICAL DATA SHEET FOR CURRENT AND POTENTIALTRANSFORMERS

4.4.12.1 For 132 & 33 kV CTs the instrument security factor at all ratios shall be less than five (5) for metering core. If any auxiliary CTs/reactor are used in the current transformers then all parameters specified shall have to be met treating auxiliary CTs as an integral part of the current transformer. The auxiliary CTs/reactor shall preferably be inbuilt construction of the CTs. In case these are to be mounted separately these shall be mounted in the central marshalling box suitably wired up to the terminal blocks.

4.4.12.2 TYPE AND RATING:

All instrument transformer shall be outdoor type, single phase, oil immersed, self-cooled suitable for mounting on steel structure. The instrument transformer shall have the following ratings and particulars.

Item	**Ratings and Particulars**	
(A) Nominal system voltage	**132kV**	**33 kV**
(B) Highest system voltage, kV	145	36
(C) Rated frequency ,HZ	50	50
(D) System earthing	Solidly earth	Solidly earth
(E) Insulation level		
(a) Impulse withstand voltage: kVp	550	170
(b) One minute p.f. Withstand voltage, kV (r.m.s.)	230	70
(F) Short time current for one second, kA	31.5	20
(G) Minimum creepage distance, mm	As per ISS	As per ISS

(H) Temperature rise		
(I) Feeder/ BYPASS/ Bus Coupler CT		
(i) No. of Cores	3	2
(ii) Transformation Ratio	As per schedule of requirement	
(iii)Rated Output		
(a) Core-1	30 VA	30 VA
(b) Core-2	15 VA	15 VA
(c) Core-3		N.A
(iv) Accuracy Class		
(a) Core-1	0.2	0.2
(b) Core-2	5P	5P
(c) Core-3	PS	N.A
(v) Accuracy Limit Factor		
(a) Core-1	--	-
(b) Core-2	10	10
(c) Core-3	-	-
(vi) Instrument security factor		
(a) Core-1	<5	<5
(b) Core-2	-	-
(c) Core-3	-	-
(vii) Minimum Knee point voltage, Volts		
(a) Core-1	-	-
(b) Core-2	-	-
(c) Core-3	1200	-
(viii) Maximum secondary resistance, ohm		
(a) Core-1	-	-
(b) Core-2	-	-
(c) Core-3	3	N.A
(ix) Maximum exciting current, at Vk/4 mA		
(a) Core-1	-	-
(b) Core-2	-	-
(c) Core-3 (at Vk/4)	30	N.A
(J) Transformer CT		
(i) No. of Cores	3	2
(ii) Transformation Ratio	As per schedule of requirement	
(iii)Rated Output	3	3
(b) Core-1	30 VA	30 VA
(b) Core-2	15 VA	15 VA
(c) Core-3	-	-
(iv) Accuracy Class		
(a) Core-1	0.2	0.2
(b) Core-2	5P	5P
(c) Core-3	PS	PS
(v) Accuracy Limit Factor		
(a) Core-1	--	-
(b) Core-2	10	10
(c) Core-3	-	-
(vi) Instrument security factor		
(a) Core-1	<5	<5
(b) Core-2	-	-

(c) Core-3		-	-
(vii) Minimum Knee point voltage, Volts			
(a) Core-1		-	-
(b) Core-2		-	-
(c) Core-3		1200	600
(viii) Maximum secondary resistance, ohm			
(a) Core-1		-	-
(b) Core-2		-	-
(c) Core-3		3	3
(ix) Maximum exciting current, at Vk/4 mA			
(a) Core-1		-	-
(b) Core-2		-	-
(c) Core-3 (at Vk/4)		30	15
POTENTIAL TRANSFORMER			
(i) No. of secondary windings			2
(ii) Transformation ratio			
(a)	Winding I	132kV/√3	33kV/√3
(b)	Winding II	/ 110V/√3	/ 110V/√3
(iii) Rated out put			
(a) Winding I		500	200
(b) Winding II		200	100
(vi) Accuracy class			
(a) Winding I		0.2	0.2
(b) Winding II		3P	3P
(v) Rated voltage factor		1.2	1.2

Note: It is intended to use different ratios of the same CT at the same time for various protections and metering cores. The CTS should therefore be suitable for the above purpose by secondary tapings only. The ratio change by secondary taps is acceptable as long as the required CT specifications are achieved at all ratios.

(i) The knee point voltage specified above shall be at higher ratio/ taps.

4.5.0 TECHNICAL SPECIFICATION OF ISOLATORS

4.5.1 SCOPE

4.5.1.1 This section of the specification is intended to cover design specifications for manufacture and testing of 132kV and 33 KV gang operated Isolators with all fittings and accessories.

4.5.1.2 The Isolators are for outdoor installation suitable for horizontally mounting on mounting structures and for use at sub-stations.

4.5.1.3 Isolators shall be supplied with Earth Switch as and where specified.

4.5.1.4 The bidder shall offer ac motor operated Isolators and earth switches.

4.5.2 GENERAL

4.5.2.1 The Isolators and accessories shall conform in general to IS 9921 (or IEC: 62271-102) except to the extent explicitly modified in specification.

4.5.2.2 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.

4.5.2.3 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.

(iii) The isolator shall be designed for use in the geographic and meteorological conditions as given in Section 1.

4.5.3 DUTY REQUIREMENTS

4.5.3.1 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.

4.5.3.2 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.

4.5.3.3 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.

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

4.5.3.5 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.

4.5.3.6 The isolator shall be capable of making/breaking magnetising current of 0.7A at 0.15 power factor and capacitive current of 0.7A at 0.15 power factor at rated voltage.

4.5.4 CONSTRUCTIONAL DETAILS

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

4.5.4.2 **Contacts:**

4.5.4.3 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.

4.5.4.4 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.

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

4.5.4.6 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.

4.5.4.7 **Blades:**

4.5.4.8 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.

4.5.4.9 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.

4.5.4.10 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.

4.5.4.11 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.

4.5.4.12 **Insulators:**

4.5.4.13 The insulator shall conform to IS: 2544 and/or IEC-60168. The insulators shall have a minimum cantilever strength of 600/400 Kg. for 145/33 kV insulators respectively.

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

4.5.4.15 **Base:**

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

4.5.5 EARTHING SWITCHES

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

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

4.5.5.3 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.

4.5.5.4 Suitable mechanical arrangement shall be provided for de-linking electrical drive for mechanical operation.

4.5.5.5 Each earth switch shall be provided with flexible copper/aluminium 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.

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

4.5.5.7 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.

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

4.5.6 OPERATING MECHANISM

4.5.6.1 The bidder shall offer motor operated Isolators and earth switches. Earth Switches of 36 kV shall only be manual operated.

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

4.5.6.3 A “Local/Remote” selector switch and a set of open/ close push buttons shall be provided on the control cabinet of the isolator to permit its operation through local or remote push buttons.

4.5.6.4 Provision shall be made in the control cabinet to disconnect power supply to prevent local/remote power operation.

4.5.6.5 Suitable reduction gearing shall be provided between the motor and the drive shaft of the isolator. The mechanism shall stop immediately when motor supply is switched off. If necessary a quick electromechanical brake shall be fitted on the higher speed shaft to effect rapid braking.

4.5.6.6 Manual operation facility (with handle) should be provided with necessary interlock to disconnect motor.

4.5.6.7 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.

4.5.7 OPERATION

4.5.7.1 The main Isolator and earth switches shall be gang operated.

4.5.7.2 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.

4.5.7.3 Each isolator and earth switch 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.

4.5.7.4 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 torsion 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.

4.5.7.5 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.

4.5.7.6 Signalling 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. Signalling 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.

4.5.7.7 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.

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

(i) Current transfer arrangement from main blades of isolator along with milivolt 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.

4.5.8 TEST AND INSPECTION

4.5.8.1 The switches shall be subjected to the following type test in accordance to with IS: 9920.

i. Dielectric test (impulse and one minute) power frequency withstands voltage.
ii. Temperature rise test
iii. Rated off load breaking current capacity
iv. Rated active load breaking capacity
v. Rated line charging breaking capacity
vi. Rated short time current
vii. Rated peak withstand current
viii. Mechanical and Electrical Endurance

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

(i) Power frequency voltage dry test
(ii) Measurement of resistance of the main circuit

(iii)Operating test.

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

4.5.9 AUXILIARY SWITCHES

4.5.9.1 All isolators and earth switches shall be provided with 220/110 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

4.5.10 CONNECTORS

4.5.10.1 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 bidder.

4.5.11 MOUNTING STRUCTURES

4.5.11.1 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 structures.

4.5.12 TECHNICAL DATA SHEET FOR ISOLATORS

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, centre 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	170
	ii) Across isolating distance	180
9	Rated 1 minute power frequency withstand voltage, kV (rms)	
	i) To earth & between poles	70
	ii) Across isolating distance	80
10	Minimum Creepage distance of insulators, mm	31mm/kV
11	Temperature rise	As per relevant IS

4.6.0 TECHNICAL SPECIFICATION FOR SURGE ARRESTORS

4.6.1 SCOPE

4.6.1.1 This Section covers the specifications for design, manufacture, shop & factory testing before dispatch of 33 kV 10 kA, Station class heavy duty, gapless metal (zinc) oxide Surge Arrestors complete with fittings & accessories.

4.6.2 STANDARDS

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

4.6.3 GENERAL REQUIREMENT

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

4.6.3.2 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.

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

4.6.3.4 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.

4.6.3.5 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.

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

4.6.3.7 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.

4.6.3.8 The reference current of the arrestor shall be high enough to eliminate the influence of grading and stray capacitance on the measured reference voltage.

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

4.6.3.10 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.

4.6.4 ARRESTOR HOUSING

4.6.4.1 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 colour, free from blisters, burrs and other similar defects.

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

4.6.4.3 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 arrester housings shall be designed for pressure relief class as given in Technical Parameters of the specification.

4.6.4.4 Sealed housings shall exhibit no measurable leakage.

4.6.5 FITTINGS & ACCESSORIES

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

4.6.5.2 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 takeoff.

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

4.6.6 SURGE MONITOR

4.6.6.1 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 arrestor shall also be supplied within the same enclosure. The number of operations performed by the arrestor 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.

4.6.6.2 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.

4.6.7 TESTS

4.6.7.1 **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). In addition, the suitability of the Surge Arrestors 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.

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

4.6.7.3 **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.

4.6.8 NAME PLATE

4.6.8.1 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

Purchase Order Number along with date

4.6.9 TECHNICAL DATA SHEET FOR SURGE ARRESTOR

	Particulars	Voltage class
		33 kV
1	Rated voltage of arrester, kV	30
2	Rated frequency, Hz	50 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
9	Line discharge class	2
10	**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 (mm)	31mm/kV

4.7.0 Technical Specification for Control and Relay Panels (With Automation)

SCOPE

This Section is intended to cover the design, manufacture, assembly, testing at manufacturer's works of Indoor Relay and Control Panels.

The Control and Relay Panels required are for control and protection of the Power Transformers, Feeders and for others according to requirements. The supply shall include all accessories, special tools, relevant software, supporting steels, spare parts, drawings, instruction manuals etc. The panels shall be supplied complete with all accessories as specified and completely assembled and all internal wiring completed.

The sub-stations will have automation as per guidelines of IEC 61850. The contractor has to supply the C&R panels to match the requirement of Sub-station Automation System (SAS) as specified in the subsequent chapter.

STANDARDS

All equipment and all component parts supplied under this specification shall conform in all respects to the latest issue of relevant Indian Standard Specifications except where specified otherwise in this specification. Equipment meeting any other authoritative standards which ensure an equal or better quality may also be acceptable.

TYPE OF PANEL

All panels shall be simplex type. One simplex panel shall be used for each feeder and bus coupler / by pass breaker. For transformer bays two simplex panels (one each for HV and LV sides) may be used if required.

Simplex Control and Relay Panels shall consist of vertical swing front panels with equipment mounted thereon and having front glass door. Each cubicle assembly shall be provided with doors on the rear having handles with built in locking facility. It shall have double leaf doors with lift off hinges at the back for panels of width more than 800 mm.

These panels shall be of the following approximate dimensions: Height: 2250mm + 15mm anti-vibration pad + 50 mm (base) Depth: 800mm (MAX)

Width: 800 mm to 1000 mm

CONSTRUCTIONAL FEATURES

The panels shall be completely metal enclosed to ensure a dust, moisture and vermin proof atmosphere. The enclosure shall provide a degree of protection not less than IP 31 in accordance with IS-2147

Panels shall be rigid free standing and floor mounting type and comprise of structural frames enclosed completely with specially selected texture finished, cold rolled sheet steel of thickness not less than 3mm for weight bearing members of the panels such as base frame, front sheet and door frames and not less than 2.0 mm for sides, door top and bottom portions. There shall be sufficient reinforcement to provide level surfaces, resistance to vibration and rigidity during transportation and installation.

All joints shall be made flush and all edges shall be bent at right angles and rounded. All structural members shall be bolted or welded together. Necessary arrangement shall be provided for bolting together the adjacent panels as well as for fastening them to the floor. The opening required for mounting the equipment shall be punched or cut and filed smooth.

All doors, removable covers and panels shall be sealed all around with synthetic rubber gaskets Neoprene/EPDM generally conforming to provision of IS 11149. However, XLPE gaskets can also be used for fixing protective toughened glass doors. Ventilating louvers, if provided shall have screens and filters. The screens shall be made of either brass or GI wire mesh.

Panels shall have additional rolled channel plinth at the bottom with smooth bearing surface. The panels shall be fixed on the embedded foundation channels with intervening layers of anti-vibration strips made of shock absorbing materials which shall be supplied by the contractor.

MOUNTING OF EQUIPMENTS

All equipment on and in the panels shall be mounted and completely wired to the terminal blocks ready for external connection. All equipment on the front panels shall be mounted flush. Terminal markings shall be clearly visible.

INTERNAL WIRING

Panels shall be supplied completely with interconnecting wiring provided between all electrical devices mounted and wired in the panels and between the devices and terminal blocks for the devices to be connected to equipment outside the panels. When panels are located adjacent to each other all inter panel wiring and connections between the panels shall be furnished and wiring shall be carried out internally. These adjacent inter panel wiring shall be clearly indicated in the drawing furnished by the CONTRACTOR.

Wiring shall be carried out with 1100-Volt grade, single core, stranded copper conductor wires with PVC insulation. The minimum size of stranded copper conductor used for internal wiring shall be as follows:

(a) All circuits except instrument transformers circuits:

(b) Instrument transformers circuit:

1.5 sq. mm. per lead.

2.5 sq. mm. per lead.

Auxiliary bus wiring for AC and DC supplies, voltage transformer circuits, annunciation circuits and other common services shall be provided near the top of the panel running throughout the entire length of the panels.

Wire terminals shall be made with solder less clamping type of 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 wires and shall not fall off when the wire is disconnected from blocks.

Interconnections to adjacent panels shall be brought out to a separate set of terminals blocks located near the slots or holes meant for taking the interconnecting wires. Arrangement shall permit easy inter connection to adjacent panels at site and wires for this purpose shall be provided by the CONTRACTOR looped and bunched properly inside the panel.

A laminated copy of total schematics is to be fixed on the inside of door.

TERMINAL BLOCKS

All internal wiring to be connected to the external equipment shall terminate on terminal blocks, preferably vertically mounted on the side of each panel. Terminal blocks shall be of 650 volts grade and have 10 amps continuous rating, moulded piece, complete with insulated barriers, stud type terminals, washers, nuts and lock nuts. Terminal block designs include a white fibre-marking strip with clear plastic/silicon chip on terminal covers. Marking on the terminal strips shall correspond to block and terminal number on the wiring diagram.

Terminal blocks for current transformer and voltage transformer secondary leads shall be provided with test links and isolating facilities. Current transformer secondary leads shall also be provided with short circuiting and earthing facilities.

At least 20% spare terminals shall be provided on each panel and these terminals shall be uniformly distributed on all terminal blocks.

There shall be a minimum clearance of 250 mm between first row of terminal blocks and associated cable gland plates. Also, the clearance between two rows of terminal blocks shall be a minimum of 150mm. A steel strip shall be connected between adjacent terminal block rows at 450-mm intervals for support of incoming cables.

PAINTING

All Sheet steelwork shall be phosphated in accordance with IS 6005.

Oil grease, dirt and warp shall be thoroughly removed by emulsion cleaning. Rust and scale shall be removed by pickling with dilute acid followed by washing with running water, rinsing with slightly alkaline hot water and drying.

After phosphating, thorough rinsing shall be carried out with clean water followed by final rinsing with dilute dichromate solution and oven drying. The phosphate coating shall be sealed with application of 2(two) coats of ready mixed, stoving type zinc chromate primer. The first coat may be 'flash dried' while the second shall be stoved.

After application of the primer, two coats of finishing synthetic enamel paint shall be applied, each coat followed by stoving. The second finishing coat shall be applied after completion of tests. Exterior Paint shall be texture finishing with RAL 7032 paint shade.

Each coat of primer and finishing paint shall be of a slightly different shade to enable inspection of the painting.

The inside of the panels shall be glossy white.

A small quantity of finishing shall be supplied minor touching up required at site after installation.

NAME PLATES AND MARKINGS

All equipment mounted on front and rear side as well as equipment mounted inside the panel shall be provided with individual nameplates with equipment designation engraved. Also, on the top of the each panel on front as well as rear side large and bold name plates shall be provided for circuit /feeder designation.

All front mounted equipment shall be also provided at the rear with individual name plates engraved with Tag numbers corresponding to the one shown in the panel internal wiring to facilitate easy tracing of the wiring. The nameplates shall be mounted directly by the side of the respective equipment and shall not be hidden by the equipment wiring.

Nameplates shall be made of non-rusting metal or 3 ply lamicord. Nameplates shall be black with white engraved lettering.

MISCELLANEOUS ACCESSORIES

A 240 Volts, single-phase plug points shall be provided in the interior of each cubicle with ON-OFF switch for connection of headlamp.

Each panel shall be provided with a LED lighting fixtures for the interior illumination of the panel complete with all fittings, i.e. lamp, switch (controlled by panel door)

Each control panel shall be provided with necessary arrangements for receiving, distributing, isolating and fusing of D.C. and A.C. supplies of various control, AC-DC super vision, signaling, lighting and space heater circuits. MCBs of requisite capacity with fail indicators shall be used, HRC fuse is not acceptable. The main input A.C. and D.C. circuits will be protected with miniature circuit breakers.

EARTHING

All panels shall be equipped with an earth bus securely fixed along with inside base of the panels. The materials and the sizes of the bus bar shall be at least 25X4 mm copper. When several panels are mounted joining each other, the earth bus shall be made continuous and necessary connectors and clamps for this purpose shall be included in the scope of supply. Provisions shall be made for extending the earth bus bar to future adjoining panels on either side.

All metallic cases of equipment shall be connected to the earth bus by independent copper wires of size not less than 2.5 sq. mm. Earthing wire shall be connected on terminals with suitable clamp connectors and soldering shall not be permitted.

PT and CT secondary neutrals or common lead shall be earthed at one place only at the terminal blocks, where they enter the panels.

Technical Specification for SAMAST Compliant Interface Energy Meter (IEM)

1. Interface Energy Meters Technical Specification

The specification covers the design, engineering, manufacturing, assembly and testing of static/electronic Interface Energy Meters) compliant Tri-vector type, Four Quadrant, Bi-Directional Energy Meter, suitable for 3-ph 4wire

connections solidly earthed system with balanced and un-balanced loads for a power factor range from zero to unity (lagging & leading), with initial and sustained accuracy of class 0.2s. The energy metering system specified herein shall be used for tariff metering for bulk, inter-utility power flows. Projection mounted type, static composite meter shall be installed for EHV/HV circuit, as a self -contained device for measurement of active energy transmittals in each successive 15 minute or 5 minute block etc. meeting the ABT requirements. These meters shall be integrated in SAMAST framework as an when it goes live so the meter shall comply to SAMAST guidelines. The meter shall also be compatible for integration with SAS system. Necessary isolation and /or suppression shall also be built-in for protecting the meter from surges, voltage spikes, fault-current etc. that occurs in VT and CT circuits of extra high voltage switchyards.

2. Basic Features of Interface Energy Meters

a) The energy metering system specified herein shall be used for tariff metering for bulk, inter-utility power flows, in different States of India. Static composite meter shall be installed at interface points as a self-contained device for measurement of Voltage (V), Frequency (f), Active (Wh) and Reactive (VArh) energy exchanged in each successive 5 min time block. All meters shall be compliant to IS 15959 and its latest amendments.

b) Each meter shall have a unique identification code, which shall be marked permanently on its front, as well as in its memory. All meters supplied to as per this specification shall have their identification code starting with "IEM", which shall not be used for any other supplies. "IEM" shall be an eight-digit running serial number, further followed by "A" and "B" for the use with CT secondary of 1A and 5A respectively. This shall be mutually agreed between the buyer and the vendor.

c) The meters shall be suitable for communication with external device like modem, DCU, etc. which shall be able to communicate with CDCS for local/remote data transfer. The meter shall compulsorily have at least 1 optical port for taking reading through Hand Held Unit (HHU).

d) Auxiliary Supply to IEM- The meters shall normally operate with the power drawn from DC auxiliary power supply (Range110V to 220V DC) to reduce the Voltage Transformer (VT) burden. In addition, there shall be provision to operate the meter from the Voltage Transformer (VT) secondary circuit having a rated secondary line-to-line voltage of 110V, and current transformers (CTs) having a rated secondary current of 1 A or 5A. Any further transformers/ transactions/ transducers required for their functioning shall be in-built in the meters. Necessary isolation and/or suppression shall also be built-in, for protecting the meters from surges and voltage spikes that occur in the VT and CT circuits of extra high voltage switchyards. The reference frequency shall be 50Hz. Also, the meter shall have suitable tolerance (up to 15% either side) for DC supply.

e) The meters shall safely withstand the usual fluctuations arising during faults etc. In particular, VT secondary voltages 115% of Vref applied continuously and 190% of Vref for 3.0 seconds, and CT secondary current 150% of Iref applied continuously and 30 times of Iref applied for 0.5 seconds shall not cause any damage to or maloperation of the meters.

f) The meters shall continue to function for the remaining healthy phase(s), in case one or two phases of VT supply fails. In case of a complete VT supply failure, the computation of average frequency shall be done only for the period during which the VT supply was available in the 5-minute block. Any time block contraction or elongation for clock correction shall also be duly accounted for.

g) The total burden imposed by a meter for measurement and operation shall be defined as per IS 14697. An automatic backup for continued operation of the meter's calendar-clock, and for retaining all data stored in its memory, shall be provided through a long-life battery, which shall be capable of supplying the required power for at least 2 years. The meters shall be supplied duly fitted with the batteries, which shall not require

to be changed for at least 10 years, as long as total VT supply interruption does not exceed two years. The battery mounting shall be designed to facilitate easy battery replacement without affecting PCB of the meter.

h) The meters shall fully comply with all stipulations in IS 14697 except those specifically modified by this specification. The reference ambient temperature shall be 27 ℃.

i) Each meter shall have a test output device (visual), as per clause 6.11 of IS 14697.1999, for checking the accuracy of active energy (Wh) measurement. The preferred pulsing rate is twenty (20) per Wh for CT sec-1A and four (4) per Wh for CT sec –5A. It shall be possible to couple this device to suitable testing equipment also.

j) Exception Management- The three line-to-neutral voltage shall be continuously monitored and in case any of these falls below defined threshold (70% of Vref), meter shall have suitable indication on LED/ LCD. The meter shall also have provision for low voltage event logging in meter memory in case of any phase voltage going below a defined threshold. The time blocks in which such a voltage failure occurs/persists shall also be recorded in the meter's memory with a symbol "*" if 3 Phase RMS voltage applied to the IEM is in between 5% to 70% of Vref and if Voltage is less than 5% of Vref, meter should record Zero voltage symbol "Z".

k) Time Accuracy - Each meter shall have a built-in calendar and clock, having an accuracy of 10 seconds per month or better. The calendar and clock shall be correctly set at the manufacturer's works. The date (year-month-day) and time (hour-min.-sec.) shall be displayed on the meter front on demand. Meter shall have the intelligence to synchronize the time with GPS (Local GPS/CDCS GPS/ NAVIC) signal and from PC using software. Limited time synchronization through meter communication port shall be possible at site. When an advance or retard command is given, twelve subsequent time blocks shall be contracted or elongated by five seconds each. All clock corrections shall be registered in the meter's memory and suitably shown on print out of collected data.

l) A touch key or push button shall be provided on the meter front for switching on the display and for changing from one indication to the next. The display shall switch off automatically about one minute after the last operation of touch key/push button. When the display is switched on, the parameter last displayed shall be displayed again, duly updated.

m) The whole system shall be such as to provide a print out (both from the local PC, and from remote central computer) of the following format:

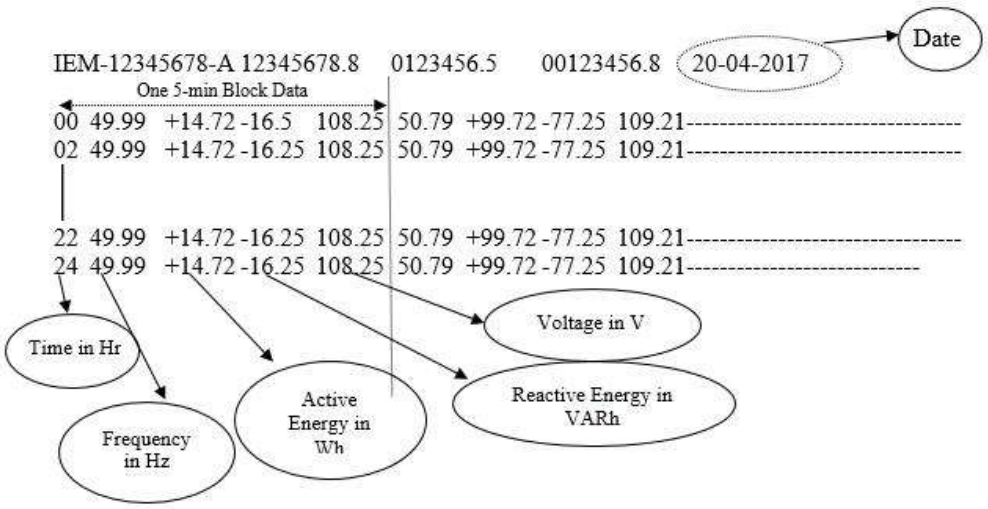

Figure 1: Standard Raw Data Format for IEM

There are 4 values in one 5 min time block. The first row shall contain the meter data for 2 hours, i.e., 24-time blocks, 00 hrs to 02:00 hrs. Similarly, the 2nd row shall contain the data for the next 2 hours and henceforth.

The above data shall be available in text file format (file extension as per IEEE standard/.txt) exportable to Excel. Indication of time retard or advance to be provided without disturbing the proposed format. Each 5-min block data consists of Frequency (in HZ), Active energy (in Wh), Reactive energy (in VARh) and Voltage (in V). All 5-minute Wh and VARh figures in. NPC/output report shall be rounded off upto third decimal.

n) The portable Hand Held unit (HHU)/ Common meter reading instrument (CMRI)/ Data Collecting Device (DCD) shall be having IS-15959:2011 compatibility for standardized parameters. The optical coupler for tapping data stored in the SEMs memory shall be compatible universally across different make of SEMs.

o) **Constructional Features**

- The meters shall be supplied housed in compact and sturdy, metallic or moulded cases of non-rusting construction and/or finish. The cases shall be designed for simple mounting on a plane, vertical surface such as a control/relay panel front. All terminals for CT and VT connections shall be arranged in a row along the meter's lower side. Terminals shall have a suitable construction with barriers and cover, to provide a secure and safe connection of CTs and VTs leads through stranded copper conductors of 2.5 sq. mm. size.

- All meters of the same model shall be totally identical in all respects except for their unique identification codes. They shall also be properly sealed and tamper evident, with no possibility of any adjustment at site, except for transactions allowed in IS 15959.

- The meters shall safely withstand, without any damage or mal operation, reasonable mechanical shocks, earthquake forces, ambient temperature variations, relative humidity etc. in accordance with IS-14697. They shall have an IP-51 category dust-tight construction, and shall be capable of satisfactory operation in an indoor, non-air-conditioned installation.

- Either the meters shall have built-in facility (e.g., test links in their terminals) for in-situ testing, or a separate test block shall be provided for each meter.

3. Measurement

a) The active energy (Wh) measurement shall be carried out on 3-phase, 4-wire principle, with an accuracy as per class **0.2S** (IS 14697).

b) The meter shall compute the net active energy (Wh) sent out from the substation bus bars during each successive 5 min block, and store it in its memory up to fourth decimal with plus sign if there is net Wh export and with a minus sign if there is net Wh import. Further Wh data in NPC/output report shall be rounded upto third decimal.

c) The meter shall count the number of cycles in VT output during each successive 5 min block, and divide the same by 300 (60 sec/min x 5min) to arrive at the average frequency. The frequency data shall be stored in the meter's memory in Hertz up to third decimal. Further Frequency data in NPC/output report shall be rounded off upto second decimal.

d) The meter shall continuously compute the average of the RMS values of the three line-to-neutral VT secondary voltages as a percentage of 63.51 V, and display the same on demand. The accuracy of the voltage measurement/computation shall be at least 0.5%, a better accuracy such as 0.2% in the 95-105%

range being desirable. The voltage data shall be stored in the meter's memory in volts up to third decimal. Further voltage data in NPC/output report shall be rounded off upto second decimal.

e) The Reactive energy (VARh) measurement shall be carried out on 3-phase, 4-wire principle, with an accuracy of 0.5S as specified in IS 14697. The meter shall compute the net Reactive energy (VARh) sent out from the substation bus bars during each successive 5 min block, and store it in its memory up to fourth decimal with plus sign if there is net VARh export and with a minus sign if there is net VARh import. It shall also display on demand the net VARh sent out during the previous 5 min block. Further VARh data in NPC/output report shall be rounded off upto third decimal.

f) The meter shall also integrate the reactive energy (VARh) algebraically into two separate registers, one for the period for which the average RMS voltage is above 103.0%, and the other for the period for which the average RMS voltage is below 97.0 %. The current reactive power (VAR), with a minus sign if negative, and cumulative reactive energy (VARh) readings of the two registers (>103% and <97%) shall be displayed on demand. The readings of the two registers at each midnight shall also be stored in the meter's memory. When reactive power is being sent out from substation bus bars, VAR display shall have a plus sign or no sign and VARh registers shall move forward. When reactive power flow is in the reverse direction, VAR display shall have negative sign and VARh registers shall move backwards. Generally, the standard PT ratios are 220 kV /110 V, 400 kV /110 V and 765 kV / 110 V. However, at the time of commissioning the vendor may confirm the same from site and configure the meter accordingly to ensure correct recording of reactive energy.

g) For CT secondary rating of 5A, all computations, displays and memory storage shall be similar except that all figures shall be one fifth of the actual, worked out from CT and VT secondary quantities.

h) Further, the meter shall continuously integrate and display on demand the net cumulative active energy sent out from the substation bus bars up to that time. The cumulative Wh reading at each midnight shall be stored in the meter's memory. The register shall move backwards when active power flows back to substation bus bars.

i) Errors for different power factors shall be as defined in IS14697.

j) For reactive power (VAR) and reactive energy (VARh) measurements, IS14697 shall be complied with. The accuracy of measurement of reactive energy shall be as per class 0.5S.

k) The harmonics shall be filtered out while measuring Wh, V and VARh, and only fundamental frequency quantities shall be measured/computed.

l) Data security shall be ensured as per IS 15959 (three layers of security).

4. Memory/ Storage

Each meter shall have a non-volatile memory in which the following shall be automatically stored:

i. Average frequency for each successive 5 min block, in Hertz up to third decimals.

ii. Net Wh transmittal during each successive 5 min block, up to fourth decimal, with plus sign if there is net Wh export and with a minus sign if there is net Wh import.

iii. Net VARh transmittal during each successive 5 min block, up to fourth decimal, with plus sign if there is net VARh export and with a minus sign if there is net MVARh import.

iv. Cumulative Wh transmittal at each midnight, in eight digits including one decimal.

v. Cumulative VARh transmittal for voltage high condition, at each midnight in eight digits including one decimal.

vi. Cumulative VARh transmittal for voltage low condition, at each midnight, in eight digits including one decimal.

vii. Average RMS voltage for each successive 5min block.

viii. Date and time blocks of failure of VT supply on any phase, as a star (*)/ (Z) mark.

ix. The meters shall store all the above listed data in their memories for a period of fifteen (15) days. The data older than fifteen (15) days shall be erased automatically

x. The software provided at CDCS, i.e., SLDC, will manage all functionalities of collection of data through DCUs, validate the data, store the data in a database, and manage the complete system. Software will also have a scheduler for scheduling the task of collection of data periodically. The periodicity of data collection shall be user defined.

5. Display

Each meter shall have digital display for indication of the following (one at a time), on demand:

i. Meter serial no. and model: IEM12345678A or IEM12345678B

ii. Date (year month day /yyyy mm dd): 20160311 d

iii. Time (hour min sec /hh mm ss): 195527 t

iv. Cumulative Wh reading: 1234567.8 C

v. Average frequency of the previous block: 49.89 F

vi. Net Wh transmittal during the previous block: - 28.75 E

vii. Net VARh transmittal during the previous block: - 18.75 R

viii. Average % Voltage: 99.2 U

ix. Reactive power (VAR): 106.5 r

x. Voltage - high VARh register reading: 1234567.5 H

xi. Voltage - low VARh register reading: 1234567.4 L

xii. Low battery indication

xiii. The three line-to-neutral voltages shall be continuously monitored and in case any of these falls below 70 %, a preferably flashing three LEDs (one LED/phase) provided on meter's front shall become steady. They shall go off if all three voltages fall below 70 %. The LED shall automatically resume flashing when all VT secondary voltages are healthy again.

xiv. The two VARh registers (xv and xvi) shall remain stay-put while VT supply is unhealthy.

Any other better or more informative mechanism to display the above shall be preferred. The above shall be mutually agreed between the meter buyer and vendor.

Navigation keys to be provided at the meter front plate to navigate the display menu.

6. Communication

a) Each meter must have an optical port on its front for tapping all data stored in its memory through HHU. In addition to the above each meter shall also be provided with a RS-485, Ethernet and USB port on one of its sides, from where all the data stored in the meter's memory can also be transferred to CDCS (through DCU), local computer and external storage. The overall intention is to tap the data stored in the meter's memories at a scheduled time from any of the above mentioned ports or any other means and transmit the same to a remote central computer using suitable means of communication. It shall be possible to securely download the IEM data through an USB port via external storage thereby removing the requirement of an MRI (Meter Reading Instrument). It shall be ensured that data transfer through USB shall be unidirectional only i.e., from Meter to external storage device in an authentication process. Meter data shall be tamper-proof.

b) All meters shall be compatible with Optical port, RS-485 port, Ethernet port and USB / RS-232 port all together at a time and communicate independently. It shall also be possible to obtain a print out (hard copy) of all data collected from the meters, using the local PC. Data collection from any local laptop/PC shall be possible by installing data collection software. Entire project has to be based on Optic Fibre/GSM/4G/3G. Bidder should quote considering availability of Optic Fibre at 80% of locations and availability of PLCC/4G at 20 % of locations. This is for bringing all the bids on common platform. However, the selected agency will have to conduct detailed survey regarding availability of the particular service for all locations. The bidder may conduct Field Survey before submission of bid.

c) The bidder shall adhere to the appropriate security algorithm for encryption and decryption

Entire project has to be based on Optic Fibre/GSM/4G/3G. Bidder should quote considering availability of Optic Fibre/PLCC/4G/3G/2G for all the locations. However, the selected agency will have to conduct detailed survey regarding availability of the particular service for all locations. Bidders may do Site Survey for availability of communication media prior to submission of bids.

The bidder may design appropriate architecture for providing end to end metering solution. He is free to decide upon the best solution out of all the available options to ensure that data from all IEMs in ASSAM are available at State Load Despatch Centre by the scheduled time. However, the entire responsibility of fully functional end to end metering system shall rest with the bidder in order to meet the performance levels as given in this document. The communication provider may adopt Optical Fibre/GSM/3G/4G communication technology or a combination of these technologies as per the site requirement adopting best available technology in the proposed area of implementation. The successful bidder shall be responsible for proper data exchange among IEM, DCU, CDCS, MDP and other operational/requisite software as part of fully functional metering system.

The bidder shall design a reliable, interference free & robust communication network keeping in view the site conditions. It shall be flexible in terms of providing communication in variable terrain & urban density. The bidder shall design the network architecture keeping in view the existing and planned infrastructure of the utility. During designing, suitable consideration shall be kept for future expansion as per requirement of Utility. Before designing the communication network, the bidder shall do the site survey and would provide the most efficient communication infrastructure. The entire infrastructure & associated civil works required for installation & commissioning of equipment/devices like DCUs, repeaters, routers & access points etc. shall be in the scope of bidder. The operational testing of all the network elements has to be demonstrated by the bidder to the satisfaction of the utility.

d) The Bidder shall provide the necessary software which would enable a local PC/ CDCS to:

i. Accept the data from the Optical/Ethernet/WAN and store it in its memory in user defined formats (text, csv, xls, etc.) in a user-defined file name (file name format must be ddmmyy substation name-utility name).

ii. Polling feature along with a task scheduler to run the data downloading software at a pre-designated date and time repeatedly or by manually selecting a meter. File naming for such downloaded data should also be in user-defined format. A detailed activity log shall also be available for each downloading operation.

iii. Upload/Import meter data (binary files) in the software for further processing. While uploading, there shall be provision to upload all selected files with single key-stroke.

iv. Convert the binary file(s) to text file(s). There should be provision to select multiple files based on filename, convert all selected files with single key-stroke and store the text files in the same location where binary files are stored.

v. Display the collected data on PC's screen in text format, with forward/backward rolling

vi. Print out in text format the data collected from one or more meters, starting from a certain date and time, as per operator's instructions

vii. Transmit the collected data, in binary format, through an appropriate communication link to the central computer, starting from a certain date and time, as per operator's instructions.

viii. Store the collected data in binary format, on a CD/Pen Drive. In addition to above, in general the software shall be able to convert IEMs data to existing format as well as in tabular (.csv) format as applicable.

e) The above software shall further ensure that absolutely no tampering (except erasing of complete data with password protection) of the collected metering data is possible during its handling by the PC. The software shall be suitable for the commonly available PCs, (Windows) and shall be supplied to Owner in a compatible form to enable its easy loading into the PCs available (or to be installed by the Owner/others) at the various substations.

f) The bidder shall ensure data integrity checks on all metered data received from data collection systems.

g) The quality of installation of the various equipment & power supply wiring to all field equipment shall be as per standards/ regulations/prevailing practices of the utility. The supply of electricity needed for operation and maintenance of entire Metering system shall be provided free of cost by the respective owners of the premises.

7. Quality Assurance

The quality control procedure to be adopted during manufacturing of the specified equipment shall be mutually discussed and finalized in due course, generally based on the established and proven practices of the manufacturer. The software shall be user friendly which can be easily installed in any PC/Laptop irrespective of operating system of the PC/Laptop, and shall be certified for ensuring data handling capabilities. The same shall be demonstrated by the

party during technical evaluation. During demonstration party shall bring standard meter. Thereafter software shall be offered for technical compatibility before taking up further necessary action in the procurement process.

8. Testing

a) All equipment, after final assembly and before dispatch from manufacturer's works, shall be duly tested to verify that is suitable for supply to the Owner. Routine and acceptance tests shall be carried out on the meters in line with IS 14697.

b) Any meter which fails to fully comply with the specification requirements shall be liable to be rejected by the Owner. However, the Owner may purchase such meters at a reduced price in case of marginal non-compliance, at his sole discretion.

c) Acceptance Tests for PC Software and data down loading using meter communication ports- All IEMs after final assembly and before dspatch from Bidder's/Manufacturer's works shall be duly tested to verify that they are suitable for downloading data using meter communication ports shall be subjected to the following acceptance test.

   i. Downloading Meter Data from the Meter(s) to PC via optical port.

   ii. Downloading meter data through USB port and RS 232.

   iii. Downloading meter data to DCU/CDCS through Ethernet as well as RS 485 port.

   iv. Compatibility with PC Software.

   v. Functioning of Time synchronization, advance and retard time commands.

   vi. Per meter downloading time verification.

d) Copy of Certificate shall be submitted to SLDC

Type Tests

a) One (1) meter in a batch shall be subjected to the complete range of type tests as per IS14697 and IS15959, after final assembly. In case of any failure to pass all specified tests, the bidder shall arrange to carry out the requisite modifications/replacements in the entire lot of meters at his own cost. After any such modifications and final assembly, two (2) meters selected out of the lot by the Owner's representative shall be subjected to the full range of type tests. The lot shall be accepted by the Owner only after successful type testing.

b) The meters used for type testing shall be separately identified, duly marked, and supplied to the Owner in case they are fully functional and as good as other (new) meters, after necessary touching up/refurbishing. In case this is not possible, the bidder shall provide their replacements at no extra cost to Owner.

c) The Bidder shall arrange all type testing specified above, and bear all expenses for the same.

d) Copy of Test certificate shall be submitted to SLDC.

e) Type test certificates completed in all respect from NABL approved test house shall be submitted along with the offer

9. ANOMALY DETECTION FEATURES

The meter shall have features to detect and log the occurrence and restoration of following anomalies, along with date and time of event: 6.1.1. Phase wise Missing Potential – The meter shall detect missing potential (1 or 2 phases) provided the line current is above a specified threshold. The voltage at that stage would be below a specified threshold.

- Phase wise Current Circuit Reversal – The meter shall detect reversal of polarity provided the current terminals are reversed. This shall be recorded for 1 or 2 phase CT reversal.
- Voltage Unbalance – The meter shall detect voltage unbalance if there is unbalance in voltages.
- Current Unbalance – The meter shall detect current unbalance if there is unbalance in load conditions. Meter should ensure true system conditions before going for current unbalance checks.
- CT Miss – The meter shall detect current miss if the current is below a defined threshold, provided the phase voltage is above a specified threshold. Snapshots of phase wise voltage, phase wise active current and phase wise power factor shall be provided with above specified anomaly events. Further, each meter module shall record the following events along with total duration:
    - Power On/Off – The meter shall detect power off if both the auxiliary supplies fail. The event shall be recorded on the next power up. At the same time power on event shall be recorded. No snapshot shall be logged with this event.
    - Feeder Supply Fail -This event shall be logged when feeder supply, i.e., all the voltages go below certain threshold. No snapshot shall be logged with this event.
- Last three hundred & fifty (350) events (occurrence + restoration), in total, shall be stored in the meter memory on first in first out basis.
- There shall be five separate compartments for logging of different type of anomalies:

Compartment No. 1	100 events of missing potential
Compartment No. 2	100 events of CT reversal
Compartment No. 3	100 events of power failure/ Power on-off
Compartment No. 4	50 events of transaction related changes as per ICS Category B

Once one or more compartments have become full, the last anomaly event pertaining to the same compartment shall be entered and the earliest (first one) anomaly event should disappear. Thus, in this manner each succeeding anomaly event shall replace the earliest recorded event, compartment wise. Events of one compartment/ category should overwrite the events of their own compartment/ category only. In general persistence time of 5 min. for occurrence and restoration respectively need to be supported in meter.

Anomaly count should increase as per occurrence (not restoration) of anomaly events. Total no. of counts shall be provided on BCS.

CONTROL & RELAY PANELS

This Section is intended to cover the design, manufacture, assembly, testing at manufacturer's works of Indoor Relay and Control Panels.

The Control and Relay Panels required are for control and protection of the Power Transformers, Feeders and for others according to requirements. The supply shall include all accessories, special tools, relevant software, supporting steels, spare parts, drawings, instruction manuals etc. The panels shall be supplied complete with all accessories as specified and completely assembled and all internal wiring completed.

The sub-stations will have automation as per guidelines of IEC 61850. The contractor has to supply the C&R panels to match the requirement of Sub-station Automation System (SAS) as specified in the subsequent chapter.

RELAYS

GENERAL

All relays shall conform to the requirements of IS 3231/IEC 60255/ IEC 61000 or other relevant Standards.

All protective relays shall be numerical type and communication protocol shall be IEC 61850. Further, test levels of EMI as indicated IEC 61850 shall be applicable to these relays.

Two sets of relevant software for relay configuration & setting, maintenance etc to be supplied to each station. The numeric relay and software shall be upgradable.

Relays shall be suitable for flush mounting with connectors from rear.

All draw out cases or plug in type modular cases will have proper testing facilities. The testing facilities provided on the relays shall be specifically stated in the bid. Necessary test plug shall be in the CONTRACTOR's scope of supply and shall be supplied loose. Unless otherwise specified all auxiliary relays and timers shall be supplied either in non-draw out cases or plug in type modular cases.

All A.C. relays shall be suitable for operation at 50 Hz. A.C. Voltage operated relays shall be suitable for110 volts VT secondary. DC auxiliary relays and timers shall be designed for 110 volts/ 220 volts DC and shall operate satisfactorily between 70% and 110% of rated voltage.

All Protective relays, auxiliary relays and timers except the lockout relays and interlocking relays shall be provided with self-reset type contacts. All protective relays, trip relays and timers shall be provided with electrically reset positive action operation indicators provided with proper inscription. Similar separate operating indicators (auxiliary relays) shall also be provided in the trip circuits of protections located outside the board such as Buchholz relays, temperature protection etc.

No control relays that shall trip the circuit breaker when the relays are de-energized shall be employed in the circuits.

All relays shall withstand a test voltage of 2.5 kV, 50 Hz r.m.s. voltage for one second.

All protective relays and alarm relays shall be provided with two extra isolated pair of contacts wired terminals exclusively for Employer's use.

GENERAL SPECIFICATION OF NUMERICAL RELAYS

Numerical Relays shall be provided for the following **applications** :

Distance Protection (Main I¬ & Main II) of different make for 220 kV lines
Distance Protection for 132 kV and 66 kV Lines
Back up directional over current and earth fault relays for 132 kV and 66 kV Lines
Back up non directional over current (3 O/C) and earth fault relays for 33kV lines
Integrated Numerical Transformer Protection
Back up non directional over current (3 O/C) and earth fault relays with high set units for power & auto transformers.

All **Numerical Relays** should have following **minimum features**.

- Relays shall be communicable on **IEC61850** protocol without any protocol converter. Certificate from KEMA confirming interoperability, ***Goose messaging & publishing as per IEC61850*** standard shall be submitted along with the tender.
- Relays shall have one no. front RJ45 or USB port for Local Relay Parameterization and♣ **Two nos. rear FO port**/ Rear RS485 for connectivity to SAS over IEC61850 protocol
- The relay shall have self-communication port monitoring feature and failure shall generate♣alarm. Relays shall have redundant power supply card i.e. in case of failure of one source fail, the redundant shall pick up instantly. Power supply card failure shall generate necessary alarm to local SCADA.
- The relay shall have sufficient battery back up to keep the internal clock running for atleast 2 years in absence of auxiliary supply
- Should have minimum 16 configurable LEDs
- Should have sufficient Binary Inputs and Binary Outputs as per scheme requirement including 30% BI & BO spare.
- All BI/BOs shall be site configurable
- Shall have front minimum 4 lines LCD display with Alpha numeric key pad♣
- Numerical relays are to be provided with built in Event / Disturbance / Fault Recorder features. The bidder shall bring out in the bid that the Numerical relays providing different protection features / application in a single unit if any one of the application/feature goes out of service the other feature/application (s) will remain un-effected.
- **The relays shall be site configurable (Including logic development)**
- Configured features♣ & set values shall be in non volatile memory Must have real time clock for time stamping of events/ disturbances with time♣ synchronization inputs (GPRS etc.), Time synchronisation through SNTP & IRIG-B compatible.
- The relays should have self-diagnostic features identifying area of fault or failure of a♣particular component or card.
- Shall have in built Circuit Breaker Failure protection based on undercurrent detection♣and/or circuit breaker auxiliary contact status. Provision shall be given to initiate the breaker fail logic using a digital input from external protection devices.

Hardware based measurement shall not be acceptable.

The relay should have high immunity to electrical and electromagnetic interference.

The same relay shall be provided with both 1A CT inputs and shall be site selectable.

It shall be possible to energise the relay from either AC or DC auxiliary supply. ***Auxiliary dc supply shall*** be ***suitable for both 110 and 220 Volt and shall be site selectable***.

Be capable of performing basic instrumentation functions and displaying various instantaneous parameters like Voltage, current, active power, reactive power, phase sequence etc. in primary values. Additionally, all sequence current and voltage values shall be displayed on-line. Also, the direction of power flow shall be displayed.

Extensive disturbance recording facility shall be available for at least up to 10 seconds to capture maximum possible information. Necessary software shall be provided for retrieving and analysing the records.

Facility for developing customised logic schemes inside the relay based on Boolean logic gates and timers should be available. Facility for renaming the menu texts as required by operating staff at site should be provided.

Must have additional feature of local breaker back up protection

- The relay shall have built in Circuit Breaker Supervision Functions
- The relay shall be able to detect any discrepancy found between NO¬ & NC contacts of breaker
- The relay shall monitor number of breaker trip operations
- The relay shall also monitor the breaker operating time

The relays shall have the following tools for fault diagnostics-

- Fault record – The relay shall have the facility to store fault records with information on cause of trip, date, time, trip values of electrical parameters. Event record – The relay shall have the facility to store time stamped event records with 1ms resolution.
- Disturbance records – The relay shall have capacity to store disturbance records of at least 10 sec. duration and sampling rate per cycle shall be more than 100.
- It shall be possible to preserve stored information in the event of an auxiliary supply failure with the help of a battery backup.
- The relay settings shall be provided with password protection.
- It shall be possible to change the relay setting from the front panel using the key pads/ Work¬ station of SAS and Laptop.

The relay shall have comprehensive self-diagnostic feature. This feature shall continuously monitor the healthiness of all the hardware and software elements of the relay. Any failure detected shall be annunciated through an output watchdog contact. The fault diagnosis information shall be displayed on the LCD. These records shall also be retrieved / retrievable from local as well as remote terminal through the communication port.

The Numerical Relays shall be provided with 2 sets of common support software compatible with, Windows 7 which will allow easy settings of relays in addition to uploading of event, fault, disturbance records, and measurements. The relay settings shall also be change from local or remote using the same software.

The manufacturer shall have to provide up-graded support software if any within 10 years span.

INTEGRATED NUMERICAL TRANSFORMER PROTECTION RELAY

General requirements

a) Shall be stable during magnetising inrush and over fluxing conditions. Stabilization under inrush conditions shall be based on the presence of second harmonic components in the differential currents.
b) Shall have saturation discriminator as an additional safeguard for stability under through fault conditions.
c) Shall have zero sequence current filtering, which may be deactivated separately for each winding, for special applications.
d) Shall have software to take care of the angle & ratio correction of CT inputs.
e) Shall have all output relays suitable for both signals and trip duties

Functional Descriptions
The integrated Numerical Transformer Protection Scheme shall have following functional qualities: -

a) **Differential protection**

The relay shall be biased differential protection with triple slope tripping characteristics with faulty phase identification / indication. The range for the differential pick-up shall be from 0.1 to 2.5 p.u. Its operating time shall not exceed 30 ms at 5 times rated current.

The relay shall have two adjustable bias slopes from 20 % to 150 % and slope from 40% to 150 %, to provide maximum sensitivity for internal faults with high stability for through faults.

The relay shall have an unrestrained high set element to back up the biased differential function and the setting range for it shall have a minimum setting of 5pu and a maximum setting of 30pu.

The relay shall have the second harmonic restraint feature for stability under transformer inrush condition. The setting shall be 15-25%.
Further, the fifth harmonic blocking for stability under transient over fluxing condition shall be provided.

b) **Restricted Earth fault Protection**

The scheme shall have in-built restricted earth Fault (REF) for both the windings. This function should be provided to maximise the sensitivity of the protection of earth faults.

The REF function should be a high impedance element. The REF function should be able to share Current Transformers with the biased differential function. As in traditional REF protections, the function should respond only to the fundamental frequency component of the currents.

For star/star transformer, both the windings shall be protected through REF, as such relay shall have sufficient analogue channels to accommodate the same.

c) **Over fluxing Protection**

The over fluxing protection shall be built in the relay. By pairs of v/f and t, it shall be possible to plot the over fluxing characteristics so that accurate adaptation of the power transformer data is ensured.
In addition the relay should have a definite time element for alarm.

d) **Thermal Overload Protection**

Shall have two stages of thermal overload protection for alarm and trip condition with continuously adjustable setting range of 100-400% of rated current and time constant setting range of 1.0 to 1000.0 min continuously.
Shall be single pole type.
Shall have a drop off/pick up ratio greater than 95%
Shall have separately adjustable time delay relays for alarm having a setting range of 1to 10 seconds continuously.

e) **Over Current Protection**

The relay shall have three stages of definite time over current protection as backup operating with separate measuring systems for the evaluation of the three phase currents, the negative sequence current and the residual current.
In addition, the relay shall have three stages of Inverse time over current protection operating based on one measuring system each for the three phase currents, the negative sequence current and the residual current.
f) Shall have additional features to provide **under/ over voltage protection.**
g) Shall have additional features to provide **under frequency protection.**

OVER CURRENT AND EARTH FAULT RELAYS

These relays shall be of numeric, single/multi pole, directional /non-directional type with or without high set element as specified. These relays shall have the following features/characteristics:
(i). IDMT characteristic with definite minimum time of 3 second at 10 times setting.
(ii). Other operating curves such as inverse, very inverse shall be selectable
(iii). Adjustable setting range of 50-200 % and 20-80% of rated current for over current and earth fault relays respectively.
(iv). The directional relays shall have a Maximum torque angle of 45° current leading for directional over current unit & 30 lag for directional earth fault. Other MTAs should be settable
(v). Voltage polarizing coil: 63.5 or 110 volt
(vi). Must have faulty phase, type of fault identification
(vii). The directional relays shall have over voltage/ under voltage & under frequency built in protection
(viii). The relay shall have blocking scheme on Reverse Power Flow.
(ix). Shall be draw out type

TRIP CIRCUIT SUPERVISION RELAY

The relay shall be capable of monitoring the healthiness of each 'phase' trip-coil and associated circuit of circuit breaker during 'ON' and 'OFF' conditions.
The relay shall have adequate contacts for providing connection to alarm and event logger.
The relay shall have time delay on drop-off of not less than 200 milli seconds and be provided with operation indications for each phase.

MASTER TRIP RELAY
High Speed Tripping Relay shall be instantaneous (operating time not to exceed 10 milli-seconds)
The relays shall reset within 20 milli seconds
The relay shall be re-settable/configurable from local SCADA.
The relays shall be D.C. operated
The relays shall have adequate contacts to meet the requirement of scheme, other functions like auto-reclose relay, LBB relay as well as cater to associated equipment like event logger, Disturbance recorder, fault Locator, etc

The relays shall be provided with operation indicators for each element/coil.

OTHER TRIP RELAYS

For transformer protection other trip relays for Buchholz, winding & oil temperature high, PRD etc. shall be provided as per requirement.

These High Speed Tripping Relays shall be instantaneous (operating time not to exceed 10 milli-seconds

The relays shall have adequate contacts to meet the requirement of scheme

DC SUPPLY SUPERVISION RELAY

The relay shall be capable of monitoring the failure of D.C. supply to which, it is connected.

It shall have adequate potential free contacts to meet the scheme requirement.

The relay shall have a 'time delay on drop-off' of not less than 100 milli seconds and

The relays shall be provided with operation indicator/flag.

PROTECTION SCHEME FOR PANELS

33 KV FEEDER PROTECTION PANEL

The 33 kV Feeder Panels shall be provided non directional single/ multi pole relays as specified

One triple pole over current relays for phase faults and one Earth Fault Relay for Earth Faults with high set elements shall be provided.

POWER AND AUTO TRANSFORMER PROTECTION PANEL

The following protections scheme shall be provided for Panels for all Power and Auto Transformers:

(a) **Main Protection**

Biased transformer differential protection employing relay type specified. As overall protection scheme for transformers following features of the Numerical Relay shall be employed:

(i) Restricted Earth Fault Protection.
(ii) Over-fluxing protection
(iii) Under Frequency and Over Voltage Protection

(b) **Backup Protection**

The backup protection shall be provided with non-directional relays as specified. One triple pole over current relays for phase faults and one Earth Fault Relay for Earth Faults with high set elements shall be provided. The high set unit should not operate due to transformer in-rush current.

SWITCHES

Control and instrument switches shall be rotary operated type with plates clearly marked to show operating position and circuit designation plates and suitable for flush mounting with only switch front plate and operating handle projecting out. Handles of different shapes and suitable inscriptions on switches shall be provided as on switch identification

The selection of operating handles for the different types of switches shall be as follows:-

(a) Breaker and isolator - Pistol grip, black control switches.
(b) Synchronizing switches-Oval; black, keyed handle.
(c) Selector switches - Oval or knob; black
(d) Instrument switches - Round, Knurled, black.

(e) Protection transfer - Pistol grip; lockable and black switch.

The control switch of breaker and isolator shall be of spring return to neutral type.

Instrument selection switches shall be of maintained contact (stay put) type. Ammeter selector switches shall have make before type contacts so as to prevent open circuit of CT secondary when changing the position of the switch.

Synchronising switches shall be of maintained contact type having a common removable handle for a group of switches. The handle shall be removable only in the OFF position and it shall be arranged to the 'ON' position. One contact of each switch shall be connected in the closing circuit of the respective breaker so that the breaker cannot be closed until the switch is turned to the 'ON' position.

The contacts of all switches shall preferably open and close with snap action. Contacts of switches shall be with coated with pure silver. Spring shall not be used as current carrying parts.

TESTS

The supplier shall carryout all tests as per relevant standards as all associated equipment including relays, meters, instruments etc. The supplier shall submit all that reports to Employer for approval before despatching the control and relay panels. The Bidder shall also submit along with the bid type test reports for relays instruments, meters and other devices of the type and class being offered. Bidder has to submit KEMA test certificate for Numeric relay on interoperability compliance of IEC 61850 in general and GOOSE messaging and publishing in particular along with the bid.

Control and relay panels shall be subjected to the following tests: a. Mechanical operation test.
b. Verification of degree of protection.
c. High voltage test (2000 volts for 1 minute)
d. Electrical control interlock and sequential operation test.
e. Verification of wiring as per approved schematic.
f. Interoperability test as per IEC 61850 (interoperability with ABB, AREVA, SIEMENS, GE and SEL)

PRE-COMMISSIONING TESTS

The contractor shall have to perform following minimum Pre-commissioning tests, as applicable, for commissioning of the C&R panels. For this purpose, the contractor shall arrange all required tools and testing equipment at site.
(i). IR values of all circuits.
(ii). Measurement of burden in CT & PT circuits.
(iii). Primary current injection of CT circuits with connected burden
(iv).Energisation of PTs at suitable low voltage and measurement of PT inputs at all measuring points
(v). Secondary ac current injection of relays, dynamic testing of all numeric relays. Tracing of zone curves, limits. Checking of relay timings, inherent or set values. For this testing, the contractor shall bring 'Omicron' or equivalent test kit.
(vi).Testing of voltage related elements like directional element, over fluxing, over/ under frequency, over/ under voltage features, tracing of curves and checking limits of set values and associated timings
(vii). Checking of Boolean logic gates, BI/BO points of the numeric relays, checking conformity to specification and checking of set logics
(viii). Checking of stability and sensitivity of differential zones by suitably applying 3-phase low voltages and shorting of primary circuits. Measurements of voltage and current inputs to all relays.

(ix). Checking stability & sensitivity of bus differential relay zones by suitably injecting current
(x). Primary injection of REF connected CTs, measurements of relay inputs and checking of stability and sensitivity of REF scheme
(xi). Checking registration of event and disturbance records in the numeric relays and downloading
(xii). Testing of carrier aided protection schemes and simulation with regard to transmission and receipt of protection signalling
(xiii). Testing of AR schemes.
(xiv). Checking of healthiness of each dc circuit of panels
(xv). Simulation of faults like Buchholz, OTI, WTI and other relays and checking of tripping of breaker and connected annunciation
(xvi). Operation of master trip relays, tripping of breaker through each trip coil and checking of inter locks
(xvii) Simulation of faults like low gas, air pressure and checking operation of inter locks. Checking anti umping scheme of CB.
(xviii).Simulation to Check Checking of PT selection schemes
(xix). Simulation to Check interlocks of all CB and isolator inter locks
(xx). Simulation to Check annunciation of all events in BCU (Bay control unit) as well as SAS (Substation automation System)
(xxi). Simulation to Check of logic of BCU.
(xxii). Operation of tap changing of transformer through SAS

TECHNICAL DATA SHEET FOR THE RELAY AND CONTROL PANELS

Features to be provided in various Relay and Control panels are indicated below.
Description below are only indicative; the Contractor shall ensure that all items are included in their off to complete the schemes described in the Specification whether such items are specifically mentioned or not.

SL NO	Item	Ratings & particulars
1	**Protection and Relays**	
	a) Back up directional over current and earth fault scheme	1 set
	b) LBB protection Scheme.	Can be function of BCU/IED's
	c) Trip Circuit supervision Relay for pre and post closing	Supervision for 02 trip coils
	d) DC Supply healthy monitoring scheme	1 No
	e) AC Supply healthy monitoring scheme	1 No
	f) High Speed Trip relay	2 Nos.
	g) Auxiliary relay, timer relay for healthiness of relays, trip transfer, auto reclose communication link etc. As required	As required (Can be function of BCU)
	h) Bus PT selection scheme	1 No
2	**Control/Status indication/annunciation**	
	a) Bay Control Unit (IED with HMI)	1 No (Function of BCU/SAS)
	b) Ethernet switch for connecting to existing ring LAN of SAS	1 No

Technical Specification of Portable Mobile Lighting Tower:

Usage	:	Outdoor
Height	:	9 Mtr.
Wind stability	:	110 km/hr
Pole Type	:	Telescopic

Material	:	Mild Steel
Light Source	:	4 x 350 W Rectangular LED Flood type IP 65, cool white, tiltable, ≥150 bm/W
Diesel Generator (Silent, Single Phase) (Engine: Cummins, Honda, Kirloshkar or reputed brand)	:	5 KVA, 230 V AC, Brushless alternator, CPCB-2, Aux power 10 A (max), Control panel with independent MCB, one touch start & stop, emergency stop and tripping on leakages, weather proof sockets, engine protection device.
Mast	:	9 Mtr., telescopic, manual winch operation with interlock, 360 degree rotatable with locking and manual operation, wind stability 110 km/hr
Platform, Trolley	:	Portable with lifting hooks and dual brakes

TECHNICAL SPECIFICATION FOR 11 & 33 KV OUTDOOR TYPE CURRENT TRANSFORMER (Metering)

1. INTRODUCTION

This section covers the specification of 33 kV and 11kV Current Transformer suitable for outdoor service. Any other parts not specifically mentioned in this specification but otherwise required for proper functioning of the equipment should be included by the tender in the offer. The CTs should normally be installed above VCB. The VCB & CT should be installed on common mounting structure. In places, where VCB are not provided in the substation, separate CT mounting structure shall be provided with CTs.

2. APPLICABLE STANDARDS

Unless otherwise modified in this specification, the Current Transformer shall comply with the latest version of relevant standards (IS 2165, IS 2705(I-IV), IS 2099, IS 5621, IS 2071, IS 335, IS 13947(part I), IEC 185, IEC 270, IEC 44(4), IEC 171, IEC 60, IEC 8263, IEC 815, Indian electricity Rules 2003) or better international standards. This list of standards is for guidance only. The contractor shall be solely responsible to design & manufacture the CT suitable for 33kV & /11 kV systems.

3. SERVICE CONDITIONS

The CT supplied against these specifications shall be suitable for satisfactory continuous operation under the tropical conditions, as mentioned for power transformers.

Maximum altitude above sea level	100m
Minimum ambient air temperature	45°C
Maximum daily average ambient air temperature	40° C
Minimum ambient air temperature	2° C
Maximum temperature attainable by an object exposed to the sun	60° C
Maximum yearly weighted average ambient temperature	32° C
Maximum relative humidity	98%
Average number of thunderstorm days per annum (isokeraunic level)	45→50(MV)
Average number of rainy days per annum	120
Average annual rainfall	2200 mm
Maximum annual rainfall	3500 mm
Maximum wind pressure	260Kg/m^2
Seismic level(Horizontal acceleration)	0.24g to 0.48g
Climatic condition Moderately hot and humid tropical climate conducive to rust and fungus growth.	

4. SYSTEM PARTICULARS

a) Nominal System Voltage 33kV & 11kV

b)	Highest system Voltage	36kV & 12kV
c)	Rated Frequency	50Hz & 50Hz
d)	No of phases	Three & Three
e)	System neutral earthing	-Solidly Earthed-
f)	One minute Power Freq. withstand voltage (rms)	70kV & 28kV
g)	Lighting Impulse withstand Voltage	170kVp & 75kVp
i)	System fault level	-25kA for 3sec-

5. TECHNICAL PARAMETERS OF CT

a)	Type	Single phase, dead tank, outdoor, oil filled & hermetically sealed
b)	Type of mounting	Pedestal type
c)	Rated primary current	As per BID
d)	Rated Continuous thermal current Primary current	120 % of rated
e)	Rated short time withstand Requirement for sec. Winding	As per IS 2705 Pt. I
f)	Rated short time withstand Current	25kA(RMS)
	i) Duration (for primary current of 150amps and above)	3Sec
	ii) Duration (for primary current below 150amps)	1Sec
g)	Rated dynamic withstand Current (KA rms)	62.5
h)	Max temp rise	As per IEC-185/ IS 2705
i)	Minimum creepage distance of porcelain housing(mm)	25 mm /KV
j)	One minute power frequency Withstand voltage between Secondary terminal & earth	3 kV

k)	Detail of Secondary Cores	Metering	Metering
	Current ratio	400-200/1 A	400-200/1 A
	Accuracy class	0.5	0.5
	Burden (VA)	15	15

Instrument security Factor	≤5	≤5
Accuracy Limit Factor	-	-

Note: The ratings indicated for instrument transformer are tentative only and may be changed to meet the requirements.

6. INSULATION

The insulation of the CT shall be so designed that the internal insulation shall have higher electrical withstand capability than the external insulation. The designed dielectrics withstand values of external and internal insulations shall be clearly brought out in the GTP. The dielectric withstand values specified in this specification are meant for fully assembled CT. The temperature rise on any part of equipment shall not exceed the maximum temperature rise limits specified in the relevant standard.

7. PORCELAIN HOUSING

It shall be single piece of homogeneous, vitreous porcelain of high mechanical & dielectric strength. It will be glazed with uniform Brown or Dark brown colour with smooth surface finish. The Creepage distance for the porcelain housing shall be at least 25 mm per kV.

8. TANK & SURFACE FINISH

The metal tanks shall have bare minimum number of welded joints so as to minimize possible locations of oil leakage. The tank shall be fabricated of MS steel sheet of min. 3.15 mm for sides & 5 mm for top & bottom. The bottom of the tank shall be adequately accessible for periodical maintenance of open surface.

The metal tanks shall be coated with at least two coats of zinc rich epoxy painting. The inner surface shall be painted with oil resistance white enamel paint. All the ferrous hardware, exposed to atmosphere, shall be hot dip galvanized. All other fixing nuts, bolts, washers in the electrical current path shall be made out of stainless steel.

9. GENERAL CONSTRUCTIONAL REQUIREMENTS

9.1 The CT shall be of dead tank design and shall be so constructed that it can be easily transported to site within the allowable transport limitation, even in horizontal position, if the transport limitation so demands. The C.T. shall be hermetically sealed and method of such sealing shall be detailed in the offer.

9.2 CT secondary terminals shall be brought out in a weatherproof terminal box. The terminal box shall be provided with removable gland plate and glands. The cable glands shall be suitable for 1100 volts grade PVC insulated, PVC sheathed multi core stranded 6 sq.mm copper conductor cable. This terminal box shall be dust and vermin proof. The dimensions of the terminal box and its opening shall be adequate to enable easy access and working space with the use of normal tools.

9.3 Polarity shall be invariably marked in each primary and secondary terminal. Facility shall be provided for short circuiting and grounding of the CT secondary terminals inside the terminal box.

9.4 The CT shall be provided with a rating plate with dimensions and marking as per IS-16227. The markings shall be punched and not painted. The serial number and code of the supplier shall also be punched on the tank to identify the unit in case of loss or damage to the rating plate.

9.5 The CT shall be vacuum filled with oil after processing and thereafter hermetically sealed to eliminate breathing and to prevent air and moisture entering into the tank. Oil filling and / or oil sampling cocks, if provided to facilitate factory processing should be permanently sealed before dispatching the CT. The method adopted for hermetic sealing shall be described in the offer.

10. WINDING

10.1. PRIMARY WINDING

It shall be made of high conductivity rigid copper wire. The primary winding current density shall not exceed the limit of 1.6 Amp per sq. mm for normal rating. The design current density for short circuit current as well as conductivity of metal used for primary winding shall be as per IS 2705. The calculation for the selection of winding cross section shall be furnished by contractor. The primary terminal shall be of standard size of 30 mm dia x 80 mm length of heavily tinned (min. thickness 15 micron) electrolytic copper of 99.9 % conductivity.

10.2 SECONDARY WINDING

Shall be made of insulated copper wire of electrolytic grade. Type of insulation used shall be described in the offer. For multi ratio design, the multi ratio will be achieved by reconnection of the primary winding or secondary winding. The excitation current of the CT shall be as low as possible. The contractor shall furnish the magnetization curves for all the cores.

The terminal box shall be dust free & vermin proof. The size of the terminal box shall be big enough to enable easy access and working space with the use of normal tools.

The secondary terminals studs shall be provided with at least 3 nuts and two plain washers, these shall be made of brass duly nickel plated. The min. stud outer dia shall be 6 mm & length 15 mm. The min spacing between the centres of the adjacent studs shall be 1.5 time the outer dia of the stud.

10.3 POLARITY

The polarity shall be marked on each CT at the primary and secondary terminals.

11. INSULATION OIL

The first filling of oil in CT shall be in contractor's scope. The oil shall be as per IS 335:2018.

To ensure prevention of oil leakage, the manufacturer will give following details supported by drawings:

i) Location of emergence of Primary & Secondary terminals
ii) Interface between porcelain & metal tanks
iii) Cover of the secondary terminal box

Any nut & bolt and screw used for fixation of the interfacing porcelain bushing for taking out the terminals shall be provided on flanges cemented to the bushings & not on the porcelain.

If gasket joints are used, Nitrite Butyl Rubber gasket shall be used. The grooves shall be machined with adequate space for accommodating gasket under pressure.

The CT shall be vacuum filled with oil after processing. It will be properly sealed to eliminate breathing & to prevent air & moisture from entering the tank. The sealing methods/arrangement shall be described by the contractor & be approved by the owner.

12. OIL LEVEL INDICATOR

The CT shall be fitted with prismatic type oil sight window at suitable location so that the oil level is clearly visible with naked eye to an observer standing at ground level.

To compensate oil volume variation due to temperature variation, Nitrogen cushion or the stainless steel bellows shall be used. Rubber diaphragms are not permitted for this purpose.

13. EARTHING

Two earthling terminals shall be provided on the metallic tank of size 16 mm dia & 30 mm length each with one plain washer & one nut for connection to the station earth mat.

14. JUNCTION BOX

The junction box shall be of MS sheet having thickness of 2mm, synthetic enamel painted as per procedure mentioned in General Technical Requirement (Min. thickness 55 micron). The shade of junction box shall be 697 of IS: 5. Disconnecting type terminal blocks for CT secondary lead shall be provided. The junction boxes shall be weather proof type with gaskets, as per section-I (Introduction and general technical requirements) conforming to IP-55 as per IS-13947 (Part-I).

15. LIFTING & MOUNTING ARRANGEMENT

The CT shall be provided with two lifting eyes to lift the CT. This shall be so positioned so as to avoid any damage to the CT during lifting for instillation or transportation purpose. This shall be detailed in General Arrangement drawing.

The CT shall be of pedestal mounting type suitable for outdoor installation on steel/cement concrete structures. All the clamps, bolts, nut and washers etc. required for mounting the CT on the structure shall be supplied along with the CT and shall be galvanized. The contractor shall supply all the terminal connectors etc. required for connection to the CT.

16. TESTING

Type Test:

The Current Transformer design offered in the Bid should have been successfully type tested at NABL laboratories for the tests indicated as follow in line with the relevant standard and technical specification. These Type Tests should have been carried out within five years prior to the date of opening of tender. The bidder shall be required to submit complete set of the type test reports along with the offer.

In case these type tests are conducted earlier than five years, all the type tests as per the relevant standard shall be carried out by the successful bidder at NABL in presence of purchaser's representative free of cost before commencement of supply. The undertaking to this effect should be furnished along with the offer without which the offer shall be liable for rejection.

If there is any change in the design/ type of old type tested current transformers to be offered against this specification, then the offer is considered for placement of order. However, successful bidders have to carry out the said type tests on offered type equipment before commencement of supply at their own expense.

Sl.No.	Type test Description
A	**Schedule of Type Test for CT**
1	Verification of terminal marking and polarity.
2	High voltage power frequency tests on primary windings.
3	High voltage power frequency tests on secondary windings.
4	Over voltage inter turn test.
5	Determination of error according to the requirement of appropriate accuracy class
6	Short time current test.
7	Impulse voltage test.
8	Temperature Rise Test.
9	Instrument Security Factor Test on Both phase of the CT as per Cl. No.7.1.2 of Is-2705 (Part-II).
10	High Voltage Power-frequency Wet withstand voltage test as per Cl. No.9.9 of IS-2705 (Part-I).

Acceptance & Routine Tests:-

All acceptance and routine tests as stipulated in the respective applicable standards amended up-to-date for current transformer shall be carried out by the supplier in the presence of purchaser's representative without any extra cost to the purchaser before dispatch.

17. INSPECTION

17.1. The inspection may be carried out by the purchaser at any stage of manufacture. The successful bidder shall grant free access to the purchaser's representative at any reasonable time when the work is in progress. All facilities must be made available by supplier/ manufacturer for unrestricted inspection of the works, raw material & manufacture of all the accessories & for conducting necessary tests as declared therein.

17.2. No current transformer shall be dispatched from its point of manufacture unless the current transformer has been satisfactorily inspected and tested.

17.3. Inspection and acceptance of any current transformer under this specification by the purchaser shall not relieve the supplier of his obligation of furnishing current transformer in accordance with the specification and shall not prevent subsequent rejection, if the current transformer is found to be defective.

18. PERFORMANCE GUARANTEE

The equipment offered shall be guaranteed for satisfactory performance for a period of 66 months from the date of receipt of complete equipment at site in good condition or 60 months from the date of satisfactory commissioning, whichever is earlier. In case of failure within this period, the supplier shall make necessary repairs / replacement of the faulty current transformer at no extra cost to the purchaser.

19. DOCUMENTATION

19.1. List of Drawings & Documents :-
The bidder shall furnish two sets of the following drawings along with offer.

a) General outline and assembly drawings of the equipment

b) Sectional views showing :-

i) General Constructional features of Current Transformer, dimensions of conductor, depth of insulation, clearance between paper insulation & the inside of porcelain, grading stages used for primary insulation, whether & how a semi conducting tape is used to cover metal foils etc.

ii) The Sectional view shall show the materials / gaskets / sealing used for perfect hermetic sealing and arrangement for compensation of oil volume variation.

iii) The insulation, the winding arrangements, method of connection of the primary / secondary winding to the primary / secondary terminals etc.

iv) Porcelain housing used and its dimensions along with the mechanical and electrical characteristics, as well as volume of oil.

c) Arrangement of secondary Terminal box & details of connection studs provided.

d) Name Plate

e) Schematic drawing

f) Type Test reports in case the equipment has already been type tested.

g) Test reports, literature, pamphlets of the bought out items, and raw material

h) Bill of material and packing list.

i) Pressure release device

j) Oil level indicator

k) Drain plug

l)Bushing drawing

18.2 The successful bidders shall submit three sets of final versions of all the above said drawings in line with Technical Specifications.

18.3 Adequate copies of acceptance and routine Test Certificates, duly approved by APDCL shall accompany the dispatched consignment.

18.4 The manufacturing of the current transformers shall be strictly in accordance with the approved drawings and no deviation shall be permitted without the written approval of the APDCL. All manufacturing and fabrication work in connection with the current transformers prior to the approval of the drawing shall be at the supplier's risk.

18.5 One set of nicely printed and bound volume of operation, maintenance and erection manuals in English language per Current Transformer of each voltage rating shall be submitted by the supplier to respective consignees along with the dispatch documents of each unit. The

manual shall contain all the drawings and information required for erection, operation and maintenance of the Current Transformer. The manual shall also contain a set of all the approved drawings, Type Test reports etc.

18.6 Approval of drawings by APDCL shall not relieve the supplier of his responsibility and liability for ensuring correctness and correct interpretation of the drawings for meeting the requirement of the Technical Specification, latest revision of applicable standards, rules and codes of practices. The equipment shall conform in all respects to high standards of engineering, design, workmanship and latest revisions of relevant standards at the time of ordering and APDCL shall have the power to reject any work or materials which, in his judgment, is not in full accordance therewith.

19. PACKING & FORWARDING

19.1 The current transformers shall be packed in wooden crates of good quality and shall be suitable for vertical / horizontal transportation as the case may be, and suitable to withstand handling during transport and outdoor storage in stores before erecting. 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 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 supplier without any extra cost.

19.2 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) Total weight of consignment.
e) Sign showing upper / lower side of the crate.
f) Handling and unpacking instructions.
g) Bill of material indicating contents of each package

19.3 The supplier shall ensure that the packing list and bill of material are approved by the APDCL before dispatch.

GUARANTEED TECHNICAL PARTICULARS OF CURRENT TRANSFORMER

Sl.No.	Particular of GTP Parameter	Bidders Confirmation	
		33kV CT	11kV CT
1	Manufacturer's Name & address		
2	Type of equipment		
3	Type of Mounting		
4	Equipment Conforming to Standards		
5	Rated Voltage / Highest System Voltage in KV		
6	Rated Primary Current (Amp)		

7	Rated Secondary Current (Amp)		
8	Frequency (HZ)		
9	Ratio of Current Transformer		
10	Details of Cores		
i)	Number of Cores		
ii)	Purpose		
iii)	Burden (VA)		
iv)	Class of Accuracy		
11	Rated Short Time Withstand Current for 1 Sec. duration		
12	Rated Dynamic Withstand Current (KAp)		
13	Method of Earthing system to be connected to		
14	One minute Dry Power Frequency Withstand Voltage (KV rms) of Primary Winding		
15	One minute Wet Power Frequency Withstand Voltage (KV rms) of Primary Winding		
16	1.2/50 micro-second Impulse Withstand Voltage (KVP)		
17	The die-electric Withstand values (KVp)of external & internal insulation		
18	One minute Power Frequency Withstand Voltage (KV rms) of Secondary Winding		
19	Minimum Creepage Distance (mm)		
20	Weight of oil (kg/Ltrs.)		
21	Total Weight (kg)		
22	Mounting details		
23	Overall dimension		
24	Type of Winding		
25	Material of Winding		
26	Size & Cross Section of Primary Winding		
27	Size & Cross Section of Secondary Winding		
28	No. of Primary Turns		

29	No. of Secondary Turns		
30	Current Density of Primary & Secondary Winding (max. – 1.6A/sq.mm)		
31	Primary Terminal		
32	Type of Insulation		
33	Whether Current Transformer confirms to Temperature Rise limits		
34	Type of oil compensation		
35	Type of pressure release device provided		
36	Partial Discharge level		
37	Rated continuous Thermal Current (120% of the rated Primary Current)		
38	Instrument Security Factor (ISF ≤ 5)		
39	Class of Insulation		
40	Actual clearance between live part & ground (mm)		

Seal and Signature of Bidder

TECHNICAL SPECIFICATION FOR 33 & 11 KV OUTDOOR TYPE POTENTIAL TRANSFORMER (Metering)

1. INTRODUCTION

This chapter covers specification of 33kV and 11kV Potential Transformer suitable for outdoor service. Any other parts not specifically mentioned in this specification but otherwise required for proper functioning of the equipment should be included by the tender in the offer.

2. APPLICABLE STANDARDS

Unless otherwise modified in this specification, the Potential Transformer shall comply with the latest version of relevant standards (IS 3156, IS 2099, IS 5621, IS 335, IS 13947(Part I), IEC 186, Indian electricity Rules 2003, IEC 815) or better international standards. This list of standards is for guidance only. The contractor shall be solely responsible to design & manufacture the PT suitable for 33 kV/11kV systems.

3. SERVICE CONDITIONS

The PT supplied against this specification shall be suitable for satisfactory continuous operation under the tropical conditions as detailed for power transformers.

Maximum altitude above sea level	100m
Minimum ambient air temperature	45°C
Maximum daily average ambient air temperature	40° C
Minimum ambient air temperature	2° C
Maximum temperature attainable by an object exposed to the sun	60° C
Maximum yearly weighted average ambient temperature	32° C
Maximum relative humidity	98%
Average number of thunderstorm days per annum (isokeraunic level)	45→50(MV)
Average number of rainy days per annum	120
Average annual rainfall	2200 mm
Maximum annual rainfall	3500 mm
Maximum wind pressure	260Kg/m^2
Seismic level(Horizontal acceleration)	0.24g to 0.48g
Climatic condition Moderately hot and humid tropical climate conducive to rust and fungus growth.	

4. SYSTEM PARTICULARS

a)	Nominal System Voltage	33kV	11kV
b)	Highest system Voltage	36kV	12kV
c)	Rated Frequency	50Hz	50Hz
d)	No of phases	Three	Three
e)	System neutral earthing	---Solidly Earthed--	
f)	One minute Power Freq. Withstand voltage (rms)	70kV	28kV
g)	Lighting Impulse withstand Voltage	170kVp	75kVp
h)	System fault level	---25 kA for 3sec---	

5. TECHNICAL PARAMETERS OF PT

a)	Rated primary Voltage	36 KV	12 KV
b)	Type	Single phase potential transformer	
c)	Voltage/ Ratio(kV)	33/0.11	11/0.11
d)	Rated voltage factor	1.2continuous	1.5–30seconds
e)	One minute power freq. Withstand voltage for Primary Terminals	70 kV(rms)	28 kV

	Secondary winding	36 kV	12 KV
f)	Min. Creepage Distance	25 mm/kV of Highest System Voltage	
g)	Detail of secondaries	Core I	Application Metering
	Accuracy	0.5	0.5
	Burden (VA)	100	100

Note: The ratings indicated for instrument transformer are tentative only and may be changed to meet the requirements.

6. INSULATION

The insulation of the potential transformers shall be so designed that the internal insulation shall have higher electrical withstand capability than the external insulation. The designed dielectrics withstand values of external and internal insulations shall be clearly brought out in the GTP (Guaranteed Technical particulars). The dielectric withstand values specified in this specification are meant for fully assembled instrument transformer. The temperature rise on any part of equipment shall not exceed the maximum temperature rise limits specified in annexure IV under the conditions specified there in.

7. PORCELAIN HOUSING

7.1. It shall be single piece of homogeneous, vitreous porcelain of high mechanical & dielectric strength. It will be glazed with uniform Brown or Dark brown colour with smooth surface finish. The creepage distance for the porcelain housing shall be at least 25mm per kV.

7.2. The contractor shall clearly detail in his bid the details of attaching the metallic flange to porcelain, pressure release valve and also how primary & secondary terminals shall be brought out.

8. TANK & SURFACE FINISH

8.1. The metal tanks shall have bare minimum number of welded joints so as to minimize possible locations of oil leakage. It shall be fabricated of MS steel sheet of min. 3.15 mm for sides & 5 mm for top & bottom. The tank will be finished with min. 2 coats of zinc rich epoxy paint externally. The inner surface shall be painted with oil resistance white enamel paint.

8.2. All ferrous hardwares, exposed to atmosphere shall be hot dipped galvanized.

9. GENERAL CONSTRUCTIONAL REQUIREMENTS

9.1. The PT shall be vacuum filled with oil after processing and hermetically sealed to eliminate breathing and to prevent air and moisture entering the tanks. Method adopted for hermetic sealing shall be described in the offer and shall be subject to approval of the purchaser.

9.2. The PT shall be so constructed that it can be easily transported to site within the allowable transport limitations, even in horizontal position, if the transport limitations so demand.

10. WINDING

PRIMARY WINDING

It shall be made of insulated electrolytic copper wire. The neutral end of the winding shall be brought outside for earthing. The primary terminal shall be of standard size of 30 mm dia x 80 mm length of heavily tinned (min. thickness 15 micron) electrolytic copper of 99.9 % conductivity.

SECONDARY WINDING

It shall be made of insulated copper wire of electrolytic grade. The terminal box shall be dust free & vermin proof. The size of the terminal box shall be big enough to enable easy access and working space with the use of normal tools.

The secondary terminals studs shall be provided with at least 3 nuts and two plain washers. These shall be made of brass duly nickel plated. The min. stud outer dia shall be 10 mm & length 15 mm. The min spacing between the centres of the adjacent studs shall be 1.5 time the outer dia of the stud.

POLARITY

The polarity shall be marked on each PT at the primary and secondary terminals.

11. INSULATION OIL

The first filling of oil in PT shall be in contractor's scope. The oil shall be as per IS 335.To ensure prevention of oil leakage, the manufacturer will give following details supported by drawings :

i) Location of emergence of Primary & Secondary terminals
ii) Interface between porcelain & metal tanks
iii) Cover of the secondary terminal box

Any nut & bolt and screw used for fixation of the interfacing porcelain bushing for taking out the terminals shall be provided on flanges cemented to the bushings & not on the porcelain.

If gasket joints are used, Nitrite Butyl Rubber gasket shall be used. The grooves shall be in machined with adequate space for accommodating gasket under pressure.

The PT shall be vacuum filled with oil after processing. It will be properly sealed to eliminate breathing & to prevent air & moisture from entering the tank. The sealing methods/arrangement shall be described by the contractor & be approved by the owner.

12. OIL LEVEL INDICATOR

The PT shall be fitted with prismatic type oil sight window at suitable location so that the oil level is clearly visible with naked eye to an observer standing at ground level.

To compensate oil volume variation due to temperature variation, Nitrogen cushion or the stainless steel bellows shall be used. Rubber diaphragms are not permitted for this purpose.

13. EARTHING

Two earthling terminals shall be provided on the metallic tank of size 16 mm dia & 30 mm length each with one plain washer & one nut for connection to the station earth mat.

14. Junction Box

The junction box shall be of MS sheet having thickness of 2mm, synthetic enamel painted as per procedure mentioned in General technical Requirement (Min. thickness 55 micron). The shade of junction box shall be 697 of IS: 5. Disconnecting type terminal blocks for PT secondary lead shall be provided. The junction boxes shall be weather proof type with gaskets as per section-I (Introduction and general technical requirements) conforming to IP-55 as per IS-13947 (Part-I).

One junction box shall be provided for 3 numbers of single phase CT's and PT's.

15. LIFTING & MOUNTING ARRANGEMENT

The PT shall be provided with two lifting eyes to lift the PT. This shall be so positioned so as to avoid any damage to the PT during lifting for installation or transportation purpose. This shall be detailed in General Arrangement drawing.

The PT shall be of pedestal mounting type suitable for outdoor installation on steel/cement concrete structures. All the clamps, bolts, nut and washers etc. required for mounting the PT on the structure shall be supplied along with the PT and shall be galvanized. The contractor shall supply all the terminal connectors etc. required for connection to the PT.

16. TESTING

16.1. **Type Tests:**

The Potential Transformer offered in the Bid should have been successfully type tested at NABL laboratories for the tests indicated as follow in line with the relevant standard and technical specification. These Type Tests should have been carried out within five years prior to the date of opening of tender. The bidder shall be required to submit complete set of the type test reports along with the offer. In case these type tests are conducted earlier than five years, all the type tests as per the relevant standard shall be carried out by the successful bidder at NABL in presence of purchaser's representative free of cost before commencement of supply. The undertaking to this effect should be furnished along with the offer without which the offer shall be liable for rejection. If there is any change in the design/ type of old type tested Potential transformers to be offered against this specification, then the offer is considered for placement of order. However, successful bidders have to carry out the said type tests on offered type Potential transformers before commencement of supply at their own expense.

Sl.No.	Type test Description
A	**Schedule of Type Test for PT**
1	Verification of terminal marking and polarity.
2	Power frequency dry withstand test on primary winding.
3	Power frequency dry withstand test on secondary winding.
4	Determination of errors according to the requirement of the appropriate accuracy class.
5	Temperature rise test.

6	Impulse voltage test for voltage transformer for service in electricity exposed installation.
7	High Voltage Power-frequency Wet withstand voltage test as per Cl. No.9.7 of IS-3156(Part-I)

Acceptance & Routine Tests:-

All acceptance and routine tests as stipulated in the respective applicable standards amended up-to-date for potential transformer shall be carried out by the supplier in the presence of purchaser's representative without any extra cost to the purchaser before dispatch.

17. INSPECTION

17.1. The inspection may be carried out by the purchaser at any stage of manufacture. The successful bidder shall grant free access to the purchaser's representative at any reasonable time when the work is in progress. All facilities must be made available by supplier/ manufacturer for unrestricted inspection of the works, raw material & manufacture of all the accessories & for conducting necessary tests as declared therein.

17.2. No potential transformer shall be dispatched from its point of manufacture unless the potential transformer has been satisfactorily inspected and tested.

17.3. Inspection and acceptance of any potential transformer under this specification by the purchaser shall not relieve the supplier of his obligation of furnishing potential transformer in accordance with the specification and shall not prevent subsequent rejection, if the potential transformer is found to be defective.

18. PERFORMANCE GUARANTEE

The equipment offered shall be guaranteed for satisfactory performance for a period of 66 months from the date of receipt of complete equipment at site in good condition or 60 months from the date of satisfactory commissioning, whichever is earlier. In case of failure within this period, the supplier shall make necessary repairs / replacement of the faulty potential transformer at no extra cost to the purchaser.

19. DOCUMENTATION

19.1. List of Drawings & Documents :-

The bidder shall furnish two sets of the following drawings along with offer.

a) General outline and assembly drawings of the equipment

b) Sectional views showing :-

i) General Constructional features of Potential transformer, dimensions of conductor, depth of insulation, clearance between paper insulation & the inside of porcelain, grading stages used for primary insulation, whether & how a semi conducting tape is used to cover metal foils etc.

ii) The Sectional view shall show the materials / gaskets / sealing used for perfect hermetic sealing and arrangement for compensation of oil volume variation.

iii) The insulation, the winding arrangements, method of connection of the primary / secondary winding to the primary / secondary terminals etc.

iv) Porcelain housing used and its dimensions along with the mechanical and electrical characteristics, as well as volume of oil.

c) Arrangement of secondary Terminal box & details of connection studs provided.

d) Name Plate

e) Schematic drawing

f) Type Test reports in case the equipment has already been type tested.

g) Test reports, literature, pamphlets of the bought out items, and raw material

h) Bill of material and packing list.

i) Pressure release device

j) Oil level indicator

k) Drain plug

l)Bushing drawing

19.1 The successful bidders shall submit three sets of final versions of all the above said drawings in line with Technical Specifications.

19.2 Adequate copies of acceptance and routine Test Certificates, duly approved by APDCL shall accompany the dispatched consignment.

19.3 The manufacturing of the potential transformers shall be strictly in accordance with the approved drawings and no deviation shall be permitted without the written approval of the APDCL. All manufacturing and fabrication work in connection with the potential transformers prior to the approval of the drawing shall be at the supplier's risk.

19.4 One set of nicely printed and bound volume of operation, maintenance and erection manuals in English language per Potential transformer of each voltage rating shall be submitted by the supplier to respective consignees along with the dispatch documents of each unit. The manual shall contain all the drawings and information required for erection, operation and maintenance of the Potential transformer. The manual shall also contain a set of all the approved drawings, Type Test reports etc.

19.5 Approval of drawings by APDCL shall not relieve the supplier of his responsibility and liability for ensuring correctness and correct interpretation of the drawings for meeting the requirement of the Technical Specification, latest revision of applicable standards, rules and codes of practices. The equipment shall conform in all respects to high standards of engineering, design, workmanship and latest revisions of relevant standards at the time of ordering and APDCL shall have the power to reject any work or materials which, in his judgment, is not in full accordance therewith.

20 PACKING & FORWARDING

20.1 The potential transformers shall be packed in wooden crates of good quality and shall be suitable for vertical / horizontal transportation as the case may be, and suitable to withstand handling during transport and outdoor storage in stores before erecting. 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 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 supplier without any extra cost.

20.2 Each consignment shall be accompanied by a detailed packing list containing the following information:

i) Name of the consignee.
ii) Details of consignment.
iii) Destination.
iv) Total weight of consignment.
v) Sign showing upper / lower side of the crate.
vi) Handling and unpacking instructions.
vii) Bill of material indicating contents of each package

20.3 The supplier shall ensure that the packing list and bill of material are approved by the APDCL before dispatch.

GUARANTEED TECHNICAL PARTICULARS OF 33KV & 11KV OUTDOOR PT

Sl.No.	Particular of GTP Parameter	Bidders Confirmation	
		33kV PT	11kV PT
1	Manufacturers name & Type of PT		
2	Manufacturer's type Designation.		
3	Whether Conforming to standards		
4	Rated Primary Voltage in kV		
5	Number of secondary windings		
6	Rated secondary voltage (Volts)		
7	Rated burden (VA)		
8	Accuracy class		
9	Highest system voltage (kV)		
10	Quantity of oil (Liters)		
i)	Type of insulation & Temperature rise limits		
ii)	Whether Potential transformer conforms to the Temperature rise limits		
iii)	Rated voltage factor & time		
iv)	One minute power frequency withstand voltage test (dry) (kV rms)		
11	One minute power frequency withstand voltage test (wet) (kV rms)		
12	1.2/50 microsecond impulse wave withstand test voltage (kVP)		

13	One minute power frequency withstand voltage on secondary (kV rms)		
14	Minimum Creepage distance (mm)		
15	Weight of oil (kg)		
16	Total weight (kg)		
17	Overall dimensions		
18	Mounting details		
19	Primary terminals		
20	Whether Type test reports (within 5 years) are submitted along with the offer?		
21	Type of oil compensation		
22	Whether experience sheet n is submitted along with the offer?		
23	Whether 5 year continuous servicing performance certificate is submitted along with the offer?		
24	Whether Drawings are submitted along with the offer?		
25	Whether Pressure release device of technical specification is provided?		
26	Type of insulation material used for PT		

Seal and Signature of Bidder

CHAPTER – 27: SPECIFICATION FOR ACDB

27.1 SCOPE :

This specification covers design, manufacture, assembly, testing, at the manufacturer's works, supply, and delivery erection and commissioning of indoor type 415 Volts AC switch boards for the sub-stations as per approved schemes.

This also includes design, supply, laying and termination of XLPE insulated armoured power and control cables required for distribution of AC auxiliary power at different points of switchyard, control room building, colony and utility area, fire fighting pump house etc. for various purpose including Air conditioning system at control room, conference room and other places if mentioned in the technical specification of Air conditioning.

27.2 STANDARDS :

The equipment covered by this specification shall, unless otherwise specified, be in accordance with, relevant IS specification. The degree of protection shall not be less than IP-54 and IP-42 as per IS:2447 in case of bus bar chambers where continuous bus bar rating exceeds 1000 Amps.

27.3 DEVIATION :

Normally the offer should be as per Technical Specification without any deviation. . In case of any deviation taken against technical specification same are to be submitted in a separate deviation sheet for review of AEGCL.

27.4 MODIFICATION :

If any modification felt necessary to improve performance, efficiency and utility of equipment, the same must be mentioned in the 'Modification schedule' with reasons duly supported by documentary evidences and advantages. Such modifications suggested may or may not be accepted, but the same must be submitted along with Pre-Bid Queries. The modifications not mentioned in Schedule will not be considered.

27.5 DESIGN CRITERIA :

i) In case of 400KV sub-station, AC source shall be supplied separately from LT side of 2 numbers,1000KVA,

3/0.415KVstationservicetransformersthroughcable as per tender auxiliary SLD.

ii) Two numbers 400 V/ 400 V Lighting Transformer with voltage variation arrangement atprimary side (in Off-load condition) in the range of ±5% in steps of 2.5%, shall be underscope of the bidder for supply, Erection, Testing & Commissioning for connection of Main of MainACDBwiththeMLDBpanel.RatingofLightingTransformersshallbeminimum100KV Afor400/220/132/33KVsub-station. **One number, 100kVA shall be provided for connection to ELDB**.However, rating may increase as per actual requirement keeping20%sparecapacity,which shall bewithinthescope of bidder.

iii) The maximum loss component shall be guided as per relevant IS / IEC.

There shall be following panels designated as

a) MAIN ACDB – 2 Numbers
b) Sub ACDB – 2 Numbers
c) Main Lighting Distribution Board (MLDB) – 1 Number
d) Emergency Lighting Distribution Board (ELDB) – 1 Number
e) HVAC DB – 1 number
f) MCB DB – 1 number

All the above AC Panels shall be interconnected as per scheme layout.

iv) Main ACDB: (415V)

Both the main AC Distribution board shall consist of the following items but not limited to this extent, within the scope of supply by Contractor with erection, Testing & Commissioning.

- 2000 A,4P Air Circuit Breaker and CT (of requisite rating) for 33/0.415 V station service transformers as INCOMER I for ACDB 1
- 2000 A,4P Air Circuit Breaker and CT (of requisite rating) for 33/0.415 V station service transformers as INCOMER II for ACDB 2
- 2 numbers 2000A, 4P Air Circuit Breaker along with 2 sets of CTs (of requisite rating) as Bus- coupler
- Ammeters, voltmeters, energy meters, frequency meters, protective relays,fuses and all other equipment etc. required for complete operation shall be provided in the incomers.
- PT shall be provided to measure the bus voltage alongwith relays.
- Current, voltage and energy measurement shall be provided to SAS.
- Bus bar shall be of copper with bus bar rating as 2000A, 25kA for 3 sec with adequate current density. Earth bus bar shall also be of copper.
- Interlocks **with DG set** shall be provided as per requirement and the same shall

be decided during detailed engineering.

- The cable from station service to Main ACDB shall be 1.1kV, 1C, 1000sqmm, 2 runs for each phase and 1 run for neutral. The size of the cable may vary during detailed engineering.
- All outgoing feeders shall be provided with ACB and MCCBs as required.

v) Sub ACDB: (415 V)

Incomer

1. Incomer from ACDB 1 to sub ACDB 1 and Incomer from ACDB 2 to sub ACDB 2 through MCCB and CT (of requisite rating)
2. Bus coupling between sub ACDB 1 and sub ACDB 2 through 2 nos MCCB and 2 nos CT (of requisite rating)
3. DG incomer (with AMF Panel) shall be connected to Sub ACDB-1 and Sub-ACDB -2
4. Ammeters, voltmeters, energy meters, frequency meters, protective relays **(SC, O/L,E/F)**, fuses and all other equipment etc. required for complete operation shall be provided in the incomers.
5. PT shall be provided to measure the bus voltage alongwith relays.
6. Current, voltage and energy measurement shall be provided to SAS.
7. Bus bar shall be of copper with adequate bus bar rating with adequate current density. Earth bus bar shall also be of copper.
8. Interlocks shall be provided as per requirement and the same shall be decided during detailed engineering.
9. For all motor feeders shall be provided with all required protective relays.
10. All outgoing feeders shall be provided with MCCBs.

vi) MLDB:

The MLDB (Main Lighting Distribution Board) shall consist of –

- Two nos. 415 V Air Circuit Breaker as Incomer I & Incomer II from Main ACDB (through 2 nos. of Lighting transformers 400V / 400V, delta / star, Z% ~ 4.5, air cooled, dry type) and one no Air Circuit Breaker as Bus –Sectionaliser.
- Current, voltage and energy measurement shall be provided to SAS.
- Ammeters, voltmeters, energy meters, frequency meters, protective relays, fuses and all other equipments etc. required for complete operation shall be provided in the incomers.
- Bus bar shall be of copper with adequate bus bar rating, with adequate current density. Earth bus bar shall also be of copper.
- Interlocks shall be provided as per requirement and the same shall be decided during detailed engineering.
- All outgoing feeders shall be provided with MCCBs.

vii) ELDB: Emergency Lighting Distribution Boards

- Two nos. 415 V MCCB as Incomer I & Incomer II from Main MLDB and one no MCCB as Bus–Sectionaliser. One Lighting transformer shall be provided for ELDB (415/415V, 50KVA).
- Current, voltage and energy measurement shall be provided to SAS.
- Ammeters, voltmeters, energy meters, frequency meters, protective relays, fuses and all other equipments etc. required for complete operation shall be provided in the incomers.

- Bus bar shall be of copper with adequate bus bar rating, with adequate current density. Earth bus bar shall also be of copper.
- Interlocks shall be provided as per requirement and the same shall be decided during detailed engineering.
- All outgoing feeders shall be provided with MCCBs.

27.6 INTERLOCK LOGIC :

Electrical & Mechanical interlocking arrangement with Trip logic between the air circuit breakers **of sub ACDB 1 and sub ACDB 2 and DG** are tobe provided.

A. Interlocking of Incomer I & Incomer II with Bus Section Breaker:

1. Under normal condition (i.e. when supply is available through both the incomers), incomers I & II shall be in closed condition, Closing of Bus Coupler breaker shall be prohibited.

2. In case of failure of either of the sources, the incomer of that source shall trip through Under-Voltage relay and Bus coupler shall be allowed to close. After restoration, the respective incomer shall be allowed to close only after opening of Bus coupler breaker.

3. The above electrical interlock should be done through Breaker auxiliary contact switch.

4. Any other interlock logic shall be decided during detailed engineering.

5. A truth table and a load list shall be provided for all the distribution boards.

B. Interlocking of Incomer I & Incomer II of Sub-ACDB with DG-Incomer Breaker:

1. Under normal condition (i.e. when supply is available through both the incomers), incomers I & II shall be in closed condition, Closing of DG-Incomer breaker shallbe prohibited.

2. In case of failure of either of the sources, the incomer of that source shall trip through Under-Voltage relay and Bus coupler shall be allowed to close, but Closing of DG-Incomer breaker shall be prohibited.

3. In case of failure of supply of both the incomers, both the incomer alongwith bus coupler shall trip through Under- Voltage relay and DG set breaker shall be allowed to switch on. After restoration, the incomer breakers shall be allowed to close only after opening of DG set breaker. Time delay relay shall be used to obtain the interlock logic.

4. The above electrical interlock should be done through Breaker auxiliary contact switches.

The interlock schemes may be modified during detailed engineering as per AEGCLs requirement and ease of operation.

27.7 TYPICAL FEEDER DISTRIBUTION OF SUBSTATION:

A. GENERAL (Exact Quantity will be finalised at the time of Detailed Engineering and within the scope of bidder. Generally, **MCCB shall be considered**. In case of exigency, SFU can be used by taking prior written approval from AEGCL approving engineer.): Cable sizes shall be considered as per the load.

1. INTERCHANGEABILITY :

All similar material and movable parts shall be interchangeable with each other. Such as the breakers, switches, contactors etc. shall be easily removable as a complete unit from the switch boards and shall be capable of being put into similar position in other switch boards for performing identical function.

2. CONSTRUCTION :

The switch boards shall be of multi-cubicle or multi box factory-built air-insulated type, fully enclosed with doors for access to the interior. 3.00 mm. thick steel sheet shall be used for the fabrication of the panels. Boards shall be easily extendible on both sides, by the addition of the vertical section after removing the end covers.

The complete panels shall not be more than 2450 mm. high with the channel base and the depth shall be preferably within 1000 mm. wide measured from rear to front faces. The working height shall be minimum 450 mm. to maximum 2000 mm. The width of the panel shall depend upon the no. of circuits to be accommodated.

All boards shall be divided into distinct vertical sections each comprising of :

(i) A completely enclosed bus bar compartment for running horizontal and vertical COPPER bus bars. Bus bar chamber shall be completely enclosed with metallicportions. Bolted covers shall be provided for access to horizontal and vertical bus bars and all joints for repair and maintenance, which shall be feasible without

disturbing feeder compartment. Proper ventilation arrangement shall have to be arranged and that shall be decided by the purchaser at the time of approval of drawings

(ii) Completely enclosed switchgear compartments one for each circuit for housing Air circuit breaker or SFU or MCB or MCCB or motor starter.

(iii) A compartment for power and control cable. Door of compartment shall be hinged. Cable compartment shall have no communication with bus bar chamber.

(iv) A compartment for relays and other control devices associated with a circuit breaker. The panels shall be designed to facilitate cable entry from the bottom through entryholes of removable gland plates provided at the bottom of the cubicle. All the accessories required for terminations of cables in the ACDB such as cable gland,terminal block etc. shall be within the scope of supply.

(v) Doors shall have pad locking facilities.

After isolation of power and control circuit connections it shall be possible to safely carry out maintenance in a compartment with the bus bar and adjacent circuit live. Necessary shrouding arrangement shall be provided for this purpose over the cable terminations located in cable alley.

In case of providing two incomers air circuit breaker in the same vertical section, insulating barriers and shroud shall be provided in the rear cable compartment in order to avoid accidental touch with live parts of one circuit when working on the other circuit.

The connections from bus bars to main switch shall be fully insulated/shrouded and securely bolted. The partition between the feeder compartment and cable alley may be non-metallic and shall allow cables cores with lugs to be easily inserted in the feeder compartment for termination.

The switch board shall be dust proof, vermin proof, rodent proof and suitable for use in tropical climate. All ventilating louvers and holes shall be covered with fine wire mesh from inside. Necessary pre-treatmentof the panel surface is to be done by seven tank process followed by 2 coats of polyurethane/enamel paint. The colour of the exterior of the panel shall be **RAL-7032** as that of the main control and relay panel. The colour of the interior panel should be as to provide a colour contrasting background for the wiring Inside the cubicle.

The switchboards shall be mounted on channel and shall be complete with channel bottom plates made of structural steel, grouting bolts, earthing bolts, washers, cable glands etc.

Both the single and three phase switches as well as the fuse terminals provided on the panel shall be of best quality and easy in operation.

The tentative entries of power and control cable shall be from bottom.

Adapter panels and dummy panels required to meet the various bus bar arrangements andlayout required shall be included in Bidder's scope of works.

All modules shall be fixed type except air circuit breaker module which shall be draw out type. All disconnecting contacts for power circuits shall be of robust design and fully self-aligning.

Fixed and moving contacts of the power draw out contact system shall be silver-plated andboth fixed and moving contacts shall be replaceable. Silver plating shall not be less than 25 microns.

All Distribution Boards shall be single front type.

All single front board shall be provided with removable bolted covers at the rear. The coversshall be provided with danger levels.

Sheet steel barriers shall be provided between two adjacent panels running to the full heightof the switch board, except for the horizontal bus bar compartment.

A. POWER BUS BARS AND INSULATORS

Bus bars shall be of Copper, liberally sized for the specified continuous current rating as per approved scheme and short circuit current rating of 50 KA (rms) for 3 sec. Necessary precaution shall be taken to avoid bimetallic action. Means shall be provided for identifying various phases of bus bars by red, yellow and blue paint. The cross section of the bus bars shall be uniform through out the length of switch gear.

Bus support shall be of arc resistant, non-tracking, low absorption type installations of highimpact strength to withstand normal as well as fault condition stresses.

i. EARTH BUS : A copper earthing shall be provided at the bottom of each panel and shall extend through out the length of switchboard. It shall be welded/bolted to the frame work of each panel and breaker earthing contact bar. Vertical bus shall be provided in each vertical section which shall in turn be bolted/welded to main horizontal ground bus. Bimetallic connection shall be provided to connect the earth bus with the main substation earth bus.

ii. The earth bus shall have sufficient cross section to carry momentary short

circuit and short time fault currents to earth bus without exceeding the allowable temperature rise.(Preferably 65x12 or higher as per calculation)

iii. The horizontal earth bus shall be projected out of the switch board ends and shall have pre-drilled holes for bolted connection between this bus to sub-station earthing conductor. A joint spaced and taps to earth bus shall be made through at least two bolts.

iv. All non-current metal works of the switch board shall be effectively bonded to the earth bus.

B. AIR CIRCUIT BREAKERS : (For two incomers and bus sectionaliser of ACDB and DG)

i) Incoming and Bus sectionalizer air circuit breaker shall be four pole air break horizontal draw out type and shall have inherent fault making and breaking capacities as per requirement. All the poles of circuit breakers shall open and close simultaneously. The neutral pole shall be 100% rated.

ii) Circuit breakers shall be mounted along with it operating mechanism on a wheeled carriage. Suitable guides shall be provided to minimise misalignment of the breaker.

iii) There shall be 'Service', 'Test' 'ISOLATED' and 'MAINTENANCE' positions for the breakers. In 'Test' position the circuit breaker shall be capable of being tested for operation without energising the power circuits i.e. the power Contacts shall be disconnected while the Control circuits shall remain undisturbed. Locking facilities shall be provided so as to prevent movement of the circuit breaker from the 'SERVICE', 'TEST'. It shall be possible to close the door in 'TEST' position.

iv) There should be provision for locking the air circuit breaker in 'ISOLATED' position to achieve mechanical interlocking with Incomer & Bus sectionalizer Air Circuit Breakers.

v) All circuit breakers shall be provided with 8 NO and 8 NC potentially free auxiliary contacts with additional 20% spare. These contacts shall be in addition to those required for internal mechanism of the breaker. Separate limit switches each having required number of contacts shall be provided in both 'SERVICE' & 'TEST' position of the breaker. All contacts shall be rated for making continuously carrying and breaking 10 Amps at 240 V AC and 2 Amp at 220 V DC.

vi) Suitable mechanical indications shall be provided on all circuit breakers to show 'OPEN', 'CLOSE', 'SERVICE', 'TEST', ISOLATED and 'SPRING CHARGED' positions.

vii) Movement of a circuit breaker between SERVICE AND TEST positions shall not be possible unless it is in OPEN position. Racking interlock for this shall be provided.

viii) Closing of a circuit breaker shall not be possible unless it is in SERVICE, TEST POSITION or in FULLY WITHDRAWN POSITION.

ix) Circuit breaker cubicles shall be provided with safety shutters operated automatically by the movement of the circuit breaker carriage to cover the stationary isolated contacts when the breaker is withdrawn. It shall however, be

possible to open the shutters intentionally, against spring pressure for testing purpose.

x) A breaker of particular rating shall be prevented from insertion in a cubicle of a different rating. The ACB's shall have rating error preventor to achieve this.

xi) Circuit breakers shall be provided with electrical anti-pumping and trip free feature even if mechanical anti-pumping feature is provided.

xii) Mechanical tripping shall be possible by means of front mounted RED 'Trip' push-button. In case of electrically operated breakers these push-buttons shall be shrouded to prevent accidental operation.

xiii) Power operated mechanism shall be provided with a universal motor suitable for operation 220V DC Control supply with voltage variation from 85% to 110% rated voltage. Motor insulation shall be class 'E' or better.

xiv) Once the closing springs are discharged, after the one closing operation of circuit breaker, it shall automatically initiate, recharging of the spring. The motor shall be such that it requires not more than 30 seconds for fully charging the closing spring.

xv) The mechanism shall be such that as long as power is available to the motor, a continuous sequence of closing and opening operations shall be possible. After failure of power supply at least one open-close-open operation shall be possible.

xvi) Provision shall be made for emergency manual charging and as soon as this manual charging handle is coupled, the motor shall automatically get mechanically decoupled.

xvii) All circuit breakers shall be provided with closing and 2 trip coils. The closing coils shall operate correctly at all values of Voltage between 85% to 110% at rated control voltage. The trip coils shall operate satisfactorily under all values of supply voltage between 70% to 110% of rated control voltage Trip ckt supervision shall be provided for both the trip coils.

xviii) The door of the circuit breaker compartment shall be interlocked so that (1) door cannot be opened while the breaker is in closed position and (2) when the door is open the breaker cannot be closed. However, facility to defeat this interlock shall be provided for testing purpose.

i) Provision for mechanical closing of the breaker only in 'TEST' and 'WITHDRAWN' positions shall be made.

ii) Air Circuit Breakers shall be from one of the following manufacturer's complying with technical specification & relevant IS & IEC

- M/s Siemens
- M/s L & T
- M/s ABB
- M/s Schneider
- M/s GE

C. SWITCH FUSE UNIT (SFU), MOULDED CASE CIRCUIT BREAKER (MCCB) AND (MCB)

i) SFU / MCCB shall be 4 pole /2 pole, capable of safely breaking the fault current of the associated feeder. Rating of SFU / MCCB's shall be chosen by the contractor depending upon requirement of outgoing feeders and **as decided in detailed engineering stage and shall be subject to approval of AEGCL.**

ii) All the SFU / MCCB shall be flush mounted on AC Distribution boards provided with Rotary operating handle with clear ON-OFF trip indication.

iii) MCCBs shall be provided with thermo-magnetic type release for over current and short circuit protection. The o/c setting shall be adjustable type. The s/c settings shall be adjustable type.

iv) The setting range of thermal release and breaking capacity of MCCBs are to be specified and shall conform to system requirement. MCCB Knob shall indicate the true position of the equipment. MCCBs shall conform to relevant Indian Standard IS : 13947 Part 2 and shall be of P2 duty.

v) AC switch board shall be installed in a separate ACDB room other than control room for 400/220/132/33KV S/stn. For tripping of any of the outgoing feeder, visual and audible alarm arrangement shall be provided in the AC Board. However arrangement has to be made for getting audible alarm at the control room for the knowledge of the operator regarding tripping of the outgoing feeders. Necessary arrangement shall also be provided for acceptance and resetting of the audible alarm. In case of tripping of Incoming feeder breaker or Bus sectionalizing breaker, arrangement of both audible and visual annunciation shall be made both at AC Board as well in Control room. Acceptance and resetting arrangement is to be provided.

vi) Interlocks shall be provided such that it is possible to open the cubicle door only when theSFU / MCCB/MCB is in 'OFF' position and to close the SFU / MCCB/MCB when the door is closed.

vii) Miniature Circuit Breaker (MCB) shall conform to IEC:898-1987 and IS:8828.

viii) SFU, MCCB & MCB shall be from one of the following manufacturer's complying with technicalspecification & relevant IS & IEC

a) M/s Siemens
b) M/s L & T
c) M/s ABB
d) M/s Schneider
e) M/s GE

In this project, MCCBs and MCBs shall only be used. MCBs shall be used below 15A.

D. CONTROL AND SELECTOR SWITCHES :

a) Control and Selector switches shall be rotary type with escutcheon plates clearly marked to show the junction and positions. Switches shall be of sturdy construction suitable for making on panel front.

b) Voltmeter selector switches shall have four stay put position with adequate no. ofcontacts for 3-phase 4-wire system. These shall be oval

handles. .

c) Contacts of the switches shall be spring assisted and shall be of suitable material forgiving long trouble free services.

d) Contact ratings shall be at least the followings :

(i) Make and carry continuously : 10 Amp.

(ii) Breaking current at 240VAC :4KA (at 0.3 p.f.lagging)

E. AIR BREAK SWITCHES :

a) Air breaker switch shall be of heavy duty, single throw group operated, load break, faultmake type complying IS:4046.

b) Switch operating handles shall be provided with pad locking facilities to lock them in 'OFF' position.

c) All switches shall be adequately rated so as to be fully protected by the associated fuses during all abnormal conditions such as over load, locked motor, short circuit etc.

d) Interlock shall be provided so that cubicle door can only be opened when the switch is in 'OFF' position and to close the switch only when the door is closed. However, suitable means shall also be provided to intentionally defeat the interlocks as mentioned above.

e) Switches and fuses MCCB/MCB for AC control supply and heater supply wherever required shall be mounted inside the cubicles.

F. INDICATING LAMPS OF CONTROL SWITCHES :

Indicating lamps shall be of the panel mounting cluster LED type. The lamps shall have suitable size plates marked with its function, wherever necessary.

Lamps shall have translucent lamp covers of the following colours.

RED	Breaker Closed.
GREEN	Breaker Open
WHITE	Breaker Auto-Trip
BLUE	For all healthy condition. (e.g. Control supply and also for "SPRING CHARGED" and "TRIP CIRCUIT HEALTHY")

AMBER For all alarm conditions (e.g. overload).

Separate indication lamps for 'SERVICE', ISOLATED and 'TEST' positions shall be provided.

G. SPACE HEATERS :

Space heaters shall be provided for preventing harmful moisture condensation in all the AC Boards. The space heaters shall be suitable for continuous operation on 240 V AC,50 HZ,1-phase supply and shall be automatically controlled by thermostats. Necessary isolating switches and fuses shall also be provided.

H. INTERNAL WIRING AND TERMINAL BLOCK :

(a) All switch boards shall be supplied completely wired internally upto the terminal blocks.

(b) All inter cubicle and inter panel wiring and connections between panel of same switch board including all bus wiring for AC and DC supplies shall be provided by the contractor.

(c) All internal wiring shall be carried out with XLPE insulated, stranded copper conductor, 1.1kV, single core, 2.5 sq. mm. or larger stranded copper wires. CT Ckts. shall be wired with 4 sq. mm. voltage grade and insulation of copper wires shall be same as above. Voltage drop shall be allowed only in the tune of 3% at the remote end of the longest outgoing feeder from the AC Panel board and 15% drop in case of starting of motor of the remote end.

(d) All wiring shall be properly supported, neatly bunched, readily accessible and securely connected to equipment terminals and terminal blocks.

(e) Each wire shall be identified at both ends and shall be properly tagged and ferruled in compliance with approved drawings. Wires shall not be spliced or tapped between terminal points.

(f) Terminal blocks shall be of 1100 V grade 'Elmex/connect well' make and have continuous rating to carry the maximum expected current on the terminals. The terminal blocks shall be fully enclosed with removable covers of transparent, non-deteriorating type plastic material. Insulating barrier shall be provided between the terminal. The terminal blocks shall

have locking arrangement to prevent its escape from the rails. **30% spare terminals are to be provided on all terminal blocks.**

(g) Terminal blocks for CT secondary leads shall be provided with test links and isolating facilities. CT secondary leads shall be provided with short circuiting and earthing facilities. Jam nut should be provided with shorting link.

(h) All terminal blocks shall be normally suitable for terminating on each side, two (2) nos. of
2.5 mm. sq. size stranded copper conductor. However, terminal blocks to be used in conjunctive with CT shall be suitable for terminating 4 sq. mm. single core Copper wires.

(i) All terminals **shall be ring type** and numbered for identification and grouped according to the function. Engraved white on-black labels shall be provided on the terminal blocks.

(j) Terminal blocks shall be arranged with at least **200 mm**. clearance between two sets of terminal block. The minimum clearance between the first row of terminal block and the associated cable gland plate shall be 250mm.

I. POWER CABLE TERMINATIONS :

(a) Cable termination compartment and arrangement for power cables shall be suitable for stranded copper Conductor, armoured XLPE insulated and sheathed 4 / 3.5 -core, 1100V grade.

(b) All necessary cable terminating accessories such as Gland plates, supporting clamps and brackets, power cable lugs, hardware etc. shall be provided by the contractor to suit the final cable sizes.

(c) The gland plate shall be of removable type and shall cover the entire cable alley. Bidder shall also ensure that sufficient space is provided for all cable termination.

J. GROUNDING :

An copper strip ground bus rated to carry maximum fault current for the specified duration shall be provided along the entire length of the distribution board.

Each casing of the equipments, relays, instruments provided in the board shall be connected directly to the ground bus by independent stranded copper wires of not less than 2.5 sq. mm.The earth bus shall have sufficient cross-section to carry the momentary short circuit and short time fault currents to earth

without exceeding the allowable temperature rise. The ground bus shall be brought out to two terminals at the two ends of the switch board for Connecting G.S. Flat of 65×12mm for all voltage classes. CT & PT secondary neutral pointshall be at one place only on the terminal block. Such earthing shall be made through links.

K. TROPICAL FINISH :

All electrical equipment, accessories and insulation of wiring shall have fungus protection involving special treatment on insulation and metal against fungus, insect and corrosion.

L. INSULATION :

The insulation at any point in the distribution board shall be of 1.1 KV grade.

27.8 ASSOCIATED EQUIPMNET AND ACCESSORIES:

A. CABLE GLANDS :

All feeders shall be provided with suitable dust tight screwed brass **double compression cable** glands conforming to the relevant IS standard.

Gland shall project above the gland plate. Terminating cables shall be armoured and the armour rods shall be connected to earth bar.

B. METERS :

The accuracy class of Electronic type KWH meter shall be 0.2. One KWH meter of 3-phase, 4-wire type shall be flush mounted on each of the incoming breaker compartments of **Main ACDB/DG**, Ammeter and voltmeter shall be of 72*144sq.mm and of flush mounting digital type with accuracy +/- 1% of full scale. The meters shall conform to the appropriate IS specification. All circuitsof the meters shall be capable of withstanding 20% overload for a period of at least 8 hours.Three no. digital Ammeter and one no digital Voltmeter shall be provided for each incoming CB's of Main ACDB/Sub ACDB's with voltmeter selectors with and ammeter selector switch.

C. NUMERICAL RELAYS :

All the protections shall be of numerical type (shall be as per make list) and supported by Test Certificates from Govt. recognized Test house and performance certificates from Govt./Power Utilities.

The relay shall have –

a) Minimum two characteristics, one IDMT of 3 sec. and the other one of definite time characteristic and the same should be site selectable.
b) Wide range of time and current setting in very small steps without sacrificing the relay characteristics.
c) Tripping indication for different type of faults until reset by the operator.
d) Continuous self supervision along with self diagnostic feature for faults within the relay and the relay should have potential free 'Change over Contact' for annunciation in the eventof internal failure.
e) Output contacts having sufficient current rating to directly energise trip coil of circuitbreaker.
f) LED indication facility for visual annunciation of different type of faults including phaseidentification.
g) Individually site selectable binary Output and Input and latching option for binary Output.

Motor starters shall be provided with ambient temp. compensated, time lagged, hand reset type over load relays with adjustable settings ranges to suit motor ratings. These relays shall have separate black coloured hand reset push button mounted on compartment door and shall have at least one changeover contact.

D. INSTRUMENT TRANSFORMER (FOR 400/220/132/33KV SUBSTATION) :

All current and voltage transformers shall be completely encapsulated cast resin insulated wound type suitable for continuous operation at the temperature prevailing inside the switch gear enclosures, when the switch board is operating at its rated condition and the outside ambient temperature is 50^{o}C.

All instrument transformers shall be able to withstand the thermal and mechanical stresses resulting from the maximum short circuit.

All instrument transformers shall have clear indelible polarity markings.

The insulation level of C.T shall be suitable for 1.1 KV grade. C.T. for 400KV portion shall be 2500/1A, 3 core type of which one core for metering and second core for protection. The third core of the C.T shall be used for REF protection and particulars shall be 20 VA, 5P20. The REF relay shall be mounted in the 33 KV C & R panel and the respective LT side phase C.T cores for REF protection shall be terminated to the terminal block of the AC panel.

All voltage transformers shall have readily accessible HRC current limiting fuses on both primary and secondary sides.

27.9 NAMEPLATES AND LABELS :

ACDB shall be provided with prominent, engraved **anodized** identification plates. The module identification plate shall clearly give feeder number and feeder designation. For single front switchboards, similar panel and board identification labels shall be provided at the rear also.

All name plates shall be non-rusting metal or 3-ply lamicold with white engraved lettering on black base ground. Suitable plastic sticker labels shall be provided for easy identification of all equipments, located inside the panel / module. These labels shall be positioned so as to be clearly visible and shall give device number as mentioned in the module wiring.

27.10 PACKING AND DESPATCH :

All equipments shall have to be dispatched suitably and securely packed in wooden crates, suitable for handling during transit by rail and / or road.

27.11 CONTRACT DRAWING & CATALOGUE :

A. After placement of Letter of Award **four (**4) copies of following drawings, GTP and literature shall be submitted to the AEGCL for approval :

i) Single line diagram of each AC Board.

ii) General Arrangementdrawingshowingdimensionsoffrontandrearvi

ewofeachswitch board with relay instruments and other devices position marked. Height, width, depth and ground fixing arrangement shall have to be indicated.
iii) Schematic wiring diagram for each switchboard.
iv) Catalogue on each type of circuit breaker, MCCB, switches, fuse, relays, meters etc. offered. The list of drawing shall be furnished in the schedule attached herein.

27.12 TESTS AT MANUFACTURER'S WORKS AND TEST CERTIFICATES :

A. Acceptance and routine test at manufacturer's works shall be carried out on each AC Board as per stipulation of relevant Indian Standard. The entire cost of acceptance and routine tests are to be carried out shall be treated as included in the quoted price of allDistribution Board.

All the acceptance and routine tests shall be carried out in presence of representative of AEGCL. Three (3) copies of test reports shall be submitted to the AEGCL for approval anddistribution to site.

B. The Contractor shall give at least 15 (fifteen) days advance notice intimating the actualdate of inspection and details of all tests that are to be carried out.

27.13 GUARANTEE :

Electrical characteristic shall be guaranteed by the bidder. In case of failure of materials to meet the guarantee, AEGCL shall have right to reject the material. Guaranteed Technical Particulars are to be submitted by successful bidder during detailed engineering along with submitted drawings/documents. However format for submission of GTP shall be handed over to intending bidders at the time of Sale of tender document.

SPECIFIC TECHNICAL PARAMETERS OF AC DISTRIBUTION BOARDS

The following particulars are to be complied with :

SL NO	DESCRIPTION		TECHNICAL PARAMETERS
1.	DIMENSIONS :		
	i)	Height of complete panel (mm)	2450 (Max.)
	ii)	Working height (mm)	450 (Min.) to 2000 (Max.)
	iii)	Depth (mm)	1000 (Max.) for outgoing panel & 1500(Max) for Air C.B. panel.
	iv)	Length of the panel (mm)	As per requirement
2.	Sheet steel thickness of Panel (mm)		3 (Min.)
3.	Insulation Level of Equipments and Wiring (KV)		1.1
4.	Minimum Rating of Fuses (Amps.)		Not less than 16
5.	Spring operated Air Circuit Breaker/ SFU / MCCBfault current breaking Capacity (KA)		50
6.	Voltmeter Range / Rating (Volts)		0 to 500
7.	Ammeter Range with Current Transformer (Amps)		As per requirement. Shall be decided during detailed engineering
8.	LT AC AIR CIRCUIT BREAKER :		
	i)	System Voltage	400 V AC +/- 10%
	ii)	Insulation Voltage	1.1 KV 1.2
	iii)	Rated Imp withstand voltage of main CktUimp	8 KV
	iv)	Rated Imp withstand voltage of Aux CktUimp	4 KV
	v)	Ambient Temperature	50°C
	vi)	Rated frequency	50 Hz
	vii)	Rated Continuous Current at 50°C	2000A for 1MVA transformer
	viii)	a) Ultimate Short Ckt Breaking CapacityIcu	50KA
		b) Service Short Ckt Breaking CapacityIcs	100% of Icu
		c) Withstand Short Ckt BreakingCapacity Icw	50 KA for 1 Sec
		d) Rated Making Capacity Icm	105 KA

	ix)	Utilisation Category	B
	x)	Suitable Isolation	Yes
	xi)	No. of Poles	4 Pole
	xii)	a) Opening Time	40-60 ms
		b) Closing Time	60-80 ms
	xiii)	Type of Breaker	Electrical Draw Out
	xiv)	a) Spring Charging Voltage	230 V AC/220V DC
		b) Permissible Variation in Voltage	85% to 110%
		c) Spring Charging Time	7-10 Sec
	xv)	a) Closing Coil Voltage	220 V DC
		b) Permissible Variation in Voltage	85% to 110%
	xvi)	a) Tripping Coil Voltage	220 V DC
		b) Permissible Variation in Voltage	70% to 120%
	xvii)	a) Mechanical Life	20,000
		b) Electrical Life with maintenance(changing arcing Contracts)	20,000
	xviii)	Termination suitable for Aluminium as per IS 13947 Part-II	Yes
	xix)	Insulation Material conforming to Glow Wire Test	Yes
	xx)	Mechanical Interlock for Incomer & BusCoupler	Yes via Castel Lock
	xxi)	Rated duration of Short Circuit Current	3 Sec
	xxii)	Maximum Temperature rise aboveAmbient at Rated Current	50°C
	xxiii)	Rated Operating Duty	O – 0.3 Sec – CO – 3 Min – CO
	xxiv)	Rated Short Circuit Breaking Capacity	30 MVA
9.	BUSBAR :		
	i)	Rated	As required.
	ii)	Short circuit withstand current	50KA (rms) for 400KV substation,**40KA** (rms) for 220 & 132KV substation
	iii)	Duration of Short Circuit	3 second
	iv)	Rupturing withstand current	106.56 (peak) KA
	v)	Temp. rise above ambient at rated current	50°C
	vi)	Made of Aluminium of current density nothigher than	As per requirement
	vii)	Insulation voltage	1.1KV
10.	SWITCHES (SFU / MCCB) :		
	i)	System Voltage	415 V AC ± 10%
	ii)	Insulating Voltage	1.1 KV
	iii)	Rated Imp withstand Voltage of main CktUimp	8 KV
	iv)	Ambient Temperature	50°C
	v)	Rated Frequency	50 Hz
	vi)	Rated Continuous Current at 50°C	As per Rating
	vii)	Ultimate Short Ckt Breaking Capacity Icu	35 KA
		Service Short Ckt Breaking Capacity Ics	100% of Icu
	viii)	Utilisation Category	A
	ix)	Suitable for Isolation	Yes

	x)	No. of Poles	4 Pole or 2 Pole – as per requirement
	xi)	a) Shunt Release Voltage	220 V DC
		b) Permissible Variation in Voltage	85% to 110%
	xii)	Termination suitable for Aluminium as per IS 13947 Part-II	Yes
	xiii)	Insulation Material conforming to Glow Wire Test	Yes
	xiv)	Thermal Over load Settings	Adjustable
	xv)	Short Circuit Setting	Adjustable for 4 Pole and Fixed for 2Pole
11.	FUSE :		
	i)	Type	HRC
	ii)	Rupturing current	Less than breaker rupturing current
	iii)	Maximum rise of temperature at ratedcurrent fuse above ambient	50°C
	iv)	Link base	Mode of porcelain equivalent element

N.B. The outgoing feeders are meant for A.C supply to different control panel, protection panel, Battery charger, PLCC equipment, etc and Transformer auxiliary supply, CB/Isolator auxiliary supply,switchyard lighting, water supply, air conditioning system at control room building, fire fighting system, oil filtration and other auxiliary supply related to 400/220/132 KV sub-station.

The successful bidder is to supply AC distribution board to be finalized as per requirement during detailed engineering and as per approved drawings, which shall be within the scope of bidder.

27.14 Catalogue of all relays with characteristic curve shall be submitted with tender documents.

27.15 **Sub Vendor List for ACDB**

Sl No.	PRODUCT	MAKE
1	**METERS DIGITALANDANALOGUE** AMMETER,VOLTMETER,	MECO,SECURE,RISHABH, VAISHNO
2	**KWHMETER**	L&T, SECURE, RISHABH
3	**FREQUENCYMETER**	RISHABH, MECO, VAISHNO
4	**FUSE FITTING &FUSELINK**	COPPERBUSHMANN, ABB, SIEMENS, L&T, GE

5	**TRANSDUCERS**VOLTAGETRANSDUCER ,CURRENTTRANSDUCER,FREQUENCY TRANSDUCERETC.	ELSTER, RISHABH, SIEMENS
6	**CONTACTORS**	L&T, SIEMENS, SCHNEIDER, GE, ABB
8	**PROTECTION AND OTHER RELAYS**	ABB,GE,SIEMENS,Schneider
7	**SFU, MCCB,**	GE, ABB, L&T, SIEMENS, LEGRAND, SCHNEIDER
8	**MCB,**	SCHNEIDER,LEGRAND,ABB, SPRECHER &SCHUH(S&S)
9	**CT**	C&S, KAPPA, GILBERT MAXWELL, ABB,PRAGATI, GE, BHEL,SIEMENS
10	PT	C&S, KAPPA, GILBERT MAXWELL, CGL
11	**LTCONTROLSWITCHES**AMMETER, VOLTMETER SELECTOR SWITCHES, BREAKER CONTROL SWITCHES,ROTARY CAM/ROTARYSWITCH	KAYCEE, RECOM, SWITRON, VAISHNO, GE, ABB
12	**ANNUNCIATOR,HOOTER,BUZZER, ELECTRONIC BELL.**	PROTON,MINILEC,ALAN, VAISHNO.,PROCON,PIRI
13	**TERMINAL BLOCK,TERMINAL END PLATE**	ELMEX, CONNECTWELL
14	**SPACE HEATER**	SOFIA,GIRISH(EGO), VIKASELECT., GIRISH, APTCONTROL, KONTACT PYROS, TELELEC, HOTWELL,
15	**THERMOSTAT**	GIRISH(EGO),VIKASELECT., APTCONTROL, KONTACTPYROS
16	**PANELTUBE FIXTURE, CHOKE, STARTER,ILLUMINATION LAMP**	PHILIPS,BAJAJ
17	**3PIN SWITCH SOCKET(INDUSTRIAL/SERVICE)/RECEPTA CLE**	ANCHOR, CGL,SCHNEIDER, LEGRAND,ABB
18	**BUS BAR SUPPORTINSULATOR**	RAMANUJ,POWERMAT,VINAYAK,SU NINSULATOR, TECHNO, ESBEECONTROL
19	**PVC/FRLSWIRE**	KEI, POLYCAB, FINOLEX
20	**LUGS**	DOVELLS,COMET,JAIN ELECTRONICS,SJMETAL
21	**HARDWARE MS&SS**	TVS,KUNDAN,AGRWAL FASTENERS,FITRIGHT
22	**POWER PACKS**	ALAN
23	**INDICATING LAMP/LED,FILLAMENT LAMP**	L&T, GE,SIEMENS, SCHNEIDER
24	**PUSHBUTTONS WITH ELEMENTS**	L&T, ABB,SIEMENS
25	**ELECTRONICTIMER**	L&T, GE, ABB, SCHNEIDER, SIEMENS

26	**RUBBERGASKET (NEOPRINE/EPDM)**	MINERVARUBBER&ENGG IND.,HANUIND., JSONPOLYMER, RITTAL, R K PROFILE, ASP MINERVA, RKPROFILE
27	**M.S.CRCA/HRCASHEETS /COILS**	TATA,SAIL,ESSAR
28	**ALUMINIUMBUSBAR**	SUDAL,HINDALCO,JINDAL, BALCO
29	**COPPER BUSBAR**	VIJAY IND., NEW INDIA CUPROTEC, CUBEXTUBING LTD (HYDERABAD)., ALCOBEXJODHPUR(MUMBAI),,MODISONME TAL,CITIZENMETALLOYS(AHMEDABAD), RHJ EXTRUSION(DAMAN)
30	**LIMITSWITCH/DOORLIMIT SWITCH**	KAYCEE,RECOM,SIEMENS, VAISHNO, L&T
31	**ALLUMINIUM SHEET /STAINLESSSTEELSHEET/COILS**	ESSAR,BALCO, HINDALCO, SAIL, TATA
32	**OIL & WINDINGTEMPERATURE INDICATOR**	PRECIMEASURE,PERFECT CONTROL(CHENNAI)
33	**AIR CIRCUITBREAKER(ACB)**	L&T, GE, ABB, SCHNEIDER, SIEMENS
34	**TIMESWITCH**	L&T, GE, ABB, SCHNEIDER, SIEMENS
35	**2POLEAC/DCSWITCH**	GE, SCHNEIDER
36	**LIGHTING TRANSFORMER**	INDCOIL, GUJARATPLUGIN, LOGICSTAT

GUARANTEED TECHNICAL PARTICULARS FOR 400/230 VOLTS A.C. POWER DISTRIBUTION SWITCHBOARDS

(To be filled in and signed by the Bidder)

1	**ACDB GENERAL**	
1.01	Name of Manufacturer	
1.02	Location of the Factory	
1.03	Date of Last Type Test Done	
1.04	Conforming Standard	

1.05	Type & Model of the ACDB as per Manufacturer	
1.06	Dimension of Panel (L x B x H) -mm	
1.07	Total Number of Incoming& OutgoingCompartment	
2	**Bus-Bar Material**	
2.1	Dimension (Width x Thickness) -mm	
2.2	Continuous Current Rating in Amps	
2.3	Current density (Amp/Sq.cm.)	
3	Air Circuit breaker	
3.01	Manufacturer	
3.02	Type & Model as per manufacturer	
3.03	Conforming Standard	
3.04	No of Poles	
3.05	Opening / Closing Time (ms)	
3.06	**Current**	
3.06.1	Rated continuous current carrying capacity in Amps	
3.06.2	Rated SC Current at 415 V (KA rms)	
3.06.3	Making capacity	
3.06.4	Rated SC Breaking Current at 415 V (KA rms)capacity	
3.06.5	Short time ratings for 1 sec.	
3.07	**Voltage**	
3.07.1	Rated Voltage	
3.07.2	Basic Insulation Level	
3.07.3	Closing/Tripping Coil Voltage	
3.08	Maximum temperature rise above ambienttemperature of 50^{o}C	
3.09	CT provided with ACB	
3.09.1	Manufacturer	

3.09.2	Type as per manufacturer	
3.09.3	Number of Core	
3.09.4	Ratio	
3.09.5	VA burden	
3.09.6	Accuracy class	
3.09.7	Type of insulation	
4	Fuse Switch Unit / Switch Disconnctors	
4.01	Manufacturer	
4.02	Type/ Model as per manufacturer with numberof Poles	
4.03	Conforming Standard	
4.04	Voltage	
4.04.1	Rated Operational Volatge without derating	
4.04.2	Insulation Volatge	
4.04.3	Impulse Withstand Voltage	
4.05	Current	
4.05.1	Operational Current	
4.05.2	Conventional enclosed Thermal Current ratingat 45 ^{0} C	
4.05.3	AC 23 A Utilisation Category Rating at 415 V (A)	
4.05.4	DC 23 A Utilisation Category Rating at 220 V DC(A)	
4.05.5	Rated AC Making Capacity at 0.35 pf	
4.05.6	Rated AC Breaking Capacity at 0.35 pf	
4.05.7	Rated DC Making Capacity / DC BreakingCapacity at 220 V, L/R 15 ms	
4.05.8	Rated Conditional Fused SC Current (KArms)	
4.05.9	Back-up Fuse rating	
4.05.10	Maximum Cut Off Current permitted (Kap)	

4.05.11	Rated AC Capacitor Power (KVAr) at 415 V AC	
4.05.12	Mechanical Endurance Cycle (number)	
4.05.13	Electrical Endurance Cycle at 0.65 pf (number)	
4.05.14	Auxilary Contact Thermal rating (A)	
5	A.C. Meters / Energy Meters (Details for Ammeters, Voltmeters, Energy-meters shall befurnished separately)	
5.01	Manufacturer	
5.02	Type	
5.03	Range	
5.04	Accuracy	
5.05	Conforming Standard	

CHAPTER – 28: SPECIFICATION FOR DCDB

28.1 SCOPE:

a) This specification covers design, manufacture, assembly, testing, supply, and delivery at site of DC switchboard. This also includes design, supply,

commissioning, laying and termination of D.C. supply cables of 1.1KV grade XLPE insulated stranded Copper cables of different sizes as per requirement for distribution of D.C. supply at different points of switchyard, control room building, Fire-fighting pump house etc. for various purpose for 400/220/132/33KV sub-station.

DC PANEL

Two numbers of D.C. Panel for distribution of D.C. supply associated with DC Supply of 400, 220,132 and 33kV System at different points in Control Room, Switch Yard and other locations as per need. The DC Panel shall have Two Incomer connected with Battery Charger -1 & BatteryCharger -2 wrt to Battery set - 1 & Battery set - 2. The DC Panel shall have one BusCoupler with proper Interlocking for independent operation of each DC System.

28.2 STANDARDS :

The equipment covered by this specification shall unless otherwise stated, be designed, constructed and tested in accordance with the applicable sections of the latest Indian Standard Specification and Indian Electricity Rules and as per this technical specification. The degree of protection shall not be less than IP-54. However, Bus bar chamber having a degree of protection of IP:42 as per IS:2147 where continuous bas bar rating exceeds 1000A.

28.3 DEVIATION :

Normally the offer should be as per Technical Specification without any deviation, **In case of any deviation taken against technical specification same are to be submitted in a separate deviation sheet for review of AEGCL.**

28.4 MODIFICATION :

If any modification felt necessary to improve performance, efficiency and utility of equipment, the same must be mentioned in the 'Modification schedule' with reasons duly supported by documentary evidences and advantages. Such modifications suggested may or may not be accepted, but the same must be submitted along with Pre-Bid Queries. The modifications not mentioned in Schedule will not be considered.

28.5 GENERAL SPECIFICATION OF D.C. SWITCH BOARD :

220 (+/- 10%) volt D.C. supply shall be made available from the station storage battery banks associated with battery charger. In case of existing sub-station, sub-station wise DC voltage shall be intimated to the successful bidder. The charger and battery shall be connected to the load bus of D.C. switchboard through separate 2-pole MCCB of suitable rating. There shall be interlocking arrangement through pad locks and keys so that one breaker can be closed at a time.

The D.C. switch boards shall be of multi-cubicle on multi box factory build air insulated type, fully enclosed with doors for access to the interior, 3.00 mm. thick steel sheet shall be used for the fabrication of the panels. Steel used for manufacturing shall be of reputed MAKE. Boards shall be easily extendible on both side, by addition of the vertical sections after removing the end covers. Dimension shall not be more than 1800 mm. high with channel base and 800 mm depth (or as per requirement) measured from the rear to front face. The working height of the switch board shall be minimum 450 mm. to maximum 1650 mm. The back cover of the switch board shall be provided with hinged door with locking arrangement. Length of the panel shall be determined as per no of circuits to be accommodated. All boards shall be divided into distinct vertical sections each comprising of -

(i) A completely enclosed bus bar compartment for running horizontal and vertical Copper bus bar. Bus bar chamber shall be completely enclosed with metallic portions. Bolted covers shall be provided for access to horizontal and vertical bus bars and all joints for repair and maintenance, which shall be feasible without disturbing feeder compartment. Proper ventilation arrangement shall have to be arranged and that shall be decided by the purchaser at the time of approval. Bus bar rating shall be as per requirement with additional 30% margin.

(ii) Completely enclosed switchgear compartments one for each circuit for housing incoming MCCB and outgoing MCCB.

(iii) A compartment for power and control cables. Door of compartment shall be hinged. Cable compartment shall have no communication with bus bar chamber.

(iv) A compartment for relays and other control devices associated with Incoming MCCB.

28.6 **Design:**

i. The D.C. switch boards shall be designed to facilitate cable entry from the bottom through entry holes of removable plates provided at the bottom of the cubicle. All the accessories required for termination of cable in the DCDB such as screwed brass cable gland, terminal block etc. shall be within the scope of supply, Gland shall project above the gland plate. Terminating cable shall be armoured and armoured rods shall be connected to earth bus. After isolation of power and control circuit connections it shall be possible to safely carryoutmaintenance in a compartment with the bus bar and adjacent circuit live. Necessary shrouding arrangement shall be provided for this purpose over the cable terminations located in cable alley.

ii. In case of providing two incomer MCCB compartment in the same vertical section, insulating barriers and shroud shall be provided in the rear cable

compartment in order to avoid accidental touch with live part of one circuit when working with the other circuit.

iii. The connections from bus bars to main switch shall be fully insulated/shrouded and securely bolted. The partition between the feeder compartment and cable alley may be non-metallic and shall allow cable cores with lugs to be easily inserted in the feeder compartment for termination.

iv. Necessary and safe earthing arrangement with supply of all accessories required for safe earthing shall be within the scope of supply.

v. **A copper earthing bus bar** shall be provided at the bottom of each panel and shall extend through out the length of switchboard. It shall be welded/bolted to the frame work of each panel and breaker. Earthing contact bar vertical bus shall be providein each vertical section which shall in turn be bolted/welded to main horizontal ground bus.

vi. The earth bus shall have sufficient cross-section to carry momentary short circuit and short line fault currents to earth bus without exceeding the allowable temperature rise.

vii. The horizontal earth bus shall be projected out to the switchboard ends and shall have predrilled holes for bolted connection between this bus to sub-station earthing conductor. A joint spaced and taps to earth bus shall be made through at least two bolts.

viii. All non-current metal works of the switchboard shall be effectively connected to the earthbus.

ix. The switchboard shall be dust and vermin proof and suitable for use in tropical climate. All ventilating louvers and holes shall be covered with fine non-ferrous wire mesh from inside. A suitable rust resisting primer paint shall be applied on the panel after the same is polished and the primer shall be evenly sprayed. The colour of the exterior of the panel shall be of same colour as that of the main control and relay panel. The colour of the interior panel should be as to provide a colour contrasting background for the wiring inside the cubicle.

x. The switchboards shall be mounted on channel and shall be complete with channel bottom plates, grouting bolts, earthing bolts, washers, cable glands etc. Fabrication of the channels shall be robust.

xi. All the MCCB's shall be of best quality and easy in operation.

xii. The number of outgoing feeders shall be controlled by suitably rated MCCB. Necessary arrangement shall be kept especially for emergency sub-station control building lighting particularly in Control room, ACDB room, Battery room, Fire fighting pump house, Corridor, Lobby, Stairs and oter emergency loads etc. in case of failure of AC main supply. Provision for audio visual indication with lamp and bell with facility for manual cancellation & resetting of alarm for failure of D.C. supply to the load bus or blowing of any fuse of

D.C. circuit shall be made. Switchboard shall be installed in the DCDB room of control room building of 400/220/132/33KV sub-station. In case of tripping of any outgoing feeder MCCB, visual and audible alarm arrangement shall be provided in the DC Board as well as in the control room. Necessary arrangement shall also be provided for acceptance and resetting of the audible alarm. In case of tripping of Incoming feeder breaker, arrangement of both audible and visual annunciation shall be made at DC Board and control room. Acceptance and resetting arrangement is also to be provided. Visual indication of the failure of D.C. voltage at the load bus or blowing of any fuse can only be cancelled when the supply at bus will be restored or the fuse is replaced.

xiii. Adopter panels and dummy panels required to meet the various bus bar arrangements and layouts required shall be included in bidders' scope.

xiv. The temperature rise of horizontal and vertical bus bars when carrying rated current along its full run shall not exceed 55ºC with Silver plated joints and 40ºC with all other type of joints over an outside ambient temperature of 50ºC.

xv. All identical circuit breakers and module chassis of same test size shall be fully interchangeable without doing any modification work.

xvi. MCCB & MCB shall be from one of the following manufacturer's complying with technicalspecification & relevant IS & IEC

a) M/s Siemens
b) M/s L & T
c) M/s ABB
d) M/s Schneider

28.7 INTERNAL WIRING AND TERMINAL BLOCK :

28.7.1 All connection terminals shall be brought in the terminal block which shall be fixed in such a position as may be readily accessible.

28.7.2 All switchboards shall be supplied completely wired internally upto the terminal blocks.

28.7.3 All inter cubicle and inter panel wiring and connections between panels of same switchboard including all bus wiring for A.C. and D.C. supply shall be provided by the contractor.

28.7.4 All internal wiring shall be carried out with XLPE insulated stranded copper conductor 2.5 sq. mm. However for annunciation scheme wiring may be drawn with 1.5 sq. mm XLPE insulated stranded copper conductor.

28.7.5 All wiring shall be properly supported, neatly bunched, and readily accessible and securely connected to equipment terminals and terminal blocks.

28.7.6 There shall be ferrule marking at both ends of the connections. Red ferrule with positive marking shall be used for the positive terminals and white ferrule with negative marking for negative terminal for D.C. wiring.

28.7.7 Each wire shall be continuous and there shall not be any joint within itself. Wiring for meter, relays, instruments and MCCB etc. used in the switchboard shall be brought to the terminal block.

28.7.8 Terminal blocks shall be of 1100V grade 'Elmex' / 'Connectwell' make and have continuous rating to carry the maximum expected current on the terminals as well as short circuit current for specified duration. The terminal blocks shall be fully enclosed with removable covers of transparent, non-deteriorating type plastic material. Insulating barrier shall be provided between the terminals. The terminal blocks shall have locking arrangement to prevent its escape from the rails.

28.7.9 All terminal blocks shall be normally suitable for terminating on each side two nos. of 2.5 sq. mm. size stranded copper conductor.

28.7.10 If required TBs of other sizes shall also be provided.

28.7.11 All terminals shall be numbered for identification and grouped according to the function. Engraved white on black **anodized aluminum** labels shall be provided on the terminal blocks.

28.7.12 Terminal blocks shall be arranged with at least 200 mm clearance between two sets of terminal block. The minimum clearance between the first row of terminal block and the associated cable gland plate shall be 250 mm.

28.7.13 Interlocks shall be designed for both the incomer breakers and bus coupler breaker. Interock logics shall be decided during detailed engineering.

28.8 NAMEPLATES AND LABELS :

D.C. distribution boards shall be provided with prominent, engraved identification plates. The module identification plate shall clearly give the feeder number and feeder designation. For single front switchboards, similar panel and board identification labels shall be provided at the rear also.

28.9 EQUIPMENT AND OTHER TECHNICAL INFORMATION FOR D.C. SWITCHBOARD :

28.9.1 One set of copper bus bar of adequate continuous rating as well as specified short circuit rating of specific duration, having continuous current density shall be provided.

28.9.2 Aux. Relay and contactor for alarm as well as visual indication against tripping of incoming MCCB as well as outgoing feeder MCCB shall be provided. However, indication will not go off till the restoration of failure.

28.9.3 'ON', 'OFF' and 'TRIP' indicating lamps for both the incoming MCCB along with required number of push button shall be within the scope of supply.

28.9.4 Digital D.C. voltmeters having a scale range of 0-300 V.D.C. flush mounted, type having accuracy. +/- 1% of full scale, shall be provided as per requirement. The meters shall conform to the appropriate IS specification.

28.9.5 Digital D.C. ammeters, flush mounted, having range of 0-300 Amps. and accuracy +/- 1% of full scale, shall be provided for measurement of load current flowing to the D.C. switchboard. Rating of ammeter hall change if the load requirement is changed. Changed rating meters shall be under the scope of the successful bidder.

28.9.6 The ampere rating of MCCB for feeder protection shall be as per requirement of the feeder current but shall not be less than 32 Amps.

28.9.7 Doors at the back of the panel shall be provided for inspection with door switch for illumination of the lamp to be provided inside the panel with separate switch fuse unit for controlling the lamp.

28.9.8 All the indicating lamps shall be of panel mounting cluster LED type. The lamps shall have suitable size plates marked with its function, wherever necessary. Lamps shall have translucent lamp covers of 'RED', 'GREEN' & 'WHITE' colour for indicating , 'ON', 'OFF' and 'AUTO-TRIP' indication of incoming MCCB's. One no. Indicating lamp is to be provided for tripping of outgoing feeder & DC supervision.

28.9.9 Space heater shall be provided for preventing harmful moisture condensation in all the D.C. Boards. The space heaters shall be suitable for continuous operation of 240V AC, 50HZ single phase supply and shall be automatically controlled by thermostats. Necessary isolating switches and HRC fuses shall be provided.

28.9.10 All the D.C. and A.C. HRC fuses, D.C. Aux. Relays, isolating copper links, D.C. emergency fuse,

28.9.11 D.C. emergency & A.C. emergency contactor, A.C. bell, indicating lamp for indicating D.C. fail of main bus, D.C. contactor etc. shall be within the scope of supply of the contractor. Three nos. Push Button for testing annunciation scheme, resetting annunciation scheme and accept of fault and bell cancellation shall be provided.

28.9.12 Moulded case circuit breaker for both incomer circuit shall be of suitable Amp. rating (as per requirement) and double pole type. Each MCCB shall be

provided with trip coil. MCCB shall be capable of safely breaking the fault current of the associated incoming feeder.

28.9.13 All the MCCB shall be flush mounted on D.C. Distribution boards.

28.9.14 MCCB's shall be provided with thermo-magnetic type release for over current and short circuit protection.

28.9.15 The setting range of thermal release and breaking capacity of MCCB's are to be specified and shall conform to circuit requirement.

28.9.16 MCCB shall have Mechanical Anti-reclosing and facilities for over load and short circuit setting adjustment. MCCB knob shall indicate the true position of the equipment. MCCB's shall conform to relevant Indian Standard.

28.9.17 Interlocks shall be provided such that it is possible to open the cubicle door only when the MCCB is in 'OFF' position and to close the MCCB when the door is closed.

28.10 GUARANTEE :

Electrical characteristics shall be guaranteed by the contractor. In case of failure of materials tomeet the guarantee, AEGCL shall have right to reject the material. Guaranteed Technical particulars are to be submitted by successful bidder during detailed engineering along with submitted drawings/documents. However, format for submission of GTP shall be handed over to intending bidders at the time of sale of tender documents.

28.11 PACKING AND DESPATCH :

All equipment shall have to be dispatched suitably and securely packed in wooden crates,suitable for handling during transit by rail and / or road.

28.12 CONTRACT DRAWINGS AND CATALOGUE :

After placement of Letter of Award four (4) copies of following drawing, G.T.P and literature shallbe submitted for approval.

(i) Single line diagram for each type of switchboard.

(ii) Dimensional drawing showing clearly the location of meter switches, MCCB etc. in the
D.C. switchboard arrangement in plan and elevation with foundation details.

(iii) Wiring diagram of D.C. switchboard showing the interconnection between

terminals of various equipment and devices on and within the panel including approved schematic drawings.

(iv) Take off terminal connection arrangement.

(v) Catalogue of D.C. switchboard equipment.

28.13 TEST AT MANUFACTURER'S WORKS AND TEST CERTIFICATES :

Acceptance and routine test at manufacturers' works shall be carried out on each A.C. Board as per stipulation of relevant Indian Standard. The following tests on each switchboard shall be carried out and two copies of the test certificates to be submitted.

(i) Checking of wiring and continuity of the circuit.
(ii) Power frequency voltage test of 3KV for one minute between wiring and earth terminal.

(iii) Insulation resistance value of all equipment. Connected in switchboard and function of the same.

All the acceptance and routine tests shall be carried out in presence of representative of AEGCL. All tests and inspection shall be made at the place of manufacturer. The manufacturer shall provide reasonable testing and inspection facilities and co-operation without any charge to satisfy the representative that the material is being supplied is in accordance with this specification. The proto of DCDB shall be inspected & checked by Ordering Authority or his representative for approval before commencement of supply. The entire cost of acceptance and routine tests that are to be carried out as per relevant IS shall be treated as included in quoted price of DCDB.

QAP: The bidder shall submit the standard Quality Assurance Plan mentioning all the routine test, FAT, site test etc.

28.14 TESTS REPORTS AND TYPE TESTS :

Type test reports of identical equipment shall be submitted in three copies.

All the Type Tests shall be carried out from laboratories which are accredited by the National Board of Testing and Calibration Laboratories (NABL) of Government of India such as CPRI/ERDA, to prove that the MCBs & other components used in DCDB meet requirements of the specification.

SPECIFIC TECHNICAL PARTICULARS OF D.C. DISTRIBUTION BOARDS

SNO	DESCRIPTION	TECHNICAL PARTICULARS
1.	Dimensions : a) Height of complete panel (mm.) b) Working height (mm.) c) Width (mm.) d) Depth	 1800 (max.) 450(min.)to 1650(max.) As per requirement. 800 mm (max.) or as per manufacturers type tested design
2.	Sheet steel thickness of panel (mm.)	3 (min.)
3.	Grade of insulation Level of equipments and wiring(KV)	1.1
4.	Annunciation for blowing of fuse or tripping of breaker	Alarm and visual indication
5.	Ammeter range	0 to **300** (or as per requirement of the load)
6.	Voltmeter range	0 to 300
7.	Accuracy class of Ammeter & Voltmeter	1% of full scale deflection
8.	Current density of Aluminium for Busbar (A/sq.mm.)	As per bus bar sizing
9.	Wiring for annunciation scheme shall be done withcopper of cross-section area (sq.mm.)	1.5 (Stranded)
10.	MCCB i) System Voltage ii) Insulating Voltage iii) Rated Imp withstand Voltage of main Ckt Uimp iv) Ambient Temperature v) Rated Continuous Current at 50°C vi) Ultimate Short Ckt Breaking Capacity Icu vii) Service Short Ckt Breaking Capacity Ics viii) Utilisation Category ix) Suitable for Isolation x) No. of Poles xi) Shunt Release Voltage xii) Permissible Variation in Voltage xiii) Termination suitable for Aluminium as per IS 13947 Part-II xiv) Insulation Material conforming to Glow Wire Test xv) Thermal Over load Settings xvi) Short Circuit Setting	 220 V DC 690 V 8 KV 50°C As per Rating 10 KA (DC Breaking) for < 100 A &30 KA for > 100 A 100% of Icu A Yes 4 Pole or 2 Pole – as perrequirement 220 V DC 85% to 110% Yes Yes Adjustable Adjustable for 4 Pole and Fixed for2 Pole

Note: The contractor is to supply DC switch board as per requirement after detailed engineering. Emergency lamp circuit in control room shall be automatically put into service through contactors when the AC supply will fail. **Catalogue of all relays with characteristic curve shall be submitted with tender documents**.

28.15 Sub Vendor List FOR DCDB:

Sl No.	PRODUCT	MAKE
	METERS DIGITALANDANALOGUE AMMETER,VOLTMETER,	MECO,SECURE,RISHABH, VAISHNO
	KWHMETER	L&T, SECURE, RISHABH
	FREQUENCYMETER	RISHABH, MECO, VAISHNO
	FUSE FITTING &FUSELINK	COPPERBUSHMANN, ABB, SIEMENS, L&T, GE
	TRANSDUCERSVOLTAGET RANSDUCER,CURRENTTR ANSDUCER,FREQUENCY TRANSDUCERETC.	ELSTER, RISHABH, SIEMENS
	CONTACTORS	L&T, SIEMENS, SCHNEIDER,GE, ABB
	PROTECTIONANDOTHERRELAYS	ABB,GE,SIEMENS,Schneider
	SFU, MCCB,	GE, ABB, L&T, SIEMENS,LEGRAND, SCHNEIDER
	MCB,	SCHNEIDER,LEGRAND,ABB, SPRECHER &SCHUH(S&S)
	CT	C&S, KAPPA, GILBERT MAXWELL, ABB,PRAGATI, GE, BHEL, SIEMENS
0	PT	C&S, KAPPA, GILBERTMAXWELL, CGL
11	**LTCONTROLSWITCHES**AMMETER, VOLTMETERSELECTOR SWITCHES,BREAKER	KAYCEE, RECOM, SWITRON, VAISHNO, GE, ABB
	CONTROLSWITCHES,ROTARYCAM / ROTARYSWITCH	
12	**ANNUNCIATOR,HOOTER,BUZZER, ELECTRONICBELL.**	PROTON,MINILEC,ALAN,VAISHNO.,PROCON,PIRI
13	**TERMINAL BLOCK,TERMINALENDPLATE**	ELMEX, CONNECTWELL
14	**SPACEHEATER**	SOFIA,GIRISH(EGO), VIKASELECT., GIRISH,APTCONTROL, KONTACT PYROS, TELELEC,HOTWELL,
15	**THERMOSTAT**	GIRISH(EGO),VIKASELECT.,APTCONTROL,KONTACTPYRO S
16	**PANELTUBEFIXTURE, CHOKE, STARTER,ILLUMINATINLAMP**	PHILIPS,BAJAJ
17	**3PIN SWITCH SOCKET(INDUSTRIAL/SERVICE)/RECE PTACLE**	ANCHOR, CGL,SCHNEIDER, LEGRAND,ABB
18	**BUS BAR SUPPORTINSULATOR**	RAMANUJ,POWERMAT,VINAYAK,SUNINSULATOR, TECHNO , ESBEECONTROL
19	**PVC/FRLSWIRE**	KEI, POLYCAB, FINOLEX

20	**LUGS**	DOVELLS,COMET,JAINELECTRONICS,SJMETAL
21	**HARDWAREMS&SS**	TVS,KUNDAN,AGRWALFASTENERS,FITRIGHT
22	**POWERPACKS**	ALAN
23	**INDICATINGLAMP/LED,FILLAMENTLAMP**	L&T, GE,SIEMENS,SCHNEIDER
24	**PUSHBUTTONSWITHELEMENTS**	L&T, ABB,SIEMENS
25	**ELECTRONICTIMER**	L&T, GE, ABB, SCHNEIDER, SIEMENS
26	**RUBBERGASKET (NEOPRINE/EPDM)**	MINERVARUBBER&ENGGIND.,HANUIND.,JSONPOLYMER, RITTAL, R K PROFILE, ASP MINERVA, RKPROFILE
27	**M.S.CRCA/HRCASHEETS /COILS**	TATA,SAIL,ESSAR
28	**ALUMINIUMBUSBAR**	SUDAL,HINDALCO,JINDAL, BALCO
29	**COPPERBUSBAR**	VIJAY IND., NEW INDIA CUPROTEC, CUBEXTUBING LTD (HYDERABAD)., ALCOBEXJODHPUR(MUMBAI),,MODISONMETAL, CITIZENMETALLOYS(AHMEDABAD),RHJ EXTRUSION(DAMAN)
30	**LIMITSWITCH/DOORLIMIT SWITCH**	KAYCEE,RECOM,SIEMENS, VAISHNO, L&T
31	**ALLUMINIUM SHEET /STAINLESSSTEELSHEET/COILS**	ESSAR,BALCO, HINDALCO, SAIL, TATA
32	**OIL & WINDINGTEMPERATURE INDICATOR**	PRECIMEASURE,PERFECTCONTROL(CHENNAI)
33	**AIR CIRCUITBREAKER(ACB)**	L&T, GE, ABB, SCHNEIDER, SIEMENS
34	**TIMESWITCH**	L&T, GE, ABB, SCHNEIDER, SIEMENS
35	**2POLEAC/DCSWITCH**	GE, SCHNEIDER
36	**LIGHTING TRANSFORMER**	INDCOIL, GUJARATPLUGIN,LOGICSTAT